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FIRST ASIA DAIRY GOAT CONFERENCE

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EDITORS:

Raseede Abdullah
M. Ariff Omar
Harinder Makkar
Joachim Otte
M. Ali Rajion
A. Razak Alimon
Liang Juan Boo
Haw Ah Kam
Chen Wei Li

PREFACE

The goat was the first animal to be domesticated by humankind. The global goat population currently stands at 921 million, of which over 90% are found in developing countries. Asia is home to about 60% of the total world goat population and has the largest goat breed share of 26%. Goats play a vital socio-economic role in Asian agriculture, particularly for resource-poor people living in harsh environments. Non-cattle milk accounts for approximately 15% of the total milk consumption by humans worldwide. Asia contributes approximately 59% to world goat milk production and Asia's demand for animal products, fueled by increasing populations and growing disposable incomes, is increasing at a high rate.

Despite their socio-economic importance, goat rearing has not attracted much attention of development practitioners, science managers and researchers or policy makers in Asia. However, lately, due to the emerging challenges of climate change and increasing pressure on natural resources and the high value of goat meat and milk across a number of Asian countries, the potential of goats with their high adaptability to a wide array of environmental conditions and „low quality' feed resources is being increasingly appreciated. Goats use poor quality roughages with high cell wall and low protein contents more efficiently than other domesticated animals.

In Asia concerted efforts are needed to address issues facing goat farmers and the goat milk processing industry to fully exploit the potential of goats. FAO joined with the Universiti Putra Malaysia (UPM), Department of Veterinary Science, Malaysia and the International Dairy Federation (IDF) in organizing the First Asia Dairy Goat Conference in Kuala Lumpur, Malaysia from 9 to 12 April 2012. The conference provided a platform to share technical information and experiences and to network for the promotion of dairy goat farming.

The conference was attended by 130 participants from 20 countries and 5 continents. These proceedings contained keynote and plenary addresses and research papers covering various disciplines including nutrition, breeding and genetics, milk and milk products and socio-economics of goat production. The deliberations and the information presented in the proceedings lead to the following conclusions and recommendations: a) there is a huge demand for goat milk in Asian countries, b) the sale price of goat milk is 2 to 4 times higher than that of cow milk in many Asian countries, c) the goat milk processing industry is not well developed in Asia and there is a need to address this issue through public-private partnerships, e) R&D work on goat production has been neglected and there is a need to generate knowledge in the areas of nutrition, health, reproduction and genetic diversity and to collate and disseminate the already available information, f) the extension work and training of goat farmers should be given top priority, g) development of sound and relevant policy options, institution building and linking farmers to markets should be addressed, leading to both increase in goat milk production and processing of goat milk, e) South-South and North-South collaboration should be promoted in areas that lead to increase in goat milk production and processing. The deliberations also stressed the need for an Asia Dairy Goat Network, and we are pleased to report that the Network, with secretariat based in UPM, and having the mission: a) facilitation, generation, collection, dissemination and exchange of knowledge on goat production, b) provision of technical, institutional and policy support to stakeholders involved in goat production and goat milk processing, and c) promotion of improved and sustainable dairy goat farming in Asia will be launched within this year.

With the publication of the conference proceedings, we hope that goat farmers, goat rearing and goat milk processing industry would attract the attention they rightfully deserve.

Hiroyuki Konuma Assistant Director-General and Regional Representative for Asia and the Pacific FAO RAP, Bangkok	Professor Dr Zukifli Idrus Director Institute of Tropical Agriculture Universiti Putra Malaysia	Berhe G. Tekola Director Animal Production and Health FAO

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Dairy Goats in Asia: Multifunctional Relevance and Contribution to Food and Nutrition Security

Devendra, C.

130A Jalan Awan Jawa, 58200 Kuala Lumpur, Malaysia
Email of corresponding author: cdev@pc.jaring.my

Introduction

Improved animal production and productivity enhancement in Asia are justified in direct response to the need for more animal proteins which are currently inadequate. This is associated *inter alia* with the following: 1) Agriculture is declining and its share to the gross domestic product (GDP) in East Asia, the Pacific and South Asia, has dropped from 30% in the 1980s to a mere 10% in 2000–2003 (ESCAP, 2008), 2) Rapidly rising incomes in Asia are driving a concurrent surge in the demand for more foods of animal origin, 3) Exploding food prices and rising cost of production inputs are expected to push an additional 40–100 millions into poverty, 4) Inadequate productivity of dietary animal protein supplies are far more serious than energy from cereals which will exacerbate food and nutritional insecurity and 5) Projected requirements for milk in China, India and Southeast Asia (FAO, 2006) up to 2020: 100, 89 and 433%, respectively and to 2050 double the current requirements.

This paper discusses the potential multifunctional value of dairy goats, efficiency of milk production, development pathways for increasing their contribution to food and nutritional security and improved livelihoods in Asia.

Goat genetic resources: Diversity and distribution

The world population of goats is about 921 million, and includes a total of 570 breeds. In the developing countries there exist over 30 potentially important indigenous "improver breeds", 15 of which are in Asia. Asia had the largest population of goats of about 60% (556 million), followed by Africa (311 million). India (35.2%), China (29.3%) and Pakistan (12.0%), together had 77% of the population and 42% of the breed share (Table 1). During the period 1986–2010 in Asia, the goat population growth rate was 2.3%/yr. Europe accounted for only 2% of the goat population, has 187 breeds and 33% breed share. Many of the European breeds have been widely introduced into many Asian countries. The majority of the goats are found dispersed in small farms which in Asia account for 67% of 470 million small farms worldwide of less than two hectares of land (Nagayets, 2005). This excludes several million landless farmers and agricultural labourers who rear goats. Concerted breeding and conservation of indigenous oat breeds is a means of mitigating climate change effects, with associated benefits to the trade of live animals and products.

"Improver breeds" are defined as potentially important breeds that are capable of making a special genetic contribution, have above average levels of performance, can enhance productivity, or are specially adapted to a particular difficult environment.

Dairy goat breeds

Asia has a 26% goat breed share in global terms, equivalent to 146 indigenous breeds (Table 1). About 94% of these breeds are meat breeds whose presence is consistent with the fact that meat is the most important product from goats in all countries without exception (Devendra, 2007).

Table 1. Goat populations, breeds and their global distribution (FAO, 2010)

Region	Year 1986	Year 2010	% (2010)	Average growth rate (%/yr)	Breeds	Breed share (%)
Africa	105.4	310.7	33. 7	2.8	89	16
Asia and Pacific	253.5	556.1	60.4	2.3	146	26
Europe	10.8	16.5	1.9	1.4	147	33
Latin America and the Caribbean	32.9	212.6	4.8	22.8	34	6
Near East	83.9	267.5	2.3	9.1	94	16
North America	1.8	3.0	0.1	1.7	20	0
Total	**488.2**	**920.6**	**-**	**7.0**	**570**	**100.0**

By comparison, dairy goats are significantly fewer, and only 13 in Asia are considered to be truly identifiable dairy breeds (Devendra and Haenlein, 2011) (Table 2).

Table 2. Asian Dairy Goats and Potential " Improver Breeds"

Nation	Dairy Goats and Potential "Improver Breeds"
China	Ma T`ou*
India	Barbari*, Beetal, Chegu*, Gaddi*, Jamnapari, Jakhrana, Malabar, Marwari*; Sangamnari*
Indonesia	Etawah (Jamnapari)
Pakistan	Bujri, Chapper*, Damani, Dera din Panah, Jattan, Jarakhell, Kachari*, Kamori, Koh-I Ghizer, Kacchan*, Kajli*, Kuranasari*, Kurri, Labri*, Patteri
Vietnam	Bach Thou

*Denotes that the breed is dual-purpose, usually producing meat and milk

In Asia only 13 dairy breeds or 9% of all breeds are identifiable. These breeds are also low-medium milkers. Many of the "improved breeds" have not been used outside of the country of origin. Additionally, 13 dual-purpose (meat and milk) goats exist, less well known and with variable milk yields. The potential of many of these breeds remains to be assessed.

Due to the presence of only a few indigenous dairy breeds with low milk yields, improved breeds with much higher milk yields have been introduced variously into Asia. These include Alpine, Anglo-Nubian, Saanen, Togggenburg and the Boer. Crossbreeding these with the indigenous breeds has been generally haphazard and gave variable results and a hotchpotch of crossbreds. In Malaysia and Trinidad for example, crossbreeding with the Anglo-Nubian up to F2-F3 generations has consistently given improved productivity.

Multifunctionality: Products and services

Goats contribute significant and extensive multipurpose functions of socio-economic and nutritional relevance. The products and services are especially important for socio-economic benefits, the stability and prosperity of poor farm households in Asia.

Products

The products from goats are meat (raw, cooked, blood, soup, goat meat extract – "Zeungtang" in Korea), milk (fresh, sour, yoghurt, butter, cheeses), skins (clothes, shoes, water/grain containers, tents, handicraft, shadow play in Indonesia, thongs etc.), hair (cashmere, mohair, garments, coarse hair rugs, tents, ropes, wigs, fish lures), horns and bones (handicraft) and manure and urine (crops, fish).

Services

Among the services that could be acquired from dairy goat production are cash income and investment, security and insurance, prestige in ownership, gifts and loans, religious rituals e.g. sacrificial slaughter, human nutrition, pack transport and draught power, medicine and control of bush encroachment.

Services from dairy goat production can be improved by promoting a wider use of „improver' breeds both within as well as in other countries with similar climates, recognising that there are disease issues that must be settled. The problem of dairy goat production is exacerbated by failure to identify the attributes with clear production objectives and improvement programs that can increase the level of production. In these circumstances there is an increasing tendency to resort to imports of one or more exotic breeds at varying costs with resultant genetic chaos. Controlled use of chosen introduced breeds is essential for efficient use of the natural resources to achieve specific socio-economic benefits.

Contribution to improve food and nutritional security

Meat

Given the drier and harsh environments that goats thrive in, their ownership by the poor and the landless provides food security and the principal means of survival. In these same environments, goats provide precious meat and milk for immediate family consumption to overcome both malnutrition and under nutrition. Small size of goats is significant in that it provides multifunctional socio-economic, managerial and biological advantages. Low individual values mean a small initial investment and small risk of loss, which is attractive to subsistence farming, especially for poor people. Managerially, they are conveniently cared for by women and children and occupy little housing space.

Milk

Total goat milk production in Asia as percentage of all milk is small and is about 3.6% (FAO, 2010). Goat milk is characterised by predominantly small milk fat globules widely referred to as homogenised goat milk, less curd yield, and weaker curd firmness which together aid digestion. The milk fat has significantly higher contents of short chain, medium chain and polyunsaturated fatty acids than cow milk and its cheeses. One litre of goat milk contains about 32 g of proteins and represents 70% of the dairy requirement of a lactating or pregnant mother. It is adequate for a child up to 11 years of age. The calcium supply of 1.7 g/litre meets the daily requirements. Goat milk provides higher levels of 6 of the 10 essential amino acids: threonine, isoleucine, lysine, cystine, tyrosine, and valine compared to cow milk (Posati and Orr, 1976). Goat milk exceeds cow milk in monounsaturated, polyunsaturated fatty acids and medium chain triglycerides all of which are well known to be beneficial for human health, especially for cardiovascular conditions (Haenlein, 2004).

The various contributions of critical dietary nutrients are especially significant for resource-poor farming families living in the shadow of continuous subsistence and vulnerability. Most of the milk is marketed informally mainly in the rural areas. In China for example, less than 5% of the goat milk is marketed (Luo, 2009), the remainder of which is presumably used for household consumption. The multifunctional value of goats owned by farmers and entrepreneurs is enlightening and is greatly enhanced by exhibitions and goat shows. Central to this is the important role of goat societies in serving development, maximising total; milk production, and a positive response to meeting the national priorities.

Efficiency of milk production

The question of whether dairy goats are more efficient than buffaloes or cows is not clear at the present time and is one of conjecture. High producing dairy goats have a relatively large intake of feed and greater production of milk than lower producing dairy goats. This is related to a greater proportion of mammary gland and volume of secretary tissue in the total body mass. The uniform requirement of feed for maintenance implies that goats of the same size but higher milk yield will be more efficient because the maintenance overheads are spread over a greater volume of production. In India, based on the calories in milk as percentage of feed energy, dairy goats (21–30%) and dairy cows (25%) were found to have similar efficiency which was higher than that of the dairy buffaloes (Sundaresan, 1978). In Great Britain, Spedding (1975) reported that in terms of milk yield per 100 kg of digestible organic matter, the dairy goat producing 185 kg was more efficient than the lactating cow (162 kg) or sheep (36 kg). In low input systems in the rural areas, dairy goats may well be particularly more efficient, using the available feeds to maximum advantage, including high efficiency in the use of fibrous crop residues to produce milk. Present knowledge on the efficiency of milk production in goats is inadequate and merits much more research on the subject.

Goats or cows for milk production?

A development dilemma for resource-poor small farmers is the choice of dairy goats or cows for small-scale household milk production at the village level. With very resource-poor peasant farmers, the choice of goats as dairy animals is related to the following advantages: low capital investment and production costs, optimum use of meagre resources which favours goats rather than cattle in low-input systems and marginal environments, faster generation turnover and therefore earlier milk production compared to cattle, effective use of family labour including women and children, reduced problems of storage and distribution of milk, production of milk for mainly household consumption and nutrition and secondarily for commercial sale. Access to a ready supply of meat and milk provides a constant source of animal proteins for poor people who cannot afford to buy these products, or alternatively, are unable to produce these products from their farm.

At low levels, dairy goat production is about one to two litres per head. Goats do not require high levels of dietary energy and protein, and can in fact survive on browse, forage and crop residues. The cost of production is relatively low and only increases when purchased concentrate supplements are fed. Under these circumstances, it is more realistic, nutritionally appropriate and economic to encourage milk production from goats in rural and peri-urban areas parallel to urban milk production from cows. Direct investment to family goat herds in rural areas is therefore likely to have much more impact on the quality of lives of the rural poor. A two-pronged strategy that could be implemented is intensification of dairy goat programmes for the rural and peri-urban areas and commercial dairy cow milk for the urban areas. Realisation of the former is a challenging task for the future.

Development strategies

Development strategies for dairy goat production should be cognisant of 1) the relevance of listening to farmers, 2) the constraint analyses and priority setting, 3) ensuring appropriate research thrusts to serve development, 4) build-up the numbers of appropriate breeds, 5) clear production objectives, 6) improved utilisation of the totality of available feeds, 7) linking production to post-production-consumption systems and 8) improving marketing systems.

References

Devendra, C., 2007. Goats: Biology, Production and Development in Asia. *Academy of Sciences Malaysia*, Kuala Lumpur, Malaysia, 246 pp.

Devendra, C., 2010. Small Farms in Asia. Revitalising Agricultural Production, Food Security and Rural Prosperity. *Academy of Sciences Malaysia*, Kuala Lumpur, Malaysia, xiii+175 pp.

Devendra, C. and G.F.W. Haenlein, 2011. Animals that Produce Dairy Foods. Goat Breeds. In: Fuquay JW, Fox PF and McSweeney PLH (Eds.), In: *Encyclopaedia of Dairy Sciences. Second Edition,* Vol. 1, San Diego: Academic Press, USA, pp. 310–324.

ESCAP, 2008. Economic and social survey of Asia and the Pacific 2008. Sustaining growth and sharing prosperity, Bangkok, Thailand, 190 pp.

FAO (Food and Agriculture Organisation), 2006. World Agriculture: towards 2030/2050, FAO, Rome, Italy

FAO (Food and Agriculture Organisation), 2010. FAO AGROSTAT, 53, FAO, Rome, Italy

Haenlein, G.F.W., 2004. Goat milk in human nutrition. *Small Ruminant Res.* 5*:* 155–163.

Posati, J.P. and M.L. Orr, 1976. Composition of foods, dairy and egg products. *Agriculture Handbook No. 8-1, USDA* – ARS, Consumer and Food Economics Institute Publishers, Washington, U.S.A., p. 77–109.

Luo, J., 2009. Dairy goat production in China. *Proceedings of the 24th Annual Goat Field Day, Langston University*, April 25, 2009.

Nagayets, O., 2005. Small farms: current status and key trends. In: *The Future of Small Farms*. International Food Policy Research Institute, Washington, D.C., U.S.A., pp. 355–356.

Spedding, C.R.W., 1975, The Biology of Agricultural Systems. Academic Press, London, United Kingdom, 261 pp.

Sundaresan, D., 1978. Dairy research at National Dairy Research Institute, *Indian Dairyman*, 30: 313–314.

Plenary 1

Linking Smallholders to Markets – Opportunities and Challenges

Otte, M.J.[1], V. Ahuja[1] & D. Roland-Holst[2]*

[1]FAO Regional Office for Asia and the Pacific, 39 Phra Atit Road, Bangkok 10200, Thailand,
[2]Department of Agricultural and Resource Economics, 223 Giannini Hall, University of California Berkeley, CA, 94720 - 3310 USA
[*]Email of corresponding author: Joachim.Otte@fao.org

Introduction

An estimated 2.6 billion people in the developing world have to live on less than US$ 2 a day. Of these people, about 1.4 billion are extremely poor, surviving on less than US$ 1.25 a day each. Asia harbours the majority of the world's extremely poor, with 933 million, while the incidence of extreme poverty is highest in sub-Saharan Africa, at one in two people (50%) (Chen and Ravallion, 2008; World Bank, 2007). The majority of the poor live in rural areas and many are smallholder farmers with livestock forming an essential component of their livelihoods portfolio. Much has been written about the „safety-net' function of livestock in subsistence-oriented rural households, and many development interventions have focused on safeguarding the livestock assets of the poor. Recognising the acceleration of demand for livestock products in the developing world, particularly in rapidly emerging Asian economies, this paper examines on the potential of livestock to act as „cargo-net' to lift households out of poverty via improved access to growing urban food markets. This perspective advocates a „market-led' approach to self-directed poverty reduction, a strategy that leverages private agency to complement other forms of development assistance.

Asia's food markets

Asia's food markets have been estimated to be in the order of PPP[1]US$ 2 to 2.5 trillion per year, by far the largest of any developing region (WRI, 2007). Approximately 10% of total food expenditure is spent on milk and dairy products (around PPP US$ 170 billion in South Asia and PPP US$ 50 billion in East Asia). Rising incomes of Asian households and high income elasticities of demand for animal source food (ASF) are projected to lead to tremendous increases in aggregate demand for livestock products over the coming decades. For milk and dairy products, the increase in consumer demand between 2000 and 2030 has been estimated to be in the order of 24 million tonnes (132% increase) for East Asia while for South Asia the corresponding figure stands at nearly 120 million tons (143%) (Robinson and Pozzi, 2011).

Despite the projected rapid income growth in Asia, the bulk of this demand for food originates in households with per capita incomes of less than PPP US$ 3,000 per year, consumers who still favour traditional and „fresh' produce offered at markets with supply chains that are mediated mainly by informal and customary networks of low income agrifood intermediaries. In these countries, only the top income decile currently presents a viable market for high-value processed cold chain products.

[1] Purchasing power parity

The current expansion of markets for ASFs in developing countries, and their large degree of diversity therefore represent enormous income potential for the rural poor, many of whom own livestock, as well as their urban market intermediaries. However, which benefits of growing urban food demand go to rural smallholders and which to expanding agrifood industries will depend to a significant extent on policy decisions. Without public commitment to promoting smallholders farmers' and agrifood intermediary market participation, it is likely that these groups will be economically marginalised, while urban growth masks continuously rising inequality.

Poverty incidence, poverty density and market access

Poverty incidence/rate describes how common poverty is in a given location but not how many poor people could be affected by a policy or programme that targets that location. As Figures 1a and 1b make this clear for the case of Vietnam, poverty incidence can be very high (i.e. poverty is common) in remote areas with little if any market access. Targeted market access policies for reducing poverty in these areas could be quite expensive, however, requiring large commitments per capita of scarce public investment funds for transport, communication, health and education infrastructure, without helping most of the poor. In low-income countries, public funds have high opportunity costs, which make such expenditures difficult to justify on the grounds of cost-effectiveness.

In contrast to poverty incidence, poverty density identifies the actual numbers of poor people in given localities across a country. Figure 1c displays poverty density and the results are visually arresting. Although poverty is very common in sparsely populated (remote) provinces, it becomes clear that the majority of the poor live in areas where poverty incidence is comparatively low, often in reasonable proximity to urban areas. This evidence suggests a different strategy for poverty reduction, one that promotes market access incrementally, radiating outwards from urban areas, rather than laying out extensive (and expensive) new corridors to remote areas. From and infrastructure perspective, such access can be facilitated with existing commitments to urban development. This permits development funds to be focused on the institutional barriers to market participation by the poor.

Barriers to market participation

Participation in expanding markets for livestock products does not occur automatically. Wherever there are profits to be made in an emerging urban consumption sector, larger commercial suppliers will compete to capture market share for any product. When household producers are unable to participate in the growing markets that attract larger commercial producers, it is generally because of barriers to market access or entry.

In agrifood supply at its smallest scale, from the smallholder farm gate, a household sells its product to a trader, initiating a chain of exchange relations across a market system that takes the product through a number of stages to reach final consumers. From the first step, this elemental agrifood supply chain is complicated by many market access barriers and information failures, which individually and collectively limit the livelihood potential of family farming. Smallholder livestock supply chains are plagued by the following imperfections: low input quality, including information and knowledge; low sanitary standards; low bargaining power; moral hazard; distrust. Each of these uncertainties undermines willingness to pay and contributes to serious adverse selection bias in such markets. Ultimately, this problem feeds back to producers, who have little incentive to invest in quality or expansion, actions that could lift them out of poverty by their own efforts. Unless these market imperfections can be overcome, the low investment trap will remain individually rational for smallholder farmers, and the livelihood potential of livestock markets cannot be realised.

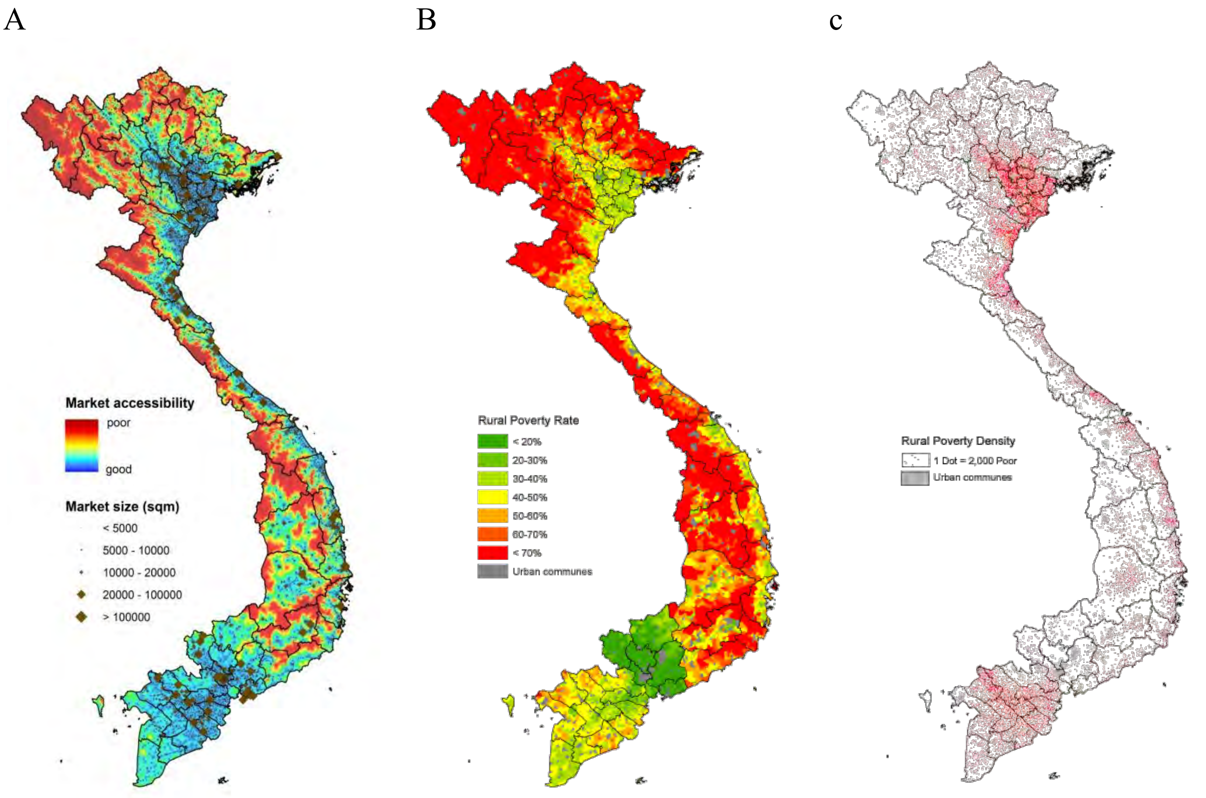

Figure 1. (a) Market accessibility, (b) Poverty incidence/rate, (c) Poverty density in Vietnam

Overcoming barriers to market participation

Diversification is a risk management strategy for smallholders, evolving from self-sufficiency and expectations that the burden of external shocks will be borne individually. For smallholders to emerge from this situation, they need a credible strategy of commercialisation, specialisation and investments in higher value added. Unfortunately, their conditions make smallholders unlikely to compete against established commercial agrifood enterprises in urban markets. To be successful, smallholder producers need to emphasise their strengths – traditional product variety and low resource costs – while policies for inclusive development are implemented to facilitate their market participation.

Willingness-to-pay surveys across a wide range of countries show that consumers put a significant premium on the traditional livestock varieties that have historically been produced by smallholders. The existence of this premium suggests that market access strategies can promote self-directed, privately financed long-term poverty alleviation. Moreover, smallholder producers are linked to downstream consumers through networks of low-income intermediary enterprises, so their continued viability secures pro-poor multiplier effects across the broader economy. Overcoming information and access barriers would improve incentives for individual enterprise investments from farm to fork, meaning that these poverty reduction initiatives could eventually be self-financed – a welcome substitute for open-ended fiscal commitments to public assistance. Finally, demonstrated willingness to pay for traditional livestock products also suggests that the general public has a distinct preference for them, countering the pressure from some commercial interests to phase them – and the associated production systems – out.

Governments can play a critical role in enhancing these pro-poor supply networks by supporting grassroots producer cooperatives and extension services and maintaining a general environment that is congenial to small enterprise development. Among other elements, this would include strengthening animal health services, protecting intellectual property rights, supporting the development of standards and reputation building through certification or branding programmes, improving existing market infrastructure, and developing small wholesale markets with registered slaughterhouse facilities in strategic urban locations.

Smallholder farmers' access to information and technology should be improved, particularly with respect to product quality, pricing, and other market conditions. On the financial side, micro-credit schemes can accelerate technology adoption and small enterprise modernisation, improving productivity and product quality/reliability and leading eventually to established brands and reputation that confer higher long-term value added at lower transaction cost. Education on contracting, negotiation, and conflict resolution would improve the extent and terms of smallholders' market participation. Governments can also reinforce the efforts of farming groups that already apply economically viable production practices, while recruiting farmers interested in emulating these examples. Such initiatives can be modelled on early strategies of Western agrifood producer cooperatives, which are now the primary guarantors of product quality and farm market access in OECD countries.

Conclusions

In many developing countries, rapidly emerging urban demand for livestock products presents an enormous opportunity for domestic agriculture, but there is also serious risk that smallholder rural majorities will miss this and be marginalised by agrifood industrialisation. It must be recognised that the majority of agricultural and rural households in developing countries are unlikely to be recruited directly into agrifood industrialisation; even intermediate stages of sector consolidation, such as contract farming, appear to be undertaken at a scale well beyond that of the average smallholder farmer. On the contrary urban demand must be more fully appreciated for its inclusive development potential, and more national livestock and other agrifood markets will only arise from determined policy commitments to overcoming existing entry barriers, information and agency failures, and historic bias in favour of integrated agrifood enterprise development.

References

Chen, S. and M. Ravallion, 2008. The developing world is poorer than we thought, but no less successful in the fight against poverty. *Policy Research Working* Paper No. 4703. Washington, DC, World Bank, Development Research Group.

Robinson, T.P. and F. Pozzi, 2011. Mapping supply and demand for animal-source foods to 2030. Animal Production and Health Division Working Paper No. 2. Rome, FAO.

World Bank, 2007. Global economic prospects 2007. Washington, DC.

WRI, 2007. The next 4 billion – Market size and business strategy at the bottom of the pyramid. World Resources Institute, Washington, DC.

Plenary 2

Challenges Facing Dairy Goat Farmers in Malaysia

Jamaluddin, A.A., K. Idris& R. Roslaini*

Department of Veterinary Services,
Wisma Tani, Precinct 4, Federal Government Administration Centre,
62630 Putrajaya, Malaysia
**Email of corresponding author: idrisk@dvs.gov.my*

Introduction

Malaysian agriculture sector in the year 2009 contributed 9% to the Gross Domestic Product. However, in terms of agriculture subsector, livestock contributed 27% to agrofood production. The current status of livestock industry shows 5.4% annual growth (2000–2009) with an ex-farm value of RM 11.26 billion in the year 2010, an increase from RM 5.56 billion in the year 2000. Trade of livestock products in the year 2009 was valued at RM 2.33 billion for exports and RM 9.06 billion for imports. The total number of farmers involved in the livestock sector in the year 2009 was 201,888. An estimated economic value for the livestock industry is RM 67 billion for the year 2010.

Production in the livestock subsector is accounted by poultry meat contributing 1,202,000 metric ton (59.37%), pork 206,000 metric ton (10.18%), egg 510,000 metric ton, milk 62,000,000 litre (3.08%), beef 42,000 metric ton (2.08%) and mutton 22,000 metric ton (0.11%). The production of mutton in the livestock subsector reflected the small number of goats in this country.

Malaysia has been producing goat's milk for some time. There has been a dramatic increase in the development of dairy goat farming in this country with large importation of dairy goats from various countries since goat milk has a significant niche market. In Malaysia scientifically based information on dairy goat farming is very limited. This paper discusses issues and challenges facing dairy goat farmers in Malaysia.

Issues and Challenges Facing Dairy Goat Famers in Malaysia

Dairy goat farming is a fast growing livestock industry in the country and a potentially profitable venture, although it is still in its infancy. However, there are issues and challenges in development and improvement of the dairy goat industry that farmers have to face. Among the issues and challenges facing dairy goat farmers in Malaysia are:

Dependency on imported breeding stock

There is insufficient quality breeding stock in this country and farmers have to rely mostly on importation of animals. Efforts have been made to develop the Germasia, a dual purpose breed, however the number of animals in the country is small. Multiplication of quality breeding stock locally is of paramount importance.

While importation of animals is explored, artificial insemination services should be carried out throughout the country to produce purebred and crossbred animals. Dairy Goat

Data Centres should be established and farmers should be encouraged to maintain individual farm records.

Ability of farmers to utilise comparative advantages concept

This concept is important for the reduction of production cost especially for feed and nutrients. Although green feeds are the main components of animal feed, farmers still use concentrate (goat pellets) extensively to feed their animals. The main ingredient of the concentrates is maize and this commodity has to be imported, the price of which fluctuates with the global market. Thus alternative feed sources have to be identified and made available within Malaysia.

Feasibility studies of alternative feed sources (energy and protein) available locally should be conducted and the findings should be made available to the farmers. More home plots planted with good quality pasture should be established, while forages under rubber and oil palm plantations should also be explored as another alternative source of green feeds.

Crop-livestock integration systems that have been studied by the Malaysian Palm Oil Board (MPOB) could be adopted to reduce operational cost. In 1999 MPOB [then Palm Oil Research Institute of Malaysia (PORIM)] developed a successful model of the integration of dairy goats (Saanen) with mature oil palm plantations and this could be adopted by the farmer. Apart from that, farmers and farmworkers should be trained so that their technical capacity may be improved to achieve high productivity. Zero-waste concept industry also should be explored in the dairy goat farming. Application of the comparative advantages concept on use of inputs, systems approach toward outputs is critical in the dynamic economic scenario for dairy goat farming.

Animal health and disease

Poor animal health and diseases are usually related to the cause of low farm productivity and indirectly to low profit margin. Zoonotic and infectious diseases such as brucellosis and foot and mouth disease, which can easily infect animals are a major threat to the animal industry. Thus actions should be taken to reduce the incidence of these diseases.

Farmers should be encouraged to practice good biosecurity standards through the adoption of Good Animal Husbandry Practice (GAHP) at farm level. They should also be trained to identify any abnormality that may surface in their herds and promptly report to the relevant authorities. While at the state level, efficiency in diagnosing diseases at an early stage by competent authority could also help in reducing economic losses.

Marketing and local consumption trends

In general, demand for dairy goat products in Malaysia is growing steadily. However, the demand for goat’s milk is very small because of the goaty odour. A supply chain in the marketing of goat’s milk in Malaysia from farm gate to consumer should be developed engaging wholesalers, retailers and customers. Grading of goat’s milk should be implemented to eventually deliver the quality of milk that meets customer satisfaction.

Conclusions

Dairy goats produce both milk and meat. Therefore it will be more viable to venture into dairy goat than meat goat farming. Dual purpose goats should be a breed of choice that will contribute greatly towards the development of the Malaysian dairy goat industry. Farmers using dairy goats would experience better viability and sustainability in their goat farming business simply because milk production will provide them a constant cash flow.

Availability and suitability of dairy goat breeds for this country will provide impetus for large-scale dairy goat farming in Malaysia. Involvement of the private sector is required to accelerate the transformation process and promote growth of the industry. The potential of value-added dairy goat products and recognition of Malaysia's halal accreditation system should be taken advantage of, to increase local and export market.

Plenary 3

Dairy Goat Farming in Australia: Current Challenges and Future Developments

Celi, P.[*] *& P.J. White*

Faculty of Veterinary Science, the University of Sydney, Camden,
PM Bag 4003, NSW 2567, Australia
[*]*Email of corresponding author: pietro.celi@sydney.edu.au*

Introduction

Goat production in Australia is regarded as an emerging industry with production and farming of goats increasing annually (Abud and Stubbs, 2009). Goats were introduced into Australia in 1788 by the first settlers as a source of meat, milk and fibre and have since adapted well to the Australian conditions (Shim-Prydon and Camacho-Barreto, 2007). In Australia the focus of production has moved from small, localised farms to larger scale farms on more suitable land. Farmers have been able to establish partnerships, local markets have expanded and exports have increased to the extent that Australia is currently the largest goat meat exporter in the world (Abud and Stubbs, 2009). Even though it is expanding, the goat industry in Australia and the dairy industry in particular, are still relatively small when compared to the main livestock enterprises. The small scale of the industry (Figure 1) is the most likely reason for the paucity of research into the different aspects of dairy goat husbandry in terms of health and production. Facts sheets and general husbandry information are readily available and easily accessible to dairy goat farmers; however, as the industry is rapidly growing, the lack of research in dairy goat health, welfare and production could represent a serious limitation to the long term viability of the industry.

Figure 1. Dairy goat production areas in Australia (RIRDC).

The aim of this paper is to provide an overview of the dairy goat industry in Australia. Current issues and challenges that the Australian dairy goat industry has to face in relation to its growth and development will also be discussed.

The dairy goat industry in Australia

The dairy goat industry in Australia has traditionally supplied fresh milk to the local market. In the past farms were small (15 to 20 milking does), and operated as niche industries; however, this is rapidly changing. The increased popularity of specialty cheeses has created an unprecedented demand for goat's milk and the cheese market is typically easier to service than the fresh milk market. Farmers are no longer tied to land near city markets and do not have to self-manage the whole enterprise from production and packaging through to marketing and distribution (MLA, 2005). The industry has grown significantly since the beginning of the nineties, currently producing almost 5 million litres of milk a year (Shim-Prydon and Camacho-Barreto, 2007). There are approximately 50,000 milking goats in Australia. Victoria, the largest producer, has 14 commercial herds with an estimated annual production of 1.1 million litres for 2003–2004 (Shim-Prydon and Camacho-Barreto, 2007). New South Wales, Queensland and Tasmania also have milk-processing facilities. The dairy goat industry is predominantly pasture based and is therefore confined to the high rainfall, agricultural areas of the country. While this offers cost of production advantages, it represents a potential threat to the industry as it increases the susceptibility of goats to intestinal parasites and footrot. From a marketing perspective, the key challenge for the Australian dairy goat industry is being able to supply a consistently high quality product to meet year round demand (Shim-Prydon and Camacho-Barreto, 2007). Goat milk production in an Australian context is typically very seasonal, with low production in winter and surpluses produced in spring and summer. Significant farm management changes are necessary to facilitate year round milk production, all of which come at an increased cost (MLA, 2005). These changes must be paralleled by an increase in research in dairy goat health, welfare and production.

Health issues in dairy goat production

The major health issues that affect the dairy goat industry and are responsible for substantial production losses and decreased goat welfare include clostridial diseases, caprine arthritis encephalitis (CAE), caseous lymphadenitis (CLA), Johne's disease, and internal parasites (Abud and Stubbs, 2009). Some of these diseases can be controlled by vaccines however many farmers rely on strict biosecurity procedures in order to maintain a clean herd. A recent survey has indicated that the two most significant health problems identified by the members of the Dairy Goat Society of Australia (DGSA) are CAE and intestinal parasites (DGSA, personal communication). Similar results were reported by another survey recently administered to goat producers in NSW (Lemon and White, unpublished observations).

Caprine arthritis encephalitis (CAE)

Caprine arthritis encephalitis (CAE), also known as „big knee', is caused by a lentivirus or 'slow' virus associated with nervous disorder (encephalomyelitis) in kids and slowly-developing disease syndromes in older goats. This results when the cells carrying the latent virus mature and multiply in different body organs, such as the mammary gland, lungs, tendons sheaths, joints and nervous tissue and result in a slow and persistent inflammatory disease (Greenwood, 1995). It is clear that CAE is a major animal welfare issue that results in major production losses through mastitis, ill-thrift, arthritis, pneumonia, ascending paralysis and encephalitis in kids.

The main spread of the virus between goats is through the ingestion of infected milk by kids or adults. Adult goats can also become infected by exposure to infected milk droplets during milking. The virus can also be spread by respiratory secretions, saliva and tears when goats are kept in close quarters. Transfer sometimes occurs by blood on equipment such as vaccination needles, tattooing equipment, dehorners and foot/hair shears, or through exposure to open wounds. Venereal spread in semen and in utero spread to kids are less likely but still occur. The virus usually enters a clean property with the introduction of an infected goat. The goat may or may not be antibody positive for CAE at the time of blood testing because of the delay between exposure to the virus and the development of antibodies. At present there is no vaccine available for the prevention of this disease, therefore biosecurity measures are essential in minimising the risk of infection. Control programmes have been conducted in many countries but CAE is still causing problems in dairy goat populations world-wide, including Australia (Figure 2).

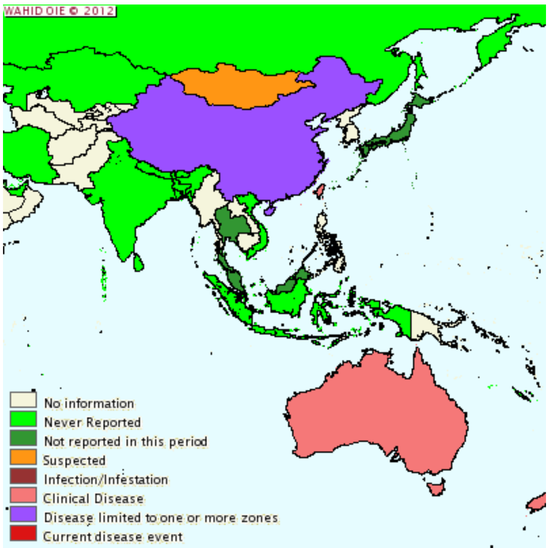

Figure 2. Caprine arthritis encephalitis distribution in Australia and Asia (World Animal Health Information Database).

CAE represents a major challenge to dairy goat farmers in Australia as it creates a significant market access issue. The International Organisation for Animal Health (OIE) has set a minimum standard for live goat imports: animals must not present clinical signs of CAE on the day of shipment; animals over one year of age must be subjected to a diagnostic test for CAE with negative results during the 30 days prior to shipment or, CAE must not be diagnosed either clinically or serologically in goats present in the flocks of origin during the past 3 years, and no goat from a flock of inferior health status was introduced into these flocks during this period.

Detecting sub-clinically infected goats is the key to preventing CAE spread. Infected goats are detected by serological testing. The most accurate test is the ELISA test although some countries still use the less specific AGID test. Repeated blood testing during a 12 month period will detect the majority of infected goats. The CAE status of goats should be determined in goats 6 months and older. Adult does should not be tested in the period one month either side of kidding as inconsistent results can occur. No goat should be tested within one month of any vaccination (Ryan, 2012). The tests currently available are expensive and Australian farmers do not have access to testing subsidies. The development of a CAE bulk milk diagnostic test would be of extreme benefit to individual farmers and to the dairy goat industry overall.

Intestinal parasites

Parasitic infections are generally regarded as the most prevalent and important health problems of grazing ruminants in Australia, with losses associated with nematodes, and ectoparasites causing a combined annual loss of approximately a billion dollars (McLeod, 1995). Despite considerable research being conducted into developing integrated parasite control programmes to minimise the use of anthelmintics, the goat industry continues to rely heavily on anthelmintics for effective internal parasite control. The role of anthelmintics in the control of gastrointestinal parasites is increasingly threatened by resistance in the target parasite species. Resistance of worms in sheep and goats to most anthelmintics is now fairly common in Australia (Besier and Love, 2002) and should be considered in the diagnosis and management of gastrointestinal parasitism. The control of gastrointestinal parasites needs to adopt a more strategic approach that involves the integration of control measures that will reduce reliance on anthelmintics and slow the development of anthelmintic resistance. Over the last 10 or more years there has only been one new worm drench registered for use in goats: Caprimec (Virbac Animal Health) has the same formulation as Virbemec and for marketing reasons this was relabelled for goats and sold in smaller containers at a higher price. It is not surprising that goat farmers largely refrained from purchasing the branded drug and purchased the cheaper Virbemec.

Representations to the Goat Industry Council of Australia (GICA) and their representations to Meat and Livestock Australia have failed to gain sufficient traction to effectively address the shortage of effective new chemicals. Recently the Australian Pesticides and Veterinary Medicines Authority (APVMA) acknowledged that goats metabolise veterinary products very differently to sheep, indeed the recommended dose rates should be 1.5 times the sheep dose. In the short term, one solution could be for the Australian dairy goat industry to obtain a minor use permit (MUP) for products registered in sheep. However, it has to be noted that for the granting of a MUP, much of the science still has to be done. Interestingly, goats are not in a separate list on the APVMA web site and there is no recognition of dose rate as an issue or any effect on withholding periods and export slaughter interval. It will only take one positive test on goat products going overseas to lead to a ban of goat products overseas export and that could result in the collapse of the Australian goat industry. In the long term, considering the rapid expansion of the goat industry in its entirety (goat, fibre and dairy), it is necessary for the industry to move outside the realm of a minor species and develop its own research, development and extension programme to address the management of gastrointestinal parasites.

Current and future developments

The main advantages of a CAE bulk milk diagnostic test are that the sample is easy to obtain and the test is reasonably cheap and therefore can be used as a routine indicator of subclinical infection. This test would also yield data for use in epidemiological studies and for studying the genetic background of CAE and other diseases. Milk composition (fat% and protein%, SCC) can also be used to study the heritability of diseases like ketosis and mastitis. Bulk milk tests would provide a solid starting point for differential diagnosis, in addition to their value for blood serological monitoring. The information from bulk milk tests should be accurately recorded and incorporated into preventive medicine programmes, particularly in relation to recently purchased animals. Regular testing of bulk milk samples will provide a simple low cost method of confirming continuing freedom from infection in known disease-free herds; including those at potential risk of introducing new infection, and thereby allow opportunity for prompt action if indicated.

Parasite management is a major problem for grazing goats. The use of drenches off-label, i.e. without the drench being registered for use in milking goats, has health, quality and export implications. It is clear that some action is urgently needed in this area. In the short term there is a need to undertake a survey within the industry regarding the chemicals utilised. This should include usage patterns, reasons why they are used, and dosages. In the long term, the sustainable control of gastrointestinal parasites requires a dramatic reduction in chemical use and increased thoroughness in monitoring for worm burdens, testing drenches for efficacy and incorporating browse and nutrition supplementation as a minimum standard for better worm control. Less reliance on chemical use is important in preserving those drench actives still providing good control.

References

Abud, G. and A. Stubbs, 2009. Dairy Goat Manual: Second Edition, *RIRDC*, 206: 1–81.

Besier, R.B. and S.C.J. Love, 2002. Anthelmintic resistance in sheep nematodes in Australia: the need for new approaches. *Aust. J. Exp. Agric.* 43: 1383–1391.

Greenwood, P.L., 1995. Effects of caprine arthritis-encephalitis virus on productivity and health of dairy goats in New South Wales, Australia. *Prev. Vet. Med*. 22: 71–89.

McLeod, R.S, 1995. Cost of major parasites to the Australian livestock industries. *Int. J. Parasitol.* 25: 1363–1367.

MLA (Meat and Livestock Australia), 2005. *Goat Farming for the Future*, pp.1–28.

Ryan, D., 2012. Caprine arthritis encephalitis (CAE). In „Primefact 857. NSW Department of Primary Industries. http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0006/342969/Caprine-arthritis-encephalitis.pdf.

Shim-Prydon and Camacho-Barreto, 2007. New Animal Products: New uses and markets for by-products and coproducts of crocodile, emu, goat, kangaroo and rabbit, *RIRDC* 117: 1–76.

Plenary 4

Improving Dairy Goat Productivity with Concomitant Mitigation of Methane

Abecia, L.[1], J. Balcells[4], P.G. Toral[1], A.I. Martín-García[1], G. Martínez[1], N.W. Tomkins[3], E. Molina-Alcaide[1], C.J. Newbold[2] & D.R. Yáñez-Ruiz[1]*

[1]Estación Experimental del Zaidín (CSIC), Profesor Albareda 1, 18008, Granada, Spain.
[2]IBERS, Aberystwyth University, Aberystwyth, SY23 3DA, United Kingdom.
[3]CSIRO Livestock Industries. ATSIP, James Cook University Townsville QLD 4812, Australia
[4]Departament Producció Animal. ETSEA. Universitat LLeida 25195 Lleida, Spain
[*]Email of corresponding author: david.yanez@eez.csic.es

Introduction

The emission of greenhouse gases by livestock and potential abatement technologies have been the subject of many international studies in recent years. In ruminants, methane (CH_4) production represents a loss of between 2 and 12% of the gross energy intake (Johnson and Johnson, 1995). In particular, in high producing lactating animals it has been estimated to be equivalent to a loss of 6% of gross energy intake as CH_4 (Tamminga et al., 2007).

A variety of nutritional management strategies to reduce methane production in ruminants have been studied. Increasing the level of grain in the diet have been shown to reduce methane emission; mainly due to associated changes in fermented substrate from fibre to starch (Blaxter and Clapperton, 1965). The addition of lipids also mitigates methane production through a reduction in rumen organic matter fermentation (Johnson and Johnson, 1995). However, it is necessary to use high quantities of supplemental lipids (≥6% DM) and this is associated with decreased fibre digestibility and DMI (dry matter intake), negating the advantages of increased energy density of the diet (Beauchemin et al., 2008; Eugène et al., 2008).

Several rumen fermentation modifiers have been tested in vitro, but very few have been successfully used *in vivo* conditions and almost none in lactating animals (McAllister and Newbold, 2008). A major constraint of feeding additives to reduce methanogenesis is that *in vitro* effects observed may not persist *in vivo*. This may be related to the degradation of the active compounds by rumen microorganisms or to the rumen ecology system develops adaptive mechanisms able to revert changes (Hart et al., 2008).

In the present work we test bromochoromethane (BCM) that has been shown to reduce methane production by up to 60% in steers fed grain-based diets over a 90-d feedlot finishing period (Tomkins et al., 2009) with no signs of toxicity or residues in edible meat and offal. Although uncomplexed BCM has an ozone-depleting effect and therefore is banned for commercial use, the strong and persistent effect on methane reduction makes it as an interesting tool to investigate side effects of methane reduction in dairy goats.

The aim of this work was to investigate the effect of addition of BCM in the diet of dairy goats on animal performance, rumen methane production and fermentation pattern, and on milk yield and composition.

Materials and methods

Eighteen pregnant Murciano-Granadina goats [43 ± 1.7 kg body weight (BW)] were kept in individual pens (1.7 × 1.2 m) with free access to water. Animals were fed twice a day (0900 h and 1500 h) alfalfa hay *ad libitum* supplied with 600 g/d of a commercial compound feed. After parturition the experimental period commenced and lasted for 10 wk, goats were randomly allocated to one of the two experimental groups: BCM+, treated with 0.30 g/100 kg BW of BCM formulation, and BCM-, as control nontreated group. Bromochoromethane treatment was given twice a day at feeding times (as before). The kids remained with their mothers for 8 wk and after weaning methane emissions were recorded over two consecutive days (day 57 and 58 of treatment) in open circuit respiration chambers. On day 59, rumen fluid was sampled using a stomach tube and aliquots stored at -20 ºC for VFA analysis. Over the last two weeks of the trial, goats were put back to the individual pens and milked once a day before the morning feeding. On day 69 and 70 sampling periods, milk yield was recorded and samples taken for the determination of milk composition. Goats were weighed on day 1 and 56 of the experimental period.

Results

Dry matter intake and mean BW were not affected by the addition of BCM (Table 1). Although milk yield was higher (1324 vs. 901 g/d; P = 0.021) for goats in BCM+ group than BCM-, milk components were not modified by the experimental treatment (data not presented).

Table 1. Productive parameters, rumen characteristic and methane emission in experimental goats treated (BCM+) or not (BCM-) with bromochloromethane (n = 9 per treatment)

	BCM-	BCM+	SED[1]	*P*-value
Productive parameters				
Initial BW, kg	40.8	43.8	1.58	0.363
BW change[2], kg	-6.6	-6.4	1.41	0.76
DM intake, g/d	992	1041	53.3	0.366
Milk Yield (g/d)	901	1324	164	0.021
Rumen parameters				
VFA (mmol/L)	58.5	74.4	8.79	0.216
Acetate (mol/100mol)	61.2	60.3	1.15	0.59
Propionate	11.1	15.5	0.54	<0.001
Butyrate	13.5	13.5	0.66	0.974
Isobutyrate	5.2	3.8	0.21	<0.001
Valerate	2.5	2.3	0.22	<0.615
Isolvalerate	6.4	4.5	0.34	<0.001
Gas Emissions				
CH_4 L/d	22.4	15.1	3.0	<0.028

Rumen total VFA concentration was not modified by the experimental treatment although VFA profile was affected by the addition of BCM formulation, increasing the proportion of propionate and decreasing those of branched-chain-VFA (namely, isobutyrate and isovalerate). Methane production by goats over two consecutive days in the chambers indicated a significant reduction in methanogenesis in BCM+ animals compared to nontreated goats. Methane emissions expressed per kg of DMI was lowered by a 48% in BCM+ goats compared with BCM- ($P = 0.013$). The emissions per kg of milk produced were also lower in BCM+ goats ($P = 0.051$).

Discussion

The reduction in BCM+ goats in methane emission is in agreement with those reported with BCM in batch and continuous culture fermenters (Goel et al., 2009) or in non-lactating cattle (Tomkins et al., 2009). We observed almost a 50% reduction after 57 d treatment, which agrees with the 60 and 50% reduction reported by Tomkins et al. (2009), respectively, over 30 and 90 d treatment in steers treated with the same dose (0.30 g/100 kg BW, twice daily).

The lack of changes in intake and the rumen VFA concentration with the BCM treatment indicates that microbial fermentation in the rumen was not compromised as observed with other antimethanogenic treatments in which the reduction in methane emissions is, at least in part, related to decreases in DMI (Beauchemin et al., 2008). The reduction in acetate-propionate ratio due to BCM treatment agrees with that previously observed in steers (Denman et al., 2007) and it has been described as a common feature of several antimethanogenic compounds, the redirection of hydrogen from methane to more propionic metabolic pathways (McAlister and Newbold, 2008).

Goats on BCM+ group produced significantly more milk than BCM- goats and DMI was equivalent to approximately 2.5% BW and equivalent to that observed for BCM- goats. To our knowledge, this is the first report on the use of BCM, or other halogenated analogue, in lactating ruminants.

The 45% increase in milk yield in BCM+ goats involves 4.48 MJ/d energy cost in milk production as compared to 3.09 MJ/d in control goats. The energy balances that result from deducting methane losses to energy intake leaves extra 1.16 MJ/d available to the animal. In addition, and assuming a similar rumen contents volume in both experimental groups (around 11% of body weight, personal communication) and equal absorption efficiency of VFAs, BCM+ goats absorbed 91% more propionate than BCM- animals (55.6 vs. 29.1 mmol/d, respectively). Such an increase in propionate production would lead to an increase in glucose synthesis and hence in milk lactose, assuming a 70% efficiency in the conversion of propionate to glucose and a 40% conversion of glucose to lactose (Newbold et al., 2005). Thus the combination of less methane losses and the increase in glucose synthesis from propionate supply justifies the increase in milk production efficiency observed here.

The imbalance in the distribution of electrons in methane explains the higher molar proportion of propionate in rumen fluid from treated goats. An increase in propionate production could have led to a higher synthesis of glucose in the liver, which may result in an increase in the synthesis of lactose in the mammary gland (Newbold et al., 2005). Because milk is isotonic with respect to blood, and lactose contributes some 60% of milk osmolarity, an increase in lactose flow to the mammary gland would result in greater milk yield (Tamminga et al., 2007). Unfortunately, our results are not directly comparable with available reports in dairy cows because of the important differences in the strategies for methane mitigation tested. The addition of lipids in the diet of dairy cows has been shown to reduce methane emissions, but the levels of supplementation normally used can be associated with decreased DMI (Beauchemin et al., 2008). The reduction in methane emissions achieved by adding lipids is not necessarily accompanied by an increase in milk yield, even if they are combined with other type of additives such as organic acids (van Zijderveld et al., 2011).

The genetic potential for milk yield from the breed of dairy goats used in this study would be expected to be higher than the value observed in the control. This is due to the relatively low amount of feed offered to the animals to facilitate intake measurements during methane measurements in the chambers. It is reasonable to anticipate that the increase in lactose yield and, subsequently milk yield, would be accompanied by comparable increases in fat or protein yield and, probably, greater loses in BW during lactation. However, this was not the case, and neither was the dilution effect in response to higher milk yield (i.e. the reduction in the concentration of fat and protein) significant. The inter-animal variation observed in this study for milk variables was high, contributing to the lack of significant changes.

References

Johnson, K.A. and D.E. Johnson, 1995. Methane emissions from cattle. *J. Anim. Sci.* 73: 2483–2492.

Tamminga, S., A. Bannink, J. Dijkstra and R. Zom, 2007. *Feeding strategies to reduce methane loss in cattle*. Report 34 of the Animal Sciences Group, Wageningen UR, Lelystad. ISSN 1570–8610.

Blaxter, K.L. and J.L. Clapperton, 1965. Prediction of the amount of methane produced by ruminants. *Br. J. Nutr.* 19: 511–22.

Beauchemin, K.A., M. Kreuzer, F. O'Mara and T.A. McAllister, 2008. Nutritional management for enteric methane abatement: a review. *Aust. J. Exp. Agric.* 48: 21–27.

Eugène, M., D. Massé, J. Chiquette and C. Benchaar, 2008. Short communication: Meta-analysis on the effects of lipid supplementation on methane production in lactating dairy cows. *Can. J. Anim. Sci.* 88: 331–334.

McAllister, T.A. and C.J. Newbold, 2008. Redirecting rumen fermentation to reduce methanogenesis. *Aust. J. Exp. Agric.* 48: 7–13.

Hart, K.J., D.R. Yáñez-Ruiz, S.M. Duval, N.R. McEwan and C.J. Newbold, 2008. Plant extracts to manipulate rumen fermentation. *Anim. Feed Sci. Technol.* 147: 8–35.

Tomkins, N.W., S.M. Colegate and R.A. Hunter, 2009. A bromochloromethane formulation reduces enteric methanogenesis in cattle fed grain-based diets. *Anim. Prod. Sci*. 49: 1053–1058.

Goel, G., H.P.S. Makkar and K. Becker, 2009. Inhibition of methanogens by bromochloromethane: effects on microbial communities and rumen fermentation using batch and continuous fermentations. *Br. J. Nutr.* 101: 1484–1492.

Denman, S.E., N.W. Tomkins and C.S. McSweeney, 2007. Quantification and diversity analysis of ruminal methanogenic populations in response to the antimethanogenic compound bromochloromethane. *FEMS Microbiol. Ecol*. 62: 313–322.

Newbold, C.J., S. Lopez, N. Nelson, J.O. Ouda, R.J. Wallace and A.R. Moss, 2005. Propionate precursors and other metabolic intermediates as possible alternative electron acceptors to methanogenesis in ruminal fermentation in vitro. *Br. J. Nutr.* 94: 27–35.

van Zijderveld, S.M., B. Fonken, J. Dijkstra, W.J.J. Gerrits, H.B. Perdok, W. Fokkink and J.R. Newbold, 2011. Effects of a combination of feed additives on methane production, diet digestibility, and animal performance in lactating dairy cows. *J. Dairy Sci.* 94: 1445–1454.

Plenary 5

The Possibility of Controlling Flow of Metabolic H into Various Pathways in Rumen Fermentation to Improve Dairy Goat Productivity

Mitsumori, M., O. Enishi & T. Shinkai*

National Institute of Livestock and Grassland Science, Tsukuba, 305-0901 Japan
**Email of corresponding author: mitumori@affrc.go.jp*

Introduction

It has been estimated that methane production by ruminants is about 15% of total anthropogenic methane emissions. Since methanogenesis in the rumen represents a 2–12% energy loss of intake, methane production from ruminants has to be considered from the perspective of both its global warming effect and feed efficiency of ruminants (Johnson and Johnson, 1995; Morgavi et al., 2010). The typical stoichiometry of rumen fermentation was proposed by Wolin (1979):

$$57.5\ C_6H_{12}O_6 \rightarrow 65\ \text{acetate} + 20\ \text{propionate} + 15\ \text{buyrate} + 35\ CH_4 + 60\ CO_2 + 25\ H_2O$$

This formula shows that methane is constituted of C and H supplied from hexose, and this relationship enables the understanding of methane production from the viewpoint of the carbon- and hydrogen-flow in the rumen. In the present paper, the possible pathways of hydrogen for methane production in the rumen are discussed.

Methanogenesis in the rumen is thought to be a consequence of the disposal of metabolic hydrogen (2H), which is mainly yielded from degradation of carbohydrate (e.g. cellulose, hemicellulose and starch) under strictly anaerobic conditions (Mitsumori and Sun, 2008; Morgavi et al., 2010). Since it is considered that reducing methane emission from the rumen provides the benefits of greenhouse gas reduction and results in improved feed efficiency, methods of estimating methane emission from the rumen and many strategies to mitigate methane production have been reported (Johnson and Johnson, 1995; Shibata and Terada, 2010).

It is known that the 2H from hydrogen-producing steps flows into hydrogen-consuming steps and pathways that produce propionate, acetate and methane and reduces sulfate and nitrate in the rumen. These pathways are integral parts of rumen fermentation. Although each hydrogen-consuming pathway needs 2H supplied from its intercellular metabolism, some microorganisms such as methanogens scramble for 2H excreted by other rumen microorganisms to obtain energy for their growth. It would however be difficult to understand the relationship between hydrogen-producing steps and hydrogen-consuming steps in the rumen, because information on metabolism of cultured rumen microorganisms is very limited and most of the rumen bacteria have not yet been cultured.

Approaches for mitigating methane have been applied in the ruminant production. Strategies or the approaches aim to depress activity of methanogens, enhance hydrogen-consuming steps excluding methanogenesis or depress hydrogen-producing steps. Hitherto, various feed additives, which are directly toxic to methanogens, exhibit antimicrobial activity, and/or produce undesirable changes in the rumen fermentation. It has been known that halogenated methane analogues such as bromochloromethane (BCM) have inhibitory effect on methane production (McCrabb et al., 1997; Goel, et al., 2009), because it reacts with coenzyme B (cobamine), which catalyses the last step of methanogenic pathway that leads to methane production (Wood et al., 1968). Currently, we investigated mechanisms of methane production in the rumen by administration of BCM to Shiba goats. Digestibility trials and measurement of methane production in whole animal were carried out using open-circuit respiration chambers equipped with gas analysers for oxygen, carbon dioxide and methane. Hydrogen gas production was calculated by formulas shown in Figure 1. Results of this study showed: (1) dramatic increase in hydrogen gas production when methanogenesis was strongly inhibited in the rumen, (2) decrease in feed intake and digestibility were not observed, and (3) >20% increase in the flow of 2H into short chain fatty acids (SCFA) and a marked increase in propionate production. These results provide a new insight into the methanogenesis in the rumen and will aid in the development of strategies to reduce methane production for improving ruminant productivity (Mitsumori et al., 2011).

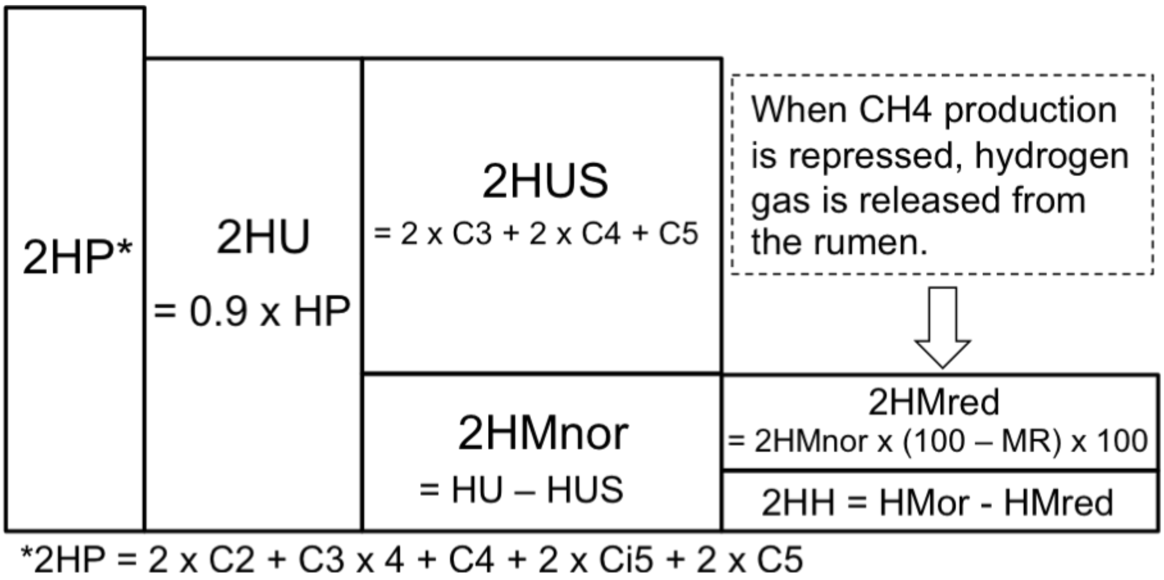

Figure 1. Calculation of 2H flowing into hydrogen gas.
[HP, 2H produced in the rumen; 2HU, the sum of 2H utilised in SCFA (2HUS) and in methane at normal level (2HMnor); 2HH, 2H utilised in hydrogen gas production; C2, acetate; C3, propionate; C4, butyrate; Ci5, isovalerate; C5, valerate; MR, methane reduction (%)].

References

Goel, G., H.P. Makkar and K. Becker, 2009. Inhibition of methanogens by bromochloromethane: effects on microbial communities and rumen fermentation using batch and continuous fermentations. *Br. J. Nutr.* 101: 1484–1492.

Johnson, K.A. and D.E. Johnson, 1995. Methane emissions from cattle. *J. Anim. Sci.* 73: 2483–2492.

McCrabb, G.J., K.T. Berger, T. Magner, C. May and R.A. Hunter, 1997. Inhibiting methane production in Brahman cattle by dietary supplementation with a novel compound and the effects on growth. *Aust. J. Agric. Res*. 48: 323–329.

Mitsumori, M. and W. Sun, 2008. Control of rumen microbial fermentation for mitigating methane emissions from the rumen. *Asian-Aust. J. Anim. Sci.* 21: 144–154.

Mitsumori, M., T. Shinkai, A. Takenaka, O. Enishi, K. Higuchi, Y. Kobayashi, I. Nonaka, N. Asanuma, S.E. Denman and C.S. McSweeney, 2011. Responses in digestion, rumen fermentation and microbial populations to inhibition of methane formation by a halogenated methane analogue. *Br. J. Nutr.* 108: 482–491.

Morgavi, D.P., E. Forano, C. Martin and C.J. Newbold, 2010. Microbial ecosystem and methanogenesis in ruminants. *Animal* 4: 1024–1036.

Shibata, M. and F. Terada, 2010. Factors affecting methane production and mitigation in ruminants. *Anim. Sci. J.* 81: 2–10.

Wolin, M.J., T.L. Miller and C.S. Stewart, 1997. *The Rumen Microbial Ecosystem*. 2nd ed. Blackie Acad. Profess. London, pp. 467–491.

Wood, J.M., F.S. Kennedy and R.S. Wolfe, 1968. The reaction of multi-halogenated hydrocarbons with free and bound reduced vitamin B_{12}. *Biochemistry* 7: 1707–1713.

Plenary 6

IDF Perspectives on the Global Dairy Situation and Development Perspectives for Non-Cow Milk

Seifert, J.

Technical Director, International Dairy Federation (IDF), 70, Boulevard Auguste Reyers, 1030 Brussels, Belgium
Email of corresponding author: JSeifert@fil-idf.org

Introduction

The International Dairy Federation (IDF) represents approximately 80% of the world's milk production across 52 different countries serving all stakeholders involved in the dairy sector. There are more than 1200 experts participating in the work of IDF.

IDF's mission is to represent the dairy sector as a whole at international level by providing the best global source of expertise and scientific knowledge in support of the development and promotion of quality milk and milk products to deliver consumers with nutrition, health and well-being.

IDF addresses key concerns such as the importance of a well-balanced diet in all stages of life, environmental protection, milk production, animal health and welfare and food safety. IDF stresses the importance of dairy products, which provide a high quality nutrient package and are an excellent food source of calcium, protein and other essential nutrients, thereby contributing to improved health and an overall higher quality of life for everybody, and particularly for vulnerable populations such as malnourished communities. Dairy products are, and shall remain, of prime importance in meeting some of the most pressing nutritional challenges all over the world.

IDF promotes the exchange of new ideas with fellow specialists across national borders, helps resolving issues and spreads best practice. Its expert committees and working groups provide experts with a platform to meet and jointly develop scientific knowledge and applications for industrial practice. IDF organises annual World Dairy Summits, a number of high-level international symposia as well as numerous seminars and workshops which contribute to the progress and understanding of dairy issues worldwide and provide unrivalled opportunities for networking with peers, sharing experiences and establishing contacts for future use.

IDF has built a formal partnership and particularly strong collaboration with the Food and Agriculture Organisation of the United Nations (FAO) with a proven track record of numerous successful joint events and publications in the past five decades. Through a tripartite initiative, involving in addition to FAO also the Institute of Tropical Agriculture of Universiti Putra in Malaysia, IDF is very pleased to contribute to the further development of the dairy goat sector in Asia.

More information about IDF can be obtained from its website: http://www.fil-idf.org/ (The global dairy situation and importance of non-cattle milk production worldwide) (IDF Bulletin, 2011).

Development of milk production

Growth of world milk production for all species picked up again in 2010. For both cow and buffalo milk however, growth is still below average. Cow's milk growth stepped up compared to 2009 (1.6% versus 0.9%) and buffalo milk stepped down compared to 2009 (3.1% versus 3.9%). Higher milk prices have certainly stimulated production but bad weather conditions and natural disasters also had an adverse effect on milk production. Goat milk production increased steadily and sheep milk also increased slightly during the past year. During the first half of 2011 milk output increased strongly in most of the countries in the southern hemisphere and moderately in most of the countries in the northern hemisphere.

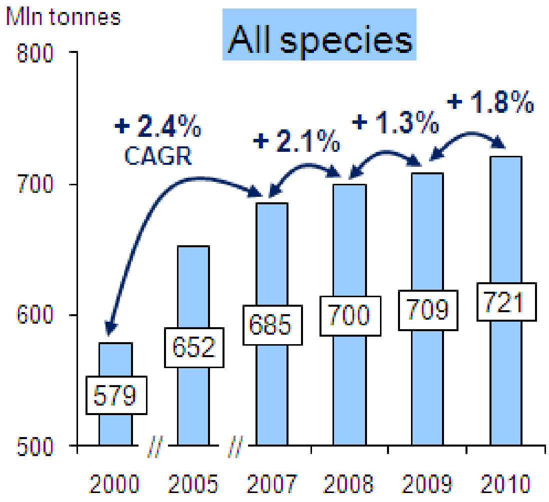

Figure 1. World Milk Production 2000-2010

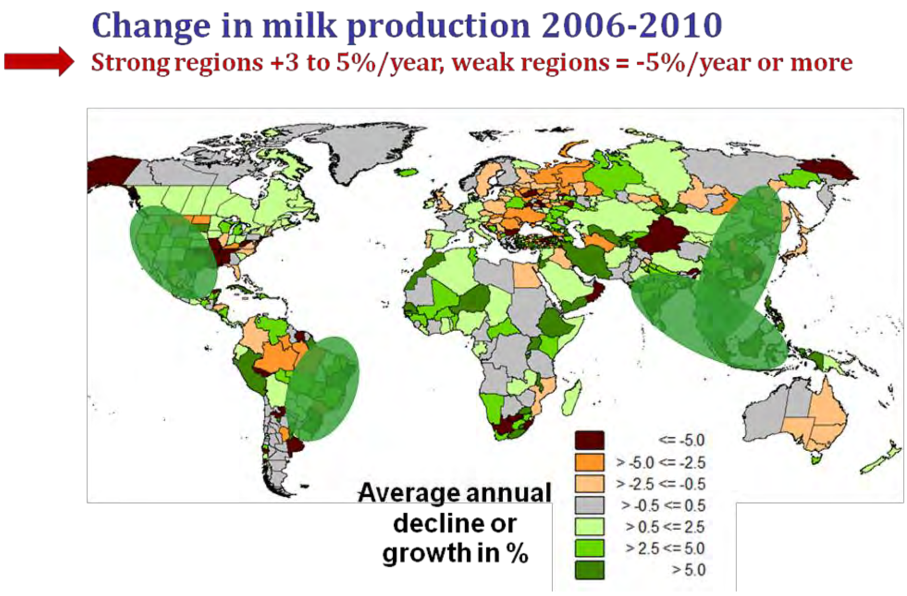

Figure 2. Development of World Milk Production by region 2006–2010 according to IFCN (Krijger et al., 2011)

Goat milk constitutes around 2.2% of total milk production, sheep milk 1.3% and camel milk 1.3%. According to FAO data for 2009, goat milk was mainly produced in Asia (59% of world milk production), in Africa (21%) and in Europe (16%); whereas sheep milk production is located in Asia (44%) and Europe (34%) and camel milk mostly in Africa (89%).

Goat milk production has been increasing regularly over the last few years, but this growth tends to be slowing. In 2010 the increase narrowed to 0.2%. Development differs widely from country to country. While goat milk production was rather dynamic in Turkey (+3.5%) and in France (+6.4%), a downturn occurred in Mexico (-1.0%), Spain (-2.9%) and the Netherlands (-8.6%).

Milk processing and consumption worldwide

World output increased last year for every dairy product, but growth was rather small for Skim Milk Powder (SMP). The large quantities of stocks stored in 2009 discouraged SMP production in Europe and did not stimulate production elsewhere, as international demand was also very strong for Whole Milk Powder (WMP) and cheeses. WMP production recovered after a drop in 2009, stimulated by firm demand in Asia and the Middle East. As for cow's milk cheese, industrial output recovered strongly, after two years of weak growth. World butter production kept growing last year, even if growth was not as sustained as in the previous year.

Global per capita consumption of milk in 2010 was 104.6 kg and recovered from the slight decrease in 2009. Asia is the most important consuming region with 39% of total world consumption, followed by Europe (29%) and North America (13%). Strongest growth occurred in South America, where Brazil and Argentina especially contributed to this increase. Strong growth in Asia is also reported.

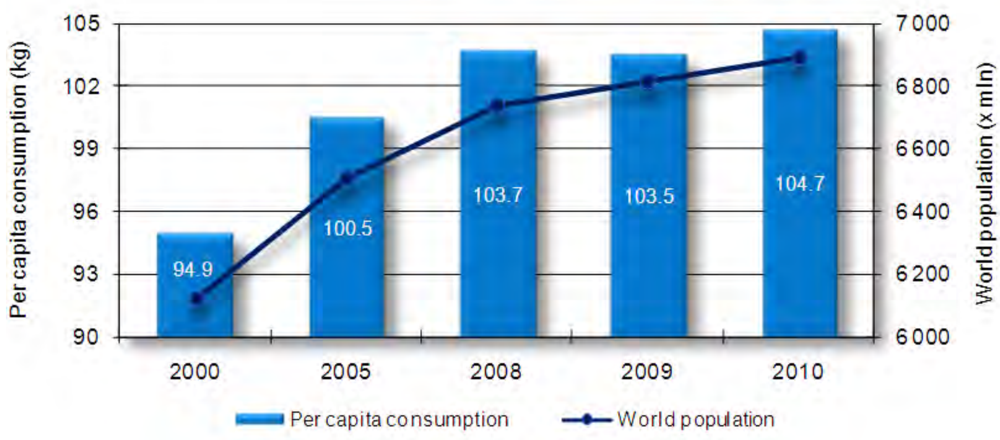

Figure 3. World Milk Consumption 2000–2010

In 2010, the overall share of world dairy trade in the global milk pool was well over 7%, which is still modest. Volume increased to 51.9 million tonnes.

Costs of milk production, prices and production outlook

The International Farm Comparison Network (IFCN) has analysed the costs of milk production based on the concept of a typical farm in 49 countries (Hemme et al., 2011).

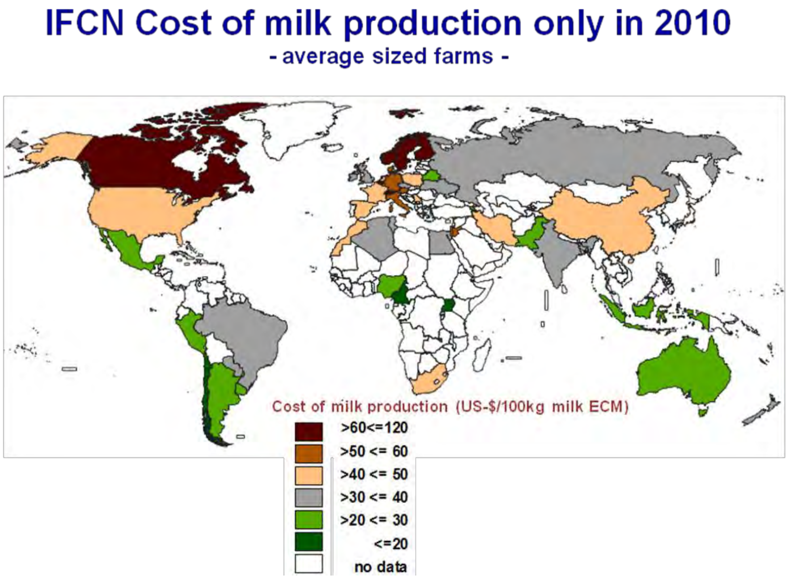

Figure 3. Average costs of milk production

Prices recovered during 2010. The first half of 2010 was a supply driven recovery due to a combination of tight dairy supply coupled with a modest recovery in the global economy. Short-term forecasts for global milk production from FAO and FAPRI look favourable.

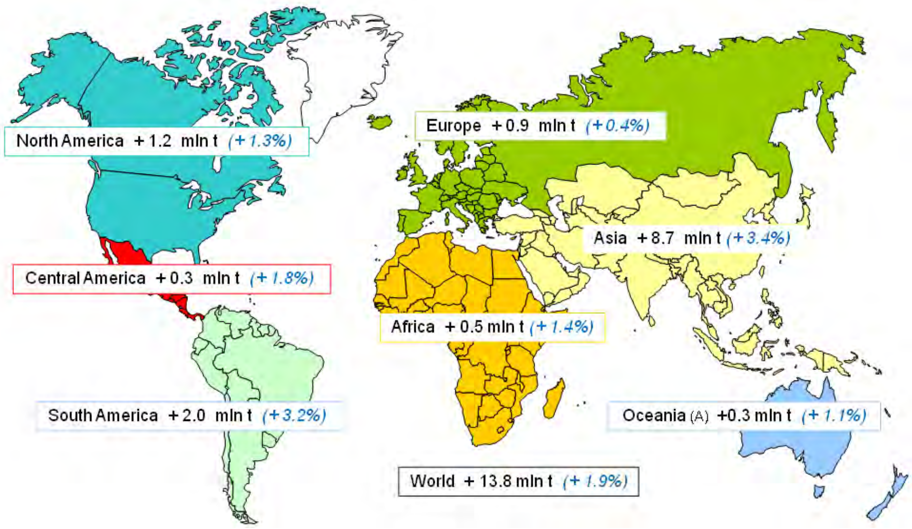

Figure 4. Milk production outlook in 2012

References

IDF Bulletin No. 451, 2011. The World Dairy Situation 2011, *International Dairy Federation* (IDF), 70, Boulevard Auguste Reyers, B-1030 Brussels, Belgium.

Hemme, T., et al., 2011. *IFCN Dairy Report 2011*, International Farm Comparison Network Dairy Research Center at University Kiel, Schauenburgerstraße 116, D-24118 Kiel, Germany.

Plenary 7

Goat Milk and Human Nutrition

Park, Y.W.

Georgia Small Ruminant Research and Extension Centre, Fort Valley State University, Fort Valley, GA 31030-4313, USA
Email of corresponding author: parky@fvsu.edu

Introduction

The goat is a main supplier of dairy and meat products for rural people around the world. Goat milk plays an important role in nutrition and socioeconomic wellbeing of developing and underdeveloped countries, where it provides basic nutrition and subsistence to the rural people, which are the majority of their populations (Park and Haenlein, 2007). Although goats produce approximately 2% of the world's total annual milk supply (FAO, 1995), their contribution to the nutritional and economic wellbeing of mankind is tremendous in many parts of the world, notably in the Mediterranean countries and in the Middle East (Juàrez and Ramos, 1986; Park, 1994a; Park and Haenlein, 2007).

On the other hand, production of goat milk and its products of cheeses and yoghurt is also a valued part of the dairy industry in developed countries, where it provides diversity to sophisticated consumer tastes, and supports people with medical afflictions, such as allergies and gastro-intestinal disorders, who need alternative dairy products (Haenlein, 1996; 1997; Park, 1992; 1994a). These facts indicate that goat milk serves 3 general types of markets around the world, which are: (a) home consumption, (b) specialty gourmet interests, and (c) medical needs.

Since cow milk is not available or not affordable to millions of rural poor people, home consumption of goat milk is important in the prevention of under-nutrition and malnutrition, simply because milk is the superior source of calcium and protein. The purpose of the present paper is to review the nutritional, chemical, medical and socioeconomic importance of goat milk in human nutrition.

Compositional characteristics of goat milk

Caprine milk, on the average, contains 12.2% total solids, consisting of 3.8% fat, 3.5% protein, 4.1% lactose and 0.8% ash, indicating that it has more fat, protein and ash, and less lactose than cow milk (Table 1) (Park, 2006). However, goat milk provides similar level of calories (70 kcal/100mL) for human nutrition as cow or human milk do. A human infant fed solely on goat milk is oversupplied with protein, Ca, P, vitamin A, B_1, B_2, niacin, pantothenic acid, while deficient in iron, vitamin B_6, B_{12}, C, D, and folic acid (Jenness, 1980).

A daily minimum supply of 800 mg calcium per person is widely recommended, as is also a minimum of 60 g protein from animal sources (NRC, 1964). Table 2 shows how far below these recommendations the average supply of calcium and protein is estimated to be especially in Africa and Asia (Park and Haenlein, 2007).

Studies on the composition of different commercial goat milk products (Park, 1990; 1994b; 1999) revealed that goat milk and its products would be excellent sources of human nutrition comparable to cow milk products (Posati and Orr, 1976). However, there were some notable differences in nutrient contents of goat milk products between studies. These differences may be attributable to differences in sources of original milk used for processing the products, because the nutrient compositions of goat milk can be greatly influenced by several factors such as season, stage of lactation, breed, diet, individual animal, and environmental management conditions (Underwood, 1977; Haenlein and Caccese, 1984; Park and Chukwu, 1988; Park, 1990).

Table 1. Comparison of average composition of basic nutrients among goat, cow and human milk

Composition	Goat	Cow	Human
Fat, %	3.8	3.6	4.0
Solid-not-fat, %	8.9	9.0	8.9
Lactose, %	4.1	4.7	6.9
Protein, %	3.4	3.2	1.2
Casein, %	2.4	2.6	0.4
Albumin, globulin, %	0.6	0.6	0.7
Non-protein N, %	0.4	0.2	0.1
Ash, %	0.8	0.7	0.3
Calories/100 mL	70	69	68

Data from Posati and Orr (1976), Jenness (1980), Haenlein and Caccese (1984) and Park (2006).

Table 2. Average daily supply of calcium and protein per person (FAO, 1995) in relation to Recommended Dietary Allowances (RDA; 800 mg calcium and 60 g animal protein; NRC, 1964 and Park and Haenlein, 2007)

	Total Supply	From animal sources	
	mg	mg	% of RDA
CALCIUM			
Africa	384	132	16
Asia	329	125	16
Europe	896	684	86
N + C America	832	569	71
S America	490	317	40
PROTEIN			
Africa	56	12	20
Asia	64	16	27
Europe	101	58	97
N + C America	97	56	93
S America	67	31	52

Compared to cow and sheep milk, goat milk has its unique differences in several important constituents and physical parameters, such as proteins, lipids, minerals, vitamins, carnitine, glycerol ethers, orotic acid, enzymes, fat globule size, casein polymorphisms. These compositional and physical differences of goat milk play significant roles in human nutrition (Park and Haenlein, 2007).

Nutritional and therapeutic values of goat milk

Compared to cow or human milk, goat milk reportedly possesses unique biologically active properties, such as high digestibility, distinct alkalinity, high buffering capacity as well as certain therapeutic values in medicine and human nutrition (Walker, 1965; Devendra and Burns, 1970; Haenlein and Caccese, 1984; Park, 1990; 1991; 1994a; Park and Haenlein, 2007).

The nutritional advantages of goat milk over cow milk do not come from its protein or mineral differences, but from the lipids, more specifically the fatty acids within the lipids (Babayan, 1981; Park, 1994a; Haenlein, 2004). Average goat milk fat differs in contents of its fatty acids significantly from average cow milk fat (Jenness, 1980), being much higher in butyric (C: 0), caproic (C6: 0), caprylic (C8: 0), capric (C10: 0), lauric (C12: 0), myristic (C14: 0), palmitic (C16: 0), lilnoleic (C18: 2), but lower in stearic (18: 0), and oleic acid (C18: 1). Owing to the high amounts of short and medium chain fatty acids (MCT), goat milk fat may have at least three significant contributions to human nutrition: (i) it may be more rapidly digested than cow milk fat, because lipase attacks ester linkages of short or MCT more easily than those of longer chains, (ii) these fatty acids exhibit beneficial effects on cholesterol metabolism such as hypocholesterolemic action on tissues and blood via inhibition of cholesterol deposition and dissolution of cholesterol in gallstones, and (iii) they have been therapeutically used for treatment of malabsorption patients suffering from steatorrhea, chyluria, hyperlipoproteinemia, and in case of intestinal resection, coronary bypass, childhood epilepsy, premature infant feeding, cystic fibrosis and gallstones. The short or MCT have the unique metabolic ability to provide direct energy instead of being deposited in adipose tissues, and lower serum cholesterol and inhibit cholesterol deposition (Kalser, 1971; Alferez et al., 2001).

Cholesterol and fatty acid concentrations among different species were compared using the data published by the Royal Society of Chemistry, UK (Holland et al., 1989) (Table 3). This table shows that the respective cholesterol contents of normal fluid goat, cow, sheep and human milk are 10, 14, 11 and 16, respectively, indicating that goat milk actually has the lowest cholesterol content among the milk from these 4 species. There is some similarity in the cholesterol values reported in the USDA Agricultural Handbook No. 8-1 (Posati and Orr, 1976; Jenness, 1980). Human milk appears to have the highest cholesterol content among the milk from the 4 species, and human colostrum has 31 mg/100 g. Cow milk powder has substantially higher cholesterol (120 mg/100 g) since it is a dried and concentrated product (Park, 2000).

Concerning fatty acid composition, the normal goat, cow, sheep and human milks contain 2.3, 2.4, 3.8, and 1.8 g/100 g saturated fatty acids, respectively, suggesting that human milk has lower saturated fat than the milk from the 3 major dairy species. The opposite trend is observed for the mono- and poly-unsaturated fatty acid levels in human milk compared to the milk from the other three species milks (Table 3). The significantly higher unsaturated fatty acids and cholesterol in human milk compared to the 3 animal species appears to be interesting and may need future investigations on certain health issues such as coronary heart diseases.

The USDA Handbook shows that goat milk has higher levels of 6 out of the 10 essential amino acids: threonine, isoleucine, lysine, cystine, tyrosine, valine than cow milk (Posati and Orr, 1976; Haenlein, 2004) (Table 4). In addition, goat milk proteins are believed to be more readily digestible and their amino acids absorbed more efficiently than those of cow milk. Caprine milk forms a softer, more friable curd when acidified, which may be related to lower contents of α_{s1}-casein in the milk (Jenness, 1980; Haenlein and Caccese, 1984). Smaller and more friable curds of goat milk would be attacked more rapidly by stomach proteases, giving better digestibility (Jenness, 1980). Goat milk is also shown to have greater buffering capacity, which would be beneficial for treatment of stomach ulcer, due to higher levels of major buffering components, such as proteins, nonprotein N and phosphate (P_2O_5) than cow milk (Park, 1991), which would be important in human nutrition.

Table 3. Cholesterol and fatty acid composition of milk from different species[a,b]

Milk	Fatty Acids (g/100 g)			Cholesterol
	SFA	MUFA	PUFA	(mg/100 g)
Cow				
Whole	2.4	1.1 (0.96)[c]	0.1	14
Skim	0.1	Tr	Tr	2
Dried whole	16.5	7.6	0.8	120
Goat	2.3	0.8 (1.11)[c]	0.1	10
Sheep	3.8	1.5	0.3	11
Human				
Colostrum	1.1	1.1	0.3	31
Mature	1.8	1.6	0.5	16
Soya	0.3	0.4	1.1	0

[a]Data taken and organised from Holland et al. (1989). [b]Park and Guo (2006). [c]USDA Handbook No. 8-1 (Posati and Orr, 1976). SFA = Saturated fatty acid; MUFA = Monounsaturated fatty acid; PUFA = Polyunsaturated fatty acid.

Table 4. Average amino acid composition (g/100 g milk) in proteins of goat and cow milk[a,b]

Essential amino acids	Goat milk	Cow milk	Difference (%) for goat milk
Tryptophan	0.044	0.046	
Threonine	0.163	0.149	+9
Isoleucine	0.207	0.199	+4
Leucine	0.314	0.322	
Lysine	0.290	0.261	+11
Methionine	0.080	0.083	
Cystine	0.046	0.030	+53
Phenylalanine	0.155	0.159	
Tyrosine	0.179	0.159	+13
Valine	0.240	0.220	+9

[a]Posati and Orr (1976); [b]Haenlein (2004).

Scientific studies with goat milk in human nutrition

Nutrition studies on goat milk

In addition to providing basic nutrition and subsistence to goat producing populations in the globe, goat milk has significant value in human nutrition especially for children and milk allergic patients. In a nutrition study involving 38 children (20 girls and 18 boys) aged 6 to 13 years, Mack (1953) fed one-half of them 0.946 litre of goat milk and the other half 0.946 litre of cow milk daily for 5 months. Children fed on the goat milk surpassed those on cow milk in weight gain, statue, skeletal mineralisation, bone density, blood plasma vitamin A, calcium, thiamine, riboflavin, niacin and hemoglobin concentrations. However, the differences were minimal in blood hemoglobin, various other biochemical and structural measurements between the two groups.

Most milk, including human milk, are deficient in iron. In a Fe bioavailability study of goat and cow milk using anemic rats, Park et al. (1986) reported that rats fed on goat milk grew significantly better, had higher liver weights, hemoglobin iron gain, and higher iron absorption rates than those on cow milk. The anemic rats receiving the whole goat milk diet showed significantly greater hemoglobin regeneration efficiencies than those on the cow milk diet.

In comparative absorption studies with rats in Spain (Barrionuevo et al., 2002), 50% of the animals' distal small intestines were removed by resection to simulate the pathological condition of malabsorption syndrome, and goat milk was fed instead of cow milk as part of the diet. The animals fed goat milk had significantly higher digestion and absorption of iron and copper than the cow milk fed group, and anemia was prevented in the goat milk fed group. Alferez et al. (2001) found the utilisation of fat and weight gain was improved with goat milk, compared to cow milk, and levels of cholesterol were reduced, while triglyceride, HDL, GOT and GPT values remained normal. Consumption of goat milk reduced total cholesterol levels and the LDL fraction, because of the higher presence of MCT (36% in goat milk vs. 21% in cow milk), which decreases the synthesis of endogenous cholesterol. In an Algerian study of 64 infants with malabsorption syndromes, Hachelaf et al. (1993) observed that the substitution of cow milk by goat milk also led to significantly higher intestinal fat absorption.

In Madagascar in another comparative nutritional study, Razafindrakoto et al. (1993) fed either cow or goat milk in addition to their regular diet to 30 hospitalised malnourished children between 1 and 5 years of age. The results showed that the children fed on goat milk outgained the children on cow milk in bodyweight by 9% (8.53 g/kg/day ± 1.37 vs. 7.82 ± 1.93) over the 2-week trial period, and fat absorption tended to be better in the goat milk children, indicating an apparent advantage of goat milk over cow milk for rehabilitating undernourished children in developing countries.

Hypoallergenicity studies on goat milk

In 1,682 allergic migraine patients, Walker (1965) found that only one in 100 infants who were allergic to cow milk, did not thrive well on goat milkfrom. Among the 1,460 patients with food allergy, 92% were due to cow milk or dairy products; 35% to wheat; 25% to fish; 18% to egg; 10% to tomato; 9% to chocolate. Some patients were allergic to more than one food.

In French clinical studies over 20 years with cow milk allergy patients, these were found to be sensitive to cow lactalbumin and α_{s1}-casein, which are species specific. The major whey protein, β-lactoglobulin, is reportedly to be responsible for cow milk allergy (Heyman and Desjeux, 1992). Substitution of cow milk with goat milk resulted in "undeniable" improvements (Sabbah et al., 1997). In other French clinical trials with children allergic to cow milk, 93% of the goat milk treated children produced positive results, and goat milk was recommended as a valuable aid in child nutrition, because of its hypoallergenicity and better digestibility compared to cow milk (Reinert and Fabre, 1997).

While some caprine milk proteins have immunological cross-reactivity with cow milk proteins (Restani et al., 1999), most studies reported that infants suffering from gastrointestinal allergy and chronic enteropathy against cow milk were cured by goat milk therapy (Walker, 1965; Van der Horst, 1976; Park, 1994a). Much more clinical studies are called for as goat milk research in clinical trials has not been well supported by the cow milk driven societies.

Guinea pigs had allergic reactions to goat milk with α_{s1}-casein, similar to cow milk, which only has this protein polymorph, and which may explain the commonly found cross-immune reaction between cow milk and some goat milk. However, only 40% of guinea pigs fed goat milk without this polymorph but instead with α_{s2}-casein showed an allergic reaction, indicating goat milk lacking α_{s1}-casein is less allergenic than other goat milk (Haenlein, 2004).

Conclusions

Caprine milk and its products are important sources of nutrition and economic wellbeing of humanity in many parts of the world. Production of caprine milk is highly important in developing countries, where it provides basic nutrition and subsistence to the rural populations. In addition, dairy goat products including fluid milk, cheeses and yoghurt are also valued parts of the total dairy industry in developed countries, by providing connoisseur consumers with diversified and exotic tastes, and by supporting people with medical afflictions, such as allergies and gastro-intestinal disorders, who need alternative dairy products. Because of its unique nutrient composition and physicochemical characteristics, goat milk has highly important nutritional, therapeutic and medical values in human nutrition and health. Further clinical and nutritional trials on human subjects are greatly needed to substantiate and confirm the reported nutritional, hypoallergenic and therapeutic significance of goat milk in human nutrition.

References

Alferez, M.J., M. Barrionuevo, I. Lopez Aliaga, M.R. Sanz Sampelayo, F. Lisbona, J.C. Robles and M.S. Campos, 2001. Digestive utilisation of goat and cow milk fat in malabsorption syndrome. *J. Dairy Res.* 68: 451–461.

Babayan, V.K., 1981. Medium chain length fatty acid esters and their medical and nutritional applications. *J. Am. Oil Chem. Soc.* 59: 49A.

Barrionuevo, M, M.J.M. Alferez, L.I. Lopez, S. Sampelayo and M.R. Campos, 2002. Beneficial effect of goat milk on nutritive utilisation of iron and copper in malabsorption syndrome. *J. Dairy Sci.* 85: 657–664.

Devendra, C. and M. Burns, 1970. *Goat production in the tropics*. Commonwealth Bur. Anim. Breeding and Genetics, Tech. Commun. No.19.

FAO, 1995. Production Yearbook 1994. *Food and Agriculture Organisation of UN*, Rome, Italy, 48, 243 pp.

Hachelaf, W., M. Boukhrelda, M. Benbouabdellah, P. Coquin, J.F. Desjeux, G. Boudraa and M. Tuhami, 1993. Digestibilite des graisses du lait de chevre chez des infants presentant une malnutrition d'origine digestive. *Comparaison avec le lait de vache. Lait*. 73: 593–599.

Haenlein, G.F.W., 1996. Status and prospect of the dairy goat industry in the United States. *J. Anim. Sci.* 74: 1173–1181.

Haenlein, G.F.W., 1997. Alternatives in dairy goat product market. Intern. *J. Anim. Sci.* 12: 149–153.

Haenlein, G.F.W., 2004. Goat milk in human nutrition. *Small Ruminant Res.*51: 155–163.

Haenlein, G.F.W. and R. Caccese, 1984. Goat milk versus cow milk. In: G.F.W. Haenlein and D.L. Ace (Eds.). *Extension Goat Handbook*. USDA Publ., Washington, D.C.

Heyman, M. and J.F. Desjeux, 1992. Significance of intestinal food protein transport. *J. Pediatr. Gastroent. Nutr*. 15: 48–57.

Holland, B., I.D. Unwin and D.H. Buss, 1989. Milk Products and Eggs. In: *The composition of Foods*. Royal Society of Chemistry. Ministry of Agriculture, Fisheries and Food. Cambridge, U.K., pp.1–100.

Jenness, R., 1980. Composition and characteristics of goat milk: Review 1968–1979. *J. Dairy Sci.* 63: 1605.

Juàrez, M. and M. Ramos, 1986. Physico-chemical characteristics of goat milk as distinct from those of cow milk. *Intl. Dairy Bull*. No. 202, p54.

Kalser, M.H., 1971. Medium chain triglycerides. *Adv. Intern. Med*. 17: 301.

Mack, P.B., 1953. A preliminary nutrition study of the value of goat's milk in the diet of children. *American Goat Society Yearbook* 1952–1953: 112–131.

NRC, 1964. Recommended Dietary Allowances. 6th ed., *National Academy of Sciences, National Research Council*, Washington, D.C., USA, 1146: 59.

Park, Y.W., 1990. Nutrient profiles of commercial goat milk cheeses manufactured in the United States. *J. Dairy Sci.* 73: 3059–3067.

Park, Y.W., 1991. Relative buffering capacity of goat milk, cow milk, soy-based infant formulas, and commercial non-prescription antiacid drugs. *J. Dairy Sci.* 74: 3326.

Park, Y.W., 1992. Advances in manufacture of goat cheese. *Proc. V. Intl. Conf. Goat*, New Delhi, India, Vol. II, Part II, p382.

Park, Y.W., 1994a.Hypo-allergenic and therapeutic significance of goat milk. *Small Ruminant Res.* 14: 151.

Park, Y.W., 1994b. Basic nutrient and mineral composition of commercial goat milk yogurt produced in the U.S. *Small Ruminant Res.* 13: 63–70.

Park, Y.W., 1999. Cholesterol contents of U.S. and imported goat milk cheeses as quantified by different colourimetric methods. *Small Ruminant Res.* 32: 77–82.

Park, Y.W., 2000. Comparison of mineral and cholesterol composition of different commercial goat milk products manufactured in USA. *Small Ruminant Res.* 37: 115–124.

Park, Y.W., 2006. Goat Milk- Chemistry and Nutrition. In: *Handbook of Milk of Non-Bovine Mammals*. Y.W. Park and G.F.W. Haenlein, eds. Blackwell Publishers. Oxford, UK and Ames, Iowa, pp. 34–58.

Park, Y.W and H.I. Chukwu, 1988. Macro-mineral concentrations in milk of two goat breeds at different stages of lactation. *Small Ruminant Res.* 1: 157–166.

Park, Y.W. and M.R. Guo, 2006. Goat Milk Products: Processing Technology, Types and Consumption Trends. In: *Handbook of Milk of Non-Bovine Mammals*. Y.W. Park and G.F.W. Haenlein, eds. Blackwell Publishers. Oxford, UK and Ames, Iowa, pp. 59–106.

Park, Y.W. and G.F.W. Haenlein, 2007. Goat Milk, Its Products and Nutrition. In: *Handbook of Food Products Manufacturing*. Y.H. Hui, ed. John Wiley & Sons, Inc., New York, NY, pp. 447–486.

Park, Y.W., A.W. Mahoney and D.G. Hendricks, 1986. Iron bioavailability in goat milk compared with cow milk fed to anemic rats. *J. Dairy Sci.* 69: 2608–2615.

Posati, L.P. and M.L.Orr, 1976. *Composition of foods.* Agric. Handbook No. 8-1. ARS, USDA, Washington, D.C.

Restani, P., A. Gaiaschi, A. Plebani, B. Beretta, G. Cavagni, A. Fiocchi, C. Poiesi, T. Velona, A.G. Ugazio and C.L. Galli, 1999. Cross-reactivity between milk proteins from different animal species. *Clin. Exp. Allergy* 29: 997–1004.

Razafindrakoto, O., N. Ravelomanana, A. Rasolofo, R.D. Rakotoarimanana, P. Gourgue, P. Coquin, A. Briend and J.F. Desjeux, 1993. *Le lait de chevre peut-il remplacer le lait de vache chez l'enfant malnutrition. Lait* 73: 601–611.

Reinert, P. and A. Fabre, 1997. *Utilisation du lait de chevre chez l'enfant*. Experience de Creteil. Proceedings, Colloque Interets Nutritionnel et Dietetique du Lait de Chevre, Inst. Nat. Rech. Agron. Publ., Paris, France 81: 119–121.

Sabbah, A., S. Hassoun and M.L. Drouet, 1997. *Allergie au lait de vache et sa substitution par le lait de chevre*. Proceedings, Colloque Interets Nutritionnel et Dietetique du Lait de Chevre, Inst. Nat. Rech. Agron. Publ., Paris, France, 81: 111–118.

Underwood, E.J., 1977. *Trace Elements in Human and Animal Nutrition*, 4th ed. Academic Press, New York, pp. 173.

Van der Horst, R.L., 1976. Foods of infants allergic to cow's milk. *S. Afr. Med. J.* 5: 927–928.

Walker, V.B., 1965. Therapeutic uses of goat's milk in modern medicine. *British Goat Society Yearbook*, pp. 24–26.

Plenary 8

Microbiota of Goat's Milk and Goat's Milk Cheese

Tsakalidou, E.

Department of Food Science and Technology, Agricultural University of Athens
Iera Odos 75, 118 55 Athens, Greece
Email of corresponding author: et@aua.gr

Introduction

Sheep and goats have been raised for milk, meat and wool for thousands of years. In fact, small ruminants are the most efficient transformers of low quality forage into high quality animal products with unique chemical composition and organoleptic features. The total world population of sheep and goats, 1024 and 768 million, respectively, is found mainly in semi-arid areas or areas with temperate pasture. Asia and Africa, together, account for the 64.5 and 91.5% of the world's sheep and goats, respectively. The respective numbers for Oceania and Europe, combined, are 27 and 2.4%. Sheep and goat meat production represents 10.8 and 7.3% of the world ruminant's meat production, respectively, with 64 and 90% of that being produced in Asia and Africa (Zervas and Tsiplakou, 2011).

Sheep and goat milk production represents 1.3 and 2.1% of the world's milk production, respectively, with the world's major commercial part being concentrated in the countries of the Mediterranean basin. Apart from France and Southern European countries, where the industrial processing of sheep and goat milk is well developed, exact statistical data on the production of these types of milk is not always available or reliable. It is estimated that the European production of sheep and goat milk ranges between 4.5 and 5.0 million tonnes, while around 6.0 million tonnes are produced in India and China. The remainder of worldwide production is 13.3 million tonnes that are produced in North Africa, Middle East and Latin America (IDF, 2009).

Sheep and goat milk is utilised for direct consumption and the manufacture of a wide range of cheeses and fermented milk products. The yield but also the quality of these products depends, among others, on milk composition, which is, in turn, influenced by the animal breed as well as the animal nutrition. A number of studies have shown that milk from sheep and goats raised on pasture is enriched with substances of natural origin like phenolic compounds, fat soluble vitamins, flavours terpenes, bioactive lipid components, such as conjugated linoleic acid, in addition of being naturally high in medium chain fatty acids, compared to milk from animals fed conventional concentrate-forage diets (Zervas and Tsiplakou, 2011).

Microbiota of goat milk

Nowadays, goats of dairy breeds highly selected for milk production are receiving increasing attention regarding milk yield and quality. Hygiene in milking and milk handling is of obvious importance to regulations for somatic cell counts (SCC) and bacterial numbers that vary among countries. The primary source of microbial contamination is post-milking handling due to poor hygiene or improper milk refrigeration. Both bacterial numbers and

SCC can be lowered by improved management conditions, including sanitation of the farm, animals and equipment along with timely transportation of milk to the storage tank.

Somatic cells in goat milk are composed of different types of leukocytes, including neutrophils, macrophages and lymphocytes. In infected udder halves, neutrophils increase with infection. High percentages of polymorphonuclear neutrophils were found in goat milk with low SCC and they increased with the stage of lactation and age, while levels of lymphocytes and macrophages decreased. It has been shown that throughout lactation streptococcal infections are rare in goats in contrast to dairy cows. Mastitis related pathogens in normal goat milk samples include *Staphylococcus* spp., *Bacillus* spp., coliforms, *Micrococcus* spp., *Streptococcus* spp., *Corynebacterium* spp. and *Pseudomonas* spp. Infection by *S. aureus* causes high SCC, while numbers decrease in the case of coagulase negative staphylococci and are certainly lower in non-infected udder halves. On the other hand, SCC were found slightly higher in milk from udder halves with subclinical infection of *S. epidermidis* than in milk with other staphylococcal infections. Interestingly, histological and pathological tests on fresh udder half tissues of goats with low, medium and high SCC revealed no changes in the mammary glands or other evidence of mastitis, indicating that healthy dairy goats with healthy udders may produce milk with SCC $> 1.0 \times 10^6$/mL, particularly in late lactation. Thus, elevated SCC alone is not necessarily a valid indication of mammary infection in dairy goats (Goetsch et al., 2011).

Microbiota of goat milk cheeses

France has a long tradition in the production of cheeses. The main ripening strains in French soft cheeses made with goat's milk are yeasts, namely *Geotrichum candidum* and *Penicillium*, although other species, such as *Candida lipolytica* and *Candida intermedia*, also seem to be involved. It has been observed that *G. candidum* is able to lower the bitterness caused by *Penicillium* in goat milk cheeses, thus confirming findings obtained for cow milk Camembert cheese. Moreover, the specific lipolytic behaviour of ripening strains and the predominant role of *G. candidum* in ripened goat milk cheeses, in comparison to *Penicillium candidum*, with respect to goat flavour development by releasing not only C18: 1 but also the goat flavour marker 4-ethyl-octanoic acid, has been highlighted. Besides fatty acids, many other compounds have been implicated in the flavor of goat milk cheese, such as alcohols, ketones, esters and lactones. It should be stressed, however, that the aromatic potential of these strains depends also on the cheese manufacturing conditions. The behaviour of various ripening strains has recently been studied more systematically in an edible goat milk cheese model, before testing them in real cheese production. The model gave a rapid and discriminatory evaluation of the flavouring potential of *Penicillium, Geotrichum* and yeasts, such as *Debaryomyces* and *Kuyveromyces*. It also provided evidence about interactions between lactic acid bacteria and ripening yeast strains (Raynal-Ljutovaca et al., 2011).

For the major Italian goat milk cheeses, namely Canestrato di Moliterno and Robiola di Roccaverano, data about the microbiota exist only for the latter. DGGE results showed that lactococci and streptococci were the main lactic acid bacteria present in Robiola di Roccaverano. Species such as *Lactococcus garviae, Streptococcus parauberis* and *Streptococcus macedonicus* were found only in artisanal products, while lactobacilli were not detected. Yeasts belonging to *Geotricum* spp. and *Kluyveromyces lactis* were present in almost all artisanal and industrial samples, while *Candida catenulate, Candida silvae, Saccharomyces exiguus, Saccharomycete* spp. and *Yarrowia lipolytica* were detected only inartisanal cheeses and *Penicillium* spp. only in the industrial products (Pirisi et al., 2011).

Almost the majority of Greek cheeses are produced from mixtures of sheep and goat milk, the latter being about 20–30% of the cheese milk mixture. Most of them are designated as cheeses of Protected Designation of Origin (PDO) and include Feta, Kasseri, Graviera, Kefalograviera, Kefalotyri, Batzos, Touloumotyri, Kalathaki of Limnos, Sfela, Teleme, Anevato, Galotyri, Katiki, Kopanisti, Pichtogalo Chanion, Krassotyri, Ladotyri, Manoura, Xinotyri, Melichloro, Manouri, Mizithra and Xynomizithra. There are several literature reports on the microbiota of Greek cheeses. In general, the predominant microflora throughout ripening consists of non-starter lactic acid bacteria (NSLAB) that proliferate and contribute by their biochemical activities to cheese ripening and the development of cheese organoleptic features. Microorganisms indicative of hygienic quality, such as enterobacteriaceae and coliforms, decline during ripening and are usually found at negligible levels in the final product (Litopoulou-Tzanetaki and Tzanetakis, 2011).

In Portugal, for the two most important cheeses prepared with mixtures of sheep and goat milk, namely Picante da Beira Baixa Rabaçal and Amarelo da Beira Baixa, lactic acid bacteria have been reported as the predominant group, while no microbiological data exist about Cabra Transmontano, which is produced with goat milk solely. Moreover, a mixed strain starter, comprising of *L. plantarum*, *E. faecium* or *E. faecalis* and *D. hansenii* and/or *Y. lipolytica* has been proposed for goat milk cheese production, based on the proteolytic and lipolytic activities of the above strains (Reis and Malcata, 2011).

In Spain, among the most important 32 goat milk cheeses, the microbiological characteristics have been studied and described for Acehuche, Armada, Camerano, Cendrat del Montsec, Gredos, Ibores, Majorero, Palmero, Tenerife and Valdeteja. Moreover, data exists about cheeses produced with mixtures of goat and sheep or cow milk, such as Cabrales, Gamonedo and Valdeon (Martinez et al., 2011).

In Turkey, several cheeses are prepared with the use of goat milk, either as a whole or as mixture with sheep or cow milk. These include Izmir brined Tulum, Cimi, Ezine, Carra or Testi and Sepet. A recent study on Sepet revealed high numbers of mesophilic aerobic bacteria and yeasts while coliforms and staphylococci were present at low levels and moulds were not determined. On the other hand, for various types of yogurt prepared from goat milk, no data from microbiological analysis have been reported so far (Hayaloglu and Karagul-Yuceer, 2011).

In the Middle East, the main dairy products from sheep and goats are yogurt and cheese, mostly produced in households or small-scale production units using traditional methods. Yogurt is the most common product. The main cheese, produced from sheep milk or a mixture of sheep and goat milk, is the fresh cheese Bayda with a high fat content. There are also low fat cheeses, such as Mushallaleh and Halloumi, which are addressing the demands of urban, more health conscious consumers. Studies on composition and characteristics of these dairy products are available, not in the international scientific literature though (Hilali et al., 2011).

In South America, the most important sheep and goat dairy products are milk, yoghurt and cheeses, with the most known cheeses being Boursin, Moleson, Chevrotin, Chabichou and Frescal, produced mainly in Argentina and Chile. Sheep and goat dairy products are artisanally manufactured using raw milk and without the addition of starter cultures, taking advantage of the autochthonous milk microbiota. Recent studies have shown that lactic acid bacteria, such as lactobacilli, enterococci and pediococci, are present in Argentinean goat milk and goat milk cheeses (Medina et al., 2011).

References

Goetsch, A.L., S.S. Zeng and T.A. Gipson, 2011. Factors affecting goat milk production and quality. *Small Ruminant Res.* 101: 5–63.

Hayaloglu, A.A. and Y. Karagul-Yuceer, 2011. Utilisation and characterisation of small ruminants' milk and milk products in Turkey: Current status and new perspectives. *Small Ruminant Res.* 101: 73–83.

Hilali, M., E. El-Maydab and B. Rischkowskya, 2011. Characteristics and utilisation of sheep and goat milk in the Middle East. *Small Ruminant Res.* 101: 92–101.

IDF, 2009. World Dairy Situation 2009, Bulletin No. 438, *International Dairy Federation*, Brussels, Belgium, pp. 5–7 and 88.

Litopoulou-Tzanetaki, E. and N. Tzanetakis, 2011. Microbiological characteristics of Greek traditional cheeses. *Small Ruminant Res.*101: 17–31.

Martinez, S., I. Franco and J. Carballo, 2011. Spanish goat and sheep milk cheeses. *Small Ruminant Res.* 101: 41–54.

Medina, R.B., R. Oliszewski, M.C. Abeijon Mukdsi, C.P. Van Nieuwenhove and S.N. Gonzalez, 2011. Sheep and goat's dairy products from South America: Microbiota and its metabolic activity. *Small Ruminant Res.* 101: 84–91.

Pirisi, A., R. Comuniana, P.P. Urgegheb and M.F. Scintu, 2011. Sheep's and goat's dairy products in Italy: Technological, chemical, microbiological, and sensory aspects. *Small Ruminant Res.* 101: 102–112.

Raynal-Ljutovaca, K., M. Le Papeb, P. Gaborita and P. Barrucand, 2011. French goat milk cheeses: An overview on their nutritional and sensorial characteristics and their impacts on consumers' acceptance. *Small Ruminant Res.* 101: 64–72.

Reis, P.J.M. and F.X. Malcata, 2011. Current state of Portuguese dairy products from ovine and caprine milks. *Small Ruminant Res.* 101: 122–133.

Zervas, G. and E. Tsiplakou, 2011. The effect of feeding systems on the characteristics of products from small ruminants. *Small Ruminant Res.* 101: 140–149.

Plenary 9

The Welfare of Dairy Goats

Phillips, C.J.C.

Centre for Animal Welfare and Ethics, School of Veterinary Science,
University of Queensland, Gatton 4343, QLD, Australia
Email of corresponding author: c.phillips@uq.edu.au

Introduction

Goats were domesticated about 10,000 years ago, making them one of the first species to be brought into man's „inner circle' of animals selected to provide for his needs. In contrast to cattle and sheep, their domestication was focused on developing a species suitable to thrive in the dry tropical and sub-tropical regions, mostly marginal lands. Their small size and efficiency as milk producers rendered them particularly suitable for this purpose. Most goats are dual purpose for milk and meat production and are kept by the rural poor in pastoral nomadic systems, providing the potential to provide a limited amount of high quality food in regions that would otherwise offer limited capacity to support humans (Ayele and Peacock, 2003). Milk supplies are typically just a small cup of milk per day from each doe and this is likely to be either sold in local markets or shared with family or other tribe members, who reciprocate with help to the pastoralists. Human and livestock survival are closely connected, and survival traits are highly sought after in the animals by the pastoralists (Omondi et al., 2008). There is little potential for artificial selection, but the pastoralists value disease resistance, fecundity, drought tolerance, body size and good milking traits in their animals. Assisting them to restock with suitable animals after a drought could improve both human and animal welfare. However, over-reliance on improvement with introduced genetics is without benefit unless accompanied by improvement of the husbandry system (Ayalew et al., 2003).

As goats predominate in less favoured areas, the inherent instability and susceptibility to variation in climate makes sustainable production difficult. There is potential for frequent and major impact on the animals' welfare. Drought, floods, political and environmental instability and competition from other agricultural sectors all challenge the welfare of goats, and the continued management of rangeland operations deserves more attention from scientists, politicians and agricultural development agencies (Devendra, 2012). Limited infrastructural funds in particular hinder improvement of goat management systems.

In the developing countries, goat flocks are small, typically about three animals, and managers of the goats are often women, e.g. about 66% in Kenya (Bett et al., 2009). Children also play an important role in husbanding the goats. Advisory services and veterinary programmes must reach the women and children to be effective in improving husbandry standards (Ayele and Peacock, 2003). Veterinary services are most likely to be utilised by large productive flocks and less likely to be used by those that keep dairy goats for social reasons, such as insurance against emergencies and risk and for prestige.

Drought conditions

Dual purpose goat production systems offer the potential to increase food security and human nutrition, but the livestock management has to be sustainable in order to survive long-term. Fodder supplies are variable and prone to drought and salinity, leading to goats consuming tree fodder, which potentially degrades the landscape. Furthermore, pressure on rangelands by increasing human populations, in Africa and Asia in particular, have placed the pastoralists in competition with farmers in dryland regions. In Asia increasing affluence in many regions, especially urban ones, is increasing demand for animal-based food. Increasing livestock populations exacerbate the shortage of fodder during the dry seasons and droughts.

Destocking during drought is hard to time effectively without accurate meteorological forecasts. Overstocking during periods between droughts makes destocking even harder. Ensuing fodder shortages may require pastoralists to purchase supplementary feed, and the resulting financial pressure is driving younger family members, especially men to become itinerant urban workers. Governments have a role in making small-scale loans available to enable pastoralists to maintain their flocks during drought or to restock afterwards. Governmental and other agencies should monitor and research the pressures on land use in pastoralist zones to be able to provide support to pastoralists under pressure.

Water availability may also be a serious constraint to flock survival during drought, especially to lactating does. Better utilisation of crop residues and improved nutrition through crop residue improvement, as well as the use of fodder trees and cacti all offer hope to provide feed supplies during drought periods (Ben Salem and Smith, 2008). However, the technologies for such simple methods to alleviate the impacts of drought and water shortages have been known for several decades, but the resource-poor pastoralist is often unable to implement them in severe droughts, leading to serious welfare concerns for the animals. Government assistance is vital to support the welfare of the goats as well as the pastoralists.

Behaviour of dairy goats

Goat behaviour is different to that of the other major domesticated ruminant species, sheep and cattle (Miranda-de la Lama and Mattiello, 2010). Although like cattle and sheep they are highly gregarious and therefore stressed by isolation, they are more likely to be aggressive than sheep and less likely to flee in the presence of a perceived aggressor. Aggression is particularly common at the feeding troughs and enriching a feedlot will reduce the aggression and increase weight gain (Flint and Murray, 2001).

The presence of horns increases the risk of injury during agonistic behaviour. Most housed goats are disbudded without anaesthetic or analgesic, which causes extreme pain, as evidenced by heart rate, cortisol and behaviour responses (Alvarez and Gutierrez, 2010). Stakeholders in the goat and sheep industries of Australia believed pain control to be more important in invasive practices than the practice itself (Phillips et al., 2009).

Health in housed and other intensive management systems

Of the 800 million or so goats in the world today, only about 9% is housed (Alvarez and Gutierrez, 2010). Of all the diseases that can afflict housed or intensively farmed goats, the most common is lameness, the pain from which has a major impact on welfare. The prevalence is often about 10%, and the risk factors include the feet being consistently wet in excreta with bacteria (Olechnowicz and Jaskowski, 2011). A welfare assessment scheme for British dairy goats, based on animal records, found that there was lameness in approximately 19% of goats, and severe claw overgrowth in 32%; other welfare issues included udder asymmetry, suggestive of mastitis, and knee calluses (Anzuino et al., 2010). Skin and udder lesions were of sufficient regularity to be a concern and the report highlights the lack of measurement techniques, for example for lameness, in comparison with dairy cows. Routine foot trimming helps to treat overgrown feet that often arise from feeding highly concentrated diets to goats that do not walk on hard ground to abrade the horn tissue on their feet. Aggression between goats is also common in intensive housing systems, but proper housing system design can help to mitigate the impact on individuals (Nordmann et al., 2011).

Helminth infection is a major concern for intensively pastured dairy goats (Hoste and Torres-Acosta, 2011). Parasite control has been rated by stakeholders in the industry as one of the most serious welfare concerns for goats and sheep in Australia (Phillips et al., 2009), however, no distinction was made between the two species. Goat farmers tend to be less likely to use prophylactic medication than cattle or sheep farmers, rendering the animals more susceptible to infectious diseases (Elbers et al., 2010). This may be due to the cost of medication, a less advanced advisory service or the type of people keeping goats, compared with cattle or sheep. The emergence of resistance to parasiticides will make this an even more important influence on welfare in future (Coles and Roush, 1992).

Transport

Some of the biggest welfare problems often occur off-farm in both developing and developed countries. For example, African goats are commonly transported south from the Sahelian zone of northern Nigeria and neighbouring countries in open-topped vehicles. Adequate standards to protect goats from heat stress during hot, dry conditions in long distance transport do not exist. If there are delays during the journey animals frequently are dead on arrival. Some benefit of administering ascorbic acid as an anti-stress agent has been demonstrated (Minka and Ayo, 2012).

Conclusions

Goats occupy a niche in dryland agriculture and are utilised to provide some high quality nutrition to pastoral nomads. Their welfare is closely tied to that of their goats. Increasing human population, environmental degradation and pressure on feed resources is putting pressure on the pastoralists' ability to maintain the welfare of their animals. Increased government intervention is warranted to assist them through provision of small loans and other benefits that will enable them, and their animals to survive in the face of these adversities. In the long term a better ability to forecast pressures on pastoralists and their goats, and the impacts that they will have, will enable action to be taken to ensure the welfare of the goats and their owners.

References

Alvarez, L. and J. Gutierrez, 2010. A first description of the physiological and behavioural responses to disbudding in goat kids. *Anim. Welfare* 19 (1): 55–59.

Anzuino, K., N.J. Bell, K. Bazeley and C.J. Nicol, 2010. Assessment of welfare on 24 commercial UK dairy goat farms based on direct observations. *Vet. Rec.* 167 (20): 774–780.

Ayalew, W., B. Rischowsky, J.M. King and E. Bruns, 2003. Crossbreds did not generate more net benefits than indigenous goats in Ethiopian smallholdings. *Agr. Syst*. 76 (3): 1137–1156.

Ayele, Z. and C. Peacock, 2003. Improving access to and consumption of animal source foods in rural households: The experiences of a women-focused goat development programme in the highlands of Ethiopia. *J. Nutr*. 133 (11): 3981S–3986S.

Ben Salem, H. and T. Smith, 2008. Feeding strategies to increase small ruminant production in dry environments. *Small Ruminant Res*. 77 (2-3): 174–194.

Bett, R.C., H.K. Bett, A.K. Kahi and K.J. Peters, 2009. Evaluation and effectiveness of breeding and production services for dairy goat farmers in Kenya. *Ecol. Econ*. 68 (8-9): 2451–2460.

Coles, G.C. and R.T. Roush, 1992. Slowing the spread of anthelmintic resistant nematodes of sheep and goats in the United Kingdom. *Vet. Rec.* 130 (23): 505–510.

Devendra, C., 2012. Rainfed Areas and Animal Agriculture in Asia: The Wanting Agenda for Transforming Productivity Growth and Rural Poverty. *Asian-Australasian J. Anim. Sci*. 25 (1): 122–142.

Elbers, A.R.W., A.A. de Koeijer, F. Scolamacchia and P.A. van Rijn, 2010. Questionnaire survey about the motives of commercial livestock farmers and hobby holders to vaccinate their animals against Bluetongue virus serotype 8 in 2008–2009 in the Netherlands. *Vaccine* 28 (13): 2473–2481.

Flint, M. and P.J. Murray, 2001. Lot-fed goats - the advantages of using an enriched environment. *Aust. J. Exp. Agr.* 41 (4): 473–476.

Hoste, H. and J.F.J. Torres-Acosta, 2011. Non chemical control of helminths in ruminants: Adapting solutions for changing worms in a changing world. *Vet. Parasitol*. 180 (1-2): 144–154.

Minka, N.S. and J.O. Ayo, 2012. Assessment of thermal load on transported goats administered with ascorbic acid during the hot-dry conditions. *Int. J. Biometeorol*. 56 (2): 333–341.

Miranda-de la Lama, G.C. and S. Mattiello, 2010. The importance of social behaviour for goat welfare in livestock farming. *Small Ruminant Res*. 90 (1-3): 1–10.

Nordmann, E., N.M. Keil, C. Schmied-Wagner, C. Graml, J. Langbein, J. Aschwanden, J. van Hof, K. Maschat, R. Palme and S. Waiblinger, 2011. Feed barrier design affects behaviour and physiology in goats. *Appl. Anim. Behav. Sci.* 133 (1-2): 40–53.

Olechnowicz, J. and J.M. Jaskowski, 2011. Lameness in small ruminants. *Medycyna Weterynaryjna* 67 (11): 715–719.

Omondi, I.A., I. Baltenweck, A.G. Drucker, G.A. Obare and K.K. Zander, 2008. Valuing goat genetic resources: a pro-poor growth strategy in the Kenyan semi-arid tropics. *Trop. Anim. Health Prod.* 40 (8): 583–596.

Phillips, C.J.C., J. Wojciechowska, J. Meng and N. Cross, 2009. Perceptions of the importance of different welfare issues in livestock production. *Animal* 3 (8): 1152–1166.

Country Report 1

Dairy Goats in Indonesia: Potential, Opportunities and Challenges

*Astuti, D.A.** *& A. Sudarman*

Faculty of Animal Science, Bogor Agricultural University, Campus IPB Darmaga, Jalan Raya Darmaga, Bogor, Indonesia
**Email of corresponding author: dewiapriastuti@yahoo.com*

Potential

Indonesia has the world's second largest animal biodiversity. Farmers in Indonesia have been introduced to animal agriculture that includes dairy goats. In fact the population of goats in Indonesia has increased gradually at an average rate of 4.6% in the last ten years, from 12 million in 2000 to 16.8 million in 2010, involving 3.5 million households (BPS, 2010). The goats are spread throughout 33 provinces with the highest population of 3.5 million heads (20%) in Central Java followed by East Java with 2.7 million heads (16%) and West Java with 1.6 million heads (9.5%). Goats offers good business opportunities in Indonesia because they are very well-adapted to the tropical environment and require low investments. Farmers usually rear a few animals without intensive management, as a living bank for emergencies and expenses and as a source of fertiliser for crops. Also, they play an important role in the social life of the villagers. Goats are usually reared to produce meat and milk. In Indonesia there are many goat breeds for example the bali, boerawa, etawah, gembrong, jawa randu, kacang, kosta, marica, muara, samosir, kapra, etawah crossbreds and saanen. Among them only etawah, etawah crossbred (etawah × local kacang goat) and saanen goats are dairy goats. The breeding center of dairy goats in Indonesia is in Kaligesing-Purworejo, Central Java. From the centre, animals are distributed to areas, which have potential to improve their performance, like Yogyakarta, Bogor, Bandung and Pasuruan.

The nutrient composition of goat milk is 17 to 13% DM, 3.3 to 4.9% CP, 4 to 7% fat, 4.6% carbohydrate, 129 mg Ca, 106 mg P, 185 mg vitamin A and 0.3 mg niacin. Moeljanto, et al. (2002) reported some benefits of goat milk over cow milk including flouride concentration being 10 to 100 times higher in goat than cow milk, thus it can be used as natural antiseptic, alkaline and healthy food. The milk is safe to consume and could neutralise stomach pH, digestible smooth proteins, easy to digest small size of fat particle, high sodium, calcium and phosphorus minerals content, white color with no odor and protective properties against osteoporosis.

Milk production in Indonesia has increased in the last five years from 616,549 tonnes in 2006 to 927,838 tonnes in 2010, with an average increment of 9.25% per year, but most of the milk comes from dairy cattle. In a few regions, the dairy goat has contributed to the total milk supply, especially in big cities such as Jakarta and Surabaya fetching high prices of US$ 2.5 to 3.0 per litre.

Opportunities

The population of Indonesia is on the increase and consequently the need for healthy food has also increased. In 2008, the consumption of meat was 7.75 kg/capita/year, an increase of 7.4% over the previous year. Egg consumption was 17.42 kg/capita/year while milk consumption was 6.92 kg/capita/year. The infant milk powder and sweet canned liquid milk are the major contributors to the overall milk consumption. Thus the production of fresh milk could potentially increase to meet increasing demands for either processed or fresh milk. Milk consumption in 2009 (0.17 L/capita/d) increased compared with that of the previous year (0.13 L/capita/d), the demand cannot be met by local production. Thus to meet this requirement, the government had to import milk powder. To overcome the lack of local milk supply, goat milk can play a role as an alternative source. Deficit of fresh milk supply from the cow is equivalent to approximately 750,000 lactating goats, which means an estimated 75,000 small farmers or households can contribute to the dairy farming business. This certainly will provide opportunities for the dairy goat farmer. Goat milk however is still not as popular as cow milk, although it is consumed for health purposes even at a high cost of US$ 5/L. The dairy goat industry in Indonesia needs to be supported by the business and research community.

Business

One good example of a dairy goat small business in Indonesia is at Unggul farm in Bogor District. In this farm, in 2007, the dairy goat population increased by 129% compared to other districts in Bogor. A case study of a smallholding dairy goats in Unggul farm in the Ciampea district, Bogor, which has 50 animals showed that it has good business indicators, with Net Present Value (NPV) of Rp 359,966,477 or US$ 36,000, an Internal Rate Return (IRR) 127%, a Net Benefit Cost Ratio (Net B/C) of 5.77 and a Payback Period (PBP) of 2 years. Another farm in West Java is the Ciangsana farm specialising in breeding dairy goats. They breed the SAPERA goat, which is a crossbred of a male Saanen with a female Etawah.

At Turi District-Yogyakarta, a cooperative dairy goat farming named Suyadi Farm supervised by the Faculty of Animal Science, Gadjah Mada University, has been running an intensive dairy goat farm over the past ten years. In this farm, milk production from the lactating goats is 0.5–1.2 L/d at market price of US$ 2.5 to 3.0/L. In this district, the goat population is around 250 heads with 38 households and the average milk production is 2.7 L/head/d.

Another district, Kemirikebo in Yogyakarta, has 623 goats involving 65 households. Urine and feces of the animals are used as fertilizer at market price of US$ 1.5/L and US$ 5/zak, respectively. The „wastes' are sold to the Salak fruit plantation in the vicinity of the farm. This business has improved the income of the goat farmers. In case of overproduction, the excess milk is processed into caramel milk candy, ice cream, milk crackers, „dodol' and yoghurt with a variety of flavors including strawberry, apple and coconut.

Rosyidi from the Pakem district of Yogyakarta is a progressive farmer who has a milking machine for his goats and a mini-factory for making yoghurt. Another farmer, Bondan from the Condongcatur district of Yogyakarta, has introduced a special way to sell the fresh milk by a door-price system (Kompas, 2011).

Research

Universities and research institutions of the Department of Agriculture have provided information and technology on good farming practices to improve production performance of dairy goats. Feed is the most important in production animals. One study determined the requirement and utilisation of traditional rations (native grass plus rice bran) in digestion, metabolism and dynamics of nutrients for lactating goats, as shown in Table 1 (Astuti et al., 2000). This study also developed equations to calculate the energy and protein requirements of the lactating etawah crossbred goats using multiple regression analysis of independent metabolic and performance parameter data as follows:

$ME (Mj/d.kg BW^{0.75}) = 0.50 + 0.068 RE (Mj/d)$ or
$ME (Mj/d) = 4.23 + 0.71 RE + 0.003 ADG + 0.006 RP + 0.002 MY$
$Protein (g/d.kg BW^{0.75}) = 10.81 – 0.02 RP (g/d)$
$Protein (g/d) = 85.05 – 5.36 RE + 0.055 ADG – 0.16 RP + 0.068 MY$

Table 1. Digestion, metabolism and glucose kinetics of lactating Etawah crossbred goats

Nutritional parameters	ad lib	90% of ad lib	80% of ad lib	SEM
DM intake (g/d)	865^{a}	765^{b}	620^{c}	38
Protein intake (g/d)	158^{a}	152^{ab}	135^{b}	17
Energy intake (MJ/d)	16.0^{a}	14.0^{b}	11.4^{c}	0.70
DM digestibility (%)	70	69	65	7
Protein digestibility (%)	66	63	62	5
Energy digestibility (%)	69	67	68	5
ME intake (MJ/d)	7.8^{a}	6.6^{ab}	6.5^{b}	1
ME/DE (%)	83	82	84	3
HP (MJ/d)*	6.3	5.5	5.2	1
Retained Energy (MJ/d)	1.6	1.2	1.3	0.6
Retained Protein (g/d)	32^{a}	25^{b}	14^{c}	3
Glucose kinetics:				
Plasma glucose (mg/dl)	104	99	98	5
Pool glucose (g/head)*	3.3^{a}	2.2^{b}	1.9^{c}	0.4
Glucose flux (mg/min.head)*	29^{a}	24^{b}	15^{c}	3
TQ (%)*	14.7	13.6	14.7	2
GNG (mg/min.head)*	26^{a}	20^{a}	13^{b}	6

Values are means
[a,b,c]Means in the same row with different superscripts are significantly different ($P<0.01$); * isotope technique. SEM = Standard error of mean.

Tempe (fermented peanuts) is one of the popular Indonesian foods. Tempe waste, which is produced as a by-product of the home industry, has potential to be used in dairy goat rations. Solid waste still has a good quality with 16% crude protein and liquid waste is available as a drink. Processing technology has introduced ways to improve the quality of tempe waste by using *Aspergillus niger* to ferment the waste to be used in dairy goat rations. A study on the use of tempe waste (Table 2) was conducted in the field on dairy goats at Yogyakarta under the supervision of the IPB-Gadjah Mada University collaboration project (Astuti et al., 2003). Nutrient uptake by the mammary gland was determined, based on the mammary artero-venous difference (Sastradipradja et al., 1996).

Table 2. Milk yield and nutrient uptake in the mammary gland of Etawah Crossbred goats fed with tempe waste.

Parameters	Control	Tempe waste	
		Fresh	Fermented
Milk yield (mL/d)	1070[b]	700[c]	1545[a]
Total milk protein (g/d)	51.45[b]	29.90[c]	74.90[a]
Total milk fat (g/d)	42.90[b]	29.00[c]	63.30[a]
Total milk lactose (g/d)	37.50[b]	27.30[c]	57.76[a]
Nutrient uptake:			
Glucose	51[b]	35[c]	72[a]
Triglycerides	45[b]	30[c]	54[a]
Total protein	45[b]	38[c]	60[a]
Acetic acids	30[b]	2[c]	45[a]

Values are means
[a,b,c]Means in the same row with different superscripts are significantly different (P<0.01); Control = ration with 50% grass: 50% concentrate; Fresh tempe waste = ration with 50% grass: 25% concentrate: 25% fresh tempe waste; Fermented tempe waste = ration with 50% grass: 25% concentrate: 25% fermented tempe waste.

Challenges

Government Support

The number of dairy goats in Indonesia is still small compared to total animal agriculture. Information on the population, milk production and on dairy goat business centres is still scarce and not common knowledge. However, the industry can blossom if both the government and private sectors provide support and focus on increasing dairy goat production. Presently Indonesia is still improving strategies to promote dairy goat industry by increasing goat population (breeding), counseling and applying high technology production.

Breeding centre

The biggest breeding centre of etawah goats in Indonesia is in the Kaligesing district, Central Java, which is supported by the government. Presently, the activities and breeding programmes in the centre have decreased due to changes in the government roles, increase in capital requirement, lack of market priority (export), high rate of sterile doe slaughter and limited post-harvest technology and facilities, among others.

Drinking fresh milk goat culture

The low milk consumption in Indonesia is not only caused by low milk production and the high price of the product, but also by culture and preference. Very few Indonesians like and can afford goat milk. Although the government had attempted to promote drinking of goat milk through programs such "Milk Day", it has not been sustainable.

References

Astuti, D.A., E.B. Laconi and D. Sastradipradja, 2003. Studies on milk production of Etawah crossbreed goat fed with tempe waste. XIXth EAAP Conference, Rostock, Germany.

Astuti, D.A, D. Sastradipradja and T. Sutardi, 2000. Nutrient Balance and Glucose Metabolism of female growing, late pregnant and lactating Etawah crossbreed goats. *Asian-Australasian J. Anim. Sci.* 13 (8): 1068–1075.

BPS, 2010 (Livestock Statistics 2010). Department of Agriculture RI. CV. Ella Citra Utama, Jakarta.

Moeljanto, R. Damayanti and Wiryanta, 2002. The potency of goat milk. Agromedia Pustaka Depok Indonesia. http://www.susukambing.net. (Accessed on October, 15).

Kompas, 2011. *Etawah goats increase the farmer income and solved environment*. Eds. Tim Website Kompas News, 10: 51: 19 WIB, July 6, 2011.

Sastradipradja, D. and D.A. Astuti, 1996. Milk productive potential of Etawah crossbreed goats based on mammary artero-venous difference of nutrient contents and milk composition. VIIIth AAAP Congress, Tokyo, Japan, October 1996.

Country Report 2

Dairy Goat in Vietnam: Potential, Opportunities and Challenges

Nguyen, M.D.[1*] *& N.A. Nguyen*[2]

[1]*National Institute of Animal Sciences (NIAS)*
[2]*Goat and Rabbit Research Centre, Vietnam*
[*]*Email of corresponding author: manhdzung.nguyen@gmail.com*

Introduction

Vietnam is a monsoon tropical country located in Southeast Asia. The total area of country is 331,114 sq km, with a population of 90 million, of which 55 million are farmers, comprising of approximately 67% of total labour force. The cultivated area is small, about 11 million ha. Agriculture is based mainly on rice production at about 37 million tons per year from 77% of the cultivated area. Rice production is supported by crops such as maize, potato, cassava, groundnut, soybean, sugarcane, fruit trees and other perennial commercial trees as coffee, tea, rubber and coconut. The agriculture output value contributes 25% of GDP, of which food production is 77% and livestock production is about 20%, mainly pigs, cattle, chicken, ducks and goats.

Goats have long been raised all over the country in an extensive free-range system with low animal performance. The total number of goats in the country is about 1.3 million of which 200,000 are dual purposes dairy and meat goat breeds. However, in the recent years, goat production has begun to receive more attention from the farmers and the Government. There have been some achievements in the area of goat breeding, nutrition, processing and disease prevention. Under the support of the government and international organisations, some programmes and projects have been carried out with satisfactory results. It is clear that goat production has played an important role in the improvement of the incomes for poor farmers in the hilly and mountainous areas and contributing to the alleviation of poverty and hunger in Vietnam. In this review, we discuss the current situation of the dairy goat industry in Vietnam, its potentials, opportunities and challenges.

Situation of dairy goat in the whole livestock production of Vietnam

As Table 1 shows, the goat population in 2006 was approximately 1,525,300 heads, while the number of dairy goats was only 150000, of which 67.5% were in the North and 32.5% were in the South of Vietnam. The number of goats in 2010 was approximately 1,288,700 heads of which 200,000 were dairy goats. The role of goat production including dairy goats is increasing and plays an important role for smallholders in poverty alleviation.

Table 1. Livestock population and production trends

	Number of animals by year ($\times 10^3$)				
Livestock	2006	2007	2008	2009	2010
Pig	26855.3	26560.7	26701.6	27627.7	27373.1
Cattle and buffaloes	9431.9	9721.1	9235.4	8989.8	8829.7
Poultry	214600.0	226000.0	248300.0	280200.0	300500.0
Dairy goat	150.0	160.0	170.0	180.0	200.0
Total Goats	1525.3	1777.7	1483.4	1375.1	1288.7

Potential

Dairy goat breeds

Local indigenous dairy goat breed

The local dairy goat breed is Bach Thao, a dual purpose goat used for meat and milk. This is the main dairy goat breed in Vietnam and found mainly in Ninh Thuan province (Central Vietnam). Recently, the Bach Thao goat has been introduced to many other provinces of Vietnam. The origin of Bach Thao goats is not clear; however, it is believed that these goats came from Europe a long time ago. The Bach Thao has a black coat with white spots and big and pendulous ears. The body weight is 75 to 80 kg for males and 40 to 45 kg for females. Milk yield is about 1.1 to 1.4 kg/day with a lactation period of 148 to 150 days. The Bach Thao can reproduce 1.7 to 1.8 litter per year. The breed has been found to perform well under improved management conditions.

Imported dairy goat breeds

Besides the local dual purpose goat breed, Vietnam has imported some exotic dairy goat breeds, the Saanen and Alpine goats from France, as frozen semen and live goats. The first batch was imported in 1998 and a second batch was imported from the US in 2002. In 1994, Vietnam imported three more dairy goat breeds, the Jumnapari, Beetal and Barbary from India. These exotic breeds have good milk yield and adapt very well to the grazing farming conditions of the country. Most of the imported goat breeds are used to cross with the local Bach Thao to improve milk yield.

Management, feeding system and feed resources

There are three main methods of goat management in Vietnam; intensive, semi-intensive and extensive management systems. In the intensive system, animals are kept in cages (Devendra and G.B. Mcleroy, 1982) and the animals are hand-fed. The kids are separated from their mothers10 days after kidding and the does milked twice daily (with milk recording). The kids are allowed to suckle after milking, and milk consumed by the kids is estimated by weighing kids before and after suckling. The kids are weaned at three months of age.

In the semi-intensive system, goats are grazed, and supplied feed at the goat house at night. This system is found suitable for the existing goat production system in Vietnam.

In the extensive system, animals are grazed without supplementation. This system is common in the rural areas of Vietnam. In remote areas, children or elder people normally take care of the goats on free-range during the day and herd them home in the evening

The average flock size in Vietnam is about 5 to 20 goats per family. There are large farms in Binh Thuan and Ninh Thuan provinces, where goat flocks reach one hundred head. Goats are kept in cages supported by pillars at a height of about 50 to 70 cm.

There is a Goat and Rabbit Research Centre (GRRC) belonging to the National Institute of Animal Sciences (NIAS), located in Hanoi, which coordinates the breeding programme under the national and international research cooperation projects for Vietnam. Dairy goat production is also under the extension programme of the Ministry of Agriculture and Rural Development (MARD) to help the smallholders in the country.

Beside the natural grasses, cultivated forages are also being introduced to farmers such as *Flemingia macrophylla*, *Trichanthera gigantean*, *Leucaena, Panicum Maximum* cv likoni, *Brachiaria ruziziensis*, and Elephant grass. Available local feed resources are also being investigated for use as goat feed including Mulberry (*Morus alba*), Bananas (main stem), cassava hay (cassava sterm and leaves) and cassava roots.

Three-quarters of Vietnam are mountainous and hilly covered by trees, which is a huge source of agro by-products that can be used as goat feed. Goats are integrated in the animal farming system so that feed that is not used by the other animals is consumed by them.

Disease situation

Some major diseases reported among goats in Vietnam are internal parasites, ecthymatosis, diarrhoea and pneumonia. The important and dangerous infectious diseases with high mortality like pasteurellosis, enterotoxaemia are effectively controlled by vaccination. The other infectious diseases that can spread rapidly like ecthymatosis, keratoconjunctivitis are treated effectively with local medicines.

Product processing and markets

At present, the products derived from goats (meat and milk) receive higher prices than other types of milk and meat and these products must compete with products from pigs, chicken, and cattle in the market. However, the signs suggest that the environment is now favourable for the promotion of goat products. During the period of 1998–2000, one project (FAO/TCP-VIE 6613) was implemented by the Goat and Rabbit Research Centre (GRRC-NIAS), which developed new methods for collecting goat milk from small farmers to small processing units for the pasteurisation and processing to make cheese and yogurt. This project has created new markets for these products and provided farmers with opportunities to increase their incomes and further improve their dairy goat production system.

There is a potential market for goat milk in Vietnam. The price of goat milk is 30,000VND per litre while it is only 20,000 VND for cow milk. There is now a big demand from consumers for goat milk, especially in the cities.

Opportunity

In the Livestock Development Strategy to 2020 of the Government of Vietnam, the outlook on livestock sector development is as follows: To develop livestock production into commodity production, reorganise livestock production and facilitate linkage between production and markets, ensure food safety, veterinary hygiene, environmental protection and improvement of social welfare, increase productivity, quality, efficiency, food safety and hygiene and encourage organisations and individuals to invest in the development of livestock industry. Recently, one national project on improvement of meat and milk in goat and sheep production in Vietnam has been approved and will soon be implemented. Together with international programmes, Vietnam now has the opportunity to expand its dairy goat systems.

Challenges

The main indigenous dairy goat breed is a dual purpose goat breed, which is mainly used for meat because milk yield is low. Farmers lack knowledge of milking technology and dairy goat farming. Free range for grazing goats in Vietnam is limited, but goat rearing is mainly extensive. Milk collection and processing systems still need be established, while the market for milk and milk products is mainly in the big cities.

Future activities

In the livestock production strategy, Vietnam aims to increase the total number of dairy goats to 300,000 head. In order to attain that target, we plan to conduct studies on improver breeds by importing high-performance dairy goat breeds from Europe and other countries in the region to cross with the local indigenous breed. This should improve the quality and quantity of goat milk. Studies will be conducted on feeding and management, product processing and marketing. We will establish pilot farms as show-farms for farmers to learn in provinces where the dairy goat projects will be implemented.

Country Report 3

Dairy Goats in Thailand: Potential, Opportunities and Challenges

Anothaisinthawee, S.[1], S. Nakavisut[1], S. Yuyuen[1] & T. Thongchumroon[2]*

[1]*Small Ruminants and Swine Research and Development Section, Bureau of Animal Husbandry and Genetic Improvement, Department of Livestock Development, Bangkok 10400, Thailand*
[2]*Pattani Livestock Research and Testing Station, Nongjik District, Pattani 91200, Thailand*
[*]*Email of corresponding author: sansak@hotmail.com*

Introduction

Thailand is one of the largest food producing and exporting countries in the world with a GDP of US$ 584 billion in 2010 (NESDB, 2011) and a population of 68.1 M. The agriculture and livestock sectors account for 11.4% and 2.5% of the GDP. In 2011, there were 3.14 million livestock farmers and 41,582 of those raised goats. The major livestock species in Thailand are chicken, ducks, swine and cattle (Table 1). Broiler chicken is the main commodity for export while other species are produced for domestic consumption and small scale trading. The numbers of all ruminant species increased in the last ten years except buffaloes. There has been a rapid increase in number of goats (140%) from 178,000 in 2002 to 427,000 in 2011. The distribution of goats is related to the Thai Muslim community. More than 60% of all goats are found in the villages along the Thai-Malaysian border where the proportion of Thai Muslim people is high.

Table 1. The number of important livestock species in Thailand from 2002 to 2011.

Year	Total Goat	Meat Goat	Dairy Goat	Dairy Cattle	Beef Cattle	Buffalo	Swine	Chicken	Duck
2011	427567	394204	33363	560659	6.6 M	1.2 M	9.7 M	317 M	32 M
2010	380277	350851	29426	529572	6.5 M	1.2 M	8.3 M	266 M	29 M
2009	383796	366998	16798	483899	8.6 M	1.4 M	8.5 M	282 M	27 M
2008	374029	344516	29513	469937	9.1 M	1.4 M	7.7 M	256 M	23 M
2007	444774			489593	8.8 M	1.6 M	9.3 M	283 M	25 M
2002	177944			358440	5.5 M	1.7 M	7.0 M	229 M	25 M
%Change*	140%			56%	20%	-29%	39%	38%	28%

Source: Information and Statistics Group, Information Technology Centre, Department of Livestock Development (DLD, 2011); *the percentage of livestock numbers in 2011 compared to those in 2002; M: Million

Distribution of goats in Thailand

The distribution of goat populations in Thailand by region in the last 10 years is shown in Table 2. The changes in numbers of goats are different in each part of the country. The number of goats in the central part has increased by 289% and this is associated with commercial dairy goat farms. Its percentage of total goat population changed from 21% to 34% in 2011. Fifty-two percent of the total goat population is raised in the South, most of which are Thai indigenous goats. The North and Northeast are not significant for goat production in Thailand.

Table 2. Goat populations in Thailand by region from 2002 to 2011.

Year	Central	%	Northeast	%	North	%	South	%	Total
2011	145517	34	16320	4	42802	10	222928	52	427567
2010	137813	36	17453	5	43163	11	181848	48	380277
2009	160278	42	20363	5	61368	16	141787	37	383796
2008	158487	42	20901	6	53702	14	140939	38	374029
2007	162926	37	21423	5	86373	19	174052	39	444774
2006	111742	34	15014	5	56149	17	141245	44	324150
2005	109681	32	13974	4	55310	16	159390	47	338355
2004	62950	25	12354	5	39729	16	135043	54	250076
2003	52967	25	5021	2	43410	20	112519	53	213917
2002	37356	21	4573	3	29579	17	106436	60	177944
2002→11	289.5%		33.3%		-41.2%		-13.3%		140.3%

Source: Information and Statistics Group, Information Technology Centre, Department of Livestock Development

Statistics and trends of dairy goat production in Thailand

There were 33,363 dairy goats in 2011 which represent approximately 8.5% of the total number of goats (see Table 3). The proportion has remained approximately the same in the last 5 years. Dairy goats are more common in the central region, comprising 61% of all. The average numbers of dairy goats per farm are higher in the central part than in the rest of the country. The higher number of goats per farm is indicative of larger farm size and more intensive and developed farms. Small scale goat farms are found mostly in the South with the average number of goats ranging from 5 to 7 heads per farm compared to 43, 14 and 24 goats per farm in the central, northeast and north regions of Thailand, respectively.

Table 3. Dairy goat rearing in Thailand by region from 2008 to 2011.

Year	Central	%	Northeast	%	North	%	South	%	Total
Number of dairy goats									
2011	20403	61	1338	4	3405	10	8217	25	33363
2010	17597	60	1344	5	3529	12	6956	24	29426
2009	12105	72	915	5	1447	9	2331	14	16798
2008	19476	66	3379	11	4387	15	2271	8	29513
Number of dairy goats farmers									
2011	471	25	96	5	144	8	1203	63	1914
2010	434	25	103	6	133	8	1035	61	1705
2009	463	54	27	3	70	8	304	35	864
2008	461	38	173	14	161	13	431	35	1226

Goat genetic resources and performance data of dairy goats

Goats in Thailand are predominantly used for meat (90%). Milk production is a smaller industry (10%). Native goats are genetic resources that can be crossed with exotic breeds to produce rangeland goats for more extensive production. There are 10 goat breeds existing in Thailand: 2 indigenous and 8 exotic breeds. There are 4 meat breeds and 4 dairy breeds. The 2 local goat breeds are the Northern Thai referred to as „Bangala', which has a large but thin body, long pendulous ears (similar to the Anglo Nubian) and a straight face profile, and the other is the Southern Native Thai goat which is small in size with short upright ears (similar to the Katjang goat found throughout Southeast Asia). Four imported breeds of meat type are

Anglo Nubian, Boer, Black Bengal and Jamnapari and the four dairy goat breeds are Saanen, Alpine, Toggenburg and Laoshan. Saanen is the most popular among dairy goats in Thailand due to its high milk yield, mainly found in the central and southern regions. Other dairy breeds are found in small numbers.

Performance data of dairy goats of Saanen, Toggenburg, Alpine and Anglo Nubian and their crossbreds with Thai native goats from one of the Government farms in Pattani province was collected and reported as follows; from 1438 records of years 2004–6 the average overall milk yield per day was 0.9 kg, starting from 1.10 ± 0.43 kg in the first month of lactation to 1.05 ± 0.41 and 0.89 ± 0.34 kg in the 2nd and 3rd month, respectively (Thongchumroon et al., 2011). The weaning weights of purebred Saanen, Anglo Nubian, and Thai native goats were 16.4, 14.6 and 8.5 kg, respectively. A private organic dairy goat farm in Phuket reported a higher daily milk production of 2–3 litres with a lactation period up to 200 days.

Potential of dairy goat production

There is some potential in improving dairy goat rearing in Thailand through genetic and breeding improvement in the national policy on goat production of the Department of Livestock Development (DLD) together with feeding, reproduction and biotechnology development.

The strategies on genetics and breeding for dairy goat production and management practices are integrated with traditional farming practices in order to improve the performance of locally adapted breeds. Emphasis is on increasing body weight, improving reproductive efficiency and reducing losses due to mortality through better nutrition and breeding. With regards to genetics, specific strategies for genetic improvements in goat breeding are as follows: a) collection of productive and reproductive performance records; b) genetic evaluation and genetic parameter estimation using BLUP technique; c) use of statistical models and adjustment of environmental factors to determine a suitable animal model to estimate important genetic parameters; d) development of breed planning to avoid losing advantageous traits such as disease resistance, and optimal use of genetic resources for comparative efficiency of different crossbreeding systems to exploit dominance of favorable effects; e) use of molecular techniques for selection assistance to increase accurate genetic progression such as selection of the gene for parasite resistance. With the national goat breeding programme initiated and eminent efforts from experts, dairy goat production in Thailand will progress to its full potential.

Dairy goat management in organic farming and integrated crop-livestock farms

Thailand is among the biggest producers of palm oil and rubber. The plantations of oil palm and rubber have been predominantly in the southern part. The total planting area is expanding very rapidly in the northeast and eastern provinces. This would give a great potential and opportunity to incorporate dairy goat farms into the palm and rubber plantation-goat integrated farms or organic farming. Goats can provide manure and weed control to the plantation while goats receive shady areas for resting, housing and shelter from the plants. These mutual benefits already realised in an organic dairy goat-rubber plant farm in Phuket where Phuket organic goat milk is produced.

Opportunities

Goat milk is more expensive than cattle milk and very rare in most parts of Thailand. The price of a 250 cc bottle of fresh goat milk is 15–17 Baht (1.5 RM) compared to 18 Baht per litre of fresh raw cow milk. The price is almost 4 times higher than cow milk. This can become an incentive for promotion of dairy goat production in the country. Dairy goat production fits well into the rural areas and in the resource capacity of small holder farmers from low-input production to business model. The goat industry in Thailand has continuously grown as local demand for milk increases. There is also another demand for goat's milk from people and children who have cow milk allergy or are unable to digest cow milk. Moreover, Thailand has run a School Milk Programme aiming to support the dairy industry, by providing milk from local producers to the young school children. This will hopefully develop a taste for milk and hence a market for the future. Milk drinking habits of Thai children will eventually lead to positive consequences for dairy goat milk production in terms of demand and technology development.

Challenges

Despite a great opportunity and potential for dairy goat rearing in Thailand, there are some challenges to overcome. Firstly, goat milk is not a common part of the meal for most Thais other than Thai Muslims. Most people have aversion against the strong smell in goat milk. Secondly, there is a lack of suitable land and feed resources in some parts of the country. Thirdly, most farmers have inadequate knowledge of goat husbandry. Finally, marketing is the weakness to be overcome for the promotion of goat product consumption and a variety of value-added products to the markets.

In order to solve the problems mentioned above, Thailand needs to increase the goat population both in quantity and quality. Establishment of effective goat breeding improvement programmes is a key to success for the accuracy of identifying the best bucks and does through well-planned breeding objectives, selection and mating programmes specifically suitable for the environment and management in each part of the country.

References

DLD (Department of Livestock Development), 2011. Annual Statistics Report 2011. Ministry of Agricultural and Cooperatives, Bangkok, Thailand. http://www.dld.go.th/ict/th/ index.php?option=com_content&view=section&id=45&Itemid=123.

NESDB (Office of the National Economic and Social Development Board), 2011. Gross Regional and Provincial Product of Thailand. http://www.nesdb.go.th/Default.aspx?tabid=96.

Thongchumroon, T., M. Thepparat, S. Anothaisinthawee and M. Duangjinda, 2011. Genetic parameter estimation of milk yield in crossbred dairy goats by random regression test day model. Department of Livestock Development, Bangkok, Thailand. http://www.dld.go.th/breeding/Journal/2554/09.54(2)_0206_133_thumrong.pdf.

Country Report 4

Dairy Goats in Pakistan: Potential, Opportunities and Challenges

Khan, M.F.[*] *& F. Ashfaq*

Small Ruminant Research Program, NARC, Park Road, Islamabad 45500, Pakistan
[*]*Email of corresponding author: drmfatahullah@gmail.com*

Introduction

Pakistan is the fourth largest country in terms of goat population following India, China and Bangladesh and third largest in terms of goat milk production in Asia (FAO, 2010). Pakistan has about 34 goat breeds with a total population of 61.5 million heads found all over the country. There are about six million people who keep goats but most of them are landless or have marginal land holdings. The population of goats is increasing at 1.3 million goats per annum in the country (Livestock Census, 1996 and 2006). The goat breeds are categorised as meat, dairy and hairy types; but the major objective of goat rearing is production of meat. However, milk obtained from goats is also important in some parts of the country and goat milk contributes to the health and nutrition of several million people in Pakistan, especially those below the poverty line. Goat milk is of particular significance for the most vulnerable groups like pregnant and nursing mothers and babies who do not like their mother's milk and so we call the goat the poor man's cow. Among the different breeds of goats, Beetal, Dera Din Panah (DDP), Nachi, Kamori, Kacchan and Damani, are classified as dual purpose, i.e. both for milk and meat. Among these breeds Beetal is more popular in Punjab because of milk and meat production. Kamori is popular in Sindh province and similarly Damani in Khyber Pukhtunkhwa (KPK). Its production potential is not fully explored which necessitates more research for the exploitation of its potential.

Goat population and distribution

According to the Economic Survey of Pakistan (2010–11) there are 61.5 million goats (Table 1). From 1996 to 2006, the population of goats increased by 1.3 million/year which is the second highest growth rate after cattle (4.4%) population in the country. This trend shows the popularity of goat rearing among the people. The growth rate of the goat population was higher during the period 1996–2006 than that for the period 1986 to 1996 reported previously by Khan (2004).

The annual growth rate of the goat population is 3.1% which is higher than that for sheep (1.25%). This trend shows the preference of goats over sheep. Punjab has the largest population of goats (37%), followed by Sindh (23.7%), Balochistan (22.7%) and KPK (16%). In some parts of the country, where cow and buffalo milk are not available or limited in supply, goat milk is the main supply for home consumption.

Dairy goat population

The dairy goat population is depicted in Table 2. There are about 11.08 million dairy goats producing about 759,000 tonnes of milk annually which is about 2% of the total milk supply in the country. The population of Kachan goat is not included because no data is available.

Table 1. Goat Population (million heads) and its distribution in different provinces of Pakistan.

Province	Year			Share (%)
	1996	2006	2011	
Punjab	15.30	19.90	22.76	37.0
Sindh	9.73	12.37	14.15	23.7
KPK	6.76	9.68	11.07	16.0
Balochistan	9.36	11.83	13.53	22.7
Pakistan	41.16	53.79	61.50	100

Source: Livestock Census (1996 and 2006), Economic Survey, 2010–11

Table 2. Dairy Goat Population (million head) by province in Pakistan

Breed	Province of Pakistan				Total
	KPK	Punjab	Sindh	Balochistan	
Beetal	0.65	3.10	0.24	0.21	4.20
Kamori	0.05	0.04	3.90	1.30	5.29
Damani	0.90	0.05	0.03	0.33	1.31
DDP	0.05	0.08	0.02	0.01	0.16
Nachi	0.02	0.03	0.03	0.04	0.12
Kachan	N/A	N/A	N/A	N/A	N/A
Total	1.67	3.30	4.22	1.89	11.08

Livestock Census (1996 and 2006): N.A: Data is not available

In Punjab, Beetal is the dominant goat breed with 3.10 million head because of its preference as dual purpose animal, i.e. both for meat and milk. According to the livestock census conducted in 2006, Kamori was the number one dairy goat breed in Sindh and had the highest population among dairy goats at the national level. Damani was the third dairy goat breed on population basis, found in the KPK province. Dera Din Panah and Nachi are famous as dairy goats of southern Punjab. Nachi is also found in the southern Punjab in the canal irrigated tracts.

Production systems

Small ruminants raised under different production systems are depicated in Table 3. There are four main systems of production for small ruminants, namely nomadic, transhumant, household and sedentary in various regions of the country since unknown times. As described by Ishaque (1993), the prevalence of household and sedentary system was highest in the Punajb, 47 and 27%, respectively and lowest in Balochistan (3%). The study conducted by FAO (2003) presents a different picture than that of Ishaque (1993). According to the latter, small ruminant production is mainly under sedentary and transhumant production systems.

However, it seems that due to degradation of rangelands, drought and flood over the last 5–6 years, production systems of small ruminants might have further changed. Due to limited grazing land, shepherds are currently keeping more small ruminants under sedentary and household systems.

Table 3. Distribution of sheep and goats by production system

Production system	1993 (%)	2003 (%)
Nomadic	44	6
Transhumant	38	32
Sedentary	6	40
Household	12	22

Ishaque (1993), FAO (2003)

As shown in Table 3, a major shift of small ruminant production is observed from nomadic to sedentary and household systems. The sedentary and household systems are more common in Punjab and Sindh provinces whereas, about 59% of sheep and goats under the transhumant system and 30% under the nomadic system are found in Balochistan (Afzal, 2003). Similarly, transhumant system is also more common in KPK.

Goat milk production

Goat's milk, total milk and share of goat's milk in total milk production in Pakistan is presented in Table 4. Milk production from goats and total production were both on the increase over the last few years, which was because of an increase in number of animals but not per animal productivity. Most of the milk produced in the country comes from buffalo and cows but a reasonable amount of milk also comes from goats.

Table 4. Goat Milk Production in Pakistan

Products	1996	2006	2011
Goat Milk	527	675	759
Total Milk*	23580	31246	37475
Percentage	2.23	2.20	2.01

*Total milk production from cattle, buffalo, sheep and goat.
Source: Agricultural statistics of Pakistan (2005–2006), Economic survey of Pakistan (2010–11).

In Arid and semi-arid areas where buffalo and cattle milk are not available, people depend upon the goat's milk (Khan and Ashfaq, 2003).

Milk production potential of different dairy goats

The average milk yield of selected dairy goat breeds of Pakistan is given in Table 5. Beetal goat is the highest producer (2 L/d) of milk followed by Kamori (1.8 L/d), Kacchan (1.7 L/d), DDP (1.6 L/d) and Damani (1.3 L/d).

The genetic potential does exist for milk production in these breeds of goats in Pakistan. It needs to be exploited through selective breeding and better management.

Table 5. Average milk yield of selected dairy goat breeds of Pakistan

Breed	Lactation milk yield (L)	Lactation length (d)	Average daily milk yield (L)
Beetal	272	140	2.0
DDP	205	130	1.6
Damani	115	100	1.2
Kamori	204	115	1.8
Kacchan	190	110	1.7
Nachi	214	160	1.3

Source: Isani and Baloch (1996), Rehman and Shah (2003) and Iqbal et al. (2003).

Recommendation

Pakistan has some important dairy goat breeds but no comprehensive research work has been done so far to enhance their productivity. These breeds need improvement through better nutrition and long term selective breeding. Continued selection as dual purpose animals could lead to improve productivity by developing the best dual breeds of the world.

Challenges and constraints

There are many challenges for goat production in the country. One of the major challenges is inadequate feed that has limited animal productivity to 60–70% of genetic potential. To increase the productivity of animals, it is important to expand and make efficient use of available feed resources. The other constraint is non-availability of genetically superior breeding bucks of these dairy goats, although in the private sector shepherds are keen to keep quality bucks. The third major constraint to productivity of goats is the presence of contagious diseases in the country, particularly peste des petits ruminants (PPR), pneumonic pasturellosis and enterotoxaemia. The availability and quality of vaccine is very important for controlling health problems to exploit the full potential of dairy goats.

References

Afzal, M., 2003. Marketing of livestock and livestock products in Baluchistan. FAO, TCP/PAK/0168. Marketing systems in Pakistan. Islamabad.

Agricultural Statistics of Pakistan, 2005–2006. Government of Pakistan, Ministry of Food, *Agriculture and Livestock Division* (Economic Wing), Islamabad.

Economic Survey of Pakistan, 2010–2011. Government of Pakistan, Finance Division Economic Advisor wing, Islamabad.

FAO, 2003. TCP/PAK/0168 Livestock Action Plan, *Food and Agricultural Organisation of the United Nations*, Islamabad-Pakistan.

FAO, 2010. FAOSTAT retrieved from the website: faostat.fao.org.

Iqbal, M.A., M.A. Mirza and M.E. Babar, 2003. Genetic potential for milk yield in different goat breeds in Pakistan. In proceeding: Goat Production in SAARC Countries held on April

22–24, Islamabad: Editors: Afzal, M. and R.H. Usmani. Pakistan Agricultural Research Council, Islamabad, pp. 156–160.

Isani, G.B. and M.N. Baloch, 1996. Sheep and goat breeds of Pakistan. Press corporation of Pakistan. Project Division. P.O. Box 3183 Karachi-75400, Pakistan.

Ishaque, M.S., 1993. Sheep Management. In: Sheep Production in Pakistan, Mackintosh, J.B. (Ed). *Pakistan Agricultural Research Council*, Islamabad, pp. 257–291.

Khan, M.F., 2004. Prospects of goat as a dairy animal in Pakistan. *South African J. Animal Sci.* 5 (Suppl. 1): 18–20.

Khan, M.F. and F. Ashfaq, 2003. Prospect of goat as a dairy animals for arid and semi-arid areas of Pakistan. In proceeding: Goat Production in SAARC Countries held on April 22–24, Islamabad: Editors: Afzal, M. and R. H. Usmani. *Pakistan Agricultural Research Council*, Islamabad, pp. 97–103.

Livestock Census, 1996 and 2006. Agricultural Census Organisation, Statistics Division, Government of Pakistan, Gulberg, Lahore, Pakistan.

Rehman, A. and S.S.A. Shah, 2003. Goat production and Development in NWFP. In proceeding: Goat Production in SAARC Countries held on April 22–24, Islamabad: Editors: Afzal, M. and R.H. Usmani. Pakistan Agricultural Research Council, Islamabad, pp. 72–76.

Lead Paper 1

Perspectives for Increasing Nutrient Use Efficiency in Dairy Goat Production

Makkar, H.P.S.

Livestock Production Systems Branch, Animal Production and Health Division, FAO, Rome, Italy
Email of corresponding author: Harinder.Makkar@fao.org

Introduction

Goat was the first animal domesticated by man. Over 90% of the 921 million goats in the world are found in developing countries and Asia has the highest proportion of about 60% of the total world goat population (FAO, 2010). Also Asia has the largest global goat breed share of 26%. Non-cattle milk consumption contributes to approximately 15% of the total milk consumption by humans worldwide and a large part of the production occurs in developing countries where the demand of animal products, fueled by increasing population, urbanisation and growing economies, is increasing at a high rate. Asian goat milk contribution to total world goat milk production is approximately 59% (FAO, 2010). Goats play a vital socio-economic role in Asian agriculture, particularly for resource-poor people; while in other parts of the world (e.g. Europe) goat milk and its products are luxury foods.

Unfortunately, goat rearing for milk production has not attracted attention of policy makers, science managers and researchers in Asia since goat production has largely been in the hands of resource-poor farmers who are politically and economically marginalised. However, lately, due to emerging challenges of global warming – higher ambient temperatures in the future, decrease in animal productivity and increase in pressure on natural resources – the role of goats is being increasingly realised and appreciated due to their high adaptability to a wide array of environmental conditions and feed resources. Goats use poor quality roughages like straws or stovers with high cell wall and low protein contents more efficiently than other domesticated animals, which is associated with factors such as longer retention time in gastrointestinal track and more efficient nitrogen utilisation in goats.

Feeds and feeding is the foundation of an animal production system since growth, reproduction, health and welfare of livestock hinge on efficient use of feeds. Moreover the release of environmental pollutants also depends on what, how and how much is fed. Perspectives for efficient use of natural resources including novel feeds, feed additives and animal germplasm that could result in increased productivity and conserve the environment and biodiversity are presented. The focus is on achieving feed-efficient dairy goat rearing in intensive and semi-intensive production systems.

Availability and nature of feeds and efficiency of nutrient use

Most goat farmers use a conservative strategy of feeding whatever is available, which may vary with season. In most situations this results in imbalanced feeding, which is non-commensurate with the objective of keeping dairy goats. For economic viability and sustainability of the dairy goat production system, the farmer must have control over what and how much is fed. A pre-requisite for this is the access of the farmers to the information on availability of feed resources in the region, their chemical composition and nutritive value. Also, the farmers need to possess adequate skills and knowledge to use this information and prepare a balanced diet. In this context, the guidelines for establishing national feed assessments developed by FAO (2012a) would help generate information on the availability of feed resources in a region or a country and lead to rational use of feed resources. Equally important is the generation of reliable information on chemical composition and nutritive value of feed resources (FAO, 2011) and collation of this information in the form of a user-friendly database, e.g. a national level database similar to FAO's Animal Feed Resource Information Systems (AFRIS) that gives information on feed resources (what, where and when in a country and their nutritive value). FAO's efforts to promote ration balancing approach initiated by National Dairy Development Board, Anand, India could possibly be extended to intensive and semi-intensive goat production systems. Application of ration balancing approach at farmers' doors for dairy cattle has been found to increase income of farmers by 10 to 15%, decrease methane production per kg of milk by 15 to 18% and increase feed conversion efficiency by over 50% (Garg, 2011). For semi-intensive goat production system the application of ration balancing approach would require information on feed intake and nutritive value of the feeds consumed during the grazing period. Simple tools to obtain this information would be required.

Novel feeds and strategies for increasing nutrient use efficiency

Goat production especially under intensive and semi-intensive systems require good quality fodder, which must be produced in high amounts from small land area; since arable land is decreasing and pressure on the available land is increasing due to increase in requirement of grains for increasing human population. *Moringa oleifera* is an under-exploited plant that grows at a high rate and can produce as much as 100 tonnes of dry matter per hectare when grown as a fodder plant by seeding the plant very closely. The plant could be harvested every 45 to 50 days on reaching approximately one metre in height. The protein content of *M. oleiera* leaves is as high as 25% and the amino acid composition of the protein is as good as soyabean meal (Foidl et al., 2001). The leaves of mulberry also have amino acid composition and protein content similar as those of Moringa and hence could also be good feed resource for dairy goats. The use of Leuceanea, Calliandra and Gliricidia leaves, as good feed supplement for dairy goats, is well established. Lesser-known feed resources (FAO, 2012b) that are adapted to harsh conditions could also be considered for integration in dairy goat production systems.

Mineral and nitrogen deficiencies especially when goats are reared on low quality roughages constrain production. Urea-molasses blocks supplementation with fibrous roughages increases goat productivity (FAO, 2007); however, in some situations making the goats consume the blocks has been a challenge, and hanging of the blocks at an appropriate height (above the height of goat's head) increased their intake by goats.

Lately, the biofuel industry has generated a number of co-products that could be valuable feed resources for dairy goats. The co-products such as distillers grains; oil seed cakes/meals from unconventional oilseeds e.g. *Camelina sativa*, non-toxic *Jatropha curcas* and *J. platyphilla*, Pongamia and Neem; and residues from sweet sorghum and cassava could be used in the production of goat rations. An extensive review on evaluation of these co-products as livestock feed (FAO, 2012c) illustrates the potential of these co-products as feed ingredients in dairy goat rations; however, use of these co-products in goat rations still needs to be demonstrated.

Some distiller grains, due to their specific processing conditions, have high rumen bypass protein and are expected to increase milk yield from high-yielding goats. Similarly, rumen protected amino acids, starch and fat could be considered for inclusion in the diets of high-yielding dairy goats.

Feed additives and supplements and nutrient use efficiency

Multi-purpose tree leaves (MPTLs) besides being rich in useful nutrients such as protein and minerals also contain plant secondary metabolites (PSMs) e.g. tannins, saponins, glycosides and terpenes having potentially useful bioactivities. Consumption of plants containing higher levels of PSMs are known to produce adverse effects; however, compared to other herbivoures, goats are more resistant to PSMs. Feeding of MPTLs and agroindustrial byproducts containing PSMs offers a number of advantages to goats, e.g. reduction in the load of internal parasites by tannins from quebracho, *Quercus coccifera*, *Caprinus orientalis* and *Chicorium intybus*. Saponins, lactones and glycosides are also reported to possess anthelmintic activity (Athanasiadou et al., 2009). Addition of pineapple leaves in the diets has also been shown to reduce internal parasites (attributed to the presence of bromalain in pineapple leaves) and its effectiveness was found to be comparable to albendazole (Makkar et al., 2007). Decrease in methane emission on using tannins and saponins in dairy goats could also be expected (Goel and Makkar, 2012).

The use of tannins and saponins as feed additives has been shown to affect meat colour, antioxidation potential of muscle, muscle cholesterol and fatty acid profile and meat colour stability (Vasta et al., 2011). Also tannins affected rumen biohydrogenation and decreased vaccenic acid and rumenic acid and increased linoleic acid and linolenic acid in the milk from ewes fed *Hedisarum coronarium* foliage containing condensed tannins (Cabiddu et al., 2009). No effect on fatty acid profile in goat milk on administration of monoterpenes blend has been observed (Malecky et al., 2009).

Linseed supplementation has also been shown to increase polyunsaturated fatty acids, the omega fatty acid and the conjugated linoleic acid fatty acids in goat milk (Delmotte et al., 2009). Enrichement of n-3 polyunsaturated fatty acids in goat milk by dietary inclusion of fish oil or microencapsulated fish oil has also been achieved (Safari et al., 2011). These changes are further expected to enhance the market value of goat milk and milk products. Systematic studies on the use of PSMs, essential oils, simple phenolics as feed additive and their effects on fatty acid profiles are required in order to generate sustained and high level desired changes in goat milk and milk products.

Performance of animals and efficiency of nutrient use

Transformation of feed into animal products requires energy and nutrients; however, this conversion is associated with losses of nutrients into the environment as excretion of nitrogen, phosphorus and trace elements and emission of methane and carbon dioxide. The efficiency of conversion of feed in animal food chains is quite variable, depending on animal species and performance status. At high levels of production, the output of edible protein in milk per kg of body weight per day from a dairy cow (body weight 650 kg) with high level of performance (40 kg milk per day) is 2 g while this value for a high performing goat (body weight 60 kg) giving 5 kg milk per day is 2.8 g. The output of edible protein per kg of body weight increases with increase in performance of the animals. Conversely, nitrogen and phosphorus excretion and methane emission per unit of edible protein output decreases with increase in performance (Niemann et al., 2011). These effects are attributed to the proportionate reduction in energy and nutrient diversion for maintenance of animals as the performance increases, provided intake of animals is not restricted. These observations suggest that for feed-efficient production systems, in addition to the good quality of feed, high genetic potential of animals is also of paramount importance.

Animal breeding for increasing nutrient use efficiency

Genomics and reproductive biotechnologies offer potential to improve goat productivity by producing goats having both higher intake and feed conversion efficiency and lower emission of methane per unit of feed digested, greater absorption of the digested nutrients, higher efficiency of anabolic processes and lower of catabolic processes, lower fat content in animal body, lower fat and lactose secretion and higher protein secretion in milk, and improved animal health with higher resistance against biotic or abiotic stress and reduced losses during production (Niemann et al., 2011). Little is known about how to achieve these traits in goats and extensive research is required in these areas.

In conclusion, to achieve feed-efficient in dairy goat production systems an integrated and holistic approach targeting feed and feeding in addition to improving animal breeding, animal health and management practices is required. This holistic approach should also include appropriate policy formulation and institutional building that support dairy goat farming, provide attractive market for goat milk and encourage milk processing industry to develop niche products for local use and for export. These key developments can boost income of resource-poor goat keepers and take them out of poverty.

References

Athanasiadou, S., I. Kyriazakis, I. Giannenas and T.G. Papachristou, 2009. Nutritional consequences on the outcome of parasitic challenges on small ruminants. Nutrition and foraging ecology of sheep and goats, *Option Méditerranéennes A.* 85: 29–40.

Cabiddu, A., G. Molle, M. Decandia, S. Spada, M. Fiori, G. Pierreda andM. Addis, 2009. Responses to condensed tannins of flowering sulla (*Hedysarum coronarium* L.) grazed by dairy sheep: Part 2: Effects on milk fatty acid profile. *Livest. Sci.* 123: 230–240.

Delmotte, C., P. Rondia, F. Dehareng, J. Latoux and J. Fameree, 2009. An oleaginous supplement to improve the nutritional quality of goat's milk and cheese (whole or extruded linseed, rapseed cake). Nutrition and foraging ecology of sheep and goats, *Option Méditerranéennes A.* 85: 445–451.

FAO, 2010. FAOSTAT statistical database. Rome, Italy (available at www.faostat.fao.org).

FAO, 2011. Quality assurance for animal feed analysis laboratories. FAO Animal Production and Health Manual No. 14. Rome, Italy.

FAO, 2012a. Conducting feed assessments. FAO Animal Production and Health Manual. Rome, Italy (in preparation).

FAO, 2012b. Use of lesser-known plants and plant parts as animal feed resources in tropical regions, by Emmanuel S. Quansah and Harinder P.S. Makkar. Animal Production and Health Working Paper. No. 8. Rome.

FAO, 2012c. Challenges and opportunities in utilization of coproducts of the biofuel industry as livestock feed. FAO, Rome, Italy.

Foidl, N., H.P.S. Makkar and K. Becker, 2001. The potential of Moringa oleifera for agricultural and industrial uses. In: L.J. Fuglie (Ed.), *The Miracle Tree: The Multiple Attributes of Moringa* (pp. 45–76). Dakar, Senegal: Church World Service.

Garg, M.R., 2011. Implementation of a novel and simple ration balancing approach at smallholder dairy farms' doorsteps in India: impact and opportunities for other developing countries. International Workshop on Feeding Systems and Ration Balancing for Dairy Farms in Tropical Countries, Villavicencio, Colombia, October 25–27, 2011.

Goel, G. and H.P.S. Makkar, 2012. Methane mitigation from ruminants using tannins and saponins. *Trop. Anim. Health Prod.* 44: 729–739.

Makkar, H.P.S, G. Francis and K. Becker, 2007. Bioactivity of phytochemicals in some lesser-known plants and their effects and potential applications in livestock and aquaculture production systems. *Animal* 1: 1371–1391.

Malecky, M., L.P. Broudiscou and P. Schmidely, 2009. Effects of a specific blend of essential oil compounds on rumen fermentation. *Anim. Feed Sci. Tech.* 154: 24–35.

Niemann, H., B. Kuhla and G. Flachowsky, 2011. Perspective for feed-efficient animal production. *J. Anim. Sci.* 89: 4344–4363.

Safari, R., R. Valizadeh, R. Kadkhodaee, A.M. Tahmasebi and A.A. Naserian, 2011. Enrichment in n-3 fatty acids of goat's milk by microencapsulated fish oil supplementation. IDF International Symposium on Sheep, Goat and other non-Cow Milk, Athens, Greece, May 16–18, 2011.

Vasta V., G. Luciano, H. Ben Salem, L. Biondi, A. Priolo and H.P.S. Makkar, 2011. The impact of plant secondary compounds on animal product quality. The 8th International Symposium on the Nutrition of Herbivores, 06–09 September 2011, Aberystwyth, Wales.

Paper 1

Use of *Indigofera zollingeriana* as a Forage Protein Source in Dairy Goat Rations

Abdullah, L., D. Apriastuti & T.A.P. Apdini,*

Department of Nutrition Science and Feed Technology, Bogor Agricultural University, 16680 Darmaga Bogor, Indonesia
**Email of corresponding author: lukiabdullah@gmail.com*

Introduction

Indigofera zollingeriana is a valuable shrubby legume that has been utilised by farmers to improve dairy goat productivity in some areas in Indonesia. Use of Indigofera in Indonesia has not been wide spread but some dairy goat farmers use this forage plant as protein source instead of commercial concentrate because of the high cost of the latter. The quality of feed at farm level often varies due to changes in the composition of some feed materials and this in turn leads to unstable milk production and quality, particularly towards the end of the lactation period.

The availability of the Indigofera herbage at the farm seems to be dependent on the plant production system. It has been recommended that a tea plantation model be used to enable an ideal and proportional harvest of young and old leaves so that the quality of herbage remains high (Abdullah and Suharlina, 2010). The use of wilted Indigofera forage including leaves and edible twigs has been shown to improve the average daily gain of local goats up to 52.38 g/day in North Sumatera (Tarigan, 2009). This is understandable because Indigofera is highly nutritional (Hassen et al., 2008), having a protein content of 27 to 31%, digestible protein 75 to 87%, utilisable fibre (NDF 49–57%; ADF 32–38%), high dry matter digestibility (72–81%), and low total tannin content (0.09–0.65%) (Abdullah, 2010).

It has been reported that farmers face the problems of high feed cost and rapid reduction of milk production two months prior to the end of lactation period if commercial feed is used. Based on the above information, an experiment using pelleted pure Indigofera feed (PIF) was conducted at Bangun Karso Farm. The objectives of the experiment were to determine the effect of PIF on milk production prior to end of lactation, the feed cost and efficiency of protein use.

Materials and methods

The experiment was conducted at Bangun Karso Farm which has been producing goat milk for more than 5 years. The farm is located in the Cijeruk district about 18 km from Bogor. Eight does comprising 4 lactating Saanen and 4 lactating Etawah crossbred (EC) goats were used in the study. Each breed group was divided into two groups of 2 animals each and fed two different rations, namely ration F1consisting of 60% elephant grass + 40% commercial concentrate or ration F2 consisting of 60% elephant grass + 40% PIF (Apdini, 2011). The Saanen and EC does were in the third and second lactation, respectively. Each ration was given 4 times daily with a minimum amount of 4% live weight for 1 month prior to the end of the lactation period. The nutritional composition of the rations was determined according to Apdini (2011). Ration F1 contained 48.25% DM, 8.31% ash, 12.76% crude protein, 32.01% crude fibre, 33.94% NFE and 57.98% TDN while ration F2 contained 48.85% DM, 7.82% ash, 17.23% crude protein, 28.56% crude fibre, 34.81% NFE and 65.77% TDN. The measured parameters are shown in Table 1. Data were analysed using statistical group comparisons (Cooper and Schindler, 2003) and descriptive analysis.

Results and Discussion

The use of the PIF in ration resulted in a higher DM digestibility of the feed (17 to 73%), feed efficiency (8 to 17%), protein use efficiency (1 to 2.5%), average milk production (121 to 383 mL/day), lower feed costs (USD 0.10 to 0.39) and feed conversion values than the commercial concentrate. Daily milk production of the does fed the commercial feed tended to decrease drastically (Figure 1) as indicated by the k-value as shown in Table 1. Drastic reduction of milk production occurred in the Saanen goats that consumed commercial feed. However, when PIF was given in the ration, the daily milk production of both groups of goats stabilised towards the end of the lactation period. Based on feed DM digestibility, feed and protein use efficiency, the Saanen goats seemed to be more responsive to PIF in the ration than the EC does.

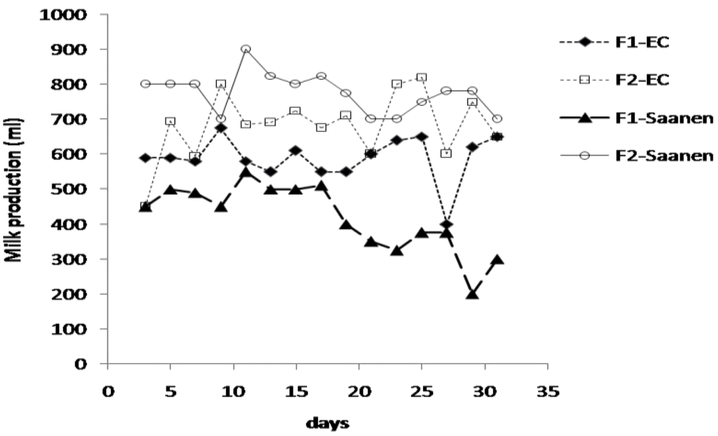

Figure 1. Change of goat milk production of end-lactation Period
F1 -60% elephant grass + 40% commercial feed; F2 - 60% elephant grass + 40% pure Indigofera feed (PIF). Data extracted from Apdini (2011).

Table 1. Use of pure Indigofera in dairy goat rations compared with the commercial Feed

	Saanen		Etawah Crossbred	
	CF	PIF	CF	PIF
Feed DM digestibility (%)*	40.59	70.13	45.47	63.08
Feed efficiency (%)[1]*	17.25	34.75	24.55	32.5
Feed conversion (kg feed/L milk)	5.8	2.9	4.1	3.1
Protein use efficiency (%)[2]*	4.50	7.00	5.35	6.20
Milk production (mL/day)[3]*	379	762	539	660
Feed cost (USD/L milk)[4]	0.93	0.54	0.67	0.57
k-value of milk production[5]	-8.57	-2.85	-0.32	3.54

*Source: data were calculated from Apdini (2011), CF = F1: 60% elephant grass + 40% commercial feed, PIF = F2: 60% elephant grass + 40% pure Indigofera feed (PIF); [1]Portion of feed DM utilised to produce 1L of milk, [2]proportion of feed protein utilised for milk protein, [3]Average milk production (1month prior end-lactation period), [4]cost of feed required for producing 1L milk (CF USD 0.28/kg and PIF USD 0.33). [5]determination value (-) = reduction, (+) = increment.

Economically, the use of 40% PIF in the ration could reduce feed conversion ratio and costs by about 42% for the Saanen and 15% for the EC goats. Since feed contributes approximately 70% towards the cost of production, substituting PIF for commercial feed would reduce feed costs and provide more profits to the farmer. Thus this study showed that the use of Indigofera herbage is very effective in stabilising milk production before termination of the lactation period while improving the quality and reducing the cost of feed.

References

Abdullah, L., 2010. Herbage production and quality of shrub Indigofera treated by different concentration of foliar fertiliser. *Med. Pet.* 33 (3): 169–175.

Abdullah, L. and Suharlina, 2010. Herbage yield and quality of two vegetative parts of Indigofera at different times of first regrowth defoliation. *Med. Pet*. 33 (1): 44–49.

Apdini, T.A.P., 2011. Pemanfaatan pellet Indigofera pada kambing Peranakan Etawah dan Saanen di peternakan Bangun Karso. Bachelero Thesis, Bogor Agricultural University.

Hassen, A., N.F.G. Rethman, W.A.Z. Apostolides and W.A. Van Niekerk, 2008. Forage production and potential nutritive value of 24 shrubby Indigofera accessions under field conditions in South Africa. *Trop. Grasslands* 42: 96–103.

Tarigan, A., 2009. Productivity and utilisation of Indigofera sp. as goat's feed obtained from different interval and intensity of cutting. Thesis. Bogor Agricultural University, Indonesia.

Cooper, D.R. and P.S. Schindler, 2003. *Business Research Methods*. 8th Ed. McGraw Hill. New York.

Paper 2

Protein Requirement for the Maintenance and Gain of Growing Goats Fed *Leucaena leucocephalade* Roughage-Based Diets in Thailand

Chaokaur, A.[1], S. Poathong[2], S. Srisuk[1], S. Maiklang[1], S. Wiangsanthiah[1] & C. Santhong[1]*

[1]Faculty of Animal Science and Agriculture, Silpakorn University,
[2]Pectchaburi Animal Research and Development Centre, 76120 Thailand
[*]Email of corresponding author: ananchaokaur@yahoo.com

Introduction

For many areas, goats are a major source of income for farmers, and there have been many reports of crossbreeding programmes aimed at improving the productivity of native goats. It has been reported that farmers could utilise the different Saanen crossbreds to improve pre-weaning growth rate of goats in Southern Thailand (Supakorn and Pralomkarn, 2009). Pralomkarn et al. (1995) reported that Thai native and Anglo-Nubain × Thai native goats have similar protein and energy requirements for growth. This experiment was designed to quantify the protein requirements for maintenance and growth of growing Anglo-Nubain crossbred goats fed under tropical conditions in Thailand.

Materials and methods

Sixteen male Anglo-Nubain crossbred goats (weighing 19.03 ± 0.3 kg, aged 6 to 12 mo) were housed in individual pens and fed *Leucaena leucocephalade* roughage-based diets with water and minerals provided *ad libitum*. They were assigned in a completely randomised design and fed one of the four feeding treatments consisting of cassava chip supplementation at the rate 0, 0.5, 1.0 and 1.5% of body weight for a 91-day period. The weight of feed offered and refused was recorded and feed sampled daily. Feed samples were analysed using standard methods and animals were weighed weekly. The crude protein intake (CPI) and average daily gain (ADG) data were regressed against time using linear regression (regression equation; CPI = a + b ADG).

Results and Discussion

The results indicated that increased levels of cassava chips resulted in linear (P<0.05) increases in roughage and protein intakes. However, the ADG was not different between groups (Table 1). The protein requirement determined from the regression of ADG on CPI exhibited a significant linear relationship [CPI = 1.1474 ADG + 157.35, (R^2 = 0.45; P<0.001; RSD = 5.54; n = 12)] (Figure 1). The crude protein requirement for maintenance and gain (100 g ADG) were 157 and 272 g/d, respectively.

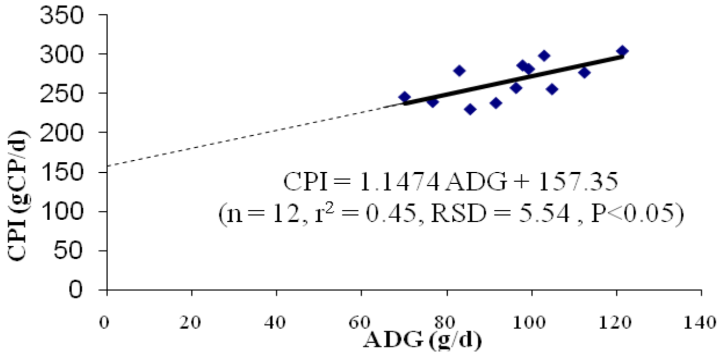

Figure 1. The relationship between crude protein intake and average daily gain.

Table 1. Body weight and intake of growing goats given levels of cassava chip supplementation.

Item	Levels of cassava chip (%BW)				*P*-value[1]		
	0	0.5	1.0	1.5	L	Q	C
Number animal, head	*n = 4*	*n = 4*	*n = 3*	*n = 4*			
Initial weight, kg	19.34	19.09	18.57	19.10	-	-	-
Final weight, kg	27.95	27.30	26.49	28.75	ns	ns	ns
Average body weight, kg	23.65	23.20	22.53	23.93	ns	ns	ns
Average daily gain, g/d	94.56	90.28	87.01	106.04	ns	ns	ns
Roughage intake, kg DM/d	1.12	1.02	0.94	0.93	**	ns	ns
Concentrate intake, kg DM/d	0	0.10	0.19	0.29	**	ns	ns
Total feed intake, kg DM/d	1.12	1.12	1.13	1.22	ns	ns	ns
Crude protein intake, kg CP/d	0.29	0.27	0.25	0.25	**	ns	ns

[1]: Probability of a significant ($P<0.05$) effect of levels or of a linear (L) or quadratic (Q) or cubic (C) effect of feeding levels.

Conclusions

The results indicated that the protein requirement for maintenance and growth for growing Anglo-Nubain crossbred goats fed a Leucaena roughage-based diet with varying levels of cassava chips under tropical condition were 157 and 272 g crude protein/d, respectively.

Acknowledgements

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References

Pralomkarn, W., S. Kochapakdee, S. Saithanoo and B.W. Norton, 1995. Energy and protein utilisation for maintenance and growth of Thai native and Anglo-Nubian × Thai native male weaner goats. *Small Ruminant Res.* 16: 13–20.

Supakorn, C. and W. Pralomkarn, 2009. Pre-weaning growth of goats for meat raised on a commercial farm in Southern Thailand. *Thai. J. Agri. Sci.* 42 (1): 13–19.

Paper 3

Yield and Quality of Forage affected by Molybdenum Fertiliser and Legume Genotypes

Susilawati, I.[1], H. Djuned[1], A.R. Tarmidi[2] & D. H. Arief[3]*

[1]Laboratory of Forage Crops, Faculty of Animal Husbandry, Universitas Padjadjaran, Jatinangor, Indonesia, [2]Laboratory of Feed Chemistry and Ruminant, Faculty of Animal Husbandry, Universitas Padjadjaran, Jatinangor, Indonesia, [3]Laboratory of Soil Microbiology, Faculty of Agriculture, Universitas Padjadjaran, Jatinangor, Indonesia.
[*]Email of corresponding author: lizahkh@yahoo.com

Introduction

Agricultural land in the tropics and subtropics are generally low in nitrogen which is required in relatively high quantity and has a very significant effect on the productivity of plants, including forage crops. Poor quality forage, including forage of low nitrogen content limits livestock productivity. A large amount of nitrogen is present in the atmosphere (79% by volume), but the majority of the plants cannot utilise it directly from the atmosphere. In principle, increasing the nitrogen supply in the soil for plants could be done by increasing biological nitrogen fixation or by the addition of inorganic nitrogen fertilizers. The continuous use of artificial nitrogen fertilizers can lead to negative impact on the environment. Therefore, in order to support the concept of sustainable agriculture, efforts to increase the supply of nitrogen through biological nitrogen fixation by Rhizobium symbiosis with legumes is appropriate. This study was carried out to examine the influence of molybdenum fertilization and legume species on yield and quality of forage in mixed cropping with Guinea grass (*Panicum maximum*) in the field.

Materials and methods

The investigation was carried out at the Faculty of Agriculture, Universitas Padjadjaran, Jatinangor, Indonesia. A randomised block design with a factorial pattern group with 2 factors and 3 replications was used. The first factor consisted of three legume species; namely Kudzu (*Pueraria phaseoloides*), Calopo (*Calopogonium mucunoides*), and mixed Kudzu with Calopo, while the second factor was the molybdenum fertiliser given at 4 levels; namely 0, 3, 6 and 9 g/kg seed.

Results and Discussion

The results showed that the legume species significantly ($P<0.05$) affected the yield and quality of forage crops, while molybdenum fertilizer did not significantly affect the yield and crude protein content of the forage crops (Table 1). Kudzu showed higher dry matter yield (11.19 t/ha) than other treatments. The molybdenum fertiliser at the rate of 6 g/kg seed produced the highest crude protein content (10.73%) (Table 2).

Table 1. Mean dry matter yield of three legume genotypes treated with molybdenum fertilizer

Treatment	Dry matter yield (tonnes/ha) Cutting sequence First	Second	Third	Total
Legume				
Kudzu	2.86^{a}	4.20^{a}	4.13^{a}	11.19
Calopo	2.63^{ab}	4.19^{a}	3.96^{ab}	10.78
Kudzu + Calopo	2.38^{b}	3.49^{b}	3.41^{b}	9.28
Molybdenum				
Without Mo	2.58	3.84	3.60	10.02
3 g kg^{-1}seed	2.62	3.85	3.98	10.45
6 g kg^{-1}seed	2.66	4.05	4.02	10.73
9 g kg^{-1}seed	2.38	4.09	3.73	10.20

[ab]Means within column with different superscripts differ at $P<0.05$

Table 2. Mean crude protein content (%) of three legume genotypes treated with molybdenum fertilizer

Treatment	Crude Protein (%) Cutting sequence First	Second	Third	Total
Legume				
Kudzu	12.15	10.97	10.05^{a}	11.06
Calopo	11.73	10.63	8.96^{b}	10.44
Kudzu + Calopo	11.78	10.88	9.37^{ab}	10.68
Molybdenum				
Without Mo	11.51	10.76	9.32	10.53
3 g kg^{-1}seed	11.91	10.76	9.10	10.59
6 g kg^{-1}seed	11.83	11.06	9.81	10.90
9 g kg^{-1}seed	12.32	10.71	9.61	10.88

[ab]Means within column with different superscripts differ at $P<0.05$

Paper 4

The Use of Rain Tree Pods as a Feed Supplement for Dairy Goats

Jetana, T.[1], S. Usawang[1] & M. Techakampu[2]*

[1]Research and Development Centre for Livestock Production Technology,
[2]Department of Obstetrics, Gynaecology and Reproduction, Faculty of Veterinary Science,
Chulalongkorn University, Bangkok 10330, Thailand
[*]Email of corresponding author: thongsuk.j@chula.ac.th

Introduction

The rain tree *(Saman samanea)* is a tropical legume and the pods of the rain tree are easily available in the dry season. It is generally known that these pods have been appreciatively eaten by cattle (Staples and Elevitch, 2006). Studies demonstrated that the rain tree pod has the advantage of enhancing microbial growth in the rumen of buffaloes (Jetana et al*.,* 2011a,b) and cattle (Jetana et al*.,* 2010). The objectives of the experiment were to determine and compare the effects of supplementation with either commercial pellets (CCP) or the pellets produced from rain tree pods (RTPP) on the whole tract apparent digestibility of DM, OM and fibre, ruminal microbial production, milk production, quality of milk and capital cost of milk production**.**

Materials and methods

The experiment was conducted with 14 *Saanen* dairy goats (weighing 29.0–58.0 kg). The animals were randomly divided into two groups of 7 animals each. Group 1 (38.4 ± 0.62 kg) was fed *ad libitum* with 2.46 kg corn silage (fresh weight) and supplemented with 1 kg of CCP (fresh weight), and Group 2 (40.9 ± 0.74 kg) was fed *ad libitum* with 2.46 kg corn silage (fresh weight) and supplemented with 1 kg of RTPP (fresh weight). The crude protein content in CCP (15.0%) and RTPP (15.2%) was similar. The CCP contained 865 g DM/kg, 31 g ash and 440 g NDF based on g/kg DM basis while RTPP contained 764 g DM/kg, 62.3 g ash, 200 g NDF, 45.3 g phenolic compounds, 10.8 g condensed tannins, 170 g total sugar and 90 g sucrose per kg DM basis.

Two studies were conducted over 35 days. The first study determined milk production and milk quality for 35 days, whilst the second study determined the nutrient digestion and microbial production in the rumen. The samples were collected for digestion and microbial production in the rumen for 7 days, during day 28 to 35 of experimentation. The animals were housed in individual pens during the experimental period with facilities for separate urine and feces collections. The feed intake and milk production of each goat were recorded daily and 20 mL of milk were taken as a sub-sample into each plastic container for chemical analysis. Total fat was determined by a simple UV spectrophotometric method (Forcato et al., 2005); milk protein was calculated by total N in milk (Micro Kjeldahl, AOAC 2000) multiplied by 6.38. Total solids were determined by taking 10 g of milk samples in 50-ml Erlenmeyer flasks and kept at 80ºC in a hot air oven for 24 hours. The ash in the milk samples was determined by burning them to a constant weight in a muffle furnace at 550ºC for 8 hours. Milk lactose was calculated by subtracting total fat, protein and ash from total solids.

On day 28 to 35, urine was collected in plastic bags containing 100 mL of 7% HCl to maintain a pH below 3. Total daily urine was weighed and sub-samples were taken, diluted 5 times with distilled water, and stored at 4ºC for PD analysis (IAEA-TECDOC-495, 1997). Total daily faeces were weighed and sub-samples (20%) were then stored at 4 ºC for chemical analysis. Ten percent of the representative aliquots of offered feed, refused feed and faecal samples were collected and stored at –20ºC. At the end of each sampling period, samples from each animal were pooled and dried in a hot air oven at 65ºC, for 72 hours, prior to analysis for dry matter (DM), ash, nitrogen (N), and neutral detergent fibre (Van Soest *et al.* 1991). Fresh drinking water was provided throughout the experiments. Purine derivatives in the urine were measured as allantoin, uric acid, xanthine and hypoxanthine and microbial-N in the rumen was calculated using equation of Jetana et al. (2003).

Results and Discussion

Table 1 shows that the RTPP intake was greater than that of CCP intake, but none of the supplemental diets affected corn silage intakes. However, digestibility coefficients of DM and OM were generally lower in goats in the RTPP than those in the CCP group. It is possible that the rain tree pods contained higher available sugar (sucrose) than the CCP diet decreasing the pH in the rumen (Hindrichsen and Kreuzer, 2009) and thus the activity of cellulolytic microbes leading to depressed fibre digestion (Table 1) (Hoover, 1986).

Lower microbial production recorded in goats supplemented with RTPP (Table 1) was in contrast with the reports by Jetana et al. (2010, 2011a,b) who demonstrated that a high sugar and protein content in the rain tree pod has advantages of enhancing the efficiency of microbial yield in the rumen of buffaloes and cattle. The contradicting results may be due to i) different animal species used, ii) different processing methods for the rain tree pods, iii) the rate of passage in animals fed the RTPP diet may be faster than in those fed the CCP diet resulting in excess non-fermentable N sources in the rumen to be fermented in the hindgut, iv) binding of condensed tannins to available nutrients (N) in the RTPP supplemental diet and v) the high content of tannins inhibiting some microbial activity (Waghorn, 2008). Though the average milk production (mL/day/$BW^{0.75}$) (Figure1) and capital cost of milk production (US dollar/kg milk) were lower (Table 1), the contents of protein, lactose and total solids in the milk were higher in goats supplemented with RTPP than in those supplemented with CCP (Table 1). The high lactose in milk is not surprising as there is high sucrose in the RTPP while the high protein in milk is probably due to the escape of tannin-protein complexes in RTPP diet from rumen fermentation, subsequently digested in the small intestine and absorbed for production of protein in milk.

Table 1. Intake, coefficient of digestion, ruminal microbial nitrogen production, milk composition and capital cost of milk production in *Saanen* goats fed corn silages and supplemented with two types of concentrate pellet

	Type of concentrate pellet		SED[1]
	CCP	RTPP	
Body weight live(kg)	38.4	40.9	1.56
Metabolic body weight (kg)	15.4	16.1	0.46
Total dry matter (DM)	1.30[b2]	1.44[a]	0.03
Concentrate pellet DM	0.70[b]	0.83[a]	0.02
Corn silage DM	0.59	0.60	0.01
Total organic matter (OM)	1.22[b]	1.35[a]	0.02
Total neutral detergent fibre (NDF)	0.69[b]	0.75[a]	0.02
The coefficients of (decimal)			
DM	0.76[a]	0.68[b]	0.02
OM	0.80[a]	0.72[b]	0.02
NDF	0.84[a]	0.78[b]	0.02
Purine derivatives in urine (mmol/day)			
Allantoin	19.2	15.5	1.92
Uric acid	7.40[a]	1.11[b]	0.58
Xanthine + Hypoxanthine	0.89	1.01	0.11
Total Purine derivatives	27.4[a]	17.6[b]	1.91
MN in the rumen (N g/day)[3]	29.1[a]	17.2[b]	2.30
Chemical composition of milk (g/kg)			
Fat	45.6	42.1	4.62
Protein	34.0[b]	39.7[a]	2.76
Lactose	23.3[b]	34.7[a]	2.94
Total ash	9.56	9.97	0.50
Solids non fat	64.0[b]	84.4[a]	2.69
Total solids	110[b]	127[a]	4.88
Capital of milk produced			
Milk yield (g/day)	922[a]	570[b]	1.92
Milk produced capital (US dollar/kg milk)	0.40[a]	0.35[b]	0.02

[1] Standard error of difference

[2ab]Values within the same row with different superscripts are significantly (P<0.05) different. Values within the same row without superscripts are not significantly (P<0.05) different

[3] Purine derivatives in milk was not included for calculation

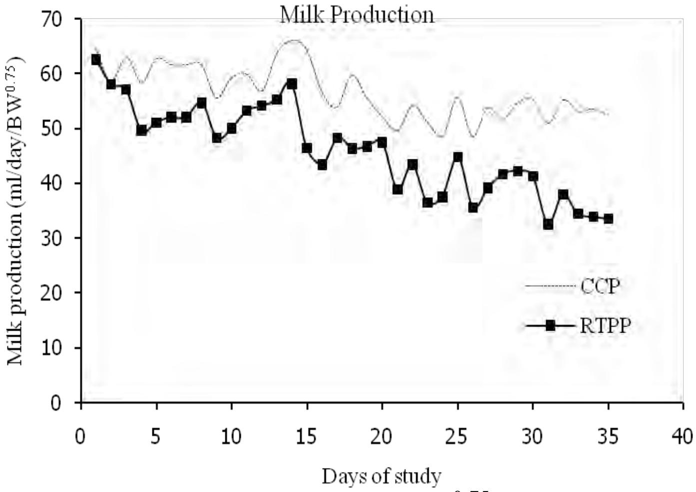

Figure 1. The average milk production (mL/day/BW$^{0.75}$) of dairy *Saanen* goats fed different types of concentrate pellets.

Conclusion

The study demonstrated an approach to use natural feed resources as an alternative feed supplement to improve the quality of milk in dairy goats. The practical implication of this study is that it would be benefit the smallholder farmers to use rain tree pods because it improves milk quality.

References

Forcato, D.O., M.P. Carmine, G.E. Echeverria, R.P. Pecora and S.C. Klvatinltz, 2005. Milk fat content measurement by a simple UV spectrophotometric method: An alternative screening method. *J. Dairy Sci.* 88: 478–481.

Hindrichsen, I.K. and M. Kreuzer, 2009. Hugh methanogenic potential of sucrose compared with starch at high ruminal pH. *J. Anim. Physio. Anim. Nutr. (Berl).* 93 (1): 61–65.

Hoover, W.H., 1986. Chemical factors involved in ruminal fibre digestion. *J. Dairy Sci.* 62: 2755–2766.

IAEA-TECDOC-495, 1997. "Estimation of rumen microbial protein production from purine derivatives in the urine." A laboratory manual for the FAO/IAEA Co-ordinated Research programme on development, standardisation and validation of nuclear based technologies for measuring microbial protein supply in ruminant livestocks for improving productivity, Vienna, Austria.

Jetana, T., N. Abdullah, J.B. Liang, S. Jalaludin and Y.W. Ho, 2003. Urinary excretion of purine derivatives as makers for development of model to estimate rumen microbial nitrogen production in goats. 20th Pacific Science Congress, 17–21 March, 2003, Bangkok, Thailand. Poster 9.

Jetana, T., S. Usawang, S. Thongruay, C. Vongpipatana and S. Sophon, 2010. Apparent digestibility, nitrogen balance, ruminal microbial nitrogen production and blood metabolites in Thai Brahman cattle fed a basal diet of rice straw and supplemented with some tropical protein-rich trees. *Asian-Aust. J. Anim. Sci.* 23: 465–474.

Jetana, T., C. Vongpipatana, S. Usawang and S. Thongruay, 2011a. The use of tropical protein-rich leaves as supplements to Thai swamp buffalo receiving a basal diet of rice straw and treated leucaena (*Leucaena leucocephala*). *Trop. Anim. Health Prod.* 43: 57–67.

Jetana, T., C. Vongpipatana, S. Usawang and S. Sophon, 2011b. Using treated leucaena (*Leucaena leucocephala*) leaves as supplements to Thai Brahman cattle giving a basal diet of rice straw. *J. Anim. Vet. Adv*. 10 (8): 1054–1060.

Khalili, H. and P. Huhtanen, 1991. Sucrose supplements in cattle given grass silage-based diet. 2. Digestion of cell wall carbohydrates. *Anim. Feed Sci. Technol.* 33**:** 263–273.

Staples, W.G. and C.R. Elevitch, 2006. *Samanea saman* (rain tree) *Fabaceace* (legume family). In: *Traditional Trees of Pacific Islands: Their Culture, Environment, and Use*. C.R. Elevitch (ed.), pp. 661–674.

Van Soest, P.J., J.B. Robertson and B.A. Lewis, 1991. Methods for dietary fibre, neutral detergent fibre and non-starch polysaccharides in relation to animal nutrition. *J. Dairy Sci.*74: 3583–3597.

Waghorn, G.C., 2008. Beneficial and detrimental effects of dietary condensed tannins for sustainable sheep and goat production-Progress and challenges. *Anim. Feed Sci. Technol.* 147: 116–139.

Paper 5

Effect of Jerusalem Artichoke Supplementation on Methanogenic Achaea in Dairy Goats using Real Time PCR Technique

Kanokwan, K.[1], S. Paengkoum[2], P. Kongmun[3], Z. Yu[4] & P. Paengkoum[1]*

[1]School of Animal Production Technology, Institute of Agricultural Technology, Suranaree University of Technology, 30000 Nakhon Ratchasima, Thailand
[2]Department of Animal Science and Agricultural Technology
Faculty of Animal Science and Agricultural Technology, Silpakorn University, Information Technology Campus. 76120 Phetchaburi, Thailand
[3]Department of Animal Science, Faculty of Agriculture, Kasetsart University, 10900 Bangkok, Thailand.
[4]The MAPLE Research Initiative, Department of animal Sciences, The Ohio State University, Columbus, OH 43210, USA
**Email of corresponding author: pramote@sut.ac.th*

Introduction

Early research on rumen methanogenic achaea focused on the reduction the loss of dietary energy for the ruminant, but lately, the objective was to mitigate methane from enteric fermentation to reduce environmental pollution (Hindrichsen et al., 2004). Inulin is a polydisperse non-starch polysaccharide naturally occurring as a storage carbohydrate in some 36,000 plant species. The main sources of inulin are chicory and Jerusalem Artichoke (*Helianthus tuberosus* L.) (Böhm et al., 2005). Inulin is considered as archetypal prebiotic and has been used successfully in monogastric animals but we know of few studies to investigate the direct effect of inulin on methanogenic achaea in rumen fluid. The objective of the present study was to determine the effect of supplementing inulin powder from Jerusalem Artichoke in diet on methanogenic bacteria in dairy goats using real-time PCR technique (Yu et al., 2005).

Materials and methods

Six female crossbred Saanen (>75% pure) goats were allocated to two treatment groups. All animals were fed with purple guinea grass (*Panicum maximum* TD 58) *ad libitum* and supplemented with concentrate at 1.5% BW (20% CP). In the control group no inulin was given to the animals while in the treatment group 10% inulin from Jerusalem Artichoke *(Helianths tuberosus)* was added to the diet. All animals were kept in individual pens and received water and mineral blocks *ad libitum*. Rumen contents were collected on day 0, 1, 7 and 14 at post-morning-feeding and immediately used for direct total protozoa and bacteria counts using a haemocytometer (Galyean, 1989). The DNA was immediately extracted from the rumen content.

Community DNA was extracted from 0.2 mL aliquots of rumen fluid to which 1 mL of lysis buffer was added and homogenised for 5 min for DNA extraction. DNA was purified using High Pure PCR Template Preparation Kit (Roche, Germany). Species-specific primers used the 16s gene, methanogens. The primer set sequences was MET630F [16S gene, methanogens (GGATTAGATACCCSGGTAGT)] and MET803R [16S gene, methanogens (GTTGARTCCAATTAAACCGCA)] were chosen from Christophersen (2007) and Skillman et al., (2006). Real-time PCR amplification was done using a FastStart Essential DNA Green Master (Roche, Germany).

Results and Discussion

Populations of total protozoa and total bacteria in the rumen fluid counted under an optical microscope are shown in Table 1. There was no significant difference among treatments (P>0.05) in the total protozoal population at 14 day after 10% inulin treatment. The protozoal count was 15.17 $\times 10^5$ cell/mL rumen content after treatment compared to 12.50 $\times 10^5$ cell/mL rumen content for the control. Total bacteria counts and pH of the rumen of goats on day 0, 1, 7 and 14 of treatment with 10% inulin were not significantly different between groups (P>0.05).

Table 1. Effect of inulin on methanogenic achaea, total protozoa and total bacteria in rumen fluid.

Sampling (day)	Methanogen ($\times 10^7$copies/mL)		SEM	Total Protozoa ($\times 10^5$/mL)		SEM	Total Bacteria ($\times 10^9$/mL)		SEM
	control	Inulin		control	Inulin		control	Inulin	
0	4.19	11.85	0.89	16.50	15.83	0.92	24.93	15.27	4.19
1	4.24	6.33	2.42	6.00^a	10.17^b	1.11	16.00	12.80	1.66
7	7.57^a	14.56^b	0.26	12.83	14.00	4.37	10.00	11.67	2.63
14	10.16	9.98	0.87	12.50	15.17	3.22	6.33	9.20	1.43

^{a,b}Values in the same row with different superscript differ significantly (P < 0.05).
SEM = standard error of the mean.

Methanogenic bacterial diversity was investigated using real-time PCR technique. The results showed that there were no significant differences among treatments (P>0.05) on population of methanogens at day 14 of with 9.98 $\times 10^7$and 10.15 $\times 10^7$ copies/mL, respectively, for the treatment and control groups (Figure 1). The results indicate that addition of 10% inulin did not affect the population of methanogens in the rumen of dairy goats.

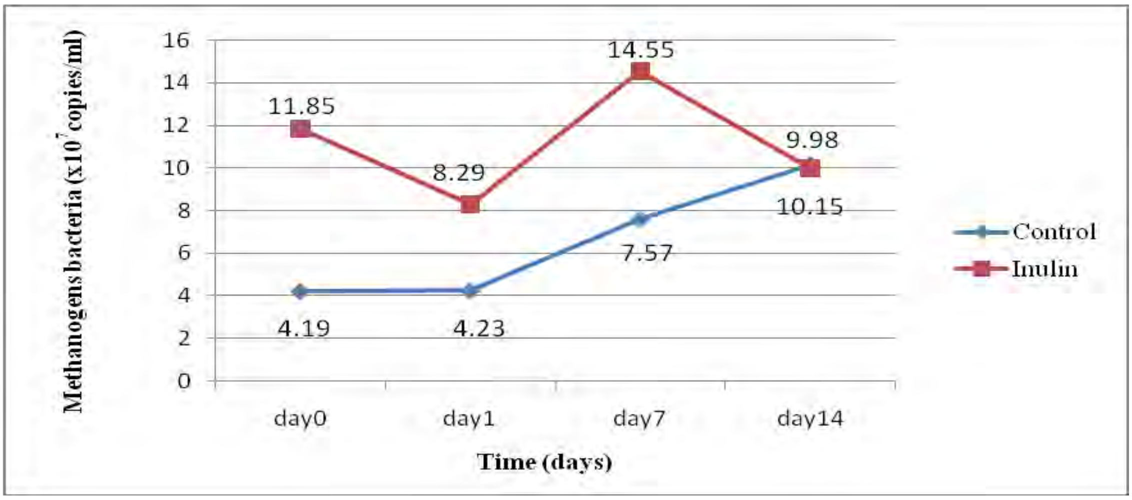

Figure 1. Populations of the rumen methanogens of goats treated with 10% inulin.
The rumen fluid samples were collected at days 0, 1, 7 and 14 after post-morning-feeding.

References

Böhm, A., I. Kaiser, A. Trebstein and T. Henle, 2005. Heat-induced degradation of inulin. Eur. *Food Res. Technol.* 220, 466–471.

Christophersen, C.T., 2007. PhD Thesis. University of Western Australia, Perth.

Galyean, M., 1989. Laboratory Procedure in Animal Nutrition Research. Department of Animal and Range Sciences, New Mexico State University, U.S.A.

Hindrichsen, I. K., H.R. Wettstein, A. Machmüller, C.R. Soliva, K.E. Bach Knudsen, J. Madsen and M. Kreuzer, 2004. Effects of feed carbohydrates with contrasting properties on rumen fermentation and methane release in vitro. *Can. J. Anim. Sci.* 84: 265–267.

Skillman, L.C., P.N. Evans, C. Strompl and K.N. Joblin, 2006. 16S rDNA directed PCR primers and detection of methanogens in the bovine rumen. *Lett. Appl. Microbiol.* 42: 222–228.

Yu, Z., F.C. Michel, G. Hansen Jr., T. Wittum and M. Morrison, 2005. Development and application of real-time PCR assays for quantification of genes encoding tetracycline resistance. *Appl. Environ. Microbiol.* 71: 6926–6933.

Paper 6

Production and Quality of Pasture with Introduced Legumes for Dairy Goats

Karti, P.D.M.H.K., L. Abdullah, D.A. Astuti, N. Kurniaty & R. Nissa*

Faculty of Animal Science, Bogor Agricultural University, Bogor, West Java 16680. Indonesia
Email of corresponding author: pancadewi_fapetipb@yahoo.com

Introduction

Goats can consume a wide variety of forages and consuming good quality forages will result in higher milk production in dairy goats. The feeding of legume forage species will increase the compliance with the protein needs of dairy goats. Uptake of minerals including N, P, and Ca from the soil can increase the quality of forage (Karti, 2010). In ruminants, volatile fatty acids (VFA) contribute up to 70% of the caloric requirement (Bergman, 1990) and fermentability of organic matter can be measured by its VFA production (Despal et al., 2011) while protein by its NH_3 production. The latter can be assimilated by rumen microorganisms for growth and other production functions of the host animals. The purpose of this study was to determine the effect of introducing legume intercropping with *Brachiaria humidicola* in pasture for feeding of dairy goats.

Materials and methods

The plant materials used were *B. humidicola* pasture with three kinds of legumes namely *Pueraria javanica*, *Centrosema pubescens* and *Calopogonium mucunoides.* The NPK fertiliser, manure and soil potential microorganisms used for this study were obtained from the Agrostology Laboratory, Faculty of Animal Science, Bogor Agricultural University. The experiment used a randomised block design with eight treatments and four replicates. The treatments were P_1: Control (pasture consists of only *Brachiaria humidicola*); P_2: *B. humidicola* combined with *Pueraria javanica*, *Centrosema pubescens* and *Calopogonium mucunoides* with NPK fertiliser; P_3: *B. Humidicola* with *P. javanica,* P_4: *B. Humidicola* with *C. pubescens;* P_5: *B. Humidicola* with *C. mucunoides;* P_6: *B. Humidicola* with *P. Javanica* and *C. pubescens;* P_7: *B. Humidicola* with *P. javanica* and *C. mucunoides and* P_8: *B. humidicola* with *P. javanica*, *C. pubescens* and *C. mucunoides.* Treatment P_3 to P_8 were given NPK at half doses, manure and potential soil microorganisms. The data were analysed using ANOVA and the differences between mean treatments were analysed using the Duncan Multiple Range Test (DMRT).

Results and Discussion

Dry matter production and P and K uptakes of plants were significantly increased with the introduction of legumes (P_2–P_8) compared to the control. Production of DM in treatments with half doses of inorganic fertiliser, manure and potential microorganisms (P_3, P_5, P_6, P_7

and P_8) were significantly higher than that using the inorganic fertiliser alone (P_2). Uptakes of N and Ca in the treatment with half doses of the inorganic fertiliser, manure and potential microorganisms (P_3–P_8) were significantly higher than using inorganic fertilizer only (P_2). Uptakes of Mg from P_3 and P_7 were significantly higher than those in P_1, P_2 and P_4. The best treatment was P_7, followed by P_3, P_5 and P_8 for DM production and mineral uptake (Table 1).

The results showed that the introduction of legumes with *B. humidicola* pasture (P_2-P_8) increased (P<0.05) the DM digestibility, VFA and NH_3, while no difference was observed among treatments on organic matter digestibility. The treatment which combined NPK fertilisers with manure and potential microorganisms (P_7, P_8, and P_5) significantly (P<0.05) increased the digestibility of DM, VFA, and NH_3 compared to the control (Table 1). The total VFA produced in this study was between 82.65 to 153.04 mM which is sufficient for the optimal growth of rumen microorganisms. The total VFA from a single feed with legume browse plants was higher than the legume browse mixed with grass (Astuti et al., 2011).

The NH_3 produced from protein fermentation in the experiment was sufficient for the growth of dairy goats as reported by Despal et al. (2011).

Table 1. The effect of introducing legumes on DM production, N, P, K, Ca and Mg uptake of plants, DMD, OMD, VFA and NH_3

Treat-ments	DM Prod (g/0.25 m^2)	Uptake of plant (mg/0.25 m^2)					Variables			
		N	P	K	Ca	Mg	KCBK (%)	KCBO (%)	VFA (mM)	NH_3 (mM)
P1	37.5^d	80.5^c	6.1^c	73.9^d	18.2^d	31.9^{bc}	43.3^c	47.2	82.7b	7.9^c
P2	110.7^c	116.2c	18.8^{ab}	210.3^{bc}	32.1^d	28.8^c	57.2^a	55.9	153.0^a	16.5^a
P3	171.2a	287.7^a	20.6^a	313.4^a	73.6^b	51.4a	52.5^b	51.5	108.3^b	13.4^b
P4	108.5^c	213.8^b	14.1^b	150.9^c	69.5^c	24.9^c	56.4^a	54.3	108.3^b	13.7^b
P5	171.8^a	235.3^{ab}	20.6^{ab}	307.4^{ab}	70.4^b	37.8^{ab}	54.3^a	53.1	141.4^a	12.7^b
P6	148.0^b	192.5^b	14.8^{ab}	156.9^c	57.7^c	44.4^{ab}	54.3^a	53.9	87.3^b	15.9^a
P7	175.2^a	268.1^a	19.3a	271.6^{ab}	94.6a	52.6^a	53.9^a	52.8	131.0^a	15.1^a
P8	156.6^b	223.9^a	12.5^{bc}	230.2^b	86.1a	32.9^{bc}	54.1^a	52.1	116.7^a	14.9^a

Notes: The treatments were P_1: Control (*Pasture consists of Brachiaria humidicola*), P_2: *B. Humidicola* with *Pueraria javanica*, *Centrosema pubescens* and *Calopogonium mucunoides* with fertiliser NPK), P_3: *B. humidicola* with *P. javanica,* P_4: *B. humidicola* with *C. pubescens,* P_5: *B. Humidicola* with *C. mucunoides,* P_6: *B. Humidicola* with *P. javanica* and *C. pubescens,* P7: *B. Humidicola* with *P. javanica* and *C. mucunoides,* P_8: *B. humidicola* with *P. javanica*, *C. pubescens* and *C. mucunoides.* DMD = dry matter digestability, OMD = organic matter digestability. Different superscripts within column show significant differences (P <0.05).

Conclusion

The introduction of legumes with *B. humidicola* pasture increased DM production, mineral uptake (N, P, K, Ca and Mg), DM digestibility, VFA and NH_3 production (P_3–P_8). Dry matter production, mineral uptake in treatments with half doses of inorganic fertilisers, manure and soil potential microorganisms (P_3–P_8) were higher than using inorganic fertiliser (P_2) and control (P_1). Treatments P_7, P_8, and P_5 increased DM digestibility and VFA and NH_3 production compared to the control. The best treatment in this study was P_7 (*B. humidicola* pasture with *P. javanica* and *C. mucunoides*) followed by P_8 (*B. humidicola* pasture with *P. javanica*, *C. pubescens* and *C. mucunoides*).

References

Astuti, D.A., A.S. Baba and I.W.T. Wibawan, 2011. Rumen fermentation, blood metabolities and performance of sheep fed tropical browse plants. *Med. Pet.* 34 (3): 201–206.

Bergman, E.N., 1990. Energy contributions of volatile fatty acids from the gastrointestinal tract in various species. *Physiol. Rev.* 70: 567–590.

Despal, T., I.M.L. Hutabarat, R. Mutia and I.G. Permana, 2011. The evaluation of nutrient quality of ramie leaves silage and hay in complete mixed ration for Etawah-Crossbreed goat using *in vitro* technique. *Indon. J. Nutr. Feed Sci.,* 2 (1): 26–31.

Karti, P.D.M.H., 2010. Development of drought resistant grasses and legumes through a quick selection technique and efficient management. The Conference of the Research Result on improving the Agricultural Production in the Tropic. Research Institutions and Community Empowerment. Bogor Agricultural University.

Paper 7

Evaluation of Tree Leaves as a Crude Protein and Energy Supplement to the Low Quality Diets of Dairy Goats

Khan, N.A.[1], G. Habib[2], Altaf-Ur-Rehman[1], M. Suleman[1] & G. Ullah[3]*

[1] Khyber Pakhtunkhwa Agricultural University Peshawar, 25130, Khyber Pakhtunkhwa, Pakistan
[2] Livestock and Dairy Development Department, Civil Secretariat Punjab, Lahore, Pakistan
[3] Livestock and Dairy Development Department, Peshawar, Khyber Pakhtunkhwa,, Pakistan
[*]Email of corresponding author: nak126@gmail.com

Introduction

Goats are predomiantly raised on natural pastures or stall-fed on low quality hay and crop residues in many developing countries, including Pakistan. In Pakistan, transhumant, nomadic and sedentary farming are the common goat production systems, where goats are extensively grazed on natural rangelands. In the last few decades, the carrying capacity of these pastures have deteriorated due to continuous overgrazing, recurrent droughts and lack of range improvement practices. In addition to the declining quantity, quality of the surviving pasture has deteriorated due to over-utilisation and a consequent depletion of highly palatable and nutritious forage species. The year-round feed availability in these rangelands also fluctuates with a prolonged winter and summer feed scarcity periods. During the pasture scarcity periods, goats are stall-fed on low quality rangeland-hay and crop residues. These low quality diets impede goat productivity due to low dry matter (DM) intake, digestibility and overall feeding value. Alternatively, supplementation of these low quality forages with CP and energy rich tree-foliages can enhance DM intake, digestibility and milk yield in goats. Our previous studies revealed that *Grewia oppositifolia* and *Ziziphus mauritiana* have better nutrient composition among 14 promising fodder trees, and are well adapted to Pakistan's arid and semi arid regions. However, the feeding value of local tree leaves needs to be evaluated due to the negative affect of tannins on palatibility, DM digestibility and bioavliability of dietary protein. The present study was therefore designed to investigate the potential of *G. oppositifolia* and *Z. mauritiana* leaves as CP and energy supplement to the low quality diets of goats.

Materials and methods

The leaves of *G. oppositifolia* and *Z. mauritiana* were harvested in a single batch and dried in shade, mixed, and transported to the Livestock Research Station Mansehra, Pakistan, for the experimental studies. Ruminal CP degradability kinetics of the supplements were determined by the method of Khan et al. (2009), using three mature Beetal bucks fitted with permanent ruminal cannulae. Lactation responses to the supplements were tested with sixteen Beetal goats (Average BW = 44.56 ± 4.20 kg). The goats were grazed on the natural pasture as a single flock and supplemented with dried leaves of *Z. mauritiana* (490 g), *G. oppositifolia* (415 g), a mixture of *Z. mauritiana* (245 g) and *G. oppositifolia* (210 g) or cottonseed cake (CSC; 250 g) on iso-nitrogenous basis for 10 weeks. Milk yield was recorded daily, and samples of feed and milk were collected weekly. The DM content of feed samples was determined by oven drying at 103°C for 24 h (6496; ISO, 1999), and CP (6.25 × N) was determined using the Kjeldahl method (ISO 5983; ISO, 2005). Tannins were analysed by the method described by Khan et al. (2009). Milk samples were analysed for total solids and protein (6.38 × N) according to AOAC (1995). Fat contents in fresh milk samples were determined using Gerber method. Solid not fat was calculated by subtracting fat contents from the total solids. *In sacco* degradability, milk production and composition data were analysed with the PROC GLM procedure in Statistical Analysis System.

Results and Discussion

The mean (n = 12) CP content of *Z. mauritiana*, *G. oppositifolia* and CSC were 141, 165 and 269 g/kg DM, respectively. Contents of condensed tannins were higher (P<0.01) in the *Z. mauritiana* (33 g/kg DM) than *G. oppositifolia* (0.6 g/kg DM). Leaves from *G. oppositifolia* were appreciably high (35 g/kg DM) in Ca. Due to high content of condensed tannins, *Z. mauritiana* leaves had the lowest rate (P<0.001) of degradation (0.11/h) and effective degradability of CP (620 g/kg) at rumen outflow rates of 0.06. Cotton seed cake had the highest rate (0.17/h) of degradability, and effective degradation of CP (780 g/kg). The leaves of *G. oppositifolia* were intermediate in the degradation kinetics. Daily milk yield differed (P<0.001) among the supplements (Table 1). The high bypass CP in *Z. mauritiana* were efficiently utilised by goats as shown by the high (P<0.05) milk yield. Nevertheless, *G. oppositifolia* and CSC were not significantly different in milk production parameters. Among the supplements a high (P<0.05) milk fat content of 5.6 g/100 g milk was recorded with CSC and *G. oppositifolia.*

Table 1. Mean yield of milk and milk composition of Beetal goats

Parameters	*Z. mauritiana*	*G. oppositifolia*	CSC	Mixed leaves	SEM	Significance
Milk yield (g/d)	569 ^{a}	459 ^{b}	445 ^{b}	458 ^{b}	14.7	***
Protein %	3.6	3.7	3.4	3.5	0.72	NS
Fat %	5.2^{ab}	5.6^{a}	5.6^{a}	5.0^{b}	1.98	*
Total solid %	12.5	12.9	13.2	12.3	2.44	NS
Solid not fat%	7.5	7.3	7.9	7.4	2.87	NS

^{abc} shows significant (P<0.05) differences between diets; * P<0.05; *** P<0.001; NS, non-significant (P>0.05); SEM, standard error of means.

Conclusions

The CP in *Z. mauritiana*, with approximately 3% condensed tannin (33 g/kg DM), degraded slowly and provided high bypass CP which resulted in higher milk yield. *G. oppositifolia* and CSC were not significantly different in milk production parameters. Leaves from *Z. mauritiana* and *G. oppositifolia* trees could be conserved by drying and fed as a supplement to minimise the production losses that invariably occur during the prolonged feed scarcity period in the tropical arid and semi arid regions.

References

AOAC, 1995. Official Method of Analysis, 16th ed. Animal Feeds: Association of Official Analytical Chemists, Arlington, VA, USA, pp. 1–18.

Khan, N.A., G. Habib and G. Ullah, 2009. Chemical composition, rumen degradability, protein utilisation and lactation response to selected tree leaves as substitute of cottonseed cake in the diet of dairy goats. *Anim. Feed Sci. Technol.* 154: 160–168.

Paper 8

Assessment of *Grewia oppositifolia* Leaves as Crude Protein Supplement to Low Quality Diets of Goats

Khan, S.[1], N.A. Khan[1], G. Habib[2], M.S. Qureshi[1] & A. Sultan[1]*

[1] *Khyber Pakhtunkhwa Agricultural University Peshawar, 25130, Khyber Pakhtunkhwa, Pakistan*
[2] *Livestock and Dairy Development Department, Civil Secretariat Punjab, Lahore, Pakistan*
[*] *Email of corresponding author: nak126@gmail.com*

Introduction

Goats are characterised by their efficient grazing behaviour and functional digestive system and thrive well under the tropical arid and semi-arid regions. Compared to other farm animals, the population of goats has increased rapidly in the harsh environmental and feed scarcity zones of the tropics. For example, in Pakistan the number of goats has increased from 29.9 million in 1986 to 59.8 million in 2011. This population growth is attributed to the drastic changes in the pattern of range-based feed resources in the country over this period. Recurrent droughts with concomitant overgrazing have severely affected vegetation growth in the natural pastures. Shrubs and trees stay behind as the dominant surviving fodder species that are better utilised by goats compared to other livestock species. Under these harsh environmental and feeding zones, goats play a vital role in providing a livelihood to poor smallholder or landless farmers. However, the productivity of goats is very low, as they are mostly grazed on low quality pastures. Moreover, the year-round feed availability in the rangelands fluctuates with prolonged winter and summer feed scarcity periods. Alternatively, goats are stall fed on crop residues and lower quality range hay (Davendra et al., 2000). These lower quality forage based diets impede the productive performance of goats. Leguminous tree foliage being rich in fermentable organic matter, protein and minerals could be used as a supplement to these low quality diets; and enhance their intake, digestibility and animal performance. *Grewia oppositifolia* is one the promising fodder trees, well-adapted to the arid, hilly, and semi-hilly regions of South Asia. The present study was therefore designed to investigate the potential of *G. oppositifolia* leaves as a low-cost crude protein (CP) supplement to the low-quality forage diets of growing goats.

Materials and methods

Leaves of *G. oppositifolia* were harvested from communal rangelands over the harvesting season (December to March) at 30-day intervals, dried in shade, mixed, and transported to the Animal Research Facilities of Agricultural University Peshawar for the studies. To investigate the effect of *G. oppositifolia* supplementation of dry matter (DM) intake, digestibility and N retention in goats, a balanced trial was conducted with four mature Beetal Bucks (48 ± 2.3 kg BW) in a 4 × 4 Latin square design. The animals were fed with a basal diet of chopped sorghum hay (CP 47.8 ± 3.45 g/kg DM) *ad libitum*. The basal diet was supplemented with cottonseed cake (CSC) or the CSC was replaced at the rates of 0.50, 0.75, and 1.00 g/g with *G. oppositifolia* leaves. The animals were housed in individual metabolic crates with a device fitted for the separate collection of feaces and urine. The animals were adapted to the diets for 10 days, and data and samples were collected daily in the last 5 days of each period. To evaluate changes in BW gain in response to the supplements, 32 (26 ± 3 kg BW; 10 ± 1 month of age) grazing goats were randomly assigned to four diets for 3 months. The grazing goats were supplemented with CSC or the various combinations of CSC: *G. oppositifolia* leaves. Animals were weighed every 2 weeks to determine BW changes. The samples were air dried at 70°C, ground to 1 mm; and analysed for the DM content by oven drying at 103°C for 24 h (6496; ISO, 1999) and CP (6.25 × N) by the Kjeldahl method (ISO 5983; ISO, 2005). The mineral contents were determined as described elsewhere by Khan et al. (2011). Data were analysed with the PROC GLM procedure in Statistical Analysis System (SAS, Version 9.2).

Results and Discussion

Grewia oppositifolia leaves maintained a higher CP content (>164 g/kg DM) during the harvesting period. The leaves were rich in Ca and K with average values of 41 and 89 g/kg DM, respectively. The leaves were also a good source of micro-minerals Zn (41 mg/kg DM), Fe (32 mg/kg DM), and Mn (202 mg/kg DM). Intakes of hay and total DM and digestibility in goats did not differ with the stepwise substitution of CSC with *G. oppositifolia* leaves. Goats retained the N in each diet, however, quantitatively N retention did not differ among the diets (Table 1). Addition of the leaves increased BW gain in the grazing goats ($P<0.05$). Among the supplemented groups, lambs fed with *G. oppositifolia* leaves showed higher BW gain (124 g/day).

Table 1. Dry matter (DM) intake, apparent DM and CP digestibility, and N retention in response to substitution of cotton seed cake (CSC) with *Grewia oppositifolia* leaves

	CSC: *G. oppositifolia*				SEM
	100: 0	50: 50	25: 75	0: 100	
DM intake g/d	611	612	618	709	63.1
DM digestibility g/kg	480	496	500	484	22.3
CP digestibility g/kg	664	644	629	614	26.4
N retained g/d	6.11	6.08	6.19	6.67	0.923
BW gain g/d	90.6[b]	110[ab]	114[ab]	124[a]	11.4

Values are means; SEM = standard error of the mean.
[a,b]means with different superscripts are significantly different ($P<0.05$)

Conclusions

The results demonstrated that *G. oppositifolia* leaves provide good quality green fodder during the prolonged winter feed scarcity period, and that the leaves can be efficiently utilised as a CP supplement for the low-quality diets of sheep.

References

Khan, N.A., G. Habib and G. Ullah 2012. Assessment of Grewia Oppositifolia leaves as feed supplement: nutrient composition, protein degradability, N metabolism and growth rate in sheep. *Tropical Animal Health and Production*. 44: 1375–1381.

Paper 9

Effect of Intersowing Italian Ryegrass (*Lolium multiflorum*) with Dwarf Napier Grass on Yield and Quality for Biomass Use

Khairani, L.[1, 2], Y. Ishii[3], S. Idota[3], R.F. Utamy[4] & A. Nishiwaki[3]*

[1]Graduate School of Agriculture, University of Miyazaki, Japan, [2]Laboratory of Forage Crops, Faculty of Animal Husbandry, Universitas Padjadjaran, Jatinangor, Indonesia, [3]Faculty of Agriculture, University of Miyazaki, [4]Interdisciplinary Graduate School of Agriculture and Engineering, University of Miyazaki, Miyazaki, Japan.
[*]Email of corresponding author: lizahkh@yahoo.com

Introduction

Intersowing of Italian ryegrass (*Lolium multiflorum* Lam, extremely early-maturing variety, Hanamiwase) with dwarf Napier grass (*Pennisetum purpureum* Scumach) was examined for yield and fibre quality in April-harvested Italian ryegrass as biomass use under 2 cutting frequencies and 3 planting densities of dwarf Napier grass to obtain the best frequency and density of Napier grass at the establishment year.

Materials and methods

The study was conducted on Andisols in the Kibana Field, University of Miyazaki, located at 51 m above sea level in southern Kyushu, Japan (31° 82'N and 131° 41'E). The trial was conducted from November 2009 to April 2010 and temperature and rainfall data were monitored via Miyazaki Meteorological Observatory. Plots were arranged in a randomised complete design with 3 replications (main plots) and each subplot (plant density) had 4 rows, at 4-m long × 5-m width with 1-m and 2-m spacing between subplots and main plots, respectively (Khairani et al., 2011). The seeds of Italian ryegrass cv Hanamiwase (Snow brand seed) were sown at 2 g/m^2 into the inter-row space of dwarf Napier grass plot which had different planting densities (1, 2 and 3 plants/m^2) on 14 November 2009. Plots were occupied in the same ratio by both Italian ryegrass and dwarf Napier grass. Plots were rain-fed and fertilised two times on 14 November 2009 and 2 March 2010 using chemical compound fertiliser at the rate of 10 g N, P_2O_5 and K_2O, each m^2/yr.

The grass was measured for plant height, plant length and tiller number before harvest on 5 April 2010 by cutting at 5 cm above the soil surface using a quadrant of 50 cm × 50 cm. Herbage mass was measured for fresh and dry weights. The fresh yield (g/m^2) of Italian ryegrass was calculated as follows: (1) Plant spacing at 1 and 2 plants m^2 of dwarf Napier grass was calculated by yield of quadrant × 2, because the area of dwarf Napier grass was calculated at 0.25 and 0.5 m^2 for 1 and 2 plant/m^2, respectively (2) Plant spacing at 3 plants m^{-2} of dwarf Napier grass was calculated by yield of quadrant × 1, because the area of dwarf Napier grass was 0.75 m^2 for 3 plants/m^2. The dry matter (DM) yield was calculated according to Tarawali et al. (1995).

Samples were analysed in duplicates for *in vitro* dry matter digestibility (IVDMD), neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL) contents using a detergent digestion protocol as described by Vogel et al. (1999). Samples were processed by the fibre extraction protocol (Vogel et al., 1999), and the ANKOM procedure (ANKOM 220 Fibre Analyser, Model 220v). IVDMD content was determined by the pepsin-cellulase digestion method (Goto and Minson, 1977).

One-way Analysis of Variance (ANOVA) was carried out using SPSS (version 15.0) and mean separation was tested using the least significance difference (LSD) method at 5% significance level. Pearson correlation coefficients were calculated among growth attributes, DM yield, cell wall components and IVDMD (for each parameter, total n = 36).

Results and Discussion

Dry matter yields of Italian ryegrass were significantly (P<0.05) higher, where it was sown at 1 plant/m^2 (1.926–1.931 Mg/ha) and 2 plants/m^2 (1.891–1.899 Mg/ha) of dwarf Napier grass plot than sown at 3 plants/m^2 (0.820–1.146 Mg/ha), while the NDF, ADF and ADL contents ranged from 50.4–54.7%, 36.4–38.6% and 6.8–8.3%, respectively. The increase in plant density led to significantly (P<0.05) decreased tiller number, fresh and DM yield, and IVDMD of Italian ryegrass with no significant difference in fibre or structural carbohydrate compositions in Italian ryegrass (P>0.05).

Table 1. Correlation coefficients of growth attributes[†], yield[†], yield components[†], chemical compositions[†] and *in vitro* dry matter digestibility[†] of Italian ryegrass

	Ethanol production potential	PH	PL	TN	FY	DMY	NDF	ADF	ADL
PH	ns	–							
PL	ns	.596**	–						
TN	.759**	-.346*	ns	–					
FY	.953**	ns	ns	.829**	–				
DMY	.973**	ns	ns	.815**	.976**	–			
NDF	ns	ns	.374*	ns	ns	ns	–		
ADF	ns	.357*	.412*	ns	ns	ns	ns	–	
ADL	ns	ns	ns	ns	ns	ns	ns	.707**	–
IVDMD	ns	ns	ns	ns	ns	ns	-.331*	ns	ns

[†] PH, plant height; PL, plant length; TN, tiller number; FY, fresh yield; DMY, dry matter yield; NDF, neutral detergent fibre; ADF, acid detergent fibre; ADL, acid detergent lignin; IVDMD, *in vitro* dry matter digestibility.
* Significant at P<0.05, ** significant at P<0.01 by Pearson's correlation analysis (n = 36), ns at P>0.05.

Conclusions

Dry matter yield, cellulose and hemicellulose contents of Italian ryegrass decreased significantly (P<0.05) with increased plant density of dwarf Napier grass

References

Goto, I. and D.J. Minson, 1977. Predicting of the dry matter digestibility of tropical grasses using a pepsin-cellulase assay. *Anim. Feed Sci. Technol.* 2: 247–253.

Khairani, L., Y. Ishii, S. Idota, R.F. Utamy, A. Yamano and A. Nishiwaki, 2011. Effect of plant density and cutting frequency of dwarf Napier grass, combined with intersowing Italian ryegrass on dry matter yield and quality for biomass use in southern Kyushu, Japan. *Japan J. Grassl. Sci.* 57 (Suppl).

Tarawali, S.A., Tarawali, G., Larbi, A. and J. Hanson, 1995. *Methods for the evaluation of legumes, grasses and fodder trees for use as livestock feed*. ILRI Manual 1. International Livestock Research Institute (ILRI), Nairobi, Kenya, 7.

Vogel, K.P., Pedersen, J.F., Masterson, S.D. and J.J. Toy, 1999. Evaluation of a filter bag system for NDF, ADF, and IVDMD forage analysis. *Crop Sci.* 39: 276–279.

Paper 10

Effect of Feeding Pattern on Rumen Microorganism Population in Saanen Goats

Thongruang, S.[1], S. Paengkoum[2] & P.Paengkoum[1]*

[1]School of Animal Production Technology, Institute of Agricultural Technology, Suranaree University of Technology, Nakhon Ratchasima, 30000, Thailand. [2]Faculty of Animal Sciences and Agricultural Technology, Silpakorn University, Cha-am, Phetchaburi, 76120, Thailand.
[*]Email of corresponding author: pramote@sut.ac.th

Introduction

Rumen microorganisms, especially the methanogenic bacteria and protozoa are the main contributing factors of enteric methane production, which contributes to the overall production of greenhouse gas (GHG) in the atmosphere causing global warming. Factors influencing ruminal methanogen production include; level of intake, type and quality of feed and environmental temperature (Shibata and Terada, 2010; Mirzaei-Aghsaghali and Maheri-Sis, 2011), but limited studies have been conducted to examine the effect of feeding system (e.g. cut-and-carry (pen-feeding) vs. grazing) on the population of ruminal methanogens.

Materials and methods

Six female crossbred Saanen goats (12 months, 30.5 ± 5 kg) were divided equally into two groups; cut-and-carry (pen-feeding) and grazing systems. All animals in the cut-and-carry group were fed *ad libitum* with purple guinea grass (*Panicum maximum* TD58) as basal roughage. Animals in the grazing group were allowed to graze between 0900 to 1800h (continuous grazing at a stocking rate of 3 goats/200 m^2). Concentrate feed was offered at a restricted amount of 1.5% BW (20% CP) at 0830 h daily. Rumen content of each animal was collected using a suction pump 4 h after the goats were fed the concentrates on days 0, 1, 7 and 14. Rumen contents were processed for the quantification of 16S gene copies of methanogens archaea using real-time PCR assay(LightCycler® Nano System version 1.0, Roche). Microscopic direct counting of the total bacteria and protozoa population was also carried out. Statistical analyses were conducted using SAS (1989) v6.12 and differences between means considered to be significant at $P<0.05$.

Results and Discussion

For the grazing goats, the average methanogenic archaes at day 14 was 3.36×10^7 copies/mL rumen content, which was significantly lower ($P<0.05$) than in the cut-and-carry goats ($10.15 \times 10^7$16S rRNA copies/mL rumen content) (Figure 1). Populations of rumen protozoa and bacteria of grazing goats were not significantly different from those of goats fed by cut-and-carry (Table 1). Rumen pH of grazing goats (7.70) was higher ($P<0.05$) than that of the cut-and-carry goats (6.70). Feed intake of concentrates was not significantly different ($P<0.05$) between cut-and-carry goats (464.86 gDM) and grazing goats (479.86 gDM). The CP of purple guinea grass for grazing goats (8.81%) was not significantly different ($P>0.05$) from that of the cut-and-carry goats (10.12%). NDF content (67.04%) of grass for cut-and-carry was significantly ($P<0.05$) higher than that for grazing goats (60.65%) because grazing goats can select to consume good quality grass of lower NDF than that those in the cut-and-carry system. Since fibre content has a major effect on ruminant methane emissions (Graeme et al., 2000) it might be possible that grazing goats produce less methane than the cut-and-carry goats as indicated by the lower counts of methanogens in the grazing goats.

Table 1. Some rumen microorganism parameters in cut-and-carry and grazing Saanen goats.

	Day	Feed of Goats		SEM
		Cut-and-carry	Grazing	
Bacteria	0	24.93×10^9	15.73×10^9	2.43
(cells/mL rumen content)	1	16.00×10^9	16.27×10^9	1.43
	7	10.00×10^9	09.67×10^9	1.15
	14	06.33×10^9	04.73×10^9	1.08
Protozoa	0	16.50×10^5	14.33×10^5	1.58
(cells/mL rumen content)	1	$06.00^b \times 10^5$	$17.33^a \times 10^5$	1.82
	7	12.83×10^5	12.50×10^5	1.97
	14	12.50×10^5	11.33×10^5	1.54
Methanogens	0	$04.19^a \times 10^7$	$01.10^b \times 10^7$	0.31
(16S rRNA gene copies/mL rumen content)	1	$04.23^a \times 10^7$	$01.59^b \times 10^7$	0.28
	7	$07.57^a \times 10^7$	$04.50^b \times 10^7$	0.25
	14	$10.16^a \times 10^7$	$03.37^b \times 10^7$	0.57

Values with different small superscript letters in the same column are significantly different ($P<0.05$)

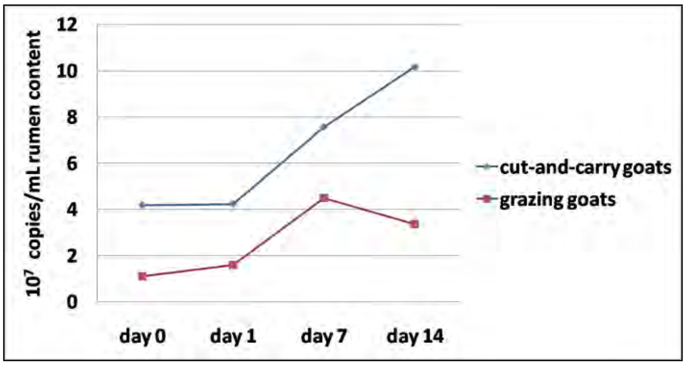

Figure 1. Methanogen counts of cut-and-carry and grazing goats.

References

Graeme, N.J., C. Strompl, D.M. Burgess, L.C. Skillman, E.R.B. Moore and K.N. Joblin, 2000. Isolation and identification of ruminal methanogens from grazing cattle. *Curr. Microbiol. J.* 40: 327–332.

Mirzaei-Aghsaghali, A. and N. Maheri-Sis, 2011. Factors affecting mitigation of methane emission from ruminants I: feeding strategies. *Asian J. of Anim. Vet.* Adv. 6 (9): 888–908.

SAS, 1989. SAS User's guide : statistics. Version 6.12. SAS Inst. Inc., Cary, NC, USA.

Shibata, M. and F. Terada, 2010. Factors affecting methane production and mitigation in ruminants. *Anim. Sci. J.* 81: 2–10.

Paper 11

Supplementation of Leucaena and *Acacia mangium* Willd Foliages on Microbial N Supply, Digestibility and N Balance in Saanen Goats

*Traiyakun, S., A. Petlum, J. Khotsakdee & P. Paengkoum**

School of Animal Technology, Institute of Agriculture Technology
Suranaree University of Technology, Muang, Nakhon Ratchasima, 30000, Thailand
**Email of corresponding author: pramote@sut.ac.th*

Introduction

Locally available feed resources, particularly crop residues, protein foliages and agro-products should be utilised to cut production cost and to meet the increasing demand feed for animal production. Ruminant feeding systems based on poor quality roughage where protein is one of the first limiting factors may require additional protein to maintain an efficient rumen ecosystem that will stimulate nutrient intake and improve animal performance (Preston and Leng, 1987). The purpose of this study was to evaluate the effectiveness of supplementing dairy goats with protein foliages such as *Leucaena* and *Acacia mangium*Willd in a rice straw-based diet.

Materials and methods

Twelve Saanen goats selected from a commercial farm based on similar body weight (27.0 ± 3.5 kg) were used for this study. The goats were housed in individual pens and allowed 3 weeks to adapt to experimental conditions. The goats were randomly allocated to three treatment groups in a 3 x 3 Latin square experiment (replicated 4 times). Each goat was given rice straw as roughage plus the respective treatment diet. The diets were iso-nitrogenous and iso-energetic containing cassava pulp, molasses, urea and commercial mineral and vitamin mix. The experimental treatments were (i) soybean meal (SBM), (ii) partial substitution of SBM with Leucaena (*Leucaena leucocephala*) foliage or (iii) partial substitution of SBM with *Acacia mangium* Willd foliage.

Results and Discussion

Microbial N supply in terms of microbial N yield (gN/d) and the efficiency of microbial synthesis (gN/kg DOMR), and microbial protein synthesis (gCP/d) among the treatment groups were not significantly (P>0.05) different (Table 1).

Replacing Leucaena and *Acacia mangium* Willd did not significantly affect average nutrient and digestible nutrient intakes, except, as expected, that total tannin and condensed tannin intakes of goats fed Leucaena foliage, were higher (P<0.05) than those of *Acacia mangium* foliage and SBM.

Table 1 Effect of soybean meal substitution with foliages on digestible organic matter intake (DOMI), microbial N supply and proportion of microbial protein synthesis in dairy goats.

	Dietary treatments			
	Control	Leucaena	*Acacia mangium* Willd	SEM
DOMI, kg/d	1.3	1.2	1.2	0.03
Digestible nutrient intake, kg/d				
Organic matter	1.25	1.21	1.20	0.058
Crude protein	0.20	0.20	0.19	0.009
Neutral detergent fiber	0.57	0.59	0.59	0.019
DOMR, kg/d *	0.8	0.8	0.8	0.02
Microbial N supply				
gN/d	15.0	14.6	13.9	0.32
gN/kgDOMR	18.7	18.7	18.6	0.64
Microbial protein, gCP/d	93.6	91.3	86.6	1.97

* DOMR = digestible OM fermented in the rumen, calculated as 0.65 x DOM intake (ARC, 1984)
SEM = standard error of means.

The present results indicate that local protein foliages from shrubs and trees can substitute imported feedstuffs such as SBM as protein supplement for dairy goat production.

References

Preston, T.R. and R.A. Leng, 1987. *Matching Ruminant Production Systems with Available Resources in the Tropics and Subtropics*. Armidale, Australia, Penambul Books.

SAS, 1985. User's Guide: Statistic, Versions 5. Edition SAS. Inst. Cary, NC.

Paper 12

Enhancing Performance of Dairy Goat by Biscuit Feeding as Fibre Source

Retnani, Y.

Laboratory of Feed Industry, Department of Nutrition and Feed Technology
Faculty of Animal Science, Bogor Agricultural University
Jl. Agatis, Kampus Darmaga, Bogor 16680, Indonesia
Email of corresponding author: yuli.retnani@yahoo.com

Introduction

Dairy goat farming in Indonesia is an activity that has potential to be developed. The milk of dairy goats is of better quality than cow milk and fetches a higher price. The problem often encountered in the dairy goats is low milk yield of less than 2 L/head/day. Productivity of dairy goats is largely determined by the availability and quality of feed. The major constraints of ruminant feed are as follows: forage is bulky and perishable thus difficult to handle, distribute and process; inconsistent supply between dry and rainy seasons; low palatability and low digestibility. Therefore, it is necessary to develop suitable technologies to produce ruminant feed which is more durable, easier to handle, distribute and feed to animals.

Biscuit is a dry product that is relatively long-lasting under normal storage conditions and easy to handle (Whiteley, 1971). To date no research has been conducted on the processing of forage into forage biscuits which can be used during feed scarcity for dairy goats in the dry season.

Materials and methods

The process of making of corn leaf biscuit as described by Kitessa et al., (1999) was used to prepare biscuits of different treatments for this study. It includes chopping, grinding, mixing, pressing and heating at temperature of 100°C for 5 minutes and finally cooling at room temperature. The experimental design used was a completely randomised design with 6 treatments and 3 replications. The treatments were: R1 (100% field grass), R2 (50% field grass + 50% corn leaf), R3 (100% corn leaf), R4 (50% field grass + 50% corn husk), R5 (50% corn leaf + 50% corn husk) and R6 (100% corn husk). The results were subjected to ANOVA and contrast orthogonal test (Steel and Torrie, 1991). The biscuit parameters measured were water activity, moisture, water absorption, density and nutrient quality (ash, crude protein, crude fibre, crude fat and nitrogen free extract).

Results and Discussion

The nutrient composition of the different grass and corn plant waste biscuits is presented in Table 1. Results of this study indicated that the treatment of biscuit had a highly significant effect ($P<0.01$) on moisture where in biscuits R1, R2 and R6 it was lower than in biscuits R3, R4 and R5. The water absorption was significantly higher ($P<0.05$) for R1, R4 and R5 than biscuits R2, R3 and R6. Water activity and density were not significantly different between biscuits (Table 2).

Table 1. Nutrient composition of biscuits of field grass and corn plant waste

Biscuit*	Nutrient Composition (%) Ash	Crude Protein	Crude Fibre	Crude Fat	Nitrogen free extract
R1	10.42	12.89	41.33	0.21	35.14
R2	9.78	14.51	31.90	0.20	43.60
R3	8.83	16.12	29.45	1.04	44.56
R4	8.45	13.51	42.49	1.31	34.24
R5	7.94	14.41	27.25	1.66	48.73
R6	9.59	13.69	38.12	1.86	36.74

- Please refer to text for composition of the different treatments

Based on this study it was shown that field grass plus corn leaf biscuits (R2) had the best physical characteristics. Corn leaf biscuit (R3) had the best nutrient quality among the different biscuits. It was concluded that field grass plus corn leaf could be processed to produce biscuits as a fibre source for ruminant feed.

Table 2. Physical characteristic of biscuits of field grass and corn plant waste

Biscuit	Parameters Water Activity	Moisture (%)	Water absorption (%)	Density (g/cm^3)
R1	0.70 ± 0.05	11.23^c ± 0.60	492.34^a ± 40.90	0.45 ± 0.03
R2	0.69 ± 0.02	11.06^c ± 0.10	383.49^c ± 31.97	0.44 ± 0.03
R3	0.69 ± 0.02	12.85^a ± 0.37	438.00^b ± 15.69	0.45 ± 0.03
R4	0.69 ± 0.02	11.73^b ± 0.17	514.48^a ± 19.95	0.48 ± 0.06
R5	0.69 ± 0.03	11.80^b ± 0.09	504.27^a ± 5.59	0.52 ± 0.03
R6	0.70 ± 0.03	11.39^c ± 0.71	452.31^b ± 42.63	0.47 ± 0.01

Means with different superscripts within the same column are significantly different at P = 0.01

References

Kitessa, S., P.C. Flinn and G.G. Irish, 1999. Comparison of methods used to predict the in vivo digestibility of feed in ruminant. *Aust. J. Agr*. 50: 825–841.

Steel, R.G.D. and J.H. Torrie, 1991. *Principle and Statistic Procedure.* McGraw-Hill Inc.

Whiteley, P.R., 1971. Biscuit Manufacture. Applied Science Publisher, London.

Paper 13

Development of a New Quantitative Competitive PCR Assay for Rumen Butyrate-Producing Bacterium, *Butyrivibrio fibrisolvens*

Taheri Ghahfarokhi, A., M. Tahmoorespur & Y. Shamshirgaran*

Animal Science Department, College of Agriculture, Ferdowsi University of Mashhad, Mashhad, Iran
**Email of corresponding author: taheri1362@gmail.com*

Introduction

Infusion of butyrate into the rumen of ruminants results in an increase of the concentration of milk fat and protein. Ruminal butyrate production can be increased by increasing the numbers of butyrate producing bacteria (Huhtanen et al., 1992). *Butyrivibrio fibrisolvens* strains are presently recognised as the major butyrate-producing bacteria in the rumen. They can be found in the digestive track of many animals and in the human gut. The aim of this study was to develop a powerful quantitative competitive polymerase chain reaction (QC-PCR) assay based on 16S rDNA for the enumeration of the strains belonging to *Butyrivibrio fibrisolvens* in rumen fluid.

Materials and methods

Species-specific PCR primers that amplify partial 16S rDNA region (213 bp as target DNA) were used in this study (Kobayashi et al., 2000). Two internal primers, bearing 5′ tails which contain two ~30 nucleotide sequences, unrelated to the target to be amplified and complementary to each other, were designed (Figure 1). To construct the homologous competitor with 50 bp insertion, a stepwise SOE-PCR (Splicing by Overlap Extension Polymerase Chain Reaction) in three separate amplifications using different primer pairs was carried out (Figure 2). For future applications and as the easiest way to determine competitor concentration, competitor fragment was cloned into a TA plasmid vector (pTZ57R/T), purified and quantified before use. The competitor was serially diluted and co-amplified by PCR with total extracted DNA from rumen fluid samples.

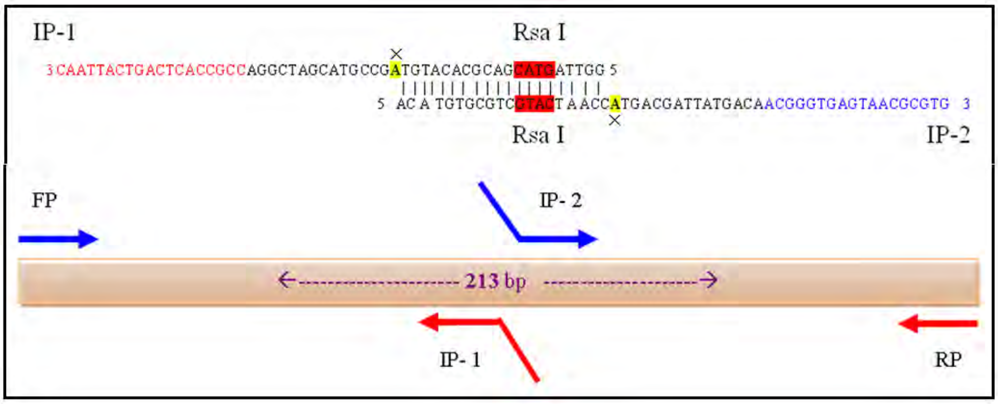

Figure 1. Design and sequence of internal primers (IP1 and IP2).

QC-PCR products were electrophoresed on agarose gel containing ethidium bromide, and photographed. Band intensities were measured using image analysis software (image J 1.42q) to determine if co-amplification had occurred with equal efficiency. The quantity of competitor against the ratio of amplified target to amplified competitor was plotted using log scale and evaluated by simple regression using the JMP® software (SAS Institute) and finally the R^2 was estimated as a criterion of competitive PCR performance.

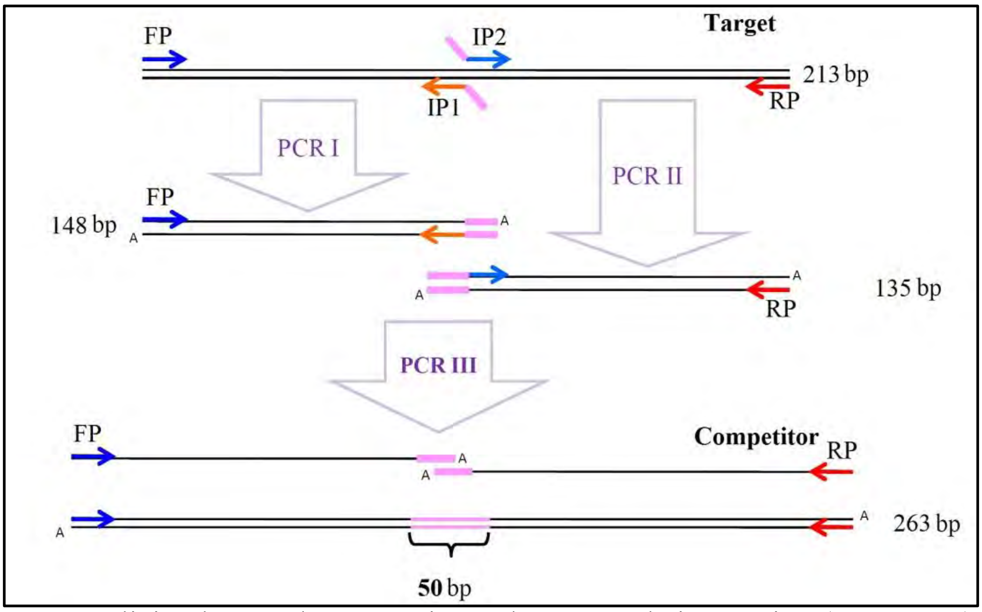

Figure 2. Splicing by overlap extension polymerase chain reaction (SOE-PCR) and used for constructing the homologous competitor fragment.

Results and Discussion

Butyrivibrio fibrisolvens species-specific primers successfully amplified a 213 bp amplicon. The log plot of the amount of amplified target DNA against the amount of amplified competitor DNA was highly linear (R^2 = 0.985) indicating that the homologous competitor can potentially represent the number of target fragments. As a result of our study a new quantitative competitive PCR (QCPCR) assay was developed for quantification and enumeration of *Butyrivibrio fibrisolvens* in rumen fluid samples. The developed QCPCR method can be used for monitoring changes in the population of *Butyrivibrio fibrisolvens* in rumen fluid samples during nutritional treatments.

References

Huhtanen P., H. Miettinen and M. Ylinen, 1992. Effect of increasing ruminal butyrate on milk yield and blood constituents in dairy cows fed a grass silage-based diet. *J. Dairy Sci.* 76 4: 1114–1124.

Kobayashi Y., R.J. Forster and R.M. Teather, 2000. Development of a competitive polymerase chain reaction assay for the ruminal bacterium *Butyrivibrio fibrisolvens* OB156 and its use for tracking an OB156 derived recombinant. *FEMS Microbiol. Lett.*188: 185–190.

Lead Paper 2

Reproductive, Production and Economic Performances of the Damascus (Shami) Goats in Cyprus

Abdullah, R.[1], M.S. Salleh[2], W.E. Wan Khadijah[1] & A.P. Mavrogenis[3]*

[1]Institute of Biology Sciences, Faculty of Science, University of Malaya, 50603 Kuala Lumpur, Malaysia, [2]Asreda Corporation Sdn. Bhd., Jalan Gelugur 4/7G, Shah Alam 40000 Selangor, [3]Agricultural Research Institute, P.O. Box 22016, 1516 Nicosia, Cyprus
[*]Email of corresponding author: ramli@um.edu.my

Introduction

Damascus (Shami) goat is a large breed, measuring 78 cm at withers, having a body circumference of 97 to 99 cm and adult live weight of 65 ± 5 kg (female) and 75 ± 5 kg (male). The Damascus goat requires an improved management and feeding environment to express its full genetic potential (Mavrogeenis et al., 1984). The goat can be managed in small tethered or large size flocks (200 to 1000), if provided with housing, feeding and other necessary facilities. The breed combines high prolificacy with high milk production and growth rate (Constantinou, 1989). The main breeding season starts in late August and extends through mid December. Occasionally a heat wave occurs in late spring or early summer, but it is characterized by irregular oestrous cycles. This paper describes the reproductive, production and economic performances of Shami goats.

Materials and methods

This study involved collection of data in Cyprus for both reproductive and production parameters as well as economic performance of Shami goats (Mavrogenis and Papachristoforou, 1990; 2000). The reproductive characteristics included percent fertility, prolificacy, conception rate, mortality at birth and mortality at weaning. The production characteristics included live weight and growth rate (birth weight, weaning weight, pre-weaning growth, 15 week weight and post-weaning growth), carcass traits (carcass weight and percent dressing) and milk performance (total yield, lactation length, amount of milk suckled, fat content, protein content and total solids). Comparison of economic performance between Shami and other goat breeds (Boer, Jamnapari and Saanen) was made.

Results and Discussion

Reproductive characteristics

First oestrus occurred between 220 and 270 days of age at live weights from 42 to 54 kg, depending on type of birth. This characteristic allows for the early breeding of kids and the initiation of the productive life at the age of 13 to 16 months. Fertility was medium to high (80 to 90%), a characteristic of most goat breeds with high milk production. The prolificacy of the breed was among the highest in the region, averaging 1.80 kids per goat kidding.

Production characteristics

Birth weights were high ranging from 3.5 to 5.5 kg, depending on type of birth and sex. Weaning was practiced between 42 and 49 days post-partum. Kids during the suckling period had free access to a starter diet containing 18% crude protein (CP) and good quality hay (0.2 kg of Lucerne hay). Following weaning they were group-fed on concentrate diets containing 16 to 18% CP and Lucerne or Barley hay offered *ad libitum*. Males grew faster than females, and singles were faster in growth than twins or other multiples, both before and after weaning. Kid carcasses were lean with 47.3 to 49.5 dressing percentages, depending on age at slaughter.

The Shami goat is a dual-purpose animal (meat and milk). It is milked principally following weaning, but also during the suckling period, because a large quantity of milk remains in the udder without being utilized by the suckling kids. Total milk production, including milk produced until weaning, ranged between 450 and 850 kg per goat per lactation. Lactation lasted for approximately 7 months following weaning, although lactations up to a year were not rare. The fat and protein contents of the milk were characteristic for high yielding breeds, ranging from 3.8 to 4.5% for fat and from 4.0 to 4.8% for protein. The milking goat responded positively to high protein diets by increased milk output and longer maintenance of milk production at a high level.

Economic performance

Shami goats gave a higher income and faster return on investment (ROI) compared to other breeds such as Boer, Jamnapari and Saanen. A two-year comparison showed Shami goats gross profit was the highest (RM 32,660) compared with Boer (RM 7,320), Jamnapari (RM 6,400) and Saanen (RM 13,800) goats. RIO values among the four breeds, was 7.25 for Shami, 4.6 for Saanen, 2.44 for Boer, and 2.13 times for Jamnapari goats.

Conclusions

In conclusion, Shami goats possess high reproductive as well as production characteristics. With high milk production, Shami is an excellent breed of dairy goat and gives better and faster economic returns on investment compared to other breeds such as Boer, Jamnapari and Saanen. Therefore, it is apparent that Shami is a good candidate among the potential dairy goat breeds under consideration for strategic planning of the Malaysian goat industry..

References

Mavrogenis, A.P., A. Constantinou and A. Louca, 1984. Environment and genetic causes of variation in production traits of Damascus goats. *Anim. Prod.* 38: 99–104.

Constantinou, A., 1989. Genetic and environmental relationships of body weight, milk yield and litter size in Damascus goats. *Small Ruminant Res.* 2: 163–174.

Mavrogenis, A.P. and C. Papachristoforou, 1990. Use of part lactation records for selection in Chios sheep and Damascus goats. *Agr. Res. Inst. Tech. Bull.* No. 122, pp. 8.

Mavrogenis, A.P. and C. Papachristoforou, 2000. Genetic and phenotypic relationships between milk production and body weight in Chios sheep and Damascus goats. *Livestock Prod. Sci*. 67: 81–87.

Paper 14

Genotypic Characterisation of Ardi Goats in Saudi Arabia

Aljumaah, R.S.[1,2], M.M. Musthafa[1,2] & M.A. Al-Shaikh[1]*

[1]Department of Animal Production, [2]Centre of Excellence in Biotechnology Research, King Saud University, P.O. Box 2460, Riyadh 11451, Kingdom of Saudi Arabia.
[*]Email of corresponding author: rjumaah@ksu.edu.sa

Introduction

Adaptation of indigenous goat populations in the Kingdom of Saudi Arabia (SA) for low feed intake, harsh environmental conditions and limited water resources was reported by El-Nouty et al. (1990). The common native goat breeds in the Kingdom are Ardi, Bishi, Jabaly and Tohami. Ardi goat is black coloured with white leaf ears and horns present in both sexes (Fig. 1). Genetic characterisation is very useful and widely used to categorise animals in the world and important for conservation of genetic resources (Kevorkian et al., 2010). Thus, characterisation could enhance many attributes of breed traits such as resistance to diseases and fertility. Microsatellites are the markers of choice for genetic characterisation of livestock due to their various advantages (Baumung et al., 2004). The objective of the present study was to evaluate the genetic variability of Ardi goats in SA based on microsatellites.

Figure 1. Male (a) and female (b) goats of Ardi breed.

Materials and methods

Unrelated and randomly selected 43 Ardi goats were blood sampled (10 mL from the jugular vein) and the DNA was extracted using GFX Genomic Blood Kit and checked for quality and quantity using a spectrophotometer. Fourteen fluorescent labelled microsatellite markers, recommended by International Society for Animal Genetics (ISAG) were used to extract and amplify the DNA by PCR using an AB GeneAmp® PCR 9700. Amplified products were separated by ABI Genetic Analyser 3130. Microsatellite fragment sizing was performed by the GeneMapper® v.4.0. Statistical analysis was carried out using Cervus v.3.0.3 from Field Genetics Limited to assess the expected heterozygosity (H_e), observed heterozygosity (H_o) and polymorphic information content (*PIC*). Fixation Index (F_{is}) and Hardy Weinberg Equilibrium (HWE) were calculated by GenePop v.4.0.10., and Bottleneck was analysed using v.1.2.02. Popgene v.1.31.

Results and Discussion

All 14 microsatellites tested amplified well and were found to be polymorphic, containing a minimum of three alleles and a maximum of nine alleles. The highest observed heterozygosity was shown by locus *SPS113* (0.88), while the lowest was (0.26) by *MAF209.* Maximum H_e was given by *MAF70* (0.83) and the minimum was (0.35) by *ILSTS005.* Ten markers (Table 1) showed higher heterozygote alleles than the homozygote. All of the markers showed alleles which were within the expected sizes. HWE test indicated that seven loci: *ILSTS011*, *ILSTS005, SPS113*, *ILSTS029*, *SRCRSP3*, *MAF70* and *OarAE54,* were in HWE. All markers, except *ILSTS005*, showed acceptable informative capacity with PIC values higher than 0.5. Mean F_{is} value was 0.18. Ardi showed higher expected genetic diversity (0.69) when compared with some Asian goat breeds of southern Sri Lanka (0.48), Jamunapari (0.54) (Gour et al., 2006), and Korean goats (0.38) (Kim et al., 2002). On the other hand Ardi showed less genetic diversity when compared with some of the Indian breeds: Kutchi (0.80), and Mehsana (0.77) (Behl et al., 2003). The mean number of alleles and H_e detected were very good indices of the genetic polymorphism within breeds. The PIC values show the suitability of the markers for analysing the genetic variability. Kumar et al. (2009) reported the PIC mean of 0.65 for Gohilwaris. The high PIC values of the particular markers suggest their usefulness for genetic polymorphism related research and linkage mapping projects in goats. Mode shift indicator and Sign test, Standardised Differences test and Wilcoxon rank test showed that there was no bottleneck in Ardi goats. In general, from all of these indices, Ardi goats have a considerable amount of genetic polymorphism. Therefore, any unique alleles present in this breed may not have been lost.

Table 1. Genetic variability parameters of Ardi goats

Marker	n_a	n_e	H_o	H_e	*PIC*	F_{is}	HWE
ILSTS011	8	2.42	0.58	0.58	0.54	0.008	NS
OarFCB20	9	2.44	0.48	0.59	0.55	0.175	*
SPS113	7	4.08	0.87	0.75	0.70	-0.161	NS
ILSTS029	7	4.40	0.69	0.75	0.71	0.049	**
MAF209	3	1.99	0.25	0.49	0.43	0.490	NS
OarFCB48	8	4.31	0.39	0.76	0.72	0.488	**
SRCRSP3	3	2.37	0.61	0.57	0.50	-0.056	NS
ETH10	7	4.31	0.50	0.76	0.71	-0.056	**
MAF70	8	5.92	0.86	0.83	0.79	-0.044	NS
ILSTS005	5	1.54	0.26	0.35	0.33	0.025	NS
OarAE54	9	3.14	0.65	0.68	0.64	0.035	NS
BM6444	4	3.19	0.57	0.68	0.60	0.163	**
INRA023	8	5.47	0.63	0.81	0.78	0.226	**
TGLA53	7	4.39	0.34	0.77	0.73	0.000	**

References

Baumung, R., H. Simianer and I. Hoffmann, 2004. Genetic diversity studies in farm animals – a survey. *J. Anim. Breed. Genet.* 121: 361–373.

Behl, R., N. Sheoran, J. Behl, R.K. Vijh and M.S. Tantia, 2003. Analysis of 22 heterologous microsatellite markers for genetic variability in Indian goats. *Anim. Biotech.* 14: 167–175.

El-Nouty, F.D., A.A. Al-Haideray and S.M. Basmaeil, 1990. Physiological responses, feed intake, urine volume and serum osmolality of Ardi goats deprived of water during spring and summer. *Aust. J. Anim. Sci.* 3: 331–336.

Gour, D.S., G. Malik, S.P.S. Ahlawat, A.K. Pandey, G.R.N. Sharma, S.C. Gupta, P.S. Bisen and D. Kumar, 2006. Analysis of genetic structure of Jamunapari goats by microsatellite markers. *Small Rum. Res.* 66: 140–149.

Kevorkian, S.E.M., S.E. Georgescu, M.A. Manea, M. Zaulet, A.O. Hermenean and M. Costache, 2010. Genetic diversity using microsatellite markers in four Romanian autochthonus sheep breeds. *Rom. Biotech. Lett.* 15 (1): 5059–5065.

Kim, K.S., J.S. Yeo, J.W. Lee, J.W. Kim and C.B. Choi, 2002. Genetic diversity of goats from Korea and China using microsatellite analysis. *Asian–Aust. J. Anim. Sci.* 15: 461–465.

Kumar, S., S.P. Dixit, N.K. Verma, D.K. Singh, A. Pande, S. Kumar, R. Chander and L.B. Singh, 2009. Genetic diversity analysis of the Gohilwari breed of Indian goat (*Capra hircus*) using microsatellite markers. *Am. J. Anim. Vet. Sci.* 4 (3): 49–57.

Paper 15

Effect of Estrus Synchronisation with Sponge and CIDR on Pregnancy Rate, Sex and Birth Type of Kids in Iranian Adani (Persian Gulf) Goats

Bidari, M.[1], M. Dashtizadeh[2,3], M.S. Yazdanshenas[1], A. Ghotbi[1] & H. Avazi Yadkuri[1]*

[1]Bushehr Province Agricultural Jehad Organisation, [2]Institute of Applied Scientific Education of Jehad e Agriculture, [3]The Centre for Research in Agriculture and Natural Resources, Bushehr, Iran
[*]Email of corresponding author: mbidari@sabamail.com

Introduction

Adani goat is a well-adapted dairy breed, which is raised in coastal areas of the Persian Gulf in the Bushehr province in southern Iran. In these areas, the climate is harsh with high temperatures and humidity and poor quality pastures. This breed of goat is well-adapted to these conditions and shortage of forage. Adani goat is maintained as household animal and has suitable litter size and high pregnancy rate. The average twinning rate is 0.7 and generally it has three pregnancies in two years. In goats, control of estrus and ovulation is a valuable tool to improve and maintain milk and meat production throughout the year. Therefore, estrus synchronisation together with artificial insemination (AI) is extensively applied in the reproductive management of goats (Leboeuf et al., 1998). Estrus synchronisation in livestock focuses on the manipulation of either the luteal or the follicular phase of the estrous cycle (Wildeus, 1999). During the breeding season, when goats are actively cycling, estrus can be synchronised with PGF2α or one of its analogues, such as cloprostenol (Bitaraf et al., 2007). The most widely used procedures for synchronisation and/or the induction of estrus are 12–21 days of intravaginal sponge treatments (Fonseca et al., 2005; Kausar et al., 2009). No study has been done on synchronisation and reproduction traits of Adani goats. The aim of this study was to investigate the effect of estrus synchronisation with CIDR and sponge on the pregnancy rate, gender and birth type of kids in Adani goats.

Materials and methods

A total of 333 dairy female Adani goats (aged 2.5 to 5 years) in seasonal breeding, were allotted to ten groups and synchronised by CIDR (EAZI-BREED, New Zealand) containing 0.3 g of progesterone (n = 127 and number of groups = 5) and sponges (EAZI-BREED, New Zealand) containing 45 mg of norgestomet (n = 206 and number of groups = 5). After 14 days the CIDR and sponge were removed and the animal injected with 2 mL PMSG and 2 mL pregnecol for the CIDR and sponge groups, respectively. After 36 hours male goats were added to the groups for 48 hours. One male goat was used to mate 6 to 7 does. The pregnancy rate was computed for each group and birth type and sex of kids recorded. The effect of CIDR and sponge on pregnancy rate was compared by *t*-test and the effect of CIDR and sponge on gender and birth type of kids was compared by Chi-Square test (via contingency tables). SAS ver. 9.1 Software was used for both analyses.

Results and Discussion

The effect of CIDR and sponge on pregnancy rate, gender and birth type of kids in Adani goats are shown in Tables 1 and 2. No significant difference was seen between sponge and CIDR (t = 0.03 and *P*>0.05) on pregnancy rate. Based on Chi-Square test, Sponge and CIDR had no significant effect on gender (χ^2 = 0.49 and *P*>0.05) and birth type (χ^2 = 5.98 and *P*>0.05) of kids. It can be concluded that either sponge or CIDR procedures can be used to synchronise estrus with a pregnancy rate of 49% in Adani does.

Table 1. The effect of sponge and CIDR on pregnancy rate in Adani goats (in percentage)

Treatment	n	Mean	t-value	*P*
Sponge	5	49.5[a]	0.03	0.9770
CIDR	5	49.2[a]		

[a]Means within column with different superscripts differ at *P*<0.05

Table2. The effect of sponge and CIDR on sex and birth type of kids (in percentage)

Treatment	Sex			Birth type			
	Male	Female	Total	1	2	3	Total
Sponge	63	68	131	66	31	1	98
CIDR	44	39	83	34	17	5	56
Total	107	107	214	100	48	6	154

References

Bitaraf, A., M.J. Zamiri, M. Kafi and J. Izadifard, 2007. Efficacy of CIDR, fluogestone acetate sponges and cloprostenol for estrous synchronisation of Nadooshani goats during the breeding season. *Iranian J Vet. Res.* 8: 218–224.

Fonseca, J.F., Bruschi, J.H. Zambrini, F.N.E. Demczuk, J.H.M. Viana and M.P. Palhao, 2005. Induction of synchronised estrus in dairy goats with different gonadotrophins. *Anim. Reprod.* 2: 50–53.

Kausar, R., S.A. Khanum, M. Hussain and M.S. Shah, 2009. Estrus synchronisation with medroxyprogesterone acetate impregnated sponges in goats (*Capra hircus*). *Pakistan Vet. J.,* 29 (1): 16–18.

Leboeuf, B., E. Manfredi, P. Boue, A. Piacere, G. Brice, G. Baril, C. Broqua, P. Humblot and M. Terqui, 1998. Artificial insemination of dairy goats in France. *Livest. Prod. Sci*. 55: 193–203.

Wildeus, S. 1999. Current concepts in synchronisation of estrus: Sheep and goats. Proceedings of the American Society of Animal Science. Pp.

Paper 16

Estimation of Genetic Parameters for Growth Traits of Iranian Adani (Persian Gulf) Goats

Dashtizadeh, M.[1,2*]*, M. S. Yazdanshenas*[3]*, A. Ghotbi*[3] *& H. Haghparast*[3]

[1]*Institute of Applied Scientific Education of Jehad e Agriculture, Bushehr, Iran,*
[2]*The Centre for Research in Agriculture and Natural Resources, Bushehr, Iran,*
[3]*Bushehr Province Agricultural Jehad Organization, Bushehr, Iran*
[*]*Email of corresponding author: dashty50@yahoo.ca*

Introduction

Adani dairy goat is one of the most important breeds in southern Iran. This breed is reared in the coastal areas of the Persian Gulf in Bushehr province. In these areas, the climate is harsh due to high temperature and humidity and lack of good pasture. Adani goats are maintained as household animals under intensive systems. This breed adapts well to the harsh conditions of, and shortage of forage in, the coastal areas. It is a good breed for the export market. The goats are very quiet in behavior.

Growth is one of the important traits in animal production. Weight gain in animals is determined not only by their own genetics but by other factors as well (Zhang et al., 2008). Therefore, it would be important to determine the additive genetic, maternal and environmental effects of animals for production. Birth traits are often considered as an early indicator of growth and production because they correlate highly between them (Portolano et al., 2002). In fact several studies have estimated genetic parameters for growth traits in Asian goats (Zhang et al., 2008; Hermiz et al., 2009; Weng-Zhong et al., 2010). Gholizadeh et al. (2010) estimated genetic parameters for birth and weaning weights in Iranian Raeini goats. However, no such study has been done on Adani goats. The aim of this study was to estimate the genetic and phenotypic parameters for growth traits of Iranian Adani goats using a multiple-traits model.

Materials and Methods

Data consisting of growth traits of Iranian Adani goats born between 2006 and 2012 were obtained from the Adani Goat Breeding Centre of the Bushehr province. The growth traits obtained were birth weight (BW), weaning weight (WW), 3-month weight (W3), 6-month weight (W6), 9-month weight (W9) and 12-month weight (W12). The data consisted of 5934 growth records for 1349 goats and progeny of 79 sires and 366 dams. Heritability, maternal effect and genetic and phenotypic correlations between growth records were estimated using the multiple-traits model. The following model was used for growth records:

$$y_{ijkl} = C_i + T_j + S_k + a_l + M_m + \sum_{n=1}^{2} Damage^{n}_{ijklmn} + \sum_{n=1}^{2} b_{n+2} AGE^{n}_{ijklmn} + e_{ijlklmn}$$

where, y_{ijkl} = Body weight, a_l = random effect for animal, M_m = random maternal effect, C_i = fixed effect of contemporary groups, T_j = fixed effect of birth type, S_k = fixed effect of sex,

$Damage$ = fixed covariate of dam age, AGE = fixed covariate of age at recording time and e_{ijlk} = residual error.
Variance components were estimated by the restricted maximum likelihood (REML) method using the wombat software.

Figure 1. Iranian Adani goats

Results and Discussion

The heritability estimates, genetic and phenotypic correlations for body weight are presented in Table 1. Heritability estimates for body weight ranged from 0.18 to 0.55 and were highest in second half of lactation. Maternal effect ranged from 0.04 to 0.62 and was highest for weaning weight. Genetic correlations between body weights were highest between adjacent weights, which decreased as the distance between them increased. Phenotypic correlations followed a similar pattern but were lower than the corresponding genetic correlations.

Table 1. Heritability (main diagonal), maternal effect (in parenthesis main diagonal), genetic (above diagonal) and phenotypic (below diagonal) correlations for body weights

	BW	WW	W3	W6	W9	W12
[1]BW	**0.55 (0.1)**	0.90	0.81	0.69	0.60	0.51
WW	0.79	**0.18 (0.62)**	0.90	0.80	0.70	0.61
W3	0.79	0.74	**0.47 (0.09)**	0.90	0.80	0.69
W6	0.68	0.71	0.9	**0.43 (0.17)**	0.90	0.80
W9	0.61	0.6	0.82	0.9	**0.53 (0.11)**	0.90
W12	0.49	0.46	0.7	0.79	0.9	**0.48 (0.04)**

BW, birth weight; WW, weaning weight, W3, weight at 3 month; W6, weight at 6 month, W9, weight at 9 month; W12, weight at 12 month

References

Gholizadeh, M., G. Rahimi Mianji, M. Hashemi and H. Hafezian, 2010. Genetic parameter estimates for birth and weaning weights in Raeini goats. *Czech J. Anim. Sci.* 55 (1): 30–36.

Hermiz, H.N., J.E. Alkass, A.A. Hobi and M.K. Asofi, 2009. Genetic and phenotypic parameters of body weights in Iraqi local goats and their crosses with Damascus. The Second Kurdistan Conference on Biological Sciences. *J. Duhok Univ.* 12 (1) (Special Issue), pp. 189–194.

Portolano, B., M. Torado, M. Finocchiaro and R. Vankaam, 2002. Estimation of the genetic and phenotypic variance of several growth traits of the Sicilian Girgentana goat. *Small. Rumin. Res*. 26: 271–289.

Weng-Zhong, L., Z. Yuan and Z. Zhong-xiao, 2010. Model selection in estimation of covariance function for growth of Angora goats. *Agri. Sci. China*, 9 (7): 1041–1049.

Zhang, H., L. Yang and Z. Shen, 2008. Variance components and genetic parameters for weight and size at birth in Boer goats. *Livest. Prod. Sci*. 115: 73–79.

Paper 17

Effects of Synchronisation and Artificial Insemination with Alpine and Saanen Semen on Reproductive Traits of Iranian Goat Breeds

Emami Mibody, M.A.[1], A.A. Gasemi[2], S.J. Hossaini[2] & R. Aliverdi Nassab[1]*

[1]*Agriculture and Natural Resource Institute Yazd, Iran*
[2]*Agriculture Office in Yazd Province, Iran.*
[*]*Email of corresponding author: emamimibody@yahoo.com*

Introduction

Yazd province is one of the driest areas in the central part of Iran. It receives less than 100 mm of rain annually. The Nodoshani and Rabati goats are the local breeds of the Yazd province and the Raeini breed is of Kerman Province (Ghorbanpor Dashtaki, 1993). The Nodoshani and Rabati breeds are dual purpose breeds (milk and cashmere wool) and Raeini breed is the most productive cashmere goats in Iran. All of these are raised under poor range conditions (Emami Mibody, 1990). Currently, goats of these breeds are raised in farms and farmers still aspire to get high producing breeds which can adapt to the environment.

This study was conducted to evaluate reproductive parameters of the Nodoshani, Rabati and Raeini breeds bred to Alpine and Saanen dairy goats to produce off springs which were reported to have high potential for milk production and reproductive performance (Abdul-Vahid, 1988; Carica and Bravo, 1987; Song et al., 2000).

Materials and Methods

Seventy does, each of the Nodoshani, Rabati and Raeini breeds, were selected and synchronised in the fall by CIDER (Horst, 1997). Teaser animals were used to detect does in heat followed by artificial insemination with Saanen and Alpine frozen semen (Whitley and Jackson, 2004.).

Heat detection rates, parturition records including sex, birth weight of kids and types of birth, were recorded and analysed by GLM procedure of the Statistical Analysis System (SAS, 1997; Song et al., 2000).

Results and Discussion

On average 94% of animals showed heat signs, with Nodoshani, Rabati and Raeini does showing 94, 97 and 91%, respectively. The average apparent pregnancy rate (parturition) was 36%: 40, 44 and 29% for Nodoshani, Rabati and Raeini does, respectively. The number of kids per parturition was 1.77 ± 0.65, 1.43 ± 0.57 and 1.58 ± 0.69 for Nodoshani, Rabati and Raeini does, respectively, with an average of 1.59 ± 0.64 kids for all breeds. The average total weight of kids in each parturition was 3.36 ± 1.3 kg for all breeds; the corresponding values being 3.93 ± 1.44, 4.05 ± 0.08 and 3.07 ± 0.87 kg for Raeini, Nodoshani and Rabati breeds, respectively. This study showed that the number of kids and their weight per parturition were highest in the Nodoshani breed.

The average gestation period was 149.74 ± 3.63 days for all breeds and 150.21 ± 2.57, 148.88 ± 1.9 and 148.93 ± 2.03 days for Raeini, Nodoshani and Rabati breeds, respectively. Raeini breed had a longer ($P<0.05$) gestation period than the other two breeds.

References

Emami Mibody, M.A., 1990. Estimation of genetic parameters of economic traits of Raeini goats. M.S. thesis, Ferdosi University, Iran.

Ghorbanpor Dashtaki, M.M., 1993. The effect of flushing and PMSG on reproductive traits of Nodoshani goat. M.S. thesis. Gillan University, Iran.

Abdul-Vahid, R. and P. Hamzah-chah, 1988. Introduction of Saanen and Anglo Nubian Local and Jamnapari. Local crossbred goats conservation on their growth performance. *CAB. Animal Breeding* Abstract.

Carica, B.E. and P.J. Bravo, 1987. Genetic improvement of Crioli goats in Venezuela by means of crossbreeding with improved breeds 1: Growth of kids. *CAB Animal Breeding* Abstract.

Horst, P., 1997. Animal breeding as a factor of influence on the conservation of natural resources and utilisation of genetic resources. *Anim. Res. Develop*. 46: 63–75.
SAS Institute Inc. 1997. Cary, North Carolina. USA.

Song, H.B., I.K. Choi and T.G. Mio, 2000. Reproductive traits in the Korean native goats. College of Natural Resources, Taegu University.

Whitley, N.C. and D.J. Jackson, 2004. An update on estrus synchronisation in goats: A minor species. *J. Anim. Sci.* 82 (E. Suppl.): E270–E276.

Paper 18

Milk Production of Local Qomi and F_1 and F_2 Qomi × Saanen Goats in Iran

Hoseini, S M.[1], A. Ghazikhani[1], M. Kalantar[2] & H. Yazdi[1]*

[1]Department of Animal Science, Saveh Branch. Islamic Azad University, Saveh, Iran
[2]Agricultural Research Centre of Qom, Qom, Iran.
[*]Email of corresponding author: gentelmanmehdi@yahoo.com

Introduction

In Iran goats are kept primarily for meat production and they are not a significant source of milk. There is a great potential for development of milk production from goats in Iran and the projects for this purpose have already been initiated in recent years. Crossbreeding is a logical step to improve meat and milk production of local goats and has been practiced in many countries. Crossbreeding has been used for a number of reasons including the benefit of heterosis, as an initial stage of transition in establishing a breed (grading up) or for the development of a new breed (Donkin, 1997). The option of crossbreeding to introduce suitable genetic material for milk production is a much more rapid method than that of attempting to improve milk yield of local goat breeds by selection (Karua, 1989). The research project was concerned with evaluation of milk production from local and crossbred goats. This study is continuation of an earlier study (Hoseini et al., 2011) and is aimed at determining the milk production of local Qomi and Qomi × Saanen goats.

Materials and Methods

Milk production records at second, third, fourth and fifth month of lactation of local Qomi, F_1 and F_2 Qomi × Saanen crossbred goats were used in this study. Data were analysed using the GLM procedure in SAS. Estrus synchronisation and artificial insemination technology were used in the breeding of local Qomi and Qomi × Saanen F_1 and F_2 goats.

Results and Discussion

The mean daily milk yield was 0.48, 1.1 and 1.4 kg for local Qomi, F_1 and F_2 Qomi × Saanen goats, respectively. There were significant differences in mean daily milk yield between local and crossbred goats. Mean milk yields from second to fifth month of lactation of local Qomi, F_1 and F_2 Qomi × Saanen goats were significantly different ($P<0.05$) (Table 1). The results of this study are similar to those of previous researchers (Donkin, 1997; Dinh, 1998; Juan et al., 2001) who also showed significant difference between local with crossbred goats. This study showed that the milk production of F_2 Qomi × Saanen was higher than that of the Qomi local and the F_1 crossbreds.

Table 1: Mean daily milk yield of local Qomi and F_1 and F_2 Qomi x Saanen goats during lactation

Month of lactation	Milk yield (kg)		
	F_2 Qomi x Saanen	F_1 Qomi x Saanen	Local Qomi
2	1.85 ± 0.02^c	1.44 ± 0.12^b	0.64 ± 0.05^a
3	1.45 ± 0.23^b	1.13 ± 0.11^b	0.53 ± 0.03^a
4	1.21 ± 0.09^b	1.08 ± 0.08^b	0.39 ± 0.03^a
5	1.11 ± 0.53^c	0.77 ± 0.05^b	0.36 ± 0.03^a

^{a,b,c} Means within row with different superscripts differ at $P<0.05$

References

Karua, S.K. and J.W. Banda, 1989. The performance of the small East African goats and their Saanen crosses in Malawi. MSc Thesis. University of Malawi, 130 pp.

Juan, M. 2001. Use of high yielding goat breed for milk production. *Livestock Prod. Sci*. 71: 59–73.

Dinh, V.B., T.V. Do and T.B. Pham, 998. Study to find out the performance of F_1 between Indian and local Co in Vietnamese raising condition. Proceeding of Workshop of Animal Production Science. pp. 112–121.

Donkin, E.F. 1997. Productivity and disease of Saanen, Indigenous and Crossbred goats on zero grazing. Ph.D. Thesis. Medical University of Southern Africa.

Hoseini, S.M., A. Ghazikhani and M. Kalantar, 2011. Comparison the genetic potential of some growth and milk traits of hybrid (crossed) Saanen with Native Goat (Lori Black Goat) versus Native goats in Qom Province. SAADC 2011 Congress, Thailand, pp. 388.

Paper 19

Serum Protein Polymorphism in Iraqi Local Goats Using Polyacrylamide Gel Electrophoresis: Transferrin (β-Globulin) Polymorphism

Jaayid, T.A.

Animal Production Department,
College of Agriculture, Basrah University, Iraq
Email of corresponding author: taleb1968@yahoo.com

The present study was conducted to determine the presence of polymorphism at transferrin (Tf) locus in local Iraqi goats using a polyacrylamide gel electrophoresis (PAGE) following the method developed by Khaertdinov and Gataulin (2000). This study was carried out at the Animal Farm, Hartha Research Station, College of Agriculture, Basrah University and in several farms in Basrah Province, Iraq. Gene frequencies were calculated by gene counting, because the mode of inheritance of each of the systems that does show variation is by co-dominant alleles at an autosomal locus. The allele frequencies in Tf locus were estimated by direct counting of the genotypes. To test differences between observed and expected genotype frequencies, a chi-square (χ^2) analysis was performed on the basis of the Hardy-Weinberg law.

Figure 1 shows the electrophoretical pattern of goat (*Capra hircus*) protein samples and the corresponding isolated Tf. PAGE at pH 8.6 gave a good separation of the four main goats serum blood fractions, i.e. prealbumin; albumin; Tf and γ-albumin. Two bands were detected when transferrin was stained with Amido Black. The goat transferrin types were named according to the nomenclature suggested by Irnazarow and Bialowas (1994) and Jurecka et al. (2009).

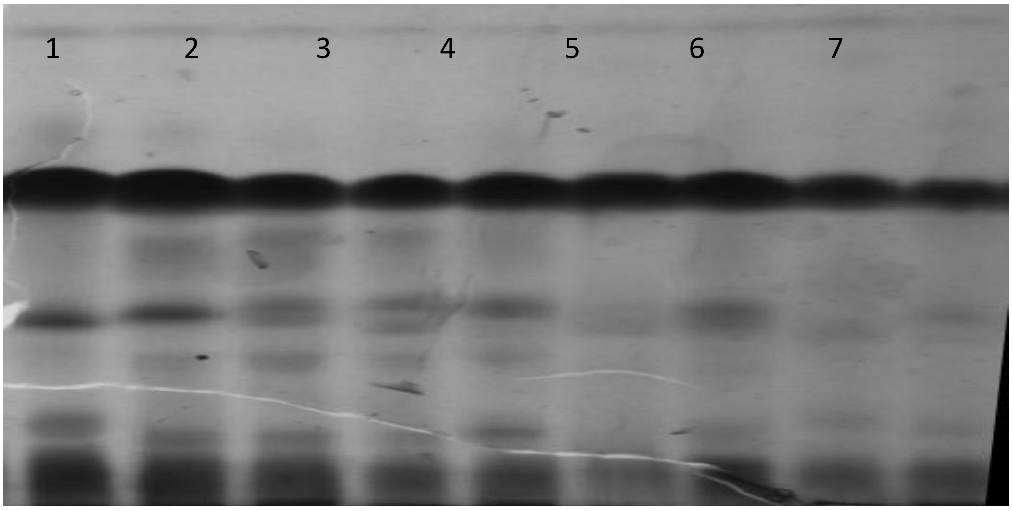

Figure 1. Transferrin genotypes detected by polyacrylamide gel disc electrophoresis patterns at pH 8.6 in local Iraqi goats

The results showed variation in the samples of goats (Table 1). The presence of transferrin genetic polymorphism with more than one allele was demonstrated. There were many genotypes (AA, BB, AB, AC and BC), in order of decreasing mobility in goats sera, from the alleles (A, B and C) that could be inherited according to Mendelian laws. The genetic variants differed by only a few amino acid substitutions. The A allele was more predominant than B and C alleles (0.55, 0.36 and 0.10, respectively). The majority of Tf genotypes represented only AA and BB variants. These had affected all five genotypes. Homozygous genotypes AA and BB (45 and 27%, respectively) were predominant followed by the heterozygous genotypes AC (11%) and BC (9%). The CC genotype was not seen. Differences between expected number and observed number for transferrin genotypes were not significant on the basis of the Hardy-Weinberg law. Hence, the transferrin polymorphism is genetic and the goat population is genetically balanced for the Tf locus. This study showed that there is lack of selection or genetic improvement programme in these animals.

Table 1. Distribution of transferrin genotype frequency and gene frequency for transferrin locus in local Iraqi goats

	Transferrin genotypes (n = 100)					χ^2	Gene frequency		
	AA	BB	AB	AC	BC		A	B	C
Number	45	27	8	11	9	2.28	0.55	0.36	0.10
%	45	27	8	11	9				

To our knowledge, this is the first large-scale analysis on the genetic polymorphism of transferrin alleles in the local Iraqi goats (*Capra hircus*). The alleles discovered could possibly be used for the benefit of the genetic improvement programmes of domestic animals and conservation of bio-diversity.

References

Irnazarow, I. and S.H. Bialowas, 1994. Genetic characteristics of carp breeding lines at the Institute of Ichthyobiology and Aquaculture of the Polish Academy of Science Golysz. 1. Polish lines. *Acta Hydroiol*. 36: 125–142.

Jurecka, P., F. Geert, B. Wiegertjes, L. Krzystof, A. Rakus, A. Andrzej and I.A. Ilgiz, 2009. Genetic resistance of carp (*Cayprinus carpio* L.) to Trypanosome borreli: Influence of transferrin polymorphisms. *Vet. Immunol. Immunopathol*. 127: 19–25.

Khaertdinov, R.A. and A.M. Gataulin, 2000. *The selection to increase protein and improvement of technological properties of milk* – Kazan, Russia, pp.164.

Paper 20

Phenotypic and Genetic Marker of Dairy Goat Performances Based on the Polymorphism of Acaca Gene

Maylinda, S. * *& T.E. Susilorini*

Faculty of Animal Husbandry, Brawijaya University, Indonesia
**Email of corresponding author: sucik_m@live.com*

Introduction

Etawa Crossbred goat or Peranakan Etawah (PE) is a popular dairy goat breed in Indonesia. In East Java, although the population of goats has increased from 2,384,973 in 2005 to 2,780,822 in 2009 (DGAHV, 2010), the performance of the Etawah Crossbred goat is still unknown. For this goat breed many aspects such as breeding, feeding, management and disease control need to be improved. Obviously superior animals can be obtained through good breeding programmes. These programmes could utilize Marker Assisted Selection (MAS) method based on the genotypic/genetic marker for a particular trait. The use of marker-based selection is very powerful because it can increase efficiency of selection according to the requirement. The aim of the study was to develop a method for breeding of Etawah crossbred goats through potential qualitative characteristic identification as a phenotypic marker for milk quality and a potential technology to determine the genetic marker in PE goat selection.

Materials and Methods

The research was conducted at Malang, East Java. Thirty-three female Etawa goats in their first to third lactation were used in the study. The parameters determined in the study were quantitative traits such as milk production, milk quality, body condition score (BCS) and qualitative traits such as head colour, ear type, and body colour. The research was conducted in two stages: field and laboratory studies.

Field study: This study involved phenotypic data collection, such as milk sample, BCS, head color, ear type, and blood sampling.

Laboratory study: This study involved milk quality and DNA analyses. DNA analysis was done by DNA and PCR and RFLP analyses. The PCR was done using primers F (5'–AGTGTAGAAGGGACAGCCCAGC–3') and R (5'–GTGGAATGACACATGGAGAGGG –3') to amplify 200 bp of ACACA gene in intron 3'. RFLP was done using Rsa1 restriction enzyme to examine base mutation. After digestion with Rsa1, the products were subjected to 2% agarose gel electrophoresis.

Based on the band pattern of the agarose gel, two alleles, G and T, were evident. By using the $PIC_i = 1 - \sum p^2_{ij}$ the resulting degree of polymorphism in ACACA locus was shown to be 43%. The relationship between qualitative and quantitative data was determined using ANOVA model One Way Layout *unbalanced design* using Genstat Release 7.22 TE 2008.

Results and Discussion

The results showed that the qualitative characters of ear type and head colour had no effect on milk fat and protein content. However the chest girth (CG), body length (BL), body height (BH) and BCS correlated well with the qualitative character such as body and head colour. Head width correlated with CG and BH, and head length with CG, BL and BH. Ear width correlated with CG and BL and ear length with BL. The BCS had significantly affected BL, while head colour significantly affected CG, BH and BL (P<0.01). The greatest influence on BH was on brown head followed by white, black and black-white with measurements of 76.0, 75.64, 72.72 and 67.57 cm, respectively.

Based on the agarose gel electrophoresis (Figure 1), the genetic polymorphism of ACACA gene in goat population was 43%, while the frequencies of G and T alleles were 31 and 69%, respectively. The genotypes that existed in the population were GT and TT. There is no significant effect of genotype on milk fat and protein content.

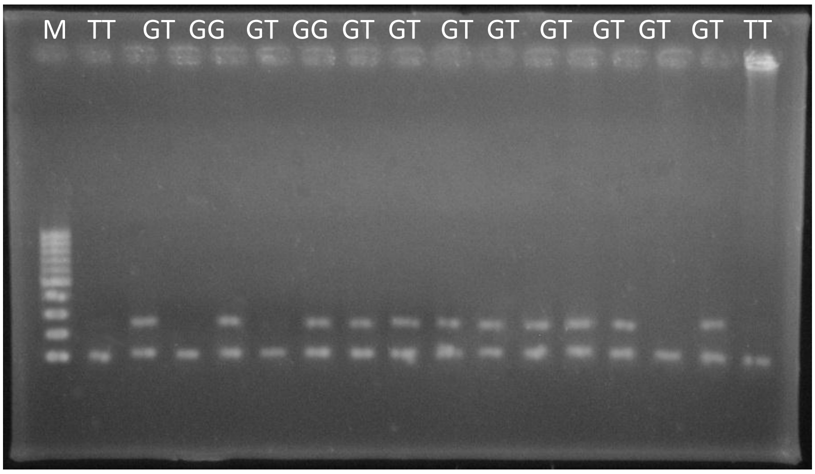

Figure 1. Agarose gel electrophoresis of PCR-RFLP products.
M = marker; GT, TT = phenotypes

Conclusions

The BCS is related with animal condition and describes the genetic potential and management implemented on the animals. It is concluded that qualitative traits have no effect on milk yield and milk quality, but have significant effect on the linear measurements of goat. Although only two genotypes of ACACA locus existed in the population, genetic polymorphism was high. The ACACA genotypes in the population could not be used as genetic marker for milk yield and milk production.

References

DGAHV, 2010. Directorate General of Animal Husbandry and Veterinary, Ministry of Agriculture of the Republic of Indonesia.

Paper 21

Effect of Body Condition Score on Milk Yield, Protein and Fat Contents in Etawah Crossbred Dairy Goats

Susilorini, T.E., Suyadi, S. Maylinda & P. Surjowardojo*

University of Brawijaya, Faculty of Animal Husbandry. Jl. Veteran, Malang 65145 Indonesia
**Email of corresponding author: tesusilorini@yahoo.co.id*

Introduction

Etawah crossbred, one of dairy goat types in Indonesia, is distributed in almost all regions. This breed is a dual purpose goat – used both for meat and milk production. This goat is believed to be the result of undirected natural crosses between Etawah goats originating from India and the local goats, Kambing Kacang, with unpredicted genetic composition. At present, this goat contributes most to the population of goats in Indonesia and is more recognized as Etawah Crossbred (*Ind*: Peranakan Etawa, PE-goat).

In station, mature Etawah crossbred doe produces between 0.5 to 2.0 L milk/day (Sutama, 2011), indicating that this breed has high potential for selection and development as milk goat type. According to FAO (2011) Etawah goat in temperate region produced daily milk on the average of 1.725 ± 0.031 kg.

It is well-known that nutrition, live weight and body condition score (BCS) are important factors, which influence the phenotype and milk production of farm animals (Meyers-Raybon, 2010). Change in BCS should be used to assess the level and change of body fat stores and as an indicator of energy balance. The ideal BCS will support peak milk production during the negative energy balance of lactation. Many studies showed that BCS had a high correlation with milk production and composition (Zahraddeen et al., 2009, Ahmed et al., 2010; Pambu et al., 2011) and affected the reproductive performance of dairy goats (Suharto et al., 2008; Serin et al., 2010). The objective of present study was to evaluate the effects of BCS on yield, protein and fat contents of milk from the Etawah crossbred dairy goats.

Materials and Methods

The study was carried out under ASPENAS (National Etawa Farmer Association) in Blitar and Malang Regencies, East Java, Indonesia. Fifty-two Etawah crossbred goats were used in the experiment, conducted during period of March to December 2011. The BCS determination was carried out at lactation by the same person, according to Detweiler et al. (2011), who scored the body conformation by palpation. Scores were assigned a five-point scale from 1 = thin to 5 = grossly fat based on palpation of the body. Half scores were also included. Milk yield was recorded within the first 90 days of lactation, and protein and fat contents were determined biweekly by the Lactoscan Milk Analyzer. Milk yield was adjusted to energy corrected milk (ECM) of 4% fat and 3.3% protein (Hemme, 2010). The goats were divided into 5 groups according to the BCS values. The data were statistically analysed by ANOVA (Genstat 12.2).

Results and Discussion

The daily milk yield increased significantly (*P*<0.01) with increase in BCS (Table 1). The animal with BCS 2 produced 1185.2 ± 399.5 mL ECM. The production was higher in the animal groups with BCS of 2.5, 3.0, 3.5 and 4.0 that recorded 1207.3 ± 366.5, 1691.9 ± 457.6, 1568.3 ± 340.1 and 1614.6 ± 396.6 mL ECM, respectively. The average milk yield in the present study was higher than that reported by Suranindiyah et al. (2009), which was 774 ± 291 mL/day for the same breed, but was lower than the Etawah pure breed goats (2.15 ± 0.30 kg/day)

Table 1. Daily milk yield, protein and fat content of Etawah Crossbred goat milk

	Body Condition Score (BCS)				
Parameter	2 (N = 7)	2.5 (N = 16)	3 (N = 21)	3.5 (N = 6)	4 (N = 2)
Milk Yield (mL ECM)	$1185.2^{a} \pm 399.5$	$1207.3^{a} \pm 366.5$	$1691.9^{b} \pm 457.6$	$1568.3^{ab} \pm 340.1$	$1614.6^{ab} \pm 396.6$
Protein (%)	3.03 ± 0.14	3.09 ± 0.13	3.06 ± 0.13	3.13 ± 0.09	2.84 ± 0.02
Fat (%)	6.37 ± 1.09	6.56 ± 0.98	6.85 ± 0.91	6.85 ± 1.06	6.09 ± 1.12

Values are means ± std errors
[a,b] Means within row with different superscripts were significantly different at *P*<0.001

Protein and fat contents in milk from the Etawah crossbred were not affected by BCS of the animals, although the does with BCS of 3.5 tended to have higher protein and fat contents in milk than the other groups. The BCS of the animal reflects the nutrient status, internal physiological condition and energy reserves in the body of animal. In the present study, increase in BCS significantly (*P*<0.01) increased milk production but did not affect protein and fat contents of milk.

Conclusions

Body condition score in an important indicator for predicting the potential milk production in Etawa Crossbreed goats. Goats with higher BCS, between 2 and 4 showed significant increase in milk production. However, BCS did not influence protein and fat content of milk.

Acknowledgements

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References

Ahmed, B.M.S., N.N. Maarof and T.Y. Petrus, 2010. Effect of body condition score on productive performance of local Karadi cows. *J. Zankoy Sulaimani*, Part A13 (1): 121–128.

FAO. 2011. Sheep and Goat Breed of India. Corporate Document Repository. http://www.fao.org/docrep/004/X6532E/X6532E00.HTM.

Hemme, 2010. IFCN Dairy Report 2010. International Farm Comparison Network. Dairy Research Centre. Kiel. Germany.

Meyers-Raybon, D., 2010. Body scoring helps breeders evaluate condition of dairy goats. http://www.dairygoatjournal.com/issues/82/82-3/Donna_Meyers-Raybon.html. (Accessed on 26 March 2011).

Pambu, R.G., E.C. Webb and L. Mohale, 2011. Differences in milk yield and composition of different goat breeds raised in the same environment in South Asia. *Agric. J.* 6 (5): 237–242.

Serin, I., G. Serin, M. Yilmaz, F. Kiral and A. Ceylan, 2010. The effect of body weight, body condition score, age, lactation, serum trygliceride, cholesterol and paraoxanase levels on pregnancy rates of Saanen goats in breeding season. *J. Anim. Vet. Adv*. 9: 1848–1851.

Sutama, I.K., 2011. Innovation technology in reproduction for the development of local dairy goats. *Pengembangan Inovasi Pertanian* 4 (3): 231–246.

Suharto, K., A. Junaedi, A. Kusumawati and D.T. Widayati, 2008. Comparison of fertility of Etawa Crossbred goats in low versus ideal body condition score after estrus synchronization and artificial insemination. *Media Kedoteran Hewan* 24 (1): 49–54.

Suranindiyah, Y., T.S.M. Widi, Sumadi, N.H. Tarmawati and U. Dwisepta, 2009. Production performance of Etawa Crossbred goats in Turi Sleman Yogyakarta. The 1st International Seminar on Animal Industry, 2009.

Zahraddeen, D., I.S.R. Butswat and S.T. Mbap, 2009. A note on factor influencing milk yield of local goats under semi-intensive system in Sudan Savannah Ecological Zone of Negeria. http://www.lrrd.org/lrrd21/3/zahr21034.htm. (Accessed on 26 March 2012).

Paper 22

Detection and Identification of Pregnancy-Associated Glycoprotein as a Biomarker for Early Stage Pregnancy in Goats

Syaheera, N.I.[1], M.A. Taib[1], S.S. Adawiyah[2] & Z. Ismail[3]*

[1]Universiti Sultan Zainal Abidin, Kuala Terengganu, 21300, Malaysia,
[2]Institute of Biological Sciences, 50603 University of Malaya, Malaysia,
[3]Department of Veterinary Services, Hulu Terengganu 21700, Malaysia.
[*]Email of corresponding author: isyaheera@yahoo.com

Introduction

In goat farming, does have to continue reproducing on regular intervals in order to increase livestock productive efficiency. Thus, early and accurate diagnosis of pregnancy is a useful management tool for improving efficiency of goat production so that expenses on feeding and vaccination could be reduced (Suguna et al., 2008; Padilla-Rivas et al., 2005). The main objective of the present study was to identify a potential early stage pregnancy biomarker, using Pregnancy Associated Glycoprotein (PAG) in the serum of Damascus goats.

Materials and Methods

Sixteen naturally bred Damascus does were used in this study. Blood was collected through jugular vein fortnightly from day 0 until day 42 of pregnancy. The day of mating was considered as day 0 of pregnancy. Out of the 16 animals, 12 animals were confirmed pregnant. Sera obtained were kept at -80^{o} C until analysis. Proteomics approach was used to seek and identify the significantly expressed proteins in the sera. To screen the serum protein for potential biomarkers, the sera were subjected to two dimensional gel electrophoresis (2DE) and the proteome maps obtained were analysed using the Image Master 2D Platinum 7.0. Any differentially expressed proteins were subjected to Maldi-Tof/Tof analysis for protein identification. In order to identify PAG spot on the proteome map, immunoblotting was performed and the spot was validated by LC-MS approach. Statistical analysis was performed using ANOVA where $P<0.05$ was considered significant.

Results and Discussion

From the 2DE proteome map, four proteins were detected as differentially expressed. Interestingly, the significantly expressed proteins with the Match ID of 196, 51, 223 and 239 were detected as early as week 2 of gestation. Compared to week 0 of pregnancy, these four proteins seemed to be upregulated by 2-fold of expression dynamic on the week 2 of pregnancy. However, these proteins were down regulated in week 4 of pregnancy. Pregnancy associated glycoprotein, which was detected using immunoblotting, only appeared in week 6 of gestation and was not detected in non-pregnant samples. Based on the LC-MS results, the protein spot was confirmed as PAG.

Four significantly expressed serum proteins (Match ID: 196, 51, 223 and 239) were successfully detected in pregnant Damascus goats using 2DE approach. Since the proteins could be detected in the second week of gestation, they have good potential to be used as a biomarker for early stage pregnancy in Damascus goats. However, a larger sample size is needed to determine the sensitivity and specificity of this biomarker. The PAG, which was detected using immunoblotting in the week 6 of pregnancy, appeared as a single spot with a molecular weight of 62 kDa and pI of 5.7. According to Sousa et al. (1998), the PAG concentration extracted from goat placenta significantly increased from week 5 to 7 before it began to fall again in week 9 of gestation. The molecular weight and pI of the protein spot were similar to those of placental PAG in other species. For instance, El Amiri et al. (1994) successfully isolated and characterised PAG from ovine placenta where the molecular weight of the ovPAG were reported to range from 55 to 66 kDa and the pI from 4.0 to 6.8. Whilst Sousa et al. (2002) also managed to extract PAG from zebu placenta, which possessed molecular masses of 51 to 69 kDa and pI of 4.4 to 6.7.

Conclusions

This study successfully detected four potential biomarkers for an early stage of pregnancy in Damascus goat. Pregnancy associated glycoprotein was also detected in goat sera where its molecular weight and pI were comparable with those of other species.

References

El Amiri, B., B. Remy, N.M. Sousa and J.F. Beckers, 2004. Isolation and characterisation of eight pregnancy associated glycoprotein present at high levels in the ovine placenta between day 60 and day 100 of gestation. *Reprod. Nutr*. Dev. 44: 169–181.

Padilla-Rivas, G.R., B. Sohnrey and W. Holtzť, 2004. Early pregnancy detection by real-time ultrasonography in Boer goats. *Small Rum. Res.* 58: 87–92.

Sousa, N.M., B. Remy, B. El Amiri, J.R.D. Figueredo, H. Banga-Mboko, P.B.D. Goncalves and J.F. Becker, 2002. Characterisation of pregnancy associated glycoproteins extracted from zebu placentas removed at different gestational periods. *Reprod. Nutr. Dev.* 42: 227–241.

Sousa, N.M., J.M. Garbayo, J.R. Figueiredo, J. Sulon, P.B.D. Goncalves and J.F. Beckers, 1998. Pregnancy-associated glycoprotein and progesterone profiles during pregnancy and postpartum in native goats form the north-east of Brazil. *Small Rum. Res.* 32: 137–147.

Suguna, K., S. Mehrotra, S.K. Agarwal, M. Hoque, S.K. Singh, U. Shanker and T. Sarath, 2008. Early pregnancy diagnosis and embryonic and fetal development using real-time, B-mode ultrasound in goats. *Small Rum. Res.* 80: 80–86.

Paper 23

West African Dwarf Goat Milk Production, Composition and Kid Growth during the Dry Season in Western Highland of Cameroon

Tendonkeng, F.[1], B. Boukila[2] & E.P. Tedonkeng[1]*

[1]Department of Animal Production, FASA, University of Dschang. P.O. Box 222 Dschang, Cameroon
[2]I.N.S.A.B., Université des Sciences et Techniques de Masuku, B.P. 941, Gabon
[*]Email of corresponding author: pamo_te@yahoo.fr

Introduction

The production potential of the West African Dwarf goats (WADG) in Cameroon in the Central African sub-region is very low because of lack of adequate nutrition (Pamo et al., 2006). Grass and crop residues which form a major part of their diet especially during the rainy season have very low nitrogen and fibre contents. Supplementation of these roughages is a promising way of alleviating nutrient deficiencies. Different types of supplementary feeding have been advocated to boost goat production (Leng, 2003) of which supplementing with leguminous tree leaves has high merit. The present study was undertaken to evaluate the effects of supplementary feeding of *Calliandra calothyrsus* and *Leucaena leucocephala* leaves on milk production and composition of WADG.

Materials and Methods

The study was conducted with WADG in the dry season (November 2001 to April 2002). The WADG grazed mixed pasture comprised of *Brachiaria ruziziensis* and *Pennisetum purpureum* between 0900 and 1700 h each day. After about a month, two bucks were introduced in the herd for a 2-month breeding period. The males were removed thereafter and 12 goats were subjected to supplementary feeding with *C. calothyrsus* and *L. leucocephala* leaves mixed in equal quantities by weight from three months prepartum up to three months postpartum. The mixture was left in the pens in the afternoon (1600 h) at the rate of 800 g per goat per night. The remaining 12 goats served as unsupplemented controls. The following observations were made: consumption of the supplements calculated from the residue every morning, kids' growth, and milk production and composition, and were analysed every two weeks from kidding up to three months. The data were analysed statistically (Steel and Torrie, 1980) and the effects of supplementary feeding on milk production and composition and on kids growth were evaluated.

Results and Discussion

On average the goats consumed between 700 to 800 g of the foliage supplement per head per day during the entire study period. The peak milk production was observed in the second week of lactation in the control group but the peak production occurred during the 3rd week in the group receiving supplement (Figure 1). Supplemented goats produced more milk ($P<0.05$) than controls during the entire period of the study. The average weekly milk production during the period of the supplementation was almost double than that of the control animals (361 ± 11 vs 183 ± 43 g).

The supplementation has not significantly influenced dry matter, ash and lactose contents of WADG milk (Table 1). Milk protein content of supplemented WADG was higher ($P<0.05$) than of the control group, while lipids content in milk of the control group was higher ($P<0.05$). It appeared that the supplementation with the leaves of *L. leucocephala* and *C. calothyrsus* had variable influence on milk composition of WADG during the dry season.

The milk consumption index of the supplemented group (5.25 ± 0.47) was comparable with that of the control group (5.25 ± 0.38). A high significant correlation (r = + 0.96; $P<0.01$) was obtained between milk consumed and weight gain of kids of the supplemented group.

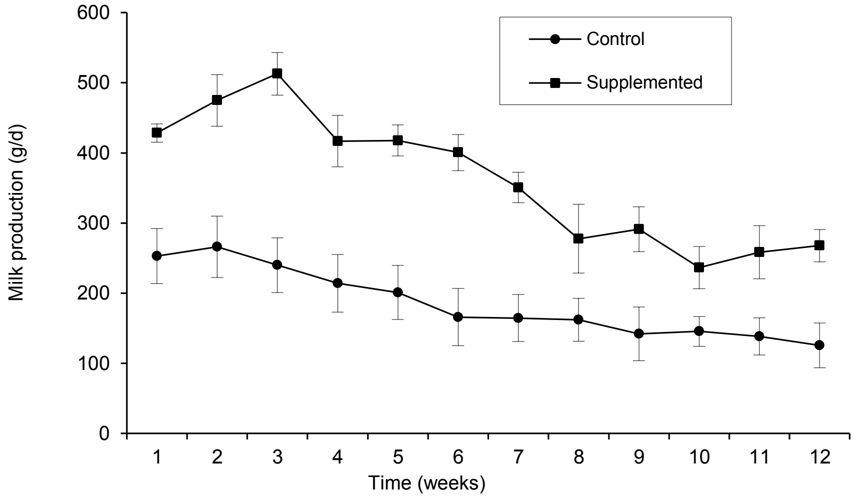


Figure 1. Weekly milk production of WADG.

Table 1. Average milk composition (g/100 g milk)

	Composition (g/100 g of milk)					
Group	DM	Protein	Lipids	Ash	^{2}P	Lactose
Control	14.7 ± 0.8	4.1^a ± 0.3	3.8^a ± 0.4	0.81 ± 0.04	0.09 ± 0.01	6.18 ± 1.18
Supplemented	14.21 ± 0.98	4.35^b ± 0.34	2.56^b ± 0.27	0.80 ± 0.05	0.09 ± 0.003	6.48 ± 0.82

[ab]Means with different superscripts within column are significantly different ($P<0.05$). DM, dry matter; ^{2}P, phosphorus

Table 2. Weight of goats at kidding and weaning

Group	Weight at kidding (kg)	Weight at weaning (kg)	Total gain (kg)	Daily weight gain (g/d)
Control	1.12 ± 0.10^a	3.56 ± 0.46^a	2.44	29.0 ± 15.4^a
Supplemented	1.35 ± 0.08^b	5.95 ± 0.45^b	4.60	54.8 ± 26.3^b

[a,b] Means with different superscripts within column are significantly different ($P<0.05$).

At kidding and weaning, the weight of kids born from supplemented goats was higher ($P<0.05$) than those of control (Table 2). At weaning, the total gain of kids of the supplemented group was almost double (4.60 kg) that of the control (2.44 kg). Also, the daily weight gain of kids from the supplemented group was higher ($P<0.05$) than that of the control.

Conclusions

Supplementary feeding with *L. leucocephala* and *C. calothyrsus* proved to be highly beneficial. It substantially increased the overall yield of milk per animal, milk protein content and growth of the supplemented animals during the dry season.

References

Leng, R.A. 2003. Draught and dry season feeding strategies for cattle, sheep and goats. Penambul Books, Queensland, Australia.

Pamo, T.E., F. Tendonkeng, J.R. Kana, B. Boukila and A.S. Nanda, 2006. Effect of *Calliandra calothyrsus* and *Leucaena leucocephala* supplementary feeding on goat production in Cameroon. *Small Rum. Res.* 65: 31–37.

Steel, R.C. and J.H. Torrie, 1980. *Principles and Procedures of Statistics*. New York, McCraw Hill Books.

Paper 24

Estimation of Genetic Parameters for Milk Production Test Day Records of Iranian Adani (Persian Gulf) Goats

Yazdanshenas, M.S.[1*], *M. Dashtizadeh*[2,3], *A. Ghotbi*[1] *& A. Nakisa*[1]

[1]*Bushehr Province Agricultural Jehad Organisation, Bushehr, Iran,* [2]*Institute of Applied Scientific Education of Jehad-E-Agriculture, Bushehr, Iran,* [3]*The Centre for Research in Agriculture and Natural Resources, Bushehr, Iran.*
[*]*Email of corresponding author: msyazdanshenas@yahoo.com*

Introduction

Adani dairy goat is one of the most important breeds in southern Iran. This breed is raised in the coastal areas of Persian Gulf in Bushehr province. In these areas, the climate is harsh due to high temperatures and humidity and the pasture is poor. Adani goats are maintained as household animals in intensive systems. This breed has suitable milk production characteristics and litter size and is well adapted to the harsh conditions and shortage of forage in the coastal areas. The lactation period in Adani goats is approximately 4 months and total milk production is between 120 to 180 kg. In dairy animals, genetic evaluation is based on test day yields. The advantage of the test day yields for genetic evaluation over accumulated values is that it is a more accurate estimate of environmental effects, and defines the contemporary groups and evaluates production traits more accurately (Van der werf et al., 1998). Several Studies have estimated the genetic parameters for milk production in goats (Bagnicka et al., 2004; Torres-Vazquez et al., 2009; Menéndez-Buxadera et al., 2010) but studies on genetic parameters in milk goats in Iran are scarce. There is no information on the milk production traits of Adani goats. The aim of this study was to estimate the genetic and phenotypic parameters for test day records of Iranian Adani goats under a multiple-trait test day model.

Materials and Methods

The data consisting of milk test day records of Iranian Adani goats collected between 2006 and 2012 were obtained from the Adani Goats Breeding Centre of Bushehr province, Iran. Records collected at approximately 15-day intervals of six tests were used for this analysis. From the data, 4093 test day records of 397 goats and daughters of 20 sires were extracted. Heritability, genetic and phenotypic correlations between test day records were estimated using the multiple-trait test day model as follows:

$$y_{ijkl} = YST_i + T_j + a_K + \sum_{n=1}^{2} DIM_{ijkl}^{n} + \sum_{n=1}^{2} b_{n+2} AGE_{ijkl}^{n} + e_{ijlk}$$

where, y_{ijkl} = test day records on milk yield, a_K = Random effect for animal, YST_i = fixed effect of year – season of test (season defined as spring, summer, autumn and winter), T_j = Kidding type (number of kids in kidding), DIM = fixed covariate of days in milk at test, AGE = fixed covariate of age at kidding and e_{ijlk} = residual error.

Variance components were estimated with restricted maximum likelihood (REML) method using the Wombat Software.

Results and Discussion

Heritability, genetic and phenotypic correlations between test day records are presented in Table 1. Heritability estimates for test day records ranged from 0.07 to 0.58 and were highest in the second half of lactation. Genetic correlations between test day records varied from 0.67 to 0.98. Genetic correlations between adjacent test day records were high (>0.9, averaging 0.94) and decreased as the distance between tests increased. Phenotypic correlations followed a similar pattern but were lower than the corresponding genetic correlations.

Table1. Heritability, genetic and phenotypic correlations between test day records of Adani goats

	[4]TD1	TD2	TD3	TD4	TD5	TD6
[4]TD1	**0.18**[1]	0.97[2]	0.86	0.93	0.76	0.67
TD2	0.74[3]	**0.07**	0.98	0.88	0.83	0.73
TD3	0.66	0.68	**0.37**	0.91	0.76	0.77
TD4	0.59	0.6	0.69	**0.39**	0.90	0.84
TD5	0.62	0.58	0.65	0.75	**0.28**	0.94
TD6	0.49	0.42	0.58	0.67	0.74	0.**58**

[1]Heritability (diagonal), [2]genetic (above diagonal) and [3]phenotypic (below diagonal). [4]TD, test day (number indicated day)

Figure 1. A typical Adani doe

References

Bagnicka, E., O. Distle, H. Hamman and M. Łukaszewicz, 2004. Heritabilities and genetic correlations between the dairy traits in goats estimated in first vs later lactations. *Anim. Sci. Pap. Rep.* 22 (2): 205–213.

Menéndez-Buxadera, A., A. Molina, F. Arrebola, M.J. Gil and J.M. Serradill, 2010. Random regression analysis of milk yield and milk composition in the first and second lactations of Murciano-Granadina goats. *J. Dairy Sci*. 93: 2718–2726.

Torres-Vázquez, J.A., M. Valencia-Posadas, H. Castillo-Juárez and H.H. Montaldo, 2009. Genetic and phenotypic parameters of milk yield, milk composition and age at first kidding in Saanen goats from Mexico. *Livestock Sci*. 126: 147–153.

Van der werf, J.H., M.D. Goddard and K. Meyer, 1998. The use of covariance function of milk production based on test day record. *J. Dairy Sci*. 81: 3300–3308.

Paper 25

Sexual Behaviour of Indigenous Does and Ewes under Mixed Flock System

Mondal, S.K., H.C. Joshi, B.H.M. Patel[*]*& T. Dutt*

Division of Livestock Production and Management, Indian Veterinary Research Institute, Izatnagar, Uttar Pradesh 243 122 India
[*]*Email of corresponding author: mpatellpm@gmail.com*

Introduction

Next to poultry, sheep and goats are the main source of animal proteins to the meat-eating population in India. Reproductive success is a must for production of viable offsprings and their subsequent growth to increase production of meat. Due to their capability to adapt to a wide range of climatic diversities, sheep and goats are traditionally being reared in Indian subcontinent under the mixed flock system. There is a paucity of published information on the goat and sheep sexual behaviour, although it plays a vital role in successful reproduction in these ungulates, specifically under mixed flock system. Therefore, in the present study, the sexual behavioural signs and activities were documented and compared in indigenous does and ewes maintained under mixed flock system.

Materials and Methods

A total of 265 mating sessions were meticulously observed, both manually and videographically, in goats (n = 3 bucks and 30 does) and sheep (n = 3 rams and 27 ewes). All experimental animals were apparently healthy and showed general appearance and vigour favourable for successful sexual activity. The feeding and management during the observation period (3 months) were kept identical. The overt physical signs shown and behavioural activities accomplished by females (Hafez, 1969) during courtship, mating and post-mating were recorded and the data analysed for comparison between does and ewes.

Results and Discussion

Among the six prominent overt signs of female courtship, swollen vulva was the most common in both does (93.8%) and ewes (96.9%). More does moved away from the male on first male exposure (65.6 vs. 20.0%; $P<0.01$), while more ewes rubbed their necks and bodies with males (37.5 vs. 88.4%; $P<0.01$) and placed their noses under males' flank (31.3 vs. 76.5%; $P<0.01$). The morning hours (05:00–09:00 h) were the most preferred time for mating for both does and ewes. The highest frequency of pre-mating activities was tail fanning (59.8 vs. 4.2; $P<0.01$) in does and turning head back (6.2) in ewes. During mating, standing still to allow mounting was the most frequent activity for both does and ewes (2.2 vs. 3.3). Post-mating urination was the most frequent activity in does and ewes (1.4 vs. 1.2). The longest pre-mating activity was clustering of male for both goats and sheep (17.2 sec vs. 83.7 sec; $P<0.05$). The longest pre-mating activity recorded was urination for both does and ewes (1104.5 sec vs. 1616.0 sec). Becoming stationery to allow males to mount was found to have the longest activity during mating for both does and ewes. After mating, squatting was the longest activity for both does and ewes.

It is concluded that does and ewes showed similar sexual behaviour patterns during pre-coital, coital and post-coital stages under mixed flock system.

References

Hafez, E.S.E., 1969. The Behaviour of Sheep and Goats. In: *The Behaviour of Domestic Animals*, 2nd Ed., Billiere, Tindell and Cassell, London.

Paper 26

Genetic and Phenotypic Parameter Estimates for Birth Weight in Iranian Indigenous Goats

Shamshirgaran, Y.[*] *& M. Tahmoorespur*

Animal Science Department, College of Agriculture, Ferdowsi University of Mashhad, Mashhad, Iran
[*]*Email of corresponding author: yas.shamshirgaran@gmail.com*

Introduction

Goat production is one of the key elements contributing to the economy of farmers living in the arid and semi-arid regions of Iran. Rapid growth during the early period can minimise the cost of rearing and thus provide more profit to the farmer. The birth weight and early growth rate of animals are determined not only by genetic potential but also by maternal and environmental factors (Mandal et al., 2006). The objective of this study was to examine the factors affecting birth weight in Iranian indigenous breed.

Materials and Methods

Data on performance and pedigree information used in this study were collected from Iranian indigenous Cashmere goats. Initially records without date of birth or weights were eliminated. Finally, the birth records of 814 goats, having the information of pedigree were used for the analysis. Breeding values for birth weight were estimated for all 814 animals using the best linear unbiased prediction (BLUP) based on an animal model with a relationship matrix. To identify fixed effects to be included in the models, a least square analysis was conducted using the General Linear Model (GLM) procedure (SAS Institute Inc., 2001). This was performed with a model which included the fixed effects of year of birth (7 classes), litter size (3 classes), sex (2 classes) and kidding parity (4 classes). All of these fixed effects were significant (P<0.001) for birth weight, and were then included in the model (Table 1). Estimation of variance and covariance components was obtained by restricted maximum likelihood (REML) using a derivative-free (DF) algorithm by fitting an animal model (Meyer, 1989). Convergence was assumed when the variance of likelihood values was less than 10^{-8}. In addition, a restart of each analysis was performed with different starting values to attempt to avoid convergence to local maxima. The general representation of the animal model used was as: $Y = Xb + Zu + e$, where Y was a n × 1 vector of records, b denoted a vector of fixed effects in the model with an association matrix X, u was the vector of direct genetic effects with an association matrix Z and e denoted the vector of residual (temporary environment) effects. The variance-covariance structure for the model was as follows,

$$V\begin{pmatrix} u \\ e \end{pmatrix} = \begin{pmatrix} A\sigma_u^2 & 0 \\ 0 & Ie\sigma_e^2 \end{pmatrix}$$

where *A* was the numerator relationship matrix, σ_u^2 was direct genetic variance and σ_e^2 was variance due to residual effects.

Results and Discussion

All fixed effects studied in this study had significant effect on birth weight of kids. Litter size had significant effect on birth weight and mean birth weight declined with larger litter size. Due to maternal effects, dams with higher kidding parity had heavier kids. Male kids were significantly heavier than female kids. The high variation in birth weight among the kidding years might have been resulted from the changes in management, climate and sample size. These findings are in agreement with the results reported in other goat breeds (Valencia et al., 2007; Zhang et al., 2009). The estimate of direct additive heritability of 0.23 ± 0.12 for birth weight in Iranian indigenous Cashmere goats found in the present study was lower than the reported estimates in other goat breeds (Zhang et al., 2009). This study had a smaller sample size and fitted a model which did not consider the maternal genetic effect and permanent maternal environmental effect.

As a conclusion, the fixed factors such as kidding parity and litter size of dam, kidding year and sex of kids are important for birth weight trait in Iranian indigenous Cashmere goat breed, and should be fitted in the models.

Table 1. Birth weight for litter size, kidding parity, sex and year of birth of kids of the Iranian indigenous Cashmere goats

Fixed effect	N	LSM ± SE	Fixed effect	N	LSM ± SE
Litter size			Sex		
1	507	2.30 ± 0.027[a]	Female	407	1.85 ± 0.033[a]
2	261	1.96 ± 0.031[b]	Male	407	2.04 ± 0.031[b]
3	46	1.57 ± 0.062[c]	Year of birth		
Kidding parity			2000	119	1.77 ± 0.050[e]
1	375	1.82 ± 0.029[a]	2001	177	2.11 ± 0.042[a]
2	268	1.92 ± 0.030[bcd]	2002	228	1.91 ± 0.034[cde]
3	145	1.99 ± 0.040[bcd]	2004	33	1.89 ± 0.072[cde]
4	26	2.04 ± 0.079[bcd]	2005	91	2.05 ± 0.049[abc]
			2006	119	1.99 ± 0.040[bcd]
			2007	47	1.88 ± 0.058[cde]

[abcde]Means with different superscripts within each fixed effect were significantly different at *P*<0.05. N, number of records; LSM, least-square means; SE, and standard errors

References

Mandal, A., F.W.C. Neser, P.K. Rout, R. Roy and D.R. Notter, 2006. Estimation of direct and maternal (co) variance components for pre-weaning growth traits in Muzaffarnagari sheep. *Livestock Sci.* 99: 79–89.

Meyer, K. 1989. Restricted maximum-likelihood to estimate variance-components for animal models with several random effects using a derivative-free algorithm. *Genet. Sel. Evol.* 21: 317–40.

Valencia, M., J. Dobler and H.H. Montaldo, 2007. Genetic and phenotypic parameters for lactation traits in a flock of Saanen goats in Mexico. *Small Rum. Res.* 68: 318–322.

Zhang, C.Y., Y. Zhang, D.Q. Xu, X. Li, J. Su and L.G. Yang, 2009. Genetic and phenotypic parameter estimates for growth traits in Boer goat. *Livestock Sci.* 124: 66–71.

Lead Paper 3

Taurine-Rich Goat Milk

Gupta, R.C.

SASRD Nagaland University, Medziphema 797106 India
Email of corresponding author: guptaramesh994@gmail.com

Introduction

Traditionally goat milk served as part of daily diet for the rural family but has fast becoming a health food for the sick and wealthy in the cities. Goat milk is reported to contain significant quantity of various immune-protective proteins, essential minerals, omega acids and large quantities of vitamins (Tommaso et al, 2004; Belewu and Adewole, 2009). In addition, the presence of free amino acids in goat milk, not required for protein synthesis of the host animal is also important for human health. Many of the free amino acids are integral part of several life processes and one of such free amino acids is Taurine. Taurine is a sulfur-containing amino acid and is chemically known as 2-aminoethanesulfonic acid. The concentration of taurine in goat milk is 20-fold higher than in cow milk and almost equal to that in human milk. Although colostrum from cows contains high concentration of taurine, it is still lower than that in goat milk. As a result, commercial milk formula is often enriched with taurine to increase its content. On the other hand, newborns and infants fed on goat milk do not need additional taurine since its content in the goat milk is almost similar to that in mothers' milk (Park et al., 2007).

Taurine is well-recognised to be beneficial to almost all life processes in the body, it is increasingly becoming an important component of food and nutraceuticals (Gupta and Kim, 2003; Gupta et al., 2005; Gupta et al., 2009).

Taurine content in Goat Milk Products

Goat milk at all stages of lactation has a high content of taurine. Among the dairy products from goat milk, whey has the highest taurine content, while cheese contains 12.5 to 16.5%. Taurine in milk products is not affected by high temperature treatment as cheese from the Cacioricotta goat milk produced by heating milk to 95 °C remained higher in taurine. In addition, taurine content in milk products does not vary with fermentation and storage period (Pasqualone et al., 2003).

Taurine Biological Action and as Components of Functional and Nutraceuticals

There is increasing evidence that sulfur amino acids (SAAs) play an important metabolic and functional role in human health and disease prevention. The SAAs also provide elemental sulfur required for growth and development, and are good sources of energy and nutrient need for various life processes.

It is possible and feasible to modulate body functions for better health by consumption of food rich in taurine. Taurine can contribute to many aspects of health, for example it has liver protection, cardio protection, retino protection and bone loss prevention activities. In addition it could act as anti-cancer, anti-bacteria, anti-diabetes, anti-aging, anti-inflammatory, anti-hypertension, anti-oxidant, anti-craving agents. It also contributes to bile salt formation. The mode of action by taurine in the prevention of diseases is suggested to be as follows:

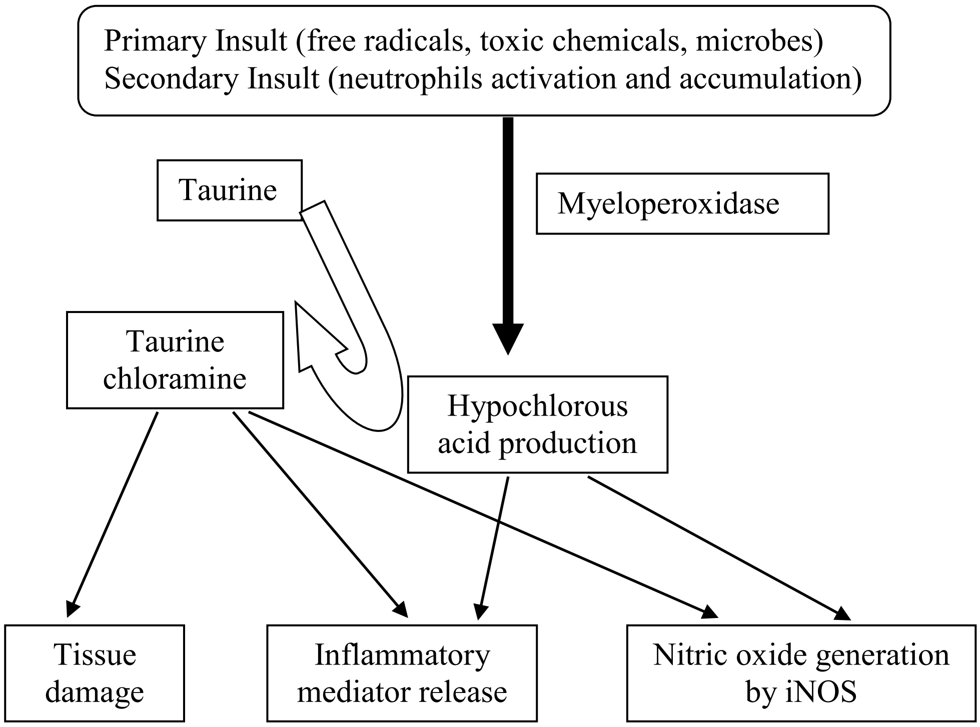


Figure 2: Role of taurine in disease prevention.

Conclusions

Goat milk riched in taurine or taurine- supplemented food and formula can provide long term beneficial effects to general health of humans.

References

Belewu, M.A. and A.M. Adewole, 2009. Goat Milk: A Feasible Dietary Based Approach to Improve the Nutrition of Orphan and Vulnerable Children. *Pakistan J. Nutr.* 8 (10): 1711–1714.

Gupta R. C. and S.J. Kim, 2003. Role of Taurine in organs' dysfunction and in their alleviation. *Crit. Care Shock* 6: 171–177.

Gupta, R.C., M. D'Archivio and R. Masella, 2009. *Taurine as drug and functional food component; Glutathione and sulfur Amino Acids in human health and disease*. John Wiley and Sons, Inc., Philadelphian, USA, pp. 543–578.

Gupta, R.C., T.Win and S. Bittner, 2005. Taurine analogues, a new class of Therapeutic: Retrospect and prospects. *Curr. Med. Chem*. 12: 2021–2039.

Park, Y.W., M. Ju´arez, M. Ramosc and G.F.W. Haenlein, 2007 Physico-chemical characteristics of goat and sheep milk. *Small Ruminant Res.* 68: 88–113.

Pasqualone, A., F. Caponio and M.T. Bilanciam, 2003 Distribution of taurine during cheese-making from goat milk. *Milchwissenschaft* 58: 619–621.

Tommaso, R.I., I.D. Catal, T. Giovanni and B. Giuliana, 2004. Improved determination of taurine by high-performance anion-exchange chromatography with integrated pulsed amperometric detection (HPAEC-IPAD) *Anal. Bioanal. Chem.*378 (3): 804–810.

Paper 27

"Feed less Food" – Effect of a Low Concentrate Diet on Milk Quality, Milk Fatty Acid Composition and Performance of Dairy Goats

Georg, H. *, *K. Sporkmann, S. Bender, G. Ude & G. Rahmann*

Thunen-Institute of Organic Farming, Trenthorst 32, D-23847 Westerau, Germany
Email of corresponding author: heiko.georg@vti.bund.de

Introduction

More than a third of the world's grain harvest is used to feed animals. According to the environmental agency of the United Nations, losses of calories by poor conversion efficiency of grain into animal food could theoretically feed 3.5 billion people (McIntyre, 2009). This shows that the production of animal protein is very energy consuming, especially when concentrates are fed to ruminants. Consequently, a major goal is to explore the potential of dairy goats for producing high quality milk in an extensive system but in an ecological friendly way.

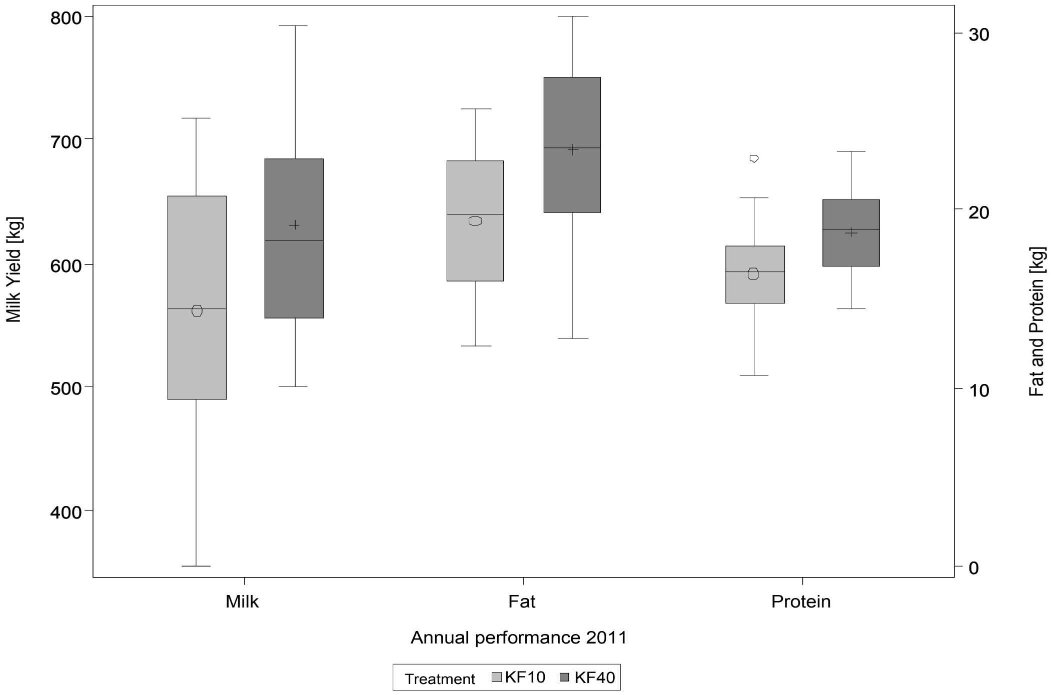
Ruminants can be divided into three categories based on their feeding behaviour: concentrate selectors (CS), grass and roughage grazers (GR) and intermediate feeders (IM) (Hofmann, 1989). CS feeders include deer and elk, whereas cattle and sheep are all grazers. Goats together with chamois, red deer, fallow deer belong to the IM feeders. IM feeders are able to browse bushes and even trees besides consuming traditional ruminant diets. Goats are generally very selective in choosing feed of the highest quality, thereby optimising the quality of their roughage diet. Due to their anatomical advantages and excellent roughage conversion efficiency, goats are destined to produce high quality milk at a minimum amount of concentrates in their ration. Thus, the objective for this study was to measure the effects of a low concentrate diet on fatty acid composition and milk yield of dairy goats.

Materials and Methods

In 2011, 50 dairy goats of our experimental herd were divided into two homogenous groups of 25 goats each based on parity, milk yield and body weight. One group (KF10) was fed according to the Bio Suisse guidelines with 10% concentrate and the other group (KF40) in accordance with the requirements of the EC regulation on organic farming with a 40% concentrate in the ration. The concentrate consisted of 100% wheat grist. Mineral licks were made available to the animals. Limited grazing was offered to both groups during the growing season. During the entire lactation period, the herds were extensively monitored, which include recording of monthly milk production and bodyweight change, biweekly feed sampling (concentrate, hay and fresh grass). In addition, milk samples were taken weekly to assess milk composition. Data were statistically analysed using SAS 9.3 (SAS Institute Inc.). Test of normality was done by calculating Shapiro-Wilk-test (proc univariate). Where appropriate, Student's *t*-test or non-parametric test procedures were used to compare group means, box-whisker plots were created to illustrate data distributions.

Results and Discussion

Figure 1 shows the annual milk yield, fat and protein contents. The fatty acid compositions are of monthly samples. Milk yield of KF10 was 68.8 kg, and fat and protein contents were 4.1 and 2.4 kg, respectively lower compared to those of KF40. The annual amount of concentrates for KF10 was 66 kg/goat, whereas it was 259 kg/goat for KF40.



Suisse guidelines (KF10) and EC regulation on organic farming (KF40)

Conjugated linolenic acid (CLA, C18: 2 c9t11), as an example of fatty acids analysed in this study, was higher in KF10 throughout the whole lactation period (Figure 2). Body weight was significantly lower for KF10 during the last three months of lactation. Health status, checked regularly for both groups, did not show any difference. The results indicate that less concentrate feeding is feasible. Future studies should quantify selective abilities of goats as a base of breeding selection.

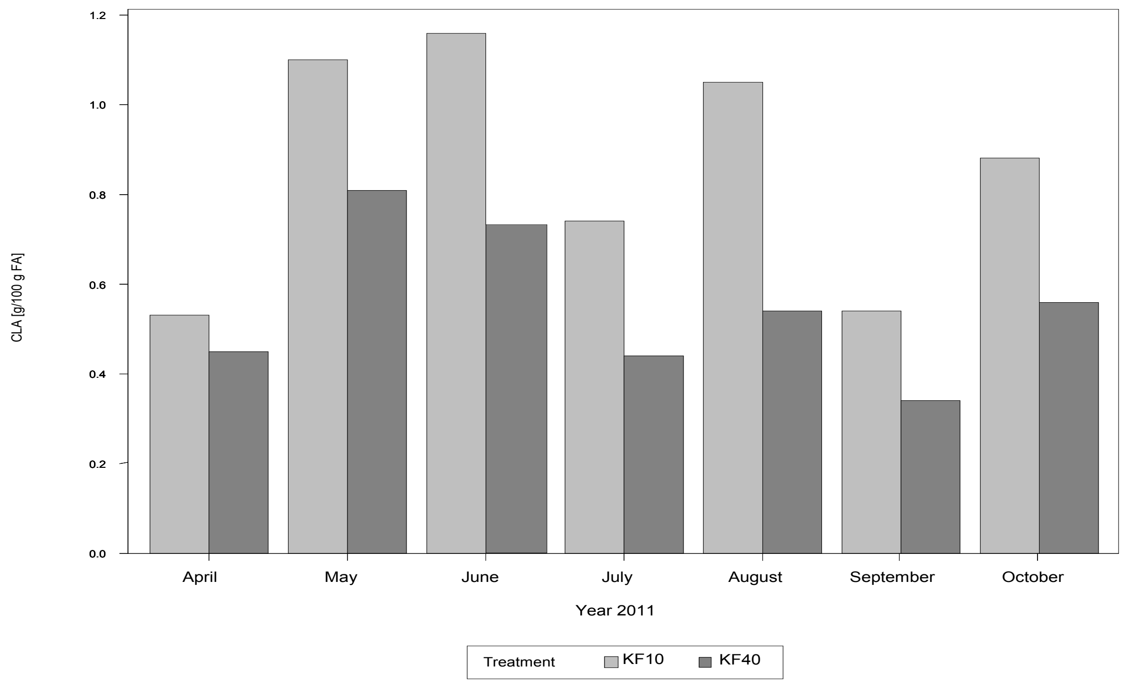


Figure 2. Conjugated linolenic acid content in milk of goats fed according to Bio Suisse guidelines (KF10) and EC regulation on organic farming (KF40)

References

Hofmann, R.R., 1989. Evolutionary steps of ecophysiological adaptation and diversification of ruminants: a comparative view of their digestive system, *Oecologia* 78 (4): 443–457.

McIntyre, B.D., 2009. *International Assessment of Agricultural knowledge, Science and Technology for Development: Agriculture at a crossroads*. Global report. Washington, DC: Island Press.

Paper 28

Comparative Studies of Milk Components of West African Dwarf Goats and Sheep

*Agbede, J.O. & N.A. Fajemisin**

Department of Animal Production and Health, Federal University of Technology Akure, Nigeria
**Email of corresponding author: debofajemisin@yahoo.co.uk*

Introduction

Dairy and dairy products are important food components especially for infants, school children and other protein vulnerable population. Unfortunately these products are in short supply in under-developed countries. In Nigeria less than 20% of protein intake is of animal origin compared to about 70% in the United States (Onu and Okongwu, 2006). In Nigeria, cow is the traditional dairy animal while goats and sheep are kept for meat, hide and skin. There are 12.2 million cattle, 13.2 million sheep and 26.0 million goats in Nigeria (Olukunle and Agbede, 2010). Despite all these, Nigeria continues to depend on imported dairy products which continue to deplete her limited foreign reserves. A viable solution is to exploit local resources to enhance dairy production. Information on milk composition in Nigeria deals largely with cattle (Adeneye, 1989) with limited information on goat milk (Akinsoyinu et al., 1977). The objective of this study was to compare the milk composition of West African Dwarf goats and sheep with a view to popularising goat milk consumption among the low income earners in peri-urban cities of Nigeria.

Materials and Methods

Four lactating West African Dwarf (WAD) does and four ewes between 1½ to 2½ years old of unknown parity were used for the study. The animals were allocated to the trial at 3 weeks after parturition and were raised on a semi-intensive system provided with cassava peels supplemented with *Morus alba*. Hand milking was done at 06.00 h thrice per week on the designated milking days to collect milk samples for 10 weeks. The milk samples collected were immediately stored at -5°C prior to analysis. Milk samples were analysed for total solids, fat, crude protein, lactose and total ash while the solid-not-fat (SNF) were calculated as the difference between the total solids and fat composition of the milk. The concentrations of Ca, Mg, P, Na and K were determined and all data collected were subjected to Student's *t*-test.

Results and Discussion

Milk composition of the WAD goats and sheep are presented in Table 1. There were no significant ($P>0.05$) differences for any of the parameters measured between goats and sheep except for K concentration. However, total solid, solid-not-fat, fat and lactose contents in goat milk were numerically higher than those in sheep milk, thus suggesting that goat milk could be of better source of dietary energy but not for protein than sheep milk. The present data were comparable to those reported for other breeds of goats and sheep (Akinsoyinu et al., 1977). The results also indicated that among all the minerals analysed, only K concentration was significantly (*P*<0.05) influenced by species effect. Generally, the values of the macrominerals recorded in this study compared favourably with those reported for goat milk by Akinsoyinu and Akinyele (1979).

Table 1. Milk composition of WAD goat and their interrelationships

Parameters	WAD goat	WAD sheep
Total Solid (g/kg)	156.1 ± 2.05	147.2 ± 1.41
Solid Not Fat (g/kg)	114.2 ± 2.12	112.3 ± 1.21
Protein (g/kg)	42.7 ± 1.01	48.8 ± 0.41
Fat (g/kg)	40.2 ± 1.02	36.9 ± 1.38
Lactose (g/kg)	56.6 ± 1.30	55.5 ± 1.18
Ash (g/kg)	7.9 ± 0.97	8.3 ± 0.14
Fat/SNF ratio	0.35 ± 0.13	0.33 ± 0.15
Protein/Fat ratio	1.06 ± 0.31	1.32 ± 0.21
Calcium (mg/100 mL)	128.41 ± 12.40	128.51 ± 12.01
Magnesium (mg/100 mL	22.11 ± 10.31	24.7 ± 7.37
Phosphorus (mg/100 mL)	69.97 ± 5.11	69.81 ± 7.12
Sodium (mg/100 mL)	71.31 ± 8.12	61.66 ± 3.13
Potassium (mg/100 mL)	126.13^{a} ± 10.31	115.66^{b} ± 10.81

[ab]Means in the same row with different superscripts differ significantly (*P*<0.05)

References

Akinsoyinu, A.O., A.U. Mba and R.O. Olubajo, 1977. Studies of milk yield and composition of West African Dwarf goats in Nigeria. *J. Dairy Res*. 46: 57–62.

Akinsoyinu, A.O. and I.O. Akinyele, 1979. Major elements in the milk of West African Dwarf goats as affected by stage of lactation. *J. Dairy Res*. 46: 427–431.

Onu, P.N. and S.N. Okongwu, 2006. Performance characteristics and nutrient utilisation of starter broilers fed raw and processed pigeon pea (*Cajanus cajan*) seed meal. *Int. J. Poult. Sci.* 5 (7): 693–697.

Olukunle, O.J. and J.O. Agbede, 2010. Integrated Approach to Food Security in Nigeria. *JoST* 1 (1): 92–106.

Adeneye, J.A., 1989. Variation in yield composition of milk from different quarters of lactating white Fulani cattle in tropical environment. *Nig. J. Animal Prod.* 16: 8–15.

Paper 29

Introduction of Goat Milk Pasteurisation Equipment to the Etawah Crossbred Dairy Goat Farmers in East Java Province, Indonesia

Anam, C., J. Riyanto & A.A. Rofiq*

Sebelas Maret University, 57126 Surakarta, Indonesia
**Email of corresponding author: jokoriyanto19@yahoo.com*

Introduction

An important characteristic of goat milk is the unique „goaty' flavour which is attributed to the different fatty acids and the relatively higher proportions of short and medium chain fatty acids in goat milk (Tziboula-Clarke, 2003). Jandall (1996) reported that the composition of goat milk as: 3.80% fat, 8.68% solid-non-fat, 4.08% lactose, 2.90% protein, 2.41% casein, 0.43% whey proteins, 0.79% total ash, 0.194% Ca, and 0.270% P, while recently Pall et al. (2011) showed that goat milk contained 4–4.5% fat, 3.2% lactose, 4.6% protein, 0.129% Ca, and 0.106% P.

In East Java, goat milk has not been fully utilised because of the lack of milk processing equipment at farm level; hence almost all the milk produced is for the consumption of the kids. It is often that the kids are unable to consume all the milk, resulting in incomplete milk let down and retention in the udder. Also goat milk has short shelf life and therefore availability of proper processing and storage equipment at the farm level is needed to preserve its quality to market it for human consumptions (Susilorini and Sawitri, 2002). The objective of this study was to determine the effect of introducing milk pasteurisation, simple cup-sealer equipments and training of the goat farmers on the production of pasteurised goat milk. Capacity building of farmers in Ngambe Ngawi district to produce dairy products from goat milk was also conducted.

Materials and Methods

Training on milk pasteurisation was held for the Etawah crossbred dairy goat farmers in the Ngambe Ngawi district, East Java Province, Indonesia. Twenty-five farmers, having a total of 70 heads of Etawah crossbred goats with an average milk production of 1.05 (0.75 to 1.25) litre/head/day, were selected for the study. Milk pasteurisation equipment, cup-sealer and training in handling the equipment and in dairy goat management were provided to the above farmers.

The milk pasteurisation equipment had a capacity of 30 litres per batch and this equipment was easy to operate because it is regulated using several simple keys. It is also easy to maintain. The main function of this equipment was to pasteurise goat milk to produce a "commercially sterile" product (Winarno, 1994). Goat milk was pasteurised at a temperature of 65–70^{o}C for 30–40 minutes. Participants were trained to operate and maintain the milk pasteurisation equipment. Functions of each component and on how to use them were explained. To increase the income of farmer, the participants were also trained to make different dairy products such as beverages, candy, "dodol" and caramel.

Results and Discussion

All participants were able to use the milk pasteurisation equipment and the cup sealer but only 25% of the participants could make dairy products. In order to increase milk production and farmers' income and to enhance the flavour of milk as demand by the community, it was suggested that goat milk must be pasteurized and dairy products such as "dodol", ice cream and candy milk should be introduced (Winarno and Fernandez, 2007). The study showed that after the training, the participants were capable to use the milk pasteurisation equipment properly and made dairy products from goat milk.

Conclusions

Introduction of milk pasteurisation equipment and training on making goat milk products had shown to be beneficial to the farmers. After taking the training, the farmers were able to create new businesses. In addition to pasteurised milk, farmers could produce fruit syrup, "dodol", ice cream and candy from goat milk.

References

Jandal, J.M., 1996. Comparative aspects of goat and sheep milk. *Small Ruminant Res.* 22: 177–185.

Pall, U.K., P.K. Mandal., V.K. Rao and C.D. Das, 2011. Quality and Utility of Goat Milk with Special Reference to India: An Overview**.** *Asian J. Anim. Sci.* 6 (1): 56–63. ISSN 1819–1878.

Susilorini, T.E. and M.E. Sawitri, 2002. Processed Milk Products, Publishing of Swadaya, Jakarta.

Tziboula-Clarke, A., 2003. *Encyclopedia of Dairy Science*. Vol. 2, Academics Press, California, USA.

Winarno, F.G., 1994, *Commercialsterilisation of food products*, Gramedia Pustaka Utama, Jakarta.

Winarno, F.G. and I.E. Fernandez, 2007. *Milk and fermentation products*, M-Brio Press, Bogor.

Paper 30

Conjugated Linoleic Acid (CLA) Content in Ferment Goat Milk

Indratiningsih, S. Djojowidagdo, Z. Bachruddin & B.P. Widyobroto*

Faculty of Animal Science, Gadjah Mada University
Jl. Fauna. No.3, Kampus UGM, Bulaksumur, Yogyakarta, 55281 Indonesia.
**Email of corresponding author: indrati_sp@yahoo.com*

Introduction

Animal food products, particularly dairy products are rich in conjugated linoleic acid (CLA). CLA have anti-carcinogenic, atherosclerosis-inhibiting and body fat reducing properties and hence its consumption is considered to have health benefits. The aim of this study was to investigate the effect of fermentation using *Lactobacillus bulgaricus* FNCC 041 on changes in CLA content in goat milk.

Materials and Methods

Milk samples were collected from goat farms in Yogyakarta, Indonesia and the cell culture used for this study was *L. bulgaricus* FNCC 041. Chemical composition including protein, lactose and fat were determined using the procedure of AOAC (1990) and CLA was determined as per Lin et al. (1999). Fermented goat milk was made from 3.0 and 5.0% starter *L. bulgaricus* and incubated at 37 °C until pH reached between 4.5 and 5.0. The chemical composition and CLA content of fermented milk products were determined.

Results and Discussion

The chemical composition of goat milk was: 86.9% water, 4.50% fat, 3.82% lactose and 3.09 mg CLA/g fat. The chemical composition of the fermented goat milk with *L. bulgaricus* starter 3.0 and 5.0% was: 13.15 and 13.25% total solids; 4.5 and 4.5% fat; 3.39 and 3.40% lactose; and 3.22 and 3.26 mg CLA/g fat, respectively. The results demonstrate that the fermentation process increased the CLA content of goat milk from 3.09 mg/g fat in fresh milk to 3.26 mg/g fat in fermented milk.

References

AOAC, 1990. Official methods of analysis of the Association of Official Analytical Chemist, Washington D.C.

Lin, H., T.D. Bolyston, L.O. Leudeche and T.D. Schultz, 1999. Conjugated Linoleic Acid Content of Cheddar type cheeses as Affected by Processing. *J. Food Sci*. 64 (5): 874–878.

Paper 31

Composition and Quality of Hand- and Machine-Milked Goat Milk

Nakthong, S.[1, 2]

[1]*Department of Animal Science, Faculty of Agriculture at Kamphaeng Saen, Kasetsart University, Kamphaeng Saen Campus, Nakhon Pathom, 73140 Thailand*
[2]*Animal Produce R and D Centre, Suwanvajokkasikit Animal R and D Institute, Kasetsart University, Kamphaeng Saen Campus, Nakornpathom, 73140 Thailand*
Email of corresponding author: agrsas@ku.ac.th

Introduction

The required quality of raw goat milk for food processing has been established in Thailand by the Thai Agricultural Commodity and Food Standard (TACFS) to ensure its safety for consumption. Quality of raw goat milk is defined by its milk composition, somatic cell and microorganism counts. Among the factors that affect quality of raw goat milk is milking management. In Thailand, most dairy goat farms are milked by hand, although some farms, because of large goat populations and limited number of workers practice machine-milking. It is possible that the different methods of milking affect milk quality. Therefore, the aim of this research was to compare the composition and quality of raw goat milk obtained by hand and machine milking.

Materials and Methods

Twenty healthy Crossbred (Native x Saanen) dairy goats aged 2 to 3 years in mid-lactation were used in the study. All animals were fed and managed under similar conditions. The goats were randomly divided to two groups of equal number (n = 10): group 1, hand milking and group 2, machine milking. The goats were milked once daily for six weeks and the milk composition analysed for Standard Plate Count (SPC), Somatic Cell Count (SCC) (Lacto Scan 90: Milkotronic Ltd., Bulgaria) (APHA, 1992) and microorganism counts (Marshall, 1993). Fat, protein and lactose contents were also determined. Methylene blue reduction and resazulin tests were conducted on the milk samples. A 500 mL raw goat milk sample was collected from each animal in a sterile bottle and stored at 4 ºC. Milk samples were collected every week and samples were analysed within 4 hours after collection to minimise microorganism proliferation. The differences in values between two groups were compared by Paired Sample *t*-test.

Results and Discussion

The result (Table 1) shows that milk fat in hand milked samples were higher than that in the milk obtained by using machine milking at weeks 1, 3, 4 and 6 (P<0.05). Fat composition of milk depends on feed, breed, lactation and the milking season (Ljutovac et al. 2008). Generally milk obtained by hand milking had higher fat content than those obtained by machine milking. At weeks 1 and 3, the milk protein compositions were significantly higher

(*P*<0.05) in hand-milked than in machine-milked samples. The lactose content of the milk however did not differ between groups (*P*>0.05).

At each sampling, the SPC of hand-milked samples were lower than in those obtained by machine milking. Since the SPC is dependent on cleanliness in farm, animal body, milking hygiene and contaminations, results of this study agree with those of Zeng and Escobar (1996) who suggested that milk obtained by hand milking is cleaner than machine milked.

Table 2 shows that in general, hand-milked milk samples, except for week 1, took longer time for the colour to change in the methylene blue reduction test. The methylene blue test is based on the rate of disappearance of the colour in milk due to addition of the methylene blue. The removal of the oxygen from milk and the formation of reducing substances during bacterial metabolism caused the colour to disappear (Atherton and Newlander, 1977). The Resazulin test (one-hour test) showed milk obtained by hand milking was of higher grade than that obtained by machine milking. Like the methylene blue reduction test, the quality of milk is based on the colour produced after a stated period of incubation or time required to reduce the dye to a given end-point (Atherton and Newlander, 1977). The Thai Agricultural Standard (TAS 6006-2008) (TACFS, 2008) recommended a 4-hour methylene blue reduction test or one-hour resazulin test with minimum grade 4.5 for goat milk. The study showed that at each week, the SPC of samples from hand milking was lower than that from machine milking. The SPC depends on farm cleanliness, animal body, hygiene of milking and related materials. The TAS 6006-2008 also recommended that the SPC of raw goat milk should not exceed 5 x 10^5 cfu/mL.

The SCC in milk obtained using machine was lower than that in milk obtained using hand. This observation does not agree with that of Zeng and Escobar (1996) who reported that there was no significant effect of milking method on SCC. The SCC is an indicator of herd health, which directly affects milk production. In fact, Ying et al. (2002) reported that raw goat milk with SCC >10^6cell/mL suggests that the goat is either in good health or has subclinical mastitis.

The coliform count was higher in milk obtained by machine milking than by hand milking. This is in agreement with the results obtained using the methylene blue reduction and resazurin tests and the SPC data. The coliform test is a measure of the sanitary practices in the control bacterial contamination of dairy and dairy products. The TAS 6006-2008 recommends that the coliform count of raw goat milk should not exceed 10^4 cfu/mL.

Table1. Raw goat milk composition of hand- and machine-milked samples

	Milking	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
Fat (%)	Hand	4.75^{a} ± 0.24	4.72^{a} ± 0.18	4.71^{a} ± 0.06	3.90^{a} ± 0.42	4.60^{a} ± 0.12	4.43^{a} ± 0.74
	Machine	3.50^{b} ± 0.03	5.06^{a} ± 0.08	3.32^{b} ± 0.14	3.49^{b} ± 0.10	4.39^{a} ± 0.06	3.90^{b} ± 0.33
Protein (%)	Hand	4.01^{a} ± 0.03	3.89^{a} ± 0.14	3.92^{a} ± 0.02	3.67^{a} ± 0.05	3.85^{a} ± 0.02	3.83^{a} ± 0.24
	Machine	3.72^{b} ± 0.02	3.92^{a} ± 0.01	3.60^{b} ± 0.01	3.64^{a} ± 0.02	3.77^{a} ± 0.10	3.78^{a} ± 0.23
Lactose (%)	Hand	4.09 ± 0.02	4.00 ± 0.12	4.02 ± 0.03	3.92 ± 0.03	3.98 ± 0.02	3.99 ± 0.13
	Machine	4.01 ± 0.07	4.06 ± 0.05	3.94 ± 0.10	3.95 ± 0.03	3.94 ± 0.04	4.02 ± 0.15
Solid not fat (%)	Hand	8.83^{a} ± 0.04	8.61^{a} ± 0.28	8.68^{a} ± 0.06	8.27^{a} ± 0.05	8.53^{a} ± 0.03	8.54^{a} ± 0.38
	Machine	8.42^{b} ± 0.03	8.70^{a} ± 0.02	8.21^{b} ± 0.03	8.26^{a} ± 0.02	8.41^{a} ± 0.02	8.50^{a} ± 0.41
pH	Hand	6.66^{a} ± 0.08	6.76^{a} ± 0.06	6.50^{a} ± 0.03	6.55^{a} ± 0.02	6.55^{b} ± 0.01	6.66^{a} ± 0.08
	Machine	6.57^{b} ± 0.03	6.77^{a} ± 0.02	6.64^{a} ± 0.03	6.62^{a} ± 0.01	6.6^{a} ± 0.01	6.57^{b} ± 0.03
Total acidity (%)	Hand	0.253^{a} ± 0.19	0.227^{a} ± 0.16	0.264^{a} ± 0.17	0.271^{a} ± 0.12	0.268^{a} ± 0.20	0.253^{b} ± 0.19
	Machine	0.267^{a} ± 0.21	0.231^{a} ± 0.11	0.235^{b} ± 0.15	0.241^{b} ± 0.18	0.264^{a} ± 0.25	0.267^{a} ± 0.21
Specific gravity	hand	1.031^{a} ± 0.001	1.031^{a} ± 0.001	1.031^{a} ± 0.001	1.029^{a} ± 0.001	1.030^{b} ± 0.001	1.031^{a} ± 0.001
	Machine	1.032^{a} ± 0.001	1.030^{a} ± 0.001	1.029^{b} ± 0.001	1.029^{a} ± 0.001	1.032^{a} ± 0.001	1.031^{a} ± 0.001

Values are mean ± SD
^{a,b}Means in the same column between methods milking (hand and machine) with different superscripts differ significantly
(*P*<0.05)

Table2. Raw goat milk biological characteristics of hand- and machine-milked samples

	Milking	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
Methylene blue (hour)	Hand	4.0^{b} ± 2.11	6.0^{a} ± 0.01	5.65^{a} ± 0.41	5.85^{a} ± 0.47	4.1^{a} ± 0.01	4.6^{a} ± 2.11
	Machine	4.6^{a} ± 0.52	5.0^{b} ± 0.01	4.8^{b} ± 0.42	5.15^{b} ± 0.34	4.0^{a} ± 0.32	4.0^{b} ± 0.52
Resazulin (grade)	Hand	4.0^{a} ± 1.83	5.9^{a} ± 0.32	4.7^{a} ± 0.32	3.8^{a} ± 0.42	4.4^{a} ± 0.70	4.0^{a} ± 1.83
	Machine	3.9^{a} ± 0.32	5.0^{b} ± 0.01	4.1^{b} ± 0.48	3.0^{b} ± 0.01	4.0^{b} ± 0.47	3.9^{a} ± 0.32
SPC (1000 cfu/mL)	Hand	4.5	19.0	12.6	24.2	10.7	7.7
	Machine	32.5	23.9	35.6	25.4	34.0	20.5
SCC (1000 cell/mL)	Hand	1312^{b} ± 345	1481^{b} ± 101	941^{a}± 491	2209^{b} ± 832	1596^{a} ± 330	1,587^{a} ± 515
	Machine	578^{a} ± 541	325^{a} ± 129	868^{a} ± 543	1103^{a} ± 515	1509^{a} ± 320	1,532^{a} ± 4.59
Coliform (cfu/mL)	Hand	445	530	2155	680	1658	784
	Machine	1340	1810	3500	1268	2060	1194

Values are mean ± std. dev.
^{a,b}Means in the same column between methods milking (hand and machine) with different superscripts differ significantly (*P*<0.05). SPC = standard plate count; SCC = somatic cell count

Conclusions

Raw goat milk obtained by hand milking had higher percentage of milk fat, protein, solid not fat and SCC number than those obtained by the machine milking. The lactose concentration of milk samples did not differ between groups. The coliform count was higher in machine-milked than hand-milked samples.

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References

APHA, 1992. *Standard Methods for the Examination of Dairy Products*. New York. pp. 448.

Atherton, H.V. and J.A. Newlander, 1977. *Chemistry and Testing of Dairy Products*. 4th Edn. AVI, Westport, CT.

Ljutovac, K.R., G. Lagriffoul, P. Paccard, I. Guillet and Y. Chilliard, 2008. Composition of goat and sheep milk products. *Small Ruminant Res.* 79: 57–72.

Marshall, R.T., 1993. *Standard Methods for the Examination of Dairy Products.* 16th ed. Washington, DC: American Public Health Association (APHA).

TACFS., 2008. Thai agricultural standard TAS 6006-2008: raw goat milk. The Royal Gazette. 125, Section 139 D.

Ying, C., H.T. Wang and J.T. Hsu, 2002. Relationship of somatic cell count, physical, chemical and enzymatic properties to the bacterial standard plate count in dairy goat milk. *Livest. Prod. Sci.* 74: 63–77.

Zeng, S.S. and E.N. Escobar, 1996. Effect of breed and milking method on somatic cell count, standard plate count and composition of goat milk. *Small Ruminant Res*. 19: 169–175.

Paper 32

Using Ultraviolet Irradiation in Combination with Pasteurisation to Reduce Microorganism Content and Extend Shelf Life of Goat Milk

Nakthong, S.[1,2], J. Boonlom[1] & S. Wichchukit[3]*

[1]Department of Animal Science, [2] Animal Produce R and D Centre, Suwanvajokkasikit Animal R and D Institute, [3]Department of Food Engineering, Kasetsart University, Kamphaeng Sean campus, Nakorn Pathom 73140, Thailand.
[*]Email of corresponding author: agrsas@ku.ac.th

Introduction

Recently, there have been some efforts to promote goat milk consumption in Thailand. Due to its low heat stability, goat milk is mostly preserved using pasteurisation. Pasteurisation preserves milk but reduces its nutrient content and sensory properties. It is a challenge to extend the shelf life of pasteurised milk with non-thermal treatment. It has been shown that ultraviolet (UV) radiation could reduce microorganisms in inoculated and raw milk (Matak et al., 2007; Reinemann et al., 2006). The objective of this study was to determine the possibility of using UV radiation in combination with pasteurisation to reduce microorganism content and extend shelf life of goat milk.

Materials and Methods

Preparation of goat milk samples. Raw goat milk samples obtained from a local farm was stored at 5 °C before analysis. The milk samples were divided in 2 parts; the first was used as raw milk sample, while the second was pasteurised by heating the milk at 80 °C for 5 minutes and then cooled to 5 °C.

UV treatment. The UV system configuration consisted of a UV lamp (32 W, 254 nm, 90 cm-length, 25 mm-diameter) in a glass jacket (29 mm-inside diameter) and a corrugated stainless steel cover in a vertical direction. For UV-treatment, each milk sample was fed into the system at 5 °C, from the bottom, using a peristaltic pump (Masterflex model 7518-00, Cole-Parmer Instrument Company, Barrington, USA). The milk samples were allowed to flow through a space between the UV lamp and the glass jacket at 0.85, 1.2 and 1.7 mL/s and recirculated for 1, 2 and 3 cycles. The system was cleaned using nitric acid solution followed by alkaline solution and then hot water at 80°C before and after each experiment.

Microbiological analysis. Goat milk samples were analysed for standard plate count and microbial pathogens such as Coliform, *Escherichia coli*, *Salmonella spp*, *Bacillus cereaus* and *Staphylococcus aureus* before and after each experiment. Pasteurised milk samples were analysed on day 1, 5, 9, 13, 15 and 20 of the storage period.

Results and Discussion

The microbial pathogens content in the raw and pasteurised milk samples were within the safe limits recommended by the Thai milk standards (TACFS, 2008; TISI, 2004). In this study all milk samples showed decrease in total microorganism count after the UV treatments. For the raw goat milk, increasing cycles of recirculation during UV treatment resulted in 20-fold reduction ($P<0.05$) in microorganism content than in untreated milk. For the pasteurised milk, UV-treatment with increasing recirculation cycles at all flow rates resulted in significantly ($P<0.05$) lower microorganism contents than in untreated milk; most remarkable being at 0.85 mL/s flow rate (Figure 1). During 20 days of storage, UV-treated milk samples also showed lower rates of microorganism growth than the untreated milk. Increasing recirculation cycles also served to decrease microorganism content in the UV-treated pasteurised milk.

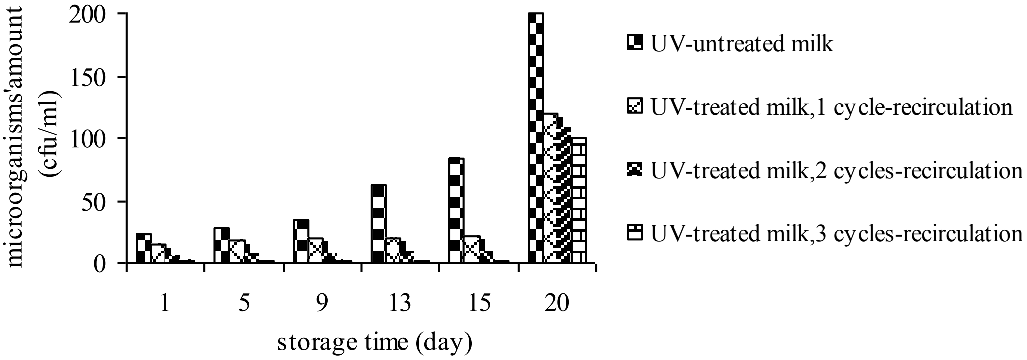

Figure 1. Microorganism *c*ontent of pasteurised goat milk after ultraviolet treatment at a flow rate of 0.85 mL/s

Conclusions

The study showed that UV radiation in combination with pasteurisation has potential to reduce microbial content and extension shelf life of goat milk.

References

Matak, K.E., S.S. Sumner, S.E. Duncan, E. Hovingh, R.W. Worobo and C.R. Hackney, 2007. Effects of ultraviolet irradiation on chemical and sensory properties of goat milk. *J. Dairy Sci.* 90: 3178–3186.

Reinemann, D.J., P. Gouws, T. Cilliers, K. Houck and J. Bishop, 2006. New methods for UV treatment of milk for improved food safety and product quality. ASABE Paper No. 066088. St. Joseph, Mich.: ASABE.

TACFS, 2008. Thai agricultural standard TAS 6006-2008: raw goat milk. The Royal Gazette. 125, Section 139D.

TISI, 2004. Thai industrial standard TIS 738-2547: fresh milk. *The Royal Gazette*. 121, Section 112D.

Paper 33

Goat Milk Production and Utilisation in Nomadic Pastoral Society of Kerman Province of Iran

Ansari-Renani, H.R.[1], B. Rischkowsky[2], J.P. Mueller[3], S.M. Seyed Momen[4] & S. Moradi[5]*

Animal Science Research Institute (ASRI), P.O. Box 31585-1483, Karaj, I. R. Iran,
[2]International Centre for Agricultural Research in the Dry Areas (ICARDA), Aleppo, Syria.
[3]Instituto Nacional de Tecnología Agropecuaria (INTA), Bariloche, Argentina.
[4]Agriculture and Natural Resources Research Centre, Kerman, I. R. Iran.
[5]Animal Science Dept., Agriculture College, University of Zanjan, Animal Science Research Institute (ASRI), Karaj, I. R. Iran
[*]Email of corresponding author: ansarirenani@yahoo.com

Introduction

According to Spooner (1973) the term "nomadism" has been applied to any society that is not settled in permanent dwellings, although etymologically it implies a pastoral subsistence base. Approximately 25% of the world's land surface supporting about 20 million pastoral households of 180–200 million people. These lands usually fall under the categories of deserts, mountains and steppes of the world which include the Sahara, Sahel and Horn of Africa; the Middle East, Pakistan, India, Tibet and Mongolia in Asia and the mountains of Peru, Bolivia, Northern Chile and Argentina in South America. The number of nomads (called *Ashayer* in Persian language) engaged in this nomadic lifestyle in Iran is estimated at 2.5 million in 1966 (9.6 percent of total population) to 1.3 million in 1998 (2.1% of total population) (Notional centre of statistics, 2000).

Nomadic pastoralist system of Baft is characterised by low population density, self reliance on basic needs, displacement of livestock between grazing sites in different seasons and weak linkages to markets and public services. Rangeland is the main grazing area and the grazing depends on the seasonal rainfall. The animals provide the owner with milk, meat and wool and as a source of income. Presently, data on nomadic pastoralist of Iran is very limited. Accordingly, the present work was designed to study the production of milk and dairy products in the nomadic region of Kerman province in Iran.

Materials and Methods

This study was undertaken in Kerman province in the south-western part of Iran. Kerman province is a highland region with <250 mm annual rainfall; and 85% of goat nutrition is based on range grazing and 15% on forage and post-harvest cereals produced in farms for fall and winter feeding. Summer is hot (up to 35 °C) and dry and winter is moderate. A total of 30 households were chosen at random within ± 20 km of Baft city in Kerman province as baseline herds. Information on nomad pastoralist activities was gathered primarily using a structured ICARDA questionnaire through indepth interviews with the nomadic men and women livestock producers of each household from Siahjel subtribe of the Raen tribe.

Results and Discussion

Nomad goat farmers in Baft are more commercially oriented than those from other parts of Iran. The goats are reared primarily as source of cashmere, milk, meat and are also sold as live animals (Table 1). The results showed a high percentage of does in different herds and this is a strong indicator that milk production is a major reason for goat rearing among nomadic goat farmers. However, milk production still ranks second among reasons for keeping goats. Milk production is for home consumption in the form of dairy products.

Table 1. Ranking in descending order of importance of keeping goats

Reasons	Bucks		Does	
	Ranking	% of importance	Ranking	% of importance
Cashmere production	6	33	7	25
Milk production	-	-	6	21
Selling and meat consumption	5	27	5	18
Breeding	4	20	4	14
Wealth, status and saving	3	13	3	15
Social activities	2	5	2	5

Nomads prefer goats over sheep as they claim that goats yield more milk over a longer period but sheep are easier to handle and produce more butter and cheese. Thus sheep milk is preferred for the production of butter, ghee (water-free butter/fat), yoghurt and dried curds. Of the total milk produced, about 5% is processed into butter, 5% into ghee, 31% into local cheese and the rest is either consumed as fresh milk or processed into other products.

Among the Raen nomads, milk is processed in the following stages; milk is filtered into a pot, heated and allowed to cool. Thereafter a small amount of yoghurt is added to the cooled milk as a starter. The yoghurt (*Maust*) is then transferred to an inverted cattle or sheep skin bag (*Toolom* or *Mashk*) which acts as a churn and water is added to the churn containing yoghurt in 1: 1 ratio. The churn is then suspended by a tripod and rocked back and forth until butter granules form. The butter (*Maske*) can be scooped out by hand or the buttermilk can be drained off by pouring. After removal of the butter, the remaining buttermilk (*Doogh*) may be consumed or further processed into hard, white cheese curds. To make cheese curds (*Suzmeh*), buttermilk is placed in a pot, gently heated on a low flame. The curd formed is put into a porous textile cloth sac and kneaded with a handful of salt while the remaining liquid continues to drip out. The curd (*Kashk or Ghoroot*) is shaped into balls, sun-dried and stored, which turns rock-hard with time. Dripped liquid can be heated while stirring with a wooden scoop to produce a soured brownish substance called *Gharaghoroot*, which is used as a paste for making stew. Ghee or clarified butter is made by removing most of the water from butter by gently heating the butter and stirring it continuously in a pot to which salt and turmeric are added. To make cheese (*Paneer*), milk is placed in a pot and gently heated on a low flame. Animal Rennet made locally is added to the heated milk. Milk is allowed to coagulate at room temperature overnight. Whey is placed in a pot and gently heated to make *Loor* which can be consumed for breakfast.

References

Spooner, B., 1973. The cultural ecology of pastoral nomads. [Reading, Mass]: Addison-Wesely. Publication.

Paper 34

Effect of Feeding Cassava Peel Chips on Nutrient Consumption and Milk Production in Dairy Goats

Suranindyah, Y., A. Astuti, I. Sundari & R. Asih*

Faculty of Animal Science, Universitas Gadjah Mada,
Jl. Fauna. No.3, Kampus UGM, Bulaksumur, Yogyakarta, Indonesia 55281
**Email of corresponding author: yuni.suranindyah@ugm.ac.id*

Introduction

Cassava peel has the potential to be a source of feed energy for animals as it contains 74.7% total digestible nutrient (TDN) and 1.3% fat (Purwanti, 2005). However cassava peel also contains cyanogenic glycoside compounds, which are potentially toxic. If present in sufficient quantities, these compounds can cause acute cyanide poisoning and death in humans and animals when consumed. According to Best and Hargrove (1993) concentrations of cyanogenic glycoside linamarine varies among cultivars. Linamarine is hydrolysed to hydrogen cyanide (HCN) by endogenous linamerase when the tissue is damaged. Processes such as drying, soaking and boiling have been used to reduce the cyanide content of cassava peel. According to Cordoso et al. (2005) sun-drying retained 25 to 33% of the original linamarine presents in cassava flour. This study was conducted to reduce HCN content of cassava peel so that it is safe as a source of energy for goats. The effect of feeding cassava peel chips on nutrient intake and milk production of goats was also investigated.

Materials and Methods

Twelve lactating Etawah crossbred goats in their second lactation were used for this study. The goats were kept in individual pens in the communal goat houses belonging to farmers. Goats were fed diet consisted of calliandra, grass, concentrate and cassava peel chips. Cassava peel chips were processed by chopping to around 3 cm x 3 cm, washed and sun-dried. The goats were divided into two groups: treatment and control of six each. Feed (Table 1) was offered to the goats at 4% body weight on dry matter (DM) basis. Goats in the control group were given feed consisting of 70% forage [calliandra (60% DM) and grass (40% DM)] and 30% concentrates. For the treatment group, the concentrate was substituted with cassava peel chips.

The goats were separated from their kids during the night and milked in the morning. Data were collected for a period of 60 days, beginning the second month of lactation to evaluate palatability of cassava peel chips, nutrient consumption and milk production.

Table 1. Nutrient composition of control and treated diets

Treatment	Feed composition (%)			
	DM	OM	CP	TDN
Control diet				
Calliandra	28.0	89.3	23.0	85.6
Grass	14.8	92.3	9.9	52.0
Concentrate	91.0	85.3	17.0	91.0
Treated diet				
Concentrate: cassava peel (70 : 30) incl. calliandra + grass	82.4	75.74	14.3	93.0

Results and Discussion

The results showed that cassava peel chips were palatable to the lactating Etawah crossbred goats. Dry matter consumption of cassava peel chips mixed with concentrate was 13.8% DM, equivalent to 0.53% of body weight (BW), while for the concentrate it was 19.6% DM of the total feed, equivalent to 0.78% of BW. In this study consumption of cassava chips was lower than the values (1.41 to 1.76% of body weight) reported by Chanjula et al. (2007).

The result of substitution of concentrates with cassava peel chips in this study showed that DM, Organic matter (OM), crude protein (CP) and energy (TDN) consumption of goats decreased significantly but milk production was not affected (Table 2).

Table 2. Nutrient consumption of lactating goats during the period of study

Parameter	Nutrient consumption (g/kg $BW^{0.75}$)	
	Control	Treated
Dry matter(g/kg $BW^{0.75}$)	$115.43^{a} \pm 1.23$	$89.56^{b} \pm 1.43$
Organic matter (g/kg $BW^{0.75}$)	$103.89^{a} \pm 1.10$	$78.82^{b} \pm 1.28$
Crude protein(g/kg $BW^{0.75}$)	$21.57^{a} \pm 0.24$	$16.59^{b} \pm 0.27$
Energy (g TDN/kg $BW^{0.75}$)	$90.72^{a} \pm 0.96$	$71.82^{b} \pm 1.10$

^{ab}Means within row with different superscripts were significantly different at $P<0.05$

The average milk production of goats in control group was 673 mL/day while that in the treated group was 645 mL/day (Table 3). Smith (1988) reported that goats fed a basal diet of urea-sprayed rice straw containing 25% cassava hay, dried cassava root and molasses-urea block had higher milk production. Fernanda et al. (2002) showed that cassava in the diet did not affect milk yield, total solids (TS) and CP of goat milk. In this study the effect of cassava peel chips in the diet on milk yield was not significant. This may be due to milking being done in the morning when only half of production capacity was collected.

The results indicated that cassava peel chips affected milk composition more than milk yield. Total solid (TS) and fat contents in milk from goats fed cassava peel chips was lower (11.66 and 2.76%, respectively) than in milk from control goats (14.42 and 4.82% respectively). A similar study on goats fed cassava waste produced milk with TS of 14.6 to 16.9%, milk fat of 6.1 to 7.9% and solid-non-fat of 8.6 to 8.9% (Belewu et al., 2007).

Table 3. Yield, fat and solid-non-fat of goat milk in control and treated groups

	Control	Treated
Milk yield(mL/day)	673.4 ± 15.81	645.5 ± 14.63
Fat (g/day)	38.0 ± 0.98	20.3 ± 0.45
Solid non fat (g/day)	73.1 ± 1.58	65.6 ± 1.38

It is concluded that substitution of 30% of concentrate with cassava peel chips in the diet of lactating goats decreased DM, OM, CP and TDN consumption but did not affect the milk yield, fat and solid-non-fat contents.

References

Belewu, M.A., A.A. Sifat and M.B. Yousuf, 2007. Evaluation of *Trichoderma harzanium* treated cassava waste on the quality and quantity of milk of goat. *J. Biotechnol*. 6: 2193–2196.

Best, R. and T.R. Hargrove, 1993. Cassava: The Latest Facts About on Ancient Crop. CIAT. Cali, Colombia.

Chanjula, P., W. Ngampongsai and M. Wanapat, 2007. Effect of replacing ground corn with cassava chips in concentrate on feed intake, nutrient utilisation, rumen fermentation characteristics and microbial population in goats. *Asian-Aust. J. Anim. Sci.* 20: 1557–1566.

Cardoso, A.R., E. Miriore, M. Ernesto, F. Massaza, J. Cliff, M.R. Haque and H.J. Bradburry, 2005. Processing of cassava roots remove cyanogenes. *J. Food Comp. Anal.* 18: 451–460.

Fernanda, M.G., 2002. Corn replacement by cassava by-product meal in the lactating goat diets: effects on milk production and composition and nutrients digestibility, *Rev. Bras. Zootec.* [online] 31: 475–483. http://dx.doi.org/10.1590/S1516-35982002000200024.

Purwanti, S., 2005. Pengaruh Perlakuan Terhadap Asam Sianida (HCN) Kulit Ubi Kayu Sebagai Pakan Alternatif. Staf Pengajar Universitas Hasanudin, Makasar. http://disnaksulsel.info/index.php?option=com_docman&task=cat_view&gid=31&Itemid=9((Accessed on 2 February 2011).

Smith, O.B., 1988. A review of ruminant responses to cassava-based diets.in: Cassava as livestock feed in Africa. http://www.fao.org/wairdocs/ILRI/x5458E/x5458e05.htm. (Accessed on 10 April 2011).

Paper 35

Comparison of Nutrition Quality between Cow and Goat Dairy Products: A Meta-analysis

Palupi, E.P.[1], A. Jayanegara[2], B. Setiawan[1] & A. Sulaeman[1]*

[1]Department of Community Nutrition, Faculty of Human Ecology, Bogor Agricultural University, 16680 Bogor, Indonesia, [2]Department of Nutrition and Feed Technology, Faculty of Animal Science, Bogor Agricultural University, 16680 Bogor, Indonesia.
[*]Email of corresponding author: eni_palupi@yahoo.com

Introduction

Goat milk plays a significant role in feeding the under nourished communities around the world (Amigo and Fontecha, 2011; Haenlein, 2004). The three main reasons for this are: (i) goat has better ability to survive in harsh climatic conditions than other ruminants (Silanikove, 2000; Morand-Fehr, 2005), (ii) goat milk has the ability to cover afflicted people with cow milk allergenicity and gastrointestinal problems (Park, 1994; Ceballos et al., 2009a); and (iii) goat milk has many desired nutritional properties (Amigo and Fontecha, 2011; Haenlein, 2004; Ceballos et al., 2009b; Silanikove et al., 2010; Alferez et al., 2006). The present study aimed at providing additional information on the nutritional quality of goat dairy products *vis-a-vis* common dairy products from cow milk by using a meta-analysis approach.

Materials and Methods

The meta-analysis was executed using three approaches; i.e. literature search and selection, studies coding and statistical analysis. The literature search was conducted on the Internet using EBSCO Information Services (http://search.ebscohost.com/) and Science Direct (http://www.sciencedirect.com/). The following keywords were used for the search: “comparison”, “nutrition”, “quality”, “composition”, “goat”, “cow”, “milk” and “dairy”. The following criteria were used for the selection: published in English as full text articles, peer-reviewed published journals, direct comparison between goat- and cow-dairy products for nutritional composition including macro- and micro-nutrients. Eventually, a total of 22 studies were derived from comprehensive reviews on 15 selected references. Based on the comprehensive review about the “premium” quality of dairy products (Haug et al., 2007; Huth et al., 2006; Steijns, 2008; Drewnowski, 2005) and the available results from the selected studies, 10 parameters were selected for the nutritional quality analysis i.e. total solid, protein, fat, ash, monounsaturated fatty acid (MUFA), polyunsaturated fatty acids (PUFA), α-linolenic acid (ALA), ratio of omega-6 to omega-3, *cis*-9, *trans*-11 conjugated linoleic acid (CLA9) and Ca. Effect size as the “Hedges' d” was applied to quantify the parameter distance between cow- and goat- dairy products (Hedges and Olkin, 1985; Sanchez-Meca and Marin-Martinez, 2010). To calculate the difference in the nutritional component between goat dairy products and that of cow, the cow group was pooled into a control group and the goat group was pooled into an experimental group. Therefore, the positive effect size indicates that parameter observed is greater in the goat group, and vice versa. The effect size calculations were calculated by using MetaWin 2.0 (Rosenberg et al., 2000).

Results

Goat dairy products contain significantly higher (95% confidence interval, CI) total solids (1.66 ± 0.18), protein (2.06 ± 0.15), fat (0.98 ± 0.17), ash (1.63 ± 0.25), PUFA (1.95 ± 0.83), ALA (4.95 ± 2.67) and significantly lower CLA9 (-1.19 ± 0.98) than those of cow milk (Figure 1). It was also observed that the goat dairy products have significantly (P<0.001) lower omega-6 to omega-3 ratios (5.16 against 10.34) than the cows milk.

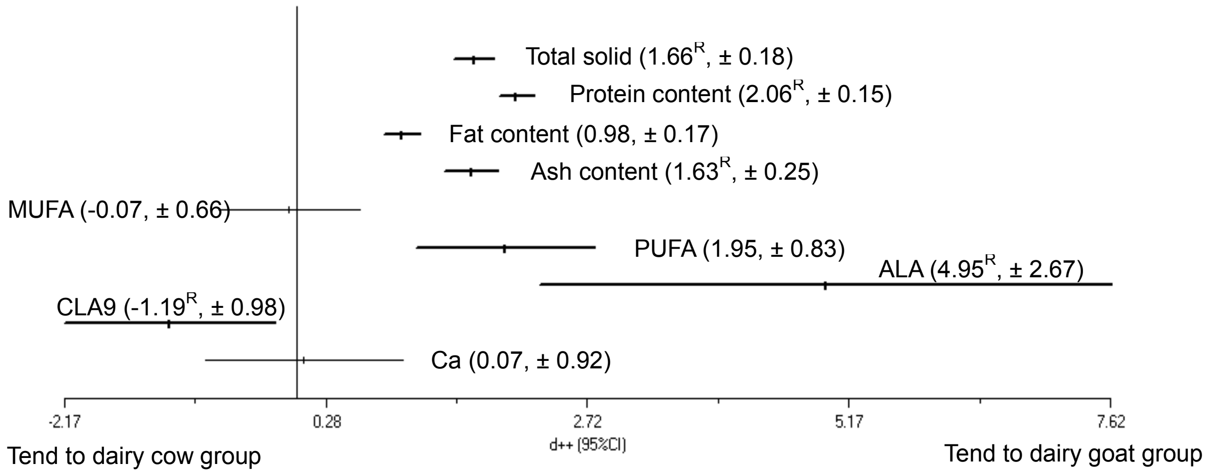

Figure 1. Forest plot of cumulative effect size and 95% CI of some parameters as the prediction for comparing the nutritional quality of cow and goat dairy products. The bold lines indicate the significant proofed analysis and the robust model

Conclusions

The current meta-analysis showed that goat dairy products have different nutritional qualities from those of cow dairy products. The unique nutritional feature of goat dairy products is that it may support human health. Further meta-analyses employing more parameters are necessary.

References

Alferez, M.J.M., I. Lopez-Aliaga, T. Nestares, J. Diaz-Castro, M. Barrionuevo, P.B. Ros and M.S. Campos, 2006. Dietary goat milk improves iron bioavailability in rats with induced ferropenic anemia in comparison with cow milk. *Int. Dairy J.* 16: 813–821.

Amigo, L. and J. Fontecha, 2011. Goat milk. *Encyclopedia of Dairy Science(Second Edition)*: 484–493.

Ceballos, L.S., M.R.S. Sampelayo, F.G. Extremera and M.R. Osorio, 2009a. Evaluation of the allergenicity of goat milk, cow milk, and their lactosera in a guinea pig model. *J. Dairy Sci.* 92: 837–846.

Ceballos, L.S., E.R. Morales, G. de la T. Adarve, J.D. Castro, L.P. Martinez and M.R.S. Sampelayo, 2009b. Composition of goat and cow milk produced under similar conditions and analysed by identical methodology. *J. Food Comps. Anal.* 22: 322–329.

Drewnowski, A., 2005. Concept of a nutritious food: Toward a nutrient density score. *The Am. J. Clin. Nutr.* 82: 721–732.

Haenlein, G.F.W., 2004. Goat milk in human nutrition. *Small Ruminant Res.* 51: 155–163.

Haug, A., A.T. Hostmark and O.M. Harstad, 2007. Bovine milk in human nutrition – A review. *Lipids Health Dis.* 6 (25): 1–16.

Hedges, L.V. and I. Olkin, 1985. *Statistical methods for meta-analysis*. Academic Press, London, UK.

Huth, P.J., D.B. DiRienzo and G.D. Miller, 2006. Major scientific advances with dairy foods in nutrition and health. *Am. Dairy Sci. Assoc.* 86: 1207–1221.

Morand-Fehr, P., 2005. Recent developments in goat nutrition and application: A review. *Small Ruminant Res.* 60: 25–43.

Park, Y.W., 1994. Hypo-allergenic and therapeutic significance of goat milk. *Small Ruminant Res.* 14: 151–159.

Rosenberg, M.S., D.C. Adams and J. Gurevitch, 2000. MetaWin: Statistical software for meta-analysis: Version 2.0. Sinauer Associates, Inc., State University of New York, Iowa State University. Sunderland, Massachusetts.

Sanchez-Meca, J. and F. Marin-Martinez, 2010. *Meta analysis. International Encyclopedia of Education*, 3rd ed., pp. 274–282.

Silanikove, N., 2000. The physiological basis of adaptation in goats to harsh environments. *Small Ruminant Res.* 3th edition. 35 (3): 181–193.

Silanikove, N., G. Leitner, U. Merin and C.G. Prosser, 2010. Recent advances in exploiting goat milk: Quality, safety and production aspects. *Small Ruminant Res*. 89: 110–124.

Steijns, J. M., 2008. Dairy products and health: Focus on their constituents or on the matrix? *Int. Dairy J.* 18: 425–435.

Paper 36

Prevalence of Gastrointestinal Parasites and Efficacy of Anthelmintics in Dairy Goats in Pakistan

Mehmood, K.[1], M. Ijaz[1], M.S. Khan[1], M.A. Khan[1], A. J. Sabir[2] & A. Rehman[3]*

[1]Department of Clinical Medicine and Surgery; [2]Department of Pathology; [3]Department of Epidemiology and Public Health; University of Veterinary and Animal Sciences, Lahore 54000 Punjab, Pakistan
[*]Email of Email of corresponding author: drkhaalid@yahoo.com

Introduction

Approximately 12 percents of 514 million goats in Asia (Aziz, 2010) are in Pakistan (59.9 million). The role of livestock in rural economy of Pakistan is evident by the fact that about 30–35 million rural population are engaged in livestock farming with each household keeping 5–6 sheep/goats producing a total of 739,000 tons of goat milk annually (Anonymous, 2010). A considerable amount of manure is also produced by the goats which are of special importance in areas where cattle are of lesser importance (Nawathe et al., 1985).

Parasitic infestation is a major health problem in goats causing loss in body weight, poor body condition, low birth weights, and difficulty in kidding (Pawel et al., 2004). Anthelmintics treatments are needed to overcome these problems. However there is a significant difference in the physiology of goats in that the level of active ingredient of the medication declines more rapidly in goat than in sheep resulting in reduced effectiveness of such treatment in goats (Mortensen et al., 2003). A longitudinal study was conducted to determine the prevalence of gastrointestinal parasites in diarrheic and non-diarrheic dairy goats at Lahore, Punjab.

Materials and Methods

In this study 240 dairy goats of different breeds; including Beetal, Nachi (Bikaneri) and Dera Din Panah (DDP) breeds, from the territory of Lahore area of (Punjab) Pakistan and presented at the University Outdoor Clinic in the Department of Clinical Medicine and Surgery (CMS), and University of Veterinary and Animal Sciences Lahore were examined for the presence of gastrointestinal parasites. The study was conducted from October 2010 to October 2011. Fecal samples weighing about 5 g were collected directly from rectum of the goats in clean polythene bags and categorised into three groups according to the nature of samples (normal in consistency, semisolid and diarrheic). All the faecal samples were examined through Direct Smear Method and Salt Flotation Technique for the presence of helminth eggs. By using Mac-Master Technique, number of eggs/g (EPG) was counted while the different ova of helminths were identified using the keys described by Soulsby (1982).

For therapeutic studies, thirty dairy goats, tested positive for gastrointestinal parasite were divided into three groups of 10 dairy goats each: group A was treated with Nilzan plus ICI® Pakistan @ 1 ml/2 kg orally, group B was treated with Albendacon (Alina Combine Pharmaceuticals®) @ 10–15 mg/kg orally and group C with *Azadirachtaindica* leaves (Neem plant) @ 2 large Spoon (10–20 g). EPG of the animals of the three groups were counted on day 0 (Pre-treatment) and day 3, 7, 14 (Post-treatment) using Mac-Master technique while the efficacy of drugs was calculated using the formula (Efficacy of drug = [(Pretreatment EPG - Post treatment EPG) / Pretreatment EPG] x 100) described by Varady et al. (2004).

Results

Among all the samples, 161 (67.1%) were detected positive for gastrointestinal parasites. When class wise infection rates were compared, highest infection rate was of nematodes 44.2% followed by trematodes 18.3% and cestodes 4.6%. Among nematodes *Haemonchus contortus, Strongylis pappilosis, Trichostrongylus* and *Trichiuris globulosa* infection rates were 27.5, 8.8, 3.8 and 4.2%, respectively. While among trematodes *Fasciola* and *Dicrocoelium* infection rates were 12.1 and 6.3%, respectively in dairy goats. *Monezia spp.* infection was 4.6%, as shown in Table 1. Ova of various gastrointestinal parasites are shown in Figure 1.

The efficacy of Nilzan plus was observed to be 64, 94 and 97% at day 3, 7 and 14 of treatment respectively. The efficacy of Nilzan plus was higher than of Albendacon which was 47, 82 and 92% at day 3, 7 and 14, respectively. The lowest efficacy of *Azadirachta indica* leaves was observed against gastrointestinal parasites (16, 25 and 33% at day 3, 7 and 14, respectively). It is concluded that Nilzan plus is the most effective drug against gastrointestinal parasites in dairy goats (Table 2).

Table 1. Infection rate of gastrointestinal parasites in dairy goats

Sample Nature	Normal Sample n = 80		Semi-solid Sample n = 80		Diarrheic Sample n = 80		Total infection Rate (%)
Parasite Species	Positive Samples	Infection rate (%)	Positive Samples	Infection rate (%)	Positive Samples	Infection rate (%)	
NEMATODES							
Haemonchus contortus	14	17.50	21	26.25	31	38.75	27.50
Strongylis pappilosis	5	6.25	7	8.75	9	11.25	8.75
Trichostrongylus spp.	2	2.50	3	3.75	4	5.00	3.75
Trichiuris globulosa	2	2.50	3	3.75	5	6.25	4.16
							44.16
TREMATODES							
Fasciola	13	16.25	10	12.50	6	7.50	12.08
Dicrocoelium	7	8.75	6	7.50	2	2.50	6.25
							18.33
CESTODES							
Monezia spp.	2	2.50	6	7.50	3	3.75	4.58
							4.58

Table 2: Comparative efficacies (%) of Nilzan plus, Albendacon (Albendazole) and *Azadirachta indica* leaves in dairy goats at different time intervals

Drugs	0 day		3rd day		7th day		14th day	
	EPG	Efficacy (%)	EPG	Efficacy (%)	EPG	Efficacy (%)	EPG	Efficacy (%)
Nilzan plus**	590±23.94	00	215 ± 31.458	64	38 ± 14.434	94	16 ± 12.500	97
Albendazole*	610±14.43	00	322 ± 94.648	47	110 ± 20.412	82	46 ± 12.500	92
Azadirachta indica	580±72.0	00	490 ± 35.355	16	435 ± 31.458	25	390 ± 31.458	33

EPG, egg per gram; *Significant (P<0.05); ** Highly significant (p<0.01)

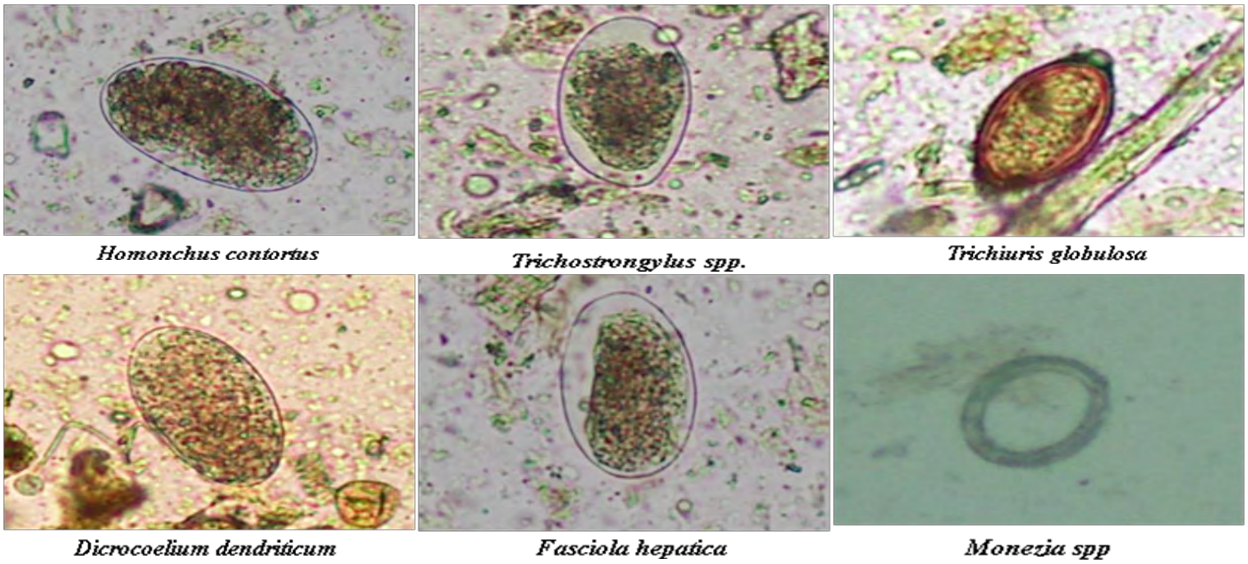

Figure 1.Various gastrointestinal parasites in dairy goats

References

Anonymous, 2010. Economic survey of Pakistan (2009-10), Govt. of the Punjab, Pakistan.
Aziz, M.A., 2010. Present status of the world goat populations and their productivity. *Lohman information* 45 (2): 42.

Mortensen, L.L., L.H. Williamson, T.H. Terrill, R.A. Kircher, M. Larsen and R.M. Kaplan, 2003. Evaluation of prevalence and clinical implications of anthelmintic resistance in gastrointestinal nematodes in goats. *J. Amer. Vet. Med. Assoc.* 223: 495–506.

Nawathe, D.R., A.S. Sohael and I. Umo, 1985. Health management of a dairy herd on the Jos Plateau (Nigeria). *Bull. Anim. Hlth. Prod. Africa* 33: 199–205

Pawel, G., R. Niznikowski, E. Strzelec, D. Popielarczyk, A. Gajewska and H. Wedrychowtcz, 2004. Prevalence of protozoan and helminth internal parasite infections in goat and sheep flocks in Poland. *Arch. Tierz. Dummerstorf*. 47: 43–49.

Soulsby, E.J.L., 1982. *Helminths, Arthropods and Protozoa of Domesticated Animals*, 7th Edition. Bailliere Tindall, London U.K. pp. 579–624, 765–766.

Varady, M., A. Konigova and J. Corba, 2004. A field study to evaluate the efficacy of fenbendazole on 9 stud farms. *Vet. Med. Czech*. 49: 42–46.

Paper 37

Phylogenetic Analysis of Serotype Asia 1 Foot-and-Mouth Disease Virus: Asia Diversity and the Iran Perspective

Tahmoorespur, M.

Animal Science Department, College of Agriculture, Ferdowsi University of Mashhad, Mashhad, Iran
Email of Email of corresponding author: m_tahmoorespur@yahoo.com

Introduction

Foot-and-mouth disease (FMD) is an infectious and sometimes fatal viral disease that affects cloven-hoofed animals, including domestic and wild bovids. The virus causes high fever for two or three days, followed by blisters inside the mouth and on the feet that may rupture and cause lameness. Susceptible animals include cattle, water buffalo, sheep, goats, pigs, antelope, deer and bison. The disease has had a dramatic impact on the farming industry leading to tremendous economic losses particularly in countries which are naturally FMD-free. Previous studies have shown that Iran has one of the highest reported FMD cases per year. This study was undertaken to compare nucleotide sequences of VP1 gene Asia 1 isolates from Iran with available corresponding sequences from Asian countries deposited in the GenBank database.

Materials and Methods

The published sequences of 60 FMD Virus (FMDV) type Asia 1 isolates recovered from different parts of Asia were included in this analysis and compared with the corresponding sequence of Asia 1 isolates from Iran. The phylogenetic tree was constructed using the Neighbour Joining method by using the Alignment and Trees toolbox of the CLC Workbench software (CLC Bio).

Results and Discussion

Nucleotide sequence comparison based upon the alignment of complete nucleotide sequence of the VP1 region indicated that Iranian Asia 1 serotypes had the greatest sequence similarity with reported isolates from Afghanistan and Pakistan with a nucleotide identity of approximately 98% (data not shown). Figure 1 shows a phylogenetic tree constructed based on the sequence alignment of 60 genomes, which are distinctly divided into five lineages. Most Iranian reported isolates clustered with Turkish, Afghanistan and Pakistan isolates into a separate branch from other serotype Asia1 isolates (lineage D and E). These findings were in accordance with a previous study on the sequence and phylogenetic analysis of Iranian serotype A foot-and-mouth disease (Jelokhani-Niarki et al., 2010). It is thought that FMD virus has a circulation in most areas of Asia. Iran is bordered on the east by Pakistan and Afghanistan and on the west by Turkey. Permeable borders and live animal trade in Asia are likely reasons for the virus circulation.

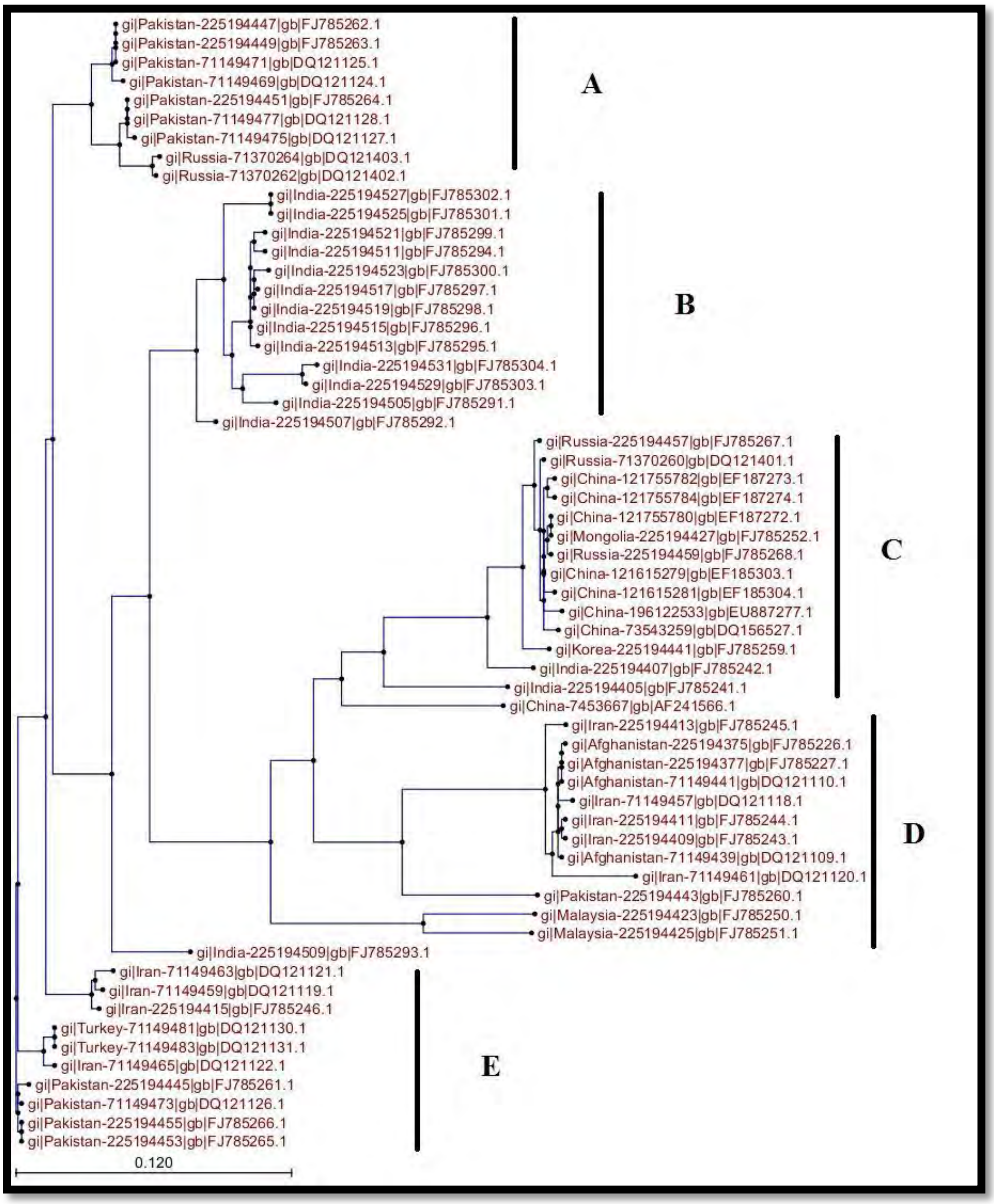

Figure 1. Nucleotide sequence similarity tree based on comparison of FMDV type Asia 1 isolates, established with VP1 coding sequences (633 bp)

References

Jelokhani-Niaraki S., M. Esmaelizad, M. Daliri, R. Vaez-Torshizi, M. Kamalzadeh and M. Lotfi, 2010. Sequence and phylogenetic analysis of the non-structural 3A and 3B protein-coding regions of foot-and-mouth disease virus subtype A, Iran 05. *J. Vet. Sci.* 11: 243–247.

Paper 38

Johne's disease in Goats: A Histopathological and Serological Study

Younus, M.[1], A. Sikandar[1], A.H. Cheema[2], A. Aslam[2] & M.A. Zaman[1]*

[1]College of Veterinary and Animal Sciences, Jhang, Pakistan, [2]Department of Pathology, University of Veterinary and Animal Sciences, Lahore, Pakistan
[*]Email of Email of corresponding author: younusrana@hotmail.com

Introduction

Johne's disease (JD) or Para-tuberculosis has emerged as one of the most important livestock diseases in the recent years. It is a chronic infectious disease of domestic, zoo and wild ruminants (Buergelt and Ginn, 2000; Kruze et al., 2006). The objective of this study was to observe the pathological changes of tissue sections of small intestines and mesenteric lymph nodes of goats suspected to be infected with Para-tuberculosis.

Materials and Methods

Tissue and blood samples of 79 goats suspected for Para-tuberculosis were collected from abattoirs of Municipal Area, Jhang, Pakistan. The presence of *Mycobacterium avium sub spp. aratuberculosis* (MAP) was determined by acid-fast staining of smear, histopathology and ELISA tests.

Results and Discussion

Pathological Studies: Of the 79 samples tested only 16.45% (13) showed the acid-fast bacilli. These acid-fast ZN stain-positive samples were taken as confirmatory of Johne's disease (naturally occurring). Further investigations were conducted on the impression smears and tissue sections of the intestine and mesenteric lymph nodes (Table 1).

Gross Lesions: Although all samples showed some thickened and variably corrugated mucosa, the gross lesions were most prominent in samples positive for acid-fast bacilli. The thickest parts of the lesion showed elevations and corrugations of different sizes which did not disappear upon stretching. However, mesenteric lymph nodes of only six animals were found to be edematous and enlarged.

Table 1. Acid-fast ZN staining of impression smears and tissue sections of intestines and mesentric lymph nodes.

Acid-Fast ZN Stain-Positive			
Intestine		Mesentric Lymph Node	
Impression Smears (n = 79)	Tissue Sections (n = 13)	Impression Smears (n = 79)	Tissue Sections (n = 4)
13/79	13/13	04/79	04/04

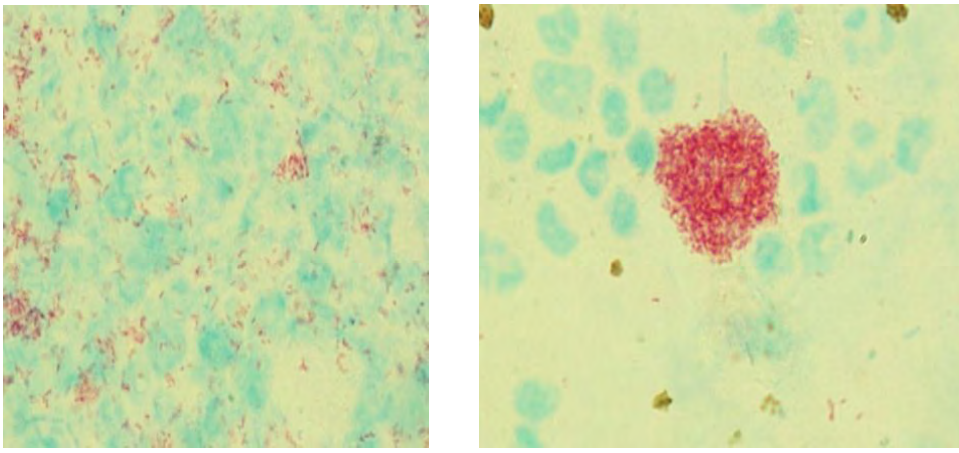

Figure 1. Small intestine of Goat. Hard pressed Impression smears prepared from the mucosa of ileum. A multibacillary form (clearly seen in right side picture) in which the ruptured cells were filled with acid fast bacilli of *Mycobacterium avium sub sp. paratuberculosis*. The bacilli appear as rose-red rods with blue background. ZN (Magnification: 800X).

References

Buergelt, C.D and P.E. Ginn, 2000. The histopathologic diagnosis of subclinical Johne's disease in North American Bison (*Bisonbison*). *Vet. Microbiol.* 77: 325–331.

Kruze, J., M.E. Salgado, A. Paredes, M. Mella and T. Collins, 2006. Goat paratuberculosis in Chile: First isolation and confirmation of *Mycobacterium avium subspecies paratuberculosis* infection in a dairy goat. *J. Vet. Diagn. Invest.* 18: 476–479.

Paper 39

Sero-epidemiological Investigation and Risk Factor Analysis of Brucellosis in Small Ruminants and Their Owners in a District Of Pakistan

Ahmad[1] M. D., M. Idrees[1], M. A. Khan[1], A. Maqbool[2] & M. H. Mushtaq[1]*

[1]Department of Epidemiology and Public Health, University of Veterinary and Animal Sciences, [2]Department of Parasitology, University of Veterinary and Animal Sciences Lahore, Pakistan
[*]Email of corresponding author: hassan.mushtaq@uvas.edu.pk

Introduction

Brucellosis is an infectious zoonotic disease of ruminants and is prevalent in many parts of the world. It has been recorded in Bosnia, Herzegovina, Mediterranean basin, Middle East, Central Asia and Latin America (Gul and Khan, 2007). The highest rate (72.9%) of infection has been reported in the Palestinian and the second highest (71.42%) in mules from Egypt (Shuaibi, 1999). In cattle and buffalo it has been reported that the incidence of brucellosis is 3.25 and 4.40%, respectively, in different areas of Pakistan (Masoumi et al., 1992). In Pakistan, Brucellosis is endemic in cattle, buffalo, sheep and goat populations (Ahmed and Munir, 1995). In Khyber Pukhtunkhwa province of Pakistan, farmers depend on agriculture and livestock as their major income but there is very little awareness about the prevalence of Brucellosis among the local farmers. In view of the significance of this disease, the present study was designed to detect prevalence of Brucellosis, and to analyse risk factors, especially in small ruminants and in livestock farmers.

Materials and Methods

This study was conducted in Buner District of Khyber Pukhtunkhwa province. Sheep, goats, cattle and buffalo farms were selected and blood samples were collected from the animals to screen for Brucellosis. Blood samples from the farmers were also sampled. Information on the farms, household characteristics, prevalence of diseases, and use of artificial insemination in animals were obtained through questionnaires. A two-stage sampling technique was used. In the first stage sampling, two villages were selected. In the second stage, five households which have livestock holdings were selected for sampling. Information about risk factors in the farmer and animals were gathered by separate structured questionnaires. To screen for Brucellosis, blood samples were collected and serum was isolated. Serum samples were screened with RBPT (Rose Bengal Plate Test).

Results and Discussion

The prevalence of Brucellosis in animals was 5.59, 6.14, 6.25, 5.55 and 3.27% in sheep, goats, cattle, buffalo and the livestock owners, respectively. Herd level prevalence for Brucellosis in sheep, goats, cattle, buffalo and mix herds was recorded as 35, 7.89, 15.55, 10.33 and 19.51%, respectively (Fig. 1). Individual herd level minimum, maximum and average prevalence was 4.76, 25 and 13.38%, respectively.

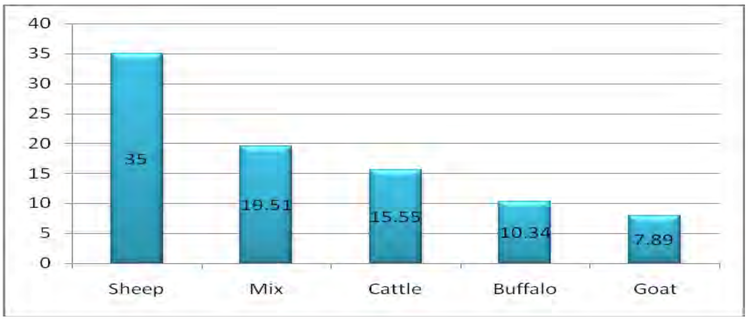

Figure 1. Herd level prevalence in %

Risk factors associated with Brucellosis in ruminants were; type of farm operation (*P*-value = 0.000), type of flooring system (*P*-value = 0.095 and OR (Odds Ratio) = 0.36), ventilation. i.e. (*P*-value = 0.252 and OR = 0.55), housing condition (*P*-value = 0.157 and OR = 0.692), animal health status (*P*-value = 0.000). Results showed a significant relationship between natural breeding of the animals and positive cases of Brucellosis. i.e. (*P*-value = 0.033 and OR = 9.98). No incidence of Brucellosis was recorded in animals which were mated by artificial insemination thus artificial insemination was significantly associated with negative cases of Brucellosis, i.e. (*P*-value = 0.033 and OR = 0.10). Among the risk factors in human, significant association was found between the occupation of the person and test results for Brucellosis while other risk factors showed no significant association.

References

Ahmed, R. and M.A. Munir, 1995. Epidemiological investigations of brucellosis in Pakistan. *Pak. Vet. J.* 15: 169–172.

Gul, S.T. and A. Khan, 2007. Epidemiology and epizootology of Brucellosis: *Pak. Vet. J.* 27: 145–151.

Masoumi, J.P., M.A. Sheikh., R. Ahmad., M. Naeem, M. Ahmad and I. Hussain, 1992. Seroprevalence of brucellosis in sheep, goats and man in Lahore area. *Indian J. Dairy Sci.* 45: 298–299.

Shuaibi, A., 1999. *Palestinianbrucellosis control programme*. Country Reports. Brucellosis Information Workshop, Ramallah, Palestine.

Lead Paper 4

Improvement in Rural Livelihood through Dairy Goat Farming in India

Thiruvenkadan, A.K.

Department of Animal Genetics and Breeding, Veterinary College and Research Institute Namakkal-637002, Tamil Nadu, India
Email of corresponding author: drthirusiva@yahoo.com

Introduction

Goat is a multi-functional animal and plays a significant role in the economy and nutrition of landless, small and marginal farmers in India. In pastoral and agricultural subsistence societies, goats are kept as a source of additional income and as an insurance against disaster. India has rich repository of goat genetic resources with 21 recognised breeds and a large proportion of non-descript or mixed breeds. These are distributed in extremes of climates i.e., from tropical desert, characterised by temperature extremes (i.e. Thar Desert) with little rainfall and sparse vegetation to high altitude mountain areas up to 2,500 m such as the Himalayan region. Goat breeds habituated in different agroclimatic zones of India have evolved themselves more through genetic isolation and natural selection than through deliberate intervention by man. Goats primarily produce meat, but also provide milk and their contribution to the nutrition of the rural poor is significant. They supply precious animal proteins of high biological value in the form of meat, milk, plus essential minerals and fat-borne vitamins to poor people, pregnant mothers and young children (Acharya, 1982; Anon., 2012). Goat milk has a certain unique characteristics like predominance of small milk fat globules and the milk fat contains significantly higher concentrations of short-chain, medium-chain and polyunsaturated fatty acids than cow milk. One litre of goat milk contains about 32 g of proteins, and represents 70% of the daily requirement of a lactating or pregnant mother. The Ca supply of 1.7 g fully meets the daily requirement.

Population statistics

The world goat population is 864 million, of which 14.5% (126 million) are in India (Table 1). Asian continent has the highest, with 44.9% of the total goat population of the world. Among the Asian countries China ranks first followed by India, Pakistan and Bangladesh.

The world goat milk production is presented in Table 2. India is the highest milk producer of goat milk in the world with a total share of 26.26%. Though population-wise China ranks first in the world but her contribution to the world goat milk production is negligible (0.07%). Bangladesh and Pakistan rank second and fourth, respectively, with regard to total world goat milk production.

Table 1. Goat population of the world

Rank	County	Population millions	Population % of world
1	China	149	17.3
2	India	126	14.5
3	Pakistan	57	6.6
4	Bangladesh	56	6.5
5	Nigeria	54	6.2
6	Sudan	43	5.0
7	Iran	25	2.9
8	Ethiopia	22	2.5
9	Mongolia	20	2.3
10	Indonesia	15	1.8
World population		**864**	

Source: FAOSAT production data www.faostat.org

Table 2. Goat milk production of the world

Sl. No	County	Population (millions)	Population % to world
1	India	4.00	26.26
2	Bangladesh	2.17	14.23
3	Sudan	1.47	9.68
4	Pakistan	0.70	4.59
5	Spain	0.59	3.89
6	France	0.58	3.84
7	Greece	0.51	3.31
8	Iran	0.41	2.69
9	Somalia	0.39	2.58
10	Indonesia	0.24	1.56
World population		**15.24**	

Source: FAOSAT production data www.faostat.org

The total milk obtained from cows, buffaloes and goats in India (2009-2010) is presented in Table 3. As per the recent census, the total milk obtained from goats in India is 3.90 million tonnes, which is 3.4% of the total milk obtained from milch animals of the country.

Table 3. Share of milk production from milch animals

Species	Milk yield (tonnes)	Contribution (%)
Cows	47825	42.5
Buffaloes	59201	52.6
Goat	3910	3.40
Total	112540	100.00

Source: Anonymous (2010)

Though goats contribute only 3.4% of the total milk production in India, it has been described as a poor man's cow because of its immense contribution to the poor man's economy. They not only supply nutritious and easily digestible milk to children but also provide regular source of additional income for the poor, landless or marginal farmers. Being small-sized animals, goats can easily be managed by women and children. Feeding, milking and taking care of goats do not require equipment or hard labour. Capital investment and feeding costs are also low. The resources required for maintaining four goats equal those for maintaining one indigenous cow. Goats can be successfully reared in areas where fodder resources are limited and milch cattle do not thrive. Returns on capital of up to 50% and recovery of 70% of retail price are possible in goat farming. In rural areas of India, goat farming plays a vital role in providing gainful employment to the economically backward communities and resource poor farmers.

Physical traits and milk production performance

The home tract and morphological characters of the important milch and dual purpose goat breeds of India are presented in Table 4.

Table 4. Morphological characteristics and utility of some important milch goat breeds of India

Breed	Body size	Utility	Characteristics
North-Western Region			
Jamunapari	Large	Milk	Predominantly white with brown patches on neck and face, long and pendulous ears, roman nose, tuff of hairs on buttocks, large and developed udder
Beetal	Large	Milk	Black or brown coat colour with white patches. Face convex, long and flat ears, large and well set udder
Jakharana	Large	Milk	Predominantly black coat with white spots on ears, narrow forehead, large udder with conical teats
Sirohi	Large	Milk, Meat	Compact body, coat colour predominantly brown with light or dark patches, flat ears, medium sized and round udder
Barbari	Medium	Milk, Meat	Body compact, white coat colour with brown patches, short erect ears, shining eyes, well set udder with small teats
Marwari	Medium	Milk, Meat	Predominantly black in colour with long hairs, few animals with white or brown patches, round and small udder
Kutchi	Medium	Milk, Meat	Coat predominantly black, few with brown or white spots, long hairs, long and drooping ears, well-developed udder
Mehasana	Medium	Milk, Meat	Black coat with white spots at the base of the ears. Leaf like and drooping ears, twisted horns, developed udder
Zalawadi	Medium	Milk, Meat	Black coat with long hairs, long and drooping ears, long twisted horns, large udder with conical teats
Southern Region			
Osmanabadi	Medium	Milk, Meat	Variable-black coat colour, white or spotted, medium long ears, small, round udder with short teats
Malabari	Medium	Milk, Meat	Coat colour varies from complete white to complete black, small twisted horns, medium sized ears, small and round udder
Surti	Medium	Milk	White in colour, medium sized ears, small horns, very well-developed udder

Source: Acharya (1982); www.nabard.org

The average milk production of the important goat breeds of India viz. Jamunapari, Beetal, Jakharana, Sirohi, Marwari, Kutchi, Barbari, Sangamneri, Malabari and Black Bengal goats are presented in Table 5. Among the different goat breeds of India, Jamunapari breed of goat is giving highest milk yield followed by Beetal and Kutchi.

Table 5 Milk yield of important goat breeds of India

Breed	Lactation	
	Yield (kg)	Length (days)
Jamunapari	201.67 ± 6.39	194
Beetal	173.90 ± 1.27	182
Jakharana	121.80 ± 8.82	115
Sirohi	113.62 ± 2.43	194
Marwari	101.49 ± 2.43	197
Kutchi	124.06 ± 2.84	195
Barbari	95.60 ± 2.78	152
Sangamneri	83.40 ± 3.43	168
Malabari	90.02 ± 4.10	178
Bengal	35.20 ± 1.56	111

Contribution to the rural economy

To resource-poor peasant farmers in India rearing of dairy goats is better than cattle because of its faster generation turnover and earlier milk production compared with cattle. At low levels of milk production of about 1 to 2 litres per head, goats do not require high levels of dietary energy and protein, and can in fact survive on browse, forage and crop residues. Under these circumstances, it is more realistic, nutritionally appropriate and economic to encourage milk production from goats in rural areas, parallel to peri-urban milk production from cows. Direct investment in family goat herds in rural areas of India is therefore likely to have much impact on the quality of the rural poor. From the equity and livelihood perspective it is considered an important component in poverty alleviation programmes. The studies revealed that the economic contribution by goats to poor farm households and livelihoods is much higher than is imagined. In semi-arid and arid areas, goats along with sheep provide the main means of survival and security. In these situations, the sale of animals, milk and manure accounted for 27.2 to 30.7%, 19.7 to 84.8%, and 1.0 to 4.5% of total farm income, respectively. In subhumid and humid areas, mixed farming is more common, and goats contributed between 17.1 and 58.0% of total farm income, mainly through the sale of animals.

Conclusions

Dairy goat farming in India plays an important role in the sustenance of rural poor farmers. However, most of the purebred population is declining due to indiscriminate crossbreeding. Though Jamunapari is the most popular breed in India, the purebred population is decreasing over the decades and as a result of recent conservation efforts made by the state and central governments further decline population in the breeding tract has been averted. The future of goat breeds in India lies on the appropriate approaches to conservation that combine a number of integrally related components and on the effective action programmes approached holistically for successful conservation of goat genetic resources. To address these issues and generate impact, the way forward will necessitate a wider recognition, better resource use, strong interdisciplinary approaches and institutional support to ensure the future contribution of goats in India and other developing countries.

References

Acharya, R.M., 1982. Sheep and Goat Breeds of India. FAO Animal Production and Health Paper, Rome, Italy.

Anon., 2010. Basic animal husbandry statistics-AHS Series-12. Ministry of Agriculture, Dairying and Fisheries, Government of India, New Delhi.

FAOSTAT, 2008. www.faostat.org.

NABARD, 2012. www.Nabard.org.

Paper 40

Housing Advancements for Smallholder Dairy Goat Farming in the Tropics

Yogendran, N.

Genetic Improvement and Farm Technologies Sdn. Bhd.
20-1, Jalan PJS 10/2, Subang Indah, 46000 Petaling Jaya, Malaysia.
Email of corresponding author: giftpharma@gmail.com

Introduction

Dairy goat farming in Malaysia started to expand in the 1990s based on imported purebred goats, namely the Saanen, Anglo Nubian, Jamnapari and a smaller number of the British Alpine. However, milk yields of these temperate goats in the Malaysian humid tropics were disappointing and well below their genetic potential. The low milk yields of purebred goats in the tropics jeopardises their commercial viability. The problem is due to a combination of biological constraints including heat stress, poor intake of feeds, poor quality feeds, poorly ventilated barns together with a wide range of tropical parasites and diseases.

The solution being tested commercially on Penang Island, Malaysia is to completely separate purebred goats from the heat stress and tropical disease load by housing them continuously in hygienic climate-controlled all-steel barns. This biological isolation approach, combined with a greatly improved cut grass plus concentrate diet, is already proven to be very successful for purebred Jersey dairy cattle. This new intensive ruminant production system that replaces grazing is given the term „Deep Tropical Agriculture' (Mohd Peter Davis and Yogendran, 2009).

A model barn for 100 purebred goats has been built on a 4 acres wetland treated for flood mitigation with large canals and ponds to contain rainwater. The lower areas were seeded with special grasses that could take the wetness whilst the higher grounds were seeded with grasses that produced more leaf.

The Dairy Goat Barn

The modular smallholder building for 100 purebred dairy goats was assembled on site using self-manufactured steel sections. The enclosed building was designed complete with an evaporative-cooled ventilation system, a milking parlour and raised expanded metal floor for waste disposal system. The building measures 13 × 27 m with the main structure constructed using 100% galvanised mild steel hollow section (MSHS). All sections were welded to size and then sent for galvanising. This assured that all welding points were rustproof and clean. The building was assembled on site using nuts and bolts without any need for welding. The walling and roofing of the barn was covered using zinc/aluminium coated metal cladding that provided the best heat reflection during the hottest times of the day. The raised flooring was constructed using galvanised expanded metal sheets measuring 1.2 × 2.1 m. These were laid to cover the total area of the barn. All goat droppings fell through the raised metal grid floors, eliminating the need to clean the standing area of the goats. The total area of the barn measuring 351 square metres was partitioned into dry goat, milking goat, kid and treatment pens and walk alleys and a milking parlour with a 4 cluster bucket milking system.

Cooling and Ventilation System

Three units of extractor fans, each with an air displacement of 44,000 cfm, were fitted on the 13 m back end of the barn. The fans were controlled by electronic sensors that determined the air extraction rate during the coolest and hottest times in the barn. During the hottest times of the day between 11 am to 4 pm, an air speed of 2.5 m/s was achieved with all 3 fans running. The front end of the barn has large cellulose cooling pads covered with dripping water, which along with the ventilation system decreases temperature in the building. During peak midday ambient temperatures, when the outside temperature was around 33°C, the temperature inside the barn would range from 26 to 27°C at animal level (Figure 1). Night ambient temperature in Malaysia ranges from 20 to 24°C and there is no need to cool the barn. During this period water to the cooling pads was programmed to shut down and the barn ventilation was reduced to only one fan running. Using the system the interior of the goat barn remain cool and dry at all times and completely free from any odour from the goats and their faeces and urine.

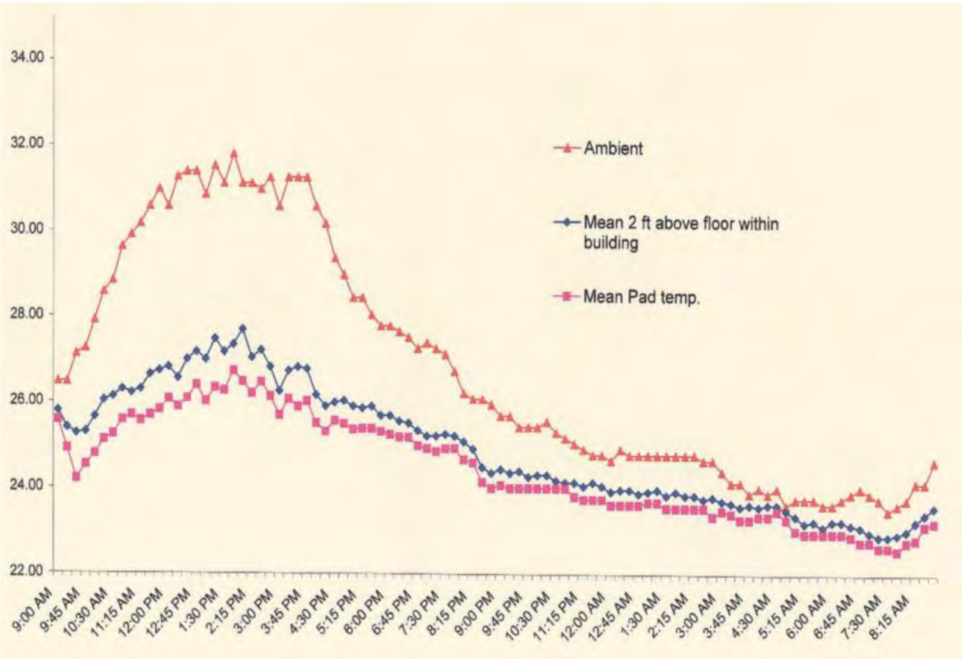

Figure 1. Mean temperature (°C) at one metre above floor in the building

Improvements in Animal Production

The barn is completed and currently waiting delivery of purebred dairy goats from Australia. From experiences in dairy cattle farming using similar systems, the intake of young grass increases tremendously and no heat stress is observed. There has also been no need to de-worm or de-tick the animals because no parasite is introduced. In areas where fertility, ovulation and production of temperate type animals are of concern due to harsh and challenging environment, these modern farming technologies allow for the successful farming of high yielding purebred. Although the high tech ruminant sheds are considerably more expensive than traditional sheds used in grazing systems, the extra cost can quickly be recovered from the improved quality and higher milk yields.

References

Mohd Peter Davis and N. Yogendran, 2009, *How Developing Countries Can Produce Emergency Food and Gain Self-Sufficiency.* Spring 2009, 21st Century Science and Technology (Washington), pp. 29–41.

Paper 41

Rural Farmer Preferences Regarding Purpose of Rearing and Choice of Body Coat Colour in Indian Rural Goats

Gokhale, S.B., D.R. Sonawane & R.S. Sharma*

BAIF Central Research Station, Uruli Knachan Pune 412202, India
**Email of corresponding author: suresh.gokhale@vsnl.net*

Introduction

Goat-rearing is an important livelihood activity among rural artisans in India. Consistent steady increase in goat population of the country indicates its relevance and importance among low income rural society looking towards goats as a means for sustainable living. Although there are many goat breeds in different regions of the country, planning either at national or village level will need to be more organised to improve the goat-rearing industry for economic purposes. Paucity of information on the likings of goat-rearing community becomes limitation in planning for goat improvement programmes. Discussions with goatkeepers indicated that besides specific purpose of rearing goats, they also have preference for goats of certain body coat colour. An investigation therefore was undertaken to understand farmer preference regarding the purpose of rearing goats and choice of body coat colour.

Materials and Methods

The study was undertaken during 2007 in selected areas in 4 districts (Arrah, Buxar, Siwan and Gopalganj) of the state of Bihar in North-Eastern part of India. The study involved 2,499 goats belonging to 800 goat-rearing families. The number of families and goats based on district is presented in Table 1.

Table 1. Village clusters, families and goats in 4 districts of Bihar State, North-eastern India

District	Number				
	Village Clusters	Goat- Keepers	Goats		
			Female	Male	Total
Arrah	8	316	444	259	703
Buxar	7	153	305	160	465
Gopalganj	6	165	333	332	665
Siwan	8	166	363	303	666
Total	**29**	**800**	**1445**	**1054**	**2499**

Goats in the rural villages are of different body coat colour like black, white, black and white, red, brown, spotted. The information regarding farmer-preference on coat colour was obtained by interviewing the goat keepers. The purpose of rearing goats was classified into: rearing for milk, meat and both (milk and meat) and body coat colour was grouped into:

black, white and other categories (because of smaller number of goats of different and mixed colour).

The goat management at village level was by extensive grazing either by individuals or by groups of goatkeepers. The goats were kept in the open or in thatched sheds as night shelters. After winter, short or long distance migration to grazing grounds is a common practice. Natural breeding was practiced; the kids suckled their mothers and weaned at between three to four months of age. Vaccinations were carried out and veterinarians were occasionally consulted for health problems. The data collected were compiled and analysed using standard statistical procedures.

Results and Discussion

The mean number of farmers per village cluster was found to be 28, with a minimum of 20 in Siwan to maximum of 40 in Arrah district and the average number of goats per village cluster was 86; ranging from 66 in Buxar to 110 in Gopalganj district. The average flock size per goat keeper was 3.1 across all districts, ranging from 2.22 in Arrah to 4.03 in Buxar and Siwan districts. To know the purpose of goat keeping, 800 goat keepers were contacted, of which 773 keepers responded to their choice regarding the economic purpose for rearing goats. The opinion of goat keepers on the purpose of rearing goats is presented in Table 2. Nearly two-third (62.87%) of goat-rearing community indicated their purpose for rearing goats was for meat, followed by dual purpose (milk and meat) (33.12%). Only 4% of the goat keepers kept goats for milk.

Table 2. Purpose of rearing goats, presented district-wise in Bihar State, North-Eastern India

District	Purpose of rearing goats						Total Families	
	Milk		Meat		Both milk and meat			
	No.	%	No.	%	No.	%	No.	%
Arrah	8	2.7	181	61.2	107	36.2	296	38.3
Buxar	7	4.7	90	60.0	56	37.3	150	19.4
Gopalganj	3	1.8	123	74.1	38	22.9	166	21.5
Siwan	13	8.1	92	57.1	55	34.2	161	20.8
Total	**31**	**4.0**	**486**	**62.9**	**256**	**33.1**	**773**	**100**

Nearly half (48%) of the goat-rearing community appeared to favour goats with black coat colour, 33.4% preferred white coat colour and 18.6% preferred goats of other coat colours. The farmer preference for body coat colour of their goats appeared to be specific. It was noted that approximate 75 goatkeepers preferred black goats for meat, 20.6% for dual purpose while only 4.3% for milk. In the case of goatkeepers preferring white coloured goats, the proportion of farmers keeping goat for meat and dual purpose was nearly same (49.03% for meat, 47.11% for milk). The trend in the group of farmers preferring other body coat coloured goats was similar to those who prefer white coloured goats, except that more (56.55%) kept goats for meat.

Analysis of variance was carried out to study the effect of area (district), body coat colour and sex of kid on chest girth, height at withers, body length and estimated body weight of kids between 4 to 6 months of age. The results indicated that the body measurements were significantly different between districts. The choice of goat colour and rate of growth of male and female kids also differed significantly between districts.

Based on the study it was concluded that rationale for planning and building of infrastructure for goat improvement programme in India should include consideration of farmer preferences.

Paper 42

Developing a Model of a Goat-Sharing System Based on Farmer Groups to Improve Etawah Crossbred Goats in the Village

Haryadi, T., Y. Suranindyah, S. Paramitasari, S. Triatmojo & A. Astuti*

Faculty of Animal Science, Universitas Gadjah Mada,
Jl. Fauna No.3, Kampus UGM, Bulaksumur, Yogyakarta, Indonesia 55281
**Email of corresponding author: yuni.suranindyah@ugm.ac.id*

Introduction

The majority of Etawah crossbred goats in the Yogyakarta Province are raised by smallholders to produce milk, meat and manure. Many of the goat farmers are organised in a system that is referred to as a communal farming system. Goat farmers generally make small investments and it is difficult for them to obtain bank loans. To solve this problem there was a need to assist them by giving soft loan, micro-credit or sharing system (Masika and Mafu, 2004). Kustantinah et al. (2006) showed that the goat-sharing scheme that was implemented by the women's group had improved women access to information, goat productivity and lead to better household prosperity.

The objective of the study was to assess the impact of the sharing system towards increasing goat numbers in the group, the function of farmer group organisation and farmer income through producing milk.

Materials and Methods

The sharing system was conducted in the "Etawa Lestari" farmer group, at the village of Candi Binangun, Pakem, Sleman. The activity started with a survey and group discussion to determine the suitability of the location. The next activity was implementation of the sharing system of goat. Monitoring of goats was conducted while extension services were provided to the farmers every month.

Results

The results showed that farmers have planted various types of plants around the location, including feed for goats, such as *Glirisidia maculata, Caliandra callothyrsus,* jack fruit and grass.

The mechanism of the sharing system could be described in the following steps :(1) at the beginning of the system each farmer was given one young pregnant goat. One buck was provided for 10 females, (2) 10 farmers received sharing goats at the beginning of the system, (3) farmers provide slatted pens. To build the pen, farmers obtained loans, which must to be paid back by installment every month during the period of sharing system, (4) the farmer had to be provide one young female goat from the first pregnancy to another farmer and improve the organisation of farmer group, (5) farmers have to manage the goat and keep it productive, and (6) the maximum period of the sharing was 2 years.

The sharing system started in 2009 with 10 young female goats and one buck. After 2 years the goat number increased to 34 and the number of group members increased from 10 to 18 farmers. Meeting of group members was routinely conducted every month. Extension services to improve knowledge and communication was provide during the farmer meetings. In 2011 three farmers started to milk their goats. The result concluded that the sharing system could increase goat number and improve the function of the farmer group organisation.

References

Kustantinah, E.R. Ørskov, H. Hartadi, A. Agus, B. Suhartanto, N. Danardono, E. Indarto, K.A. Santosa, S. Nurtini and M. Lomax, 2006**.** Animal production through a women's group goat-sharing scheme. In: *Proceeding of the 12th AAAP Animal Science Congress*, Busan Korea, 18-22 September.

Masika, P.J. and J.V. Mafu, 2004. Aspect of Goat Farming in the Communal Farming System of the Central Eastern cape, South Africa, *Small Ruminant Res*. 52: 161–164.

Paper 43

Normative Pen Mating Behaviour in Local Goats of the Rohilkhand Region

Kerketta, S., M. Singh, B.H.M. Patel, D. Upadhyay, S.K. Mondal, B. Bhushan & T. Dutt*

LPM, Indian Veterinary Research Institute
Izatnagar, Bareilly (UP), 243122, India
Email of corresponding author: mpatellpm@gmail.com

Introduction

Goats in tropical climate show oestrus in a particular season. During such breeding season, ensuring proper conception through natural mating is mainly decided by the quality of the buck. Generally, one buck is maintained for 30 to 40 does for proper breeding. Thus, evaluation of male fertility prior to breeding is of paramount importance to achieve breeding success. Therefore, a functional Breeding Soundness Examination system, which incorporates libido test scores, body conformation or testicular traits evaluation, is needed. However such examinations are still uncommon for small ruminants in general and goat bucks in particular. The government of India is in the process of identifying and documenting new breeds. In this context Rohilkhandi is a black coloured goat found in the Rohilkhand region of Uttar Pradesh. Information on the male is almost nonexistent. Therefore, an attempt was made to study the pen mating behaviour and establish a relationship with testicular traits.

Materials and Methods

The present study was conducted using available males maintained at the farm, which is located at an altitude of 169.2 meters above the mean sea level, at latitude of 28° 22’ North and at longitude of 79° 24’ East. The place falls in the upper Gangetic Plain Region of India. Available Rohilkhandi bucks were categorised into Group I: Experienced (2 years old), Group II: Non-experienced adolescence (1 year old), Group III: Pubertal (6–12 months old) and Group IV: Weaner (3–6 months old). Body weight (BW), *Scrotal biometrylike* scrotal circumference (SC), testis thickness (TT) and testicular volume (TV) were determined. Normative sexual behaviour was also studied in Groups I to III. Each male was observed 3 times in an observation pen measuring 5 × 5 sq meters after introduction of females. Ongoing activities such as vocalisation, leg kicking, leg kicking with vocalisation, flehmen reaction, sniffing, false mounting (without thrust), mounting, ejaculation were recorded every 10 sec for 30 min. After the behaviour was recorded, the reaction time, number of mounts, refractive period and total number of ejaculations were calculated.

Results and Discussion

Leg kicking (5.0–6.7 min) followed by leg kicking with vocalisation (3.02–3.5 min) were most predominant courtship behaviour in all the three groups which did not differ significantly. False mounting was relatively more in Group III which indicated the non-experience of the bucks. Total ejaculation number in Groups I, II, III was 2.75 ± 0.92, 3.34 ± 1.29 and 1.33 ± 0.32, respectively which differed significantly ($P<0.05$). However, none of the animals in Group IV showed any ejaculation. Mean introductory ejaculation latency of the respective group was 0.49, 1.72 and 8.34 sec. The body weight for Groups I, II, III and IV were 37.95, 21.8, 10.0 and 9.33 kg, respectively. The SC was relatively high in Group I (24.27 cm) in comparison to Group II (21.61 cm) bucks. The same pattern was also observed for testicular volume. Testicular thickness was 4.9 to 5.74 cm in Group I and II, and 2.76 to 3.73 cm in group III and IV. It can be concluded that bucks aged above one year are best for breeding.

Paper 44

Emerging Stall-fed Goat Farming for Milk and Meat in the Periurban Districts of Karnataka, India

Manu, C.[1*] *& B.L. Chidananda*[2]

[1]*Department of Dairy Economics and Business Management, Dairy Science College, Karnataka Veterinary, Animal and Fisheries Sciences University, Southern Region Campus,*
[2]*Department of Animal Sciences, College of Agriculture, University of Agricultural Sciences, GKVK, Bangalore, India*
[*]*Email of corresponding author: manumanage@gmail.com*

Introduction

The small ruminant goat is a very special animal for small and marginal farmers including landless folks and has been reared successfully and sustainably from time immemorial. However, dwindling resources like forest and other foraging area and scarce labor have lowered profitability of goat keeping. Stall-feeding is emerging as a successful model for sustaining livestock activity with assured and constant returns to the poor farmers.

Materials and Methods

An enterprising farmer under the technical guidance of Department of Animal Sciences, University of Agricultural Sciences, Bangalore had started stall-feeding goats. In 2008, with 25 goats of Jamunapari breed, which is predominantly a milking breed, the farmer has increased the number to 200. To feed the goats, South African maize, lucerne and finger millet were planted under the drip and sprinkler irrigation system. Silage was provided during the summer months. Semi-intensive housing was provided for different age group animals. A feeding stand provided chopped fodder and feed concentrate. The male to female ratio was 1: 25. The farm has now grown into a successful stall-fed Goat unit and won prizes at the annual "KRISHI MELA" (Agriculture Fair), an event that had attracted nearly a million farmers and Agri-entrepreneurs alike. This farm has emerged as a successful stall-fed Goat farm and is motivating other farmers to take up the venture. Rearing Jamnapari goats is an Agribusiness enterprise that has created a niche market serving the nearby cosmopolitan city like Bangalore. This industry will gradually introduce concept of broiler mutton, packed goat milk, branding and vertical integration in goats to improve and increase products for export.

Fig1. Champion Cyprus Shami Buck

Fig 2. Champion Milk producers – 1000 litres/305 days

Fig 3. Jamnapari Buck

Fig 4. Milking Indian Breed

Technology transfer

The proposed introduction of Cyprus Shami goat frozen semen to the local breeds will boost both milk and meat production in India in general and in the state of Karnataka in particular. The recently held Global Summit on Agribusiness and Food Processing by Government of Karnataka will hasten the process of introduction of the Cyprus Goats frozen semen to Karnataka. To boost the industry, recently the Minister for Agriculture and his delegation visited Cyprus for technical evaluation and import of the breed to improve the genetics of local breeds for purpose of improving goat milk and meat production in Karnataka state. The import of frozen semen and breeding stock of Cyprus Shami goats into India is in the process.

Paper 45

The Role of Goat in Poverty Reduction among Smallholder Farmers in Egypt

Metawi, H.M.[1] *& E.Z.M. Oudah*[2*]

[1]*Animal Production Research Institute, Agriculture Research Centre, Cairo, Egypt*
[2]*Department of Animal Production, Faculty of Agriculture, Mansoura University, PC: 35516, Mansoura, Egypt*
[*]*Email of corresponding author: saidauda@yahoo.com*

Introduction

In Egypt 4 200 000 heads of goats produced about 16 107 tonnes milk in the year 2009 (FAO, 2012). In the Nile valley region in Egypt, goats are found in smallholdings as mixed flocks with sheep and other farm animals like cattle and buffaloes. Goats play an important role in Egyptian subsistent farming systems. They are of greater importance as a source of meat and cash for other activities in the family, as well as a source of milk for poor families. This study was conducted in the Nile valley of Egypt to determine the role of goat production in reducing rural poverty and obtain information on their productivity in small-scale farming.

Materials and Methods

The study zone was stratified into three districts: Damietta, Borg El-Arab and El-Sharqiya. Each zone represents one of three Egyptian local goat breeds namely Zaraibi, Barki and Baladi, respectively. Results were based on survey of 164 goat owners and monitoring of 30 flocks. Bio-economic data were collected and submitted to cost-benefit analysis. The current production system was described and the social and economic roles played by goats in income generation were considered.

Generally, goat management was based on primary experiences, and the modern technology was not applied. Berseem (*Trifolium alexandrinum*) was the principal feed resource in winter and spring. During summer and autumn months, flocks were fed mainly on green fodder (sorghum) and grazed crop residues. The majority of farmers usually supplement females at the suckling (82.5%) and late pregnancy (70%) stages. The breeding season usually starts in June-July. Bucks, aged one year old, were used for mating. In the Damietta district, about 74.4% of breeders owned Zaraibi bucks. On the other hand, in the El-Sharqiya district only 20% of goat owners kept their own bucks. The average weaning and marketing ages were 4 and 7.5 months, respectively.

Results and Discussion

Table l shows the main features of goat production systems in Egypt. Over 90% of Barki herd farmers practiced outdoor grazing for their animals while more than 50% of Baladi and Zaraibi herd farmers either confined their goats under zero grazing or practiced restricted grazing on fields close to their homesteads. The field data revealed negative relationship between the number of small ruminants per acre and poverty level. The contribution of livestock to the household economy in the Borg El-Arab district is significantly higher than in other districts. The most important reasons given for keeping goats among farmers was as a saving (Table 2).The preweaning mortality rate and kidding interval were higher among Baladi goats than the two other breeds (Table 3).

Table 1. Main features of goat production systems

Parameter	District		
	Damietta	Borg El-Arab	El-Sharqiya
Farm size (acres) :			
≥1 (% of holders)	95.0	10.0	70.0
Average	1.70	11.5	1.93
Family size (person)	5.60	5.70	6.40
Flock size (head)	12.6	123.0	13.3
Flock composition (%)			
Goat flocks	75.0	9.70	26.6
Mixed flocks	25.0	90.3	73.4
Goat in mixed flock	73.0	26.3	38.7

Table 2. Most important reasons given by farmers for keeping goats

Reason	Farmer (%)
Income	29.8
Saving	59.7
Milk consumption	4.50
Meat consumption	5.90

Table 3. Production and reproduction performances of goats under field conditions

Parameter	Breed		
	Zaraibi	Barki	Baladi
Birth type (%)			
Single	22.1	50.0	24.7
Twin	45.7	49.9	61.5
Triplicate	26.1	0.54	10.1
Quadruplets	6.16	–	3.3
Litter size (kids)	1.89	1.50	2.16
Pre-weaning mortality (%)	11.5	11.4	15.7
Kidding interval (day)	250	278	311
Weaning weight (kg)	14.8	14.3	10.8

Conclusions

To enhance the profitability and sustainability of smallholder production system in the long-run, flock owners need to be aware of the importance of time of vaccination and feed supplementation to the animals. At the same time, the identification and use of alternative feed resources and strategic feeding management might be options for development of the goat sector in Egypt. Income from smallholder Zaraibi goat operation contributes significantly to the livelihoods of farmers in the Damietta district.

Reference

FAO, 2012. FAOSTAT, FAO Statistics Division, February 2012.

Paper 46

Integration of Etawah Crossbred Dairy Goat with Cocoa in East Java Province, Indonesia

Riyanto, J.[*] *& C. Anam*

Sebelas Maret University, 57126 Surakarta, Indonesia
[*]*Email of corresponding author: jokoriyanto19@yahoo.com*

Introduction

Etawah crossbred dairy goats found in Indonesia are mostly maintained by farmers in the rural areas. Etawah crossbred dairy goats are easy to maintain and are capable of utilising the leaves of various food crops, legumes and crop wastes as sources of feed. The pod cocoa waste makes up of 75% of the fresh cocoa pod and is a potential feed ingredient. Unfermented and fermented (using *P. Chrysosporium*) cocoa pods contain 8.69 and 13.84% crude protein, respectively (Suparjo et al., 2011). Utilisation of 30% cocoa fermented products in feeding resulted in average daily gain of 83.93 to 101.79 g/head/day in goats (Suparjo et al., 2011) and 55 g/head/day in sheep (Tuah et al., 1995).

East Java Province, Indonesia has cocoa plantation area totalling 2,290 ha and in 2009 its cocoa production was 5,004 tonnes from the small plantations, 13,345 tonnes from state plantations and 4,816 tonnes from private plantations. However, cocoa pod waste is currently used only as a mulch and has not been used as feed material. These facts form the basis for implementation of the programme on integration of goat in the cocoa agricultural system in Ngawi regency of East Java. The objective of this study was to examine the application of an integrated business model of Etawah crossbred dairy goats with cocoa, by cocoa farmers in the region, through the utilisation of estate cocoa waste as goat feed.

Materials and Methods

The location of the study was at 7º21'–7º31' South latitude and 110º10'–111º40' East longitude in the Ngawi district of East Java Province. Farmers live in the District Ngrambe on highlands at the foot of Lawu Mount with most areas of the land used for cocoa plantation. The integrated Etawah crossbred dairy goats with cocoa model was applied in two villages, namely Village Sambirejo (10 farmers and 25 Etawah crossbred dairy goats and Manisharjo villages (15 farmers and 45 Etawah crossbred dairy goats). Forage feed was derived from (1) waste of food crops (WFC): banana leaf, jackfruit leaves and cassava leaves, (2) leaves of legume crops (LLC): *Gliricidia sepium* and *Leucaena leucocephala* and (3) field grasses (FG). Basal concentrate (BC) consisted of 40% rice bran, 30% waste of cassava flour processing, 10% milled corn, 12% soybean meal, 5% coconut meal, 2% mineral and 1% salt.

The application of the integrated Etawah crossbred dairy goats with cocoa production system was for about 12 months in 2009 with the stages of socialisation, counselling, training, demonstration, implementation, monitoring, evaluation, study visits, workshop, and publications. Processed products from pod cocoa waste: (1) pod cocoa meal (PCM): cocoa pods chopped, sun-dried and milled, (2) pod cocoa meal molasses block (PCB): pod cocoa meal mixed with BC and molasses cooked and moulded into blocks, and (3) fermented pod cocoa (FPC): cocoa pod chopped, *Aspergillus* fermented, dried and milled. The duration of the study was 3 to 4 months and feed was given at 2 to 3 kg/head/day at a ratio of 60 forage: 40 concentrate.

Results and Discussion

Farmers fed diets of forage and concentrate in 3 different compositions. Forage level was the same but the concentrate level was changed. Forage consisted of FG, WFC and LLC 20%, 5%and 25% respectively with 3 combined use of concentrates consisted of (1) BC 20% + PCM 20%, (2) PCB 40% and (3) BC 25 % + FPC 15% (Table 1).

Table 1. Profile of integrated Etawah crossbred dairy goats with cocoa production in East Java Indonesia

Parameter	FG 20% - WFC 15% - LLC 25% - BC 20% - PCM 20%	FG 20% - WFC 15% - LLC 25% - PCB 40%	FG 20% - WFC 15% - LLC 25% - BC 25% - FPC 15%
Number of farmers			
Sambirejo Village	3	5	2
Manisharjo Village	4	7	4
Number of Etawah goat			
Sambirejo Village	10	8	7
Manisharjo Village	23	13	9
Average daily gain (g/head/day)			
Sambirejo Village	75–100	100–125	75–100
Manisharjo Village	75–100	75–100	100–125
Milk production (liter/head/day)			
Sambirejo Village	0.75–1.00	1.00–1.25	0.75–1.00
Manisharjo Village	1.00–1.25	1.00–1.25	0.75–1.00

Note: For full form of abbreviations see materials and Method section

The integration comprising of FG 20% - WFC 15% - LLC 25% - PCB 40% was most widely applied by Etawah crossbred dairy goat ranchers in the two villages. Achievement of daily weight gain and milk production was in the good range (Table 1). The use of fermented cocoa in goats yielded weight gain from 83.9 to 101.8 g/head/day (Suparjo et al., 2011) and 95 g/head/day (Aregheore, 2002). Another study on the application of integrated farming systems through the utilisation of local agricultural waste reported average daily gain of 100 to 125 g/head/day in Etawah crossbred dairy goats (Riyanto et al., 2007).

Conclusions

For dairy goats in East Java, the most widely used feeding approach that integrates cocoa is: field grasses (FG)-waste of food crops (WFC)-leaves of legume crops (LLC)-pod cocoa meal molasses block (PCB) with the composition of 20%, 15%, 25%, and 40%, respectively. It produced average daily gain of 100–125 g/head/day and milk production of 1.00–1.25 liter/ head/day.

References

Aregheore, E.M., 2002. Chemical evaluation and digestibility of cocoa (*Theobroma cacao*) byproducts fed to goats. *Trop. Anim. Health Prod.* 34: 339–348.

Riyanto, J., A.N. Chamdi and S.H. Purnomo, 2006. Application of the Etawa crossbred goat pellet and fermented wafer block feed based-on waste of local agricultural to support the efforts of reconstruction and rehabilitation programme for farmers post-earthquake occurrence disaster at the Kulonprogo District, Yogyakarta Province. Report Research. Ministry of Research and Technology, Indonesia.

Suparjo, K.G. Wiryawan, E.B. Laconi and D. Mangunwidjaja, 2011. Goat performance of given fermented cocoa. *J. Media Peternakan* ISSN 2087-4634. April 2011, p. 35–41.

Tuah, A.K., F.Y. Obese, E.R. Orskov, D.B. Okai, D. Adomako, K.O. Amaning, A.N. Said and J.F.D. Greenhalgh, 1995. The performance of Djallonke sheep fed on diets containing various proportions of cocoa pod husk and 5% NaOH-treated maize cobs. *Anim. Feed Sci. Technol.* 5: 269–279.

Paper 47

Dairy Goat Feeding Characteristics in Malang District East Java, Indonesia

Hidayati, A.[1], Hartutik[2], Soebarinoto[2] & Kusmartono[2]*

[1]Agricultural Animal Husbandry Faculty, Muhammadiyah University of Malang
[2]Animal Husbandry Faculty, Brawijaya University, Malang, Indonesia
[*]Email of corresponding author: asmah.hidayati@yahoo.com

Introduction

Most farmers in the upland areas choose to rear dairy goats because goats can be cared easily by the women and children and milk can be fed to children. In addition, the investment cost for goat rearing is lower and the price of goat milk is higher than that of cow milk. However, there are several constraints in goat milk production one of them is the low availability of local forages for use as feed especially in the dry seasons. The objective of this study was to assess how locally available forages are used as feed for dairy goats by the rural farmers.

Materials and Methods

The study was conducted in the uplands and slopy (20–60^o) areas of the Malang district to determine the potential of rearing dairy goats in these areas. A survey was carried out to obtain primary and secondary data. The secondary data was obtained from agencies such as the district offices. The social data was extracted from 64 dairy goat households which were selected from the six regions on the basis of dairy goat populations. The primary data was obtained by a questionnaires and interviews. Through stratified sampling, 22 households were chosen to determine characteristics of feed (feed composition, feed consumption) and milk production. Data were collected over 6 months (3 months each in dry and wet seasons).

Annual measurement. Characteristics of feed and milk production were measured 3 times during the wet and dry seasons with an interval of 7 days between each measurement. The fodder given to the animals was separated into legume trees, grass, non-legumes trees, crop wastes and concentrates or byproducts and these were weighed. Milk production was measured at the time of milking in the morning after the animals were given concentrate or additional feed. Goat milk produced per colony per day was measured using 1000 mL measuring cups.

Chemical analyses. Samples of feed were analysed for proximate composition (AOAC, 1990). To determine total digestible nutrient (TDN), the samples were analysed using the Moores *in vitro* modification technique (Tilley and Terry, 1963) and converted to TDN based on Ibrahim (1986) equations.

Statistical analyses: Social data were tabulated and analysed by description. Data on feed characteristic were calculated in the mean value and subjected to statistical analyses using the paired *t*-test design models (Minitab 14.0 for windows statistical software, 1995).

Results and Discussion

Social condition of households. The social condition of household and characteristics of dairy goat feed are shown in Tables 1 and 2, respectively.

Table1. Social condition of households

Variable			
Ages (%)	20–33 years 25.71	34–48 years 54.29	48–61 years 20.00
Education level (%)	Elementary (40.63)	Junior high school (28.13)	Senior high school (15.63)
Dairy goats keeps (%)	1–8 heads (51.44)	9–16 heads (25.71)	>16 heads (22.85)
Landholding (m^2)	Sawah (224.5 ± 224.5)	Tegalan (1700 ± 886.1)	Pekarangan (292.22 ± 171.82)
Farming experiences (%)	1–5 years (34.28)	6–10 years (45.72)	>10 years (20.00)

Table 2. Characteristics of dairy goat feed, composition and milk production

Variable	Wet season	Dry season
Feed composition of dairy goat feed (%)		
a. Legume tree	$79.75^a \pm 4.58$	$40.23^b \pm 6.16$
b. Grass	$36.61^a \pm 1.98$	$47.97^b \pm 19.55$
c. Non-legume tree	$48.29^a \pm 5.92$	$63.77^b \pm 16.12$
d. Crop wastes	$1.37^a \pm 5.92$	$14.04^b \pm 9.55$
e. Byproduct/concentrate	18.54 ± 5.92	18.74 ± 0.89
Consumption of nutrient and milk production		
a. DM intake (g/h/d)	$1396.3^a \pm 393.3$	$1341.6^b \pm 147.1$
b. CP intake (g/h/d)	$234.9^a \pm 131.0$	$143.1^b \pm 37.62$
c. TDN intake (g/h/d)	$1061.4^a \pm 330.0$	$824.9^b \pm 471.3$
d. Milk Production (l/h/d)	$0.8159^b \pm 0.125$	$0.7942^b \pm 0.159$

$^{a, b}$ values with different superscripts in the same row indicate significant differences at $P<0.05$

The main problem in goat production is the limited grazing land particularly in the intensive cropping area during the wet seasons (Phengsavanh, 2003). In addition, native grass, shrubs and fodder trees become dry in the dry seasons which lead to decline in feed quality and availability. Use of crop wastes and concentrates as the energy sources were lesser than of forages especially in the wet seasons. These conditions affect the milk production which is quite similar between the two seasons. If concentrates and forage are used at the optimum ratio, this will increase the milk quality especially the milk fat (Van Raust et al., 2009) and it will have an impact on the milk price. The different seasons, level of farmers' education, land ownership and farming experiences all play important roles in dairy goat production which rely heavily on forage utilisation.

Conclusions

Type of dairy goats and feeds found in the upland areas is dependent on season, level of farmer education, land ownership and farming experience. The use of forages was dominantly legume tree in the wet and tree leaf in the dry seasons. The use of crop wastes in the dry seasons is higher than in the wet seasons, and it has an impact on the milk production.

References

AOAC, 1990. *Official methods of analyses of the Association of Official Analytical Chemist* 15th eds. Washington D.C. USA.

Tilley, J.M.A. and R.A. Terry, 1963. A two stage technique for the in-vitro digestion of forage crops. *Grass Forage Sci.* 18 (2): 104–111.

Ibrahim, M.N.M., 1986. *Feeding Tables for Ruminants in Srilanka*. Kandy Offset. Printer. Kandy.

Phengsavanh, P., 2003. *Goat production in smallholder farming system in Lao PRR. MSc thesis in tropical livestock system*. SLU Dept of Animal Nutrition and Management. Uppsala, Sweden, pp. 43.

Van Raust, G.V. Fierest, J. De Rick and E. van Bockstacle, 2009. Influence of ensiling forages at different dry matters and silage additives on lipid metabolism and fatty acids composition. *Anim. Feed Sci. Technol.* 150 (1-2): 62–74.

Paper 48

Lactation Performance of Local Goats of Rohilkhand Region, India under Semi-intensive System

Upadhyay, D., B.H.M. Patel, S. Kerketta, M. Singh, S.K. Mondal & T. Dutt*

Livestock Products and Management Section, Indian Veterinary Research Institute
Izatnagar, Bareilly (UP), 243122, India
**Email of corresponding author: mpatellpm@gmail.com*

Introduction

India has 140.53 million goats, ranking second in goat population in the world. Goat contributes 3.4% (3.9 million tonnes) of the India's total milk (112.5 million tonnes) production (Anonymous, 2010). The country has 23 well-described breeds, which constitute about 25% of the total goat population, but the rest are considered as non-descript. Rohilkhandi is a non-descript goat breed found in Rohilkhand region of Western Uttar Pradesh, which falls in the Upper Gangetic Plain Region of India. Recording of milk production is very important to classify a non-descript goat as either a meat or dual purpose breed. Therefore, an attempt was made to record exact amount of milk production using 25 local goats and to establish relationship between udder morphological characteristics and total milk yield.

Materials and Methods

Does were divided into three groups: T_1 = Weaning group (n = 10), kids completely separated from doe after two days of colostrum feeding, T_2 = Udder bag method group (n = 6), kids remained with the dam but no access to milk by tying udder bag around the mammary system and T_3 = Milk test day group (n = 9), kids remained with dam but a day before the milk test day, kids were separated from their mother in the evening. All goats from the three groups were housed in separate sheds, with open paddock, which allowed the animals to move freely. Green and dry fodder and water were always made available in the open paddock and 300 g concentrate mixture was given per head/day. Does were milked twice daily and the volume recorded for 90 days. Udder length (UL), teat length (TL), udder volume (UV) and distance between teats (DBT) were also measured monthly. Milk composition was analyzed weekly using Lactoscan (*Mega-Necto*™, New Delhi) as per the standard procedure.

Results and Discussion

Details of milk yield and milk composition are presented in Table 1. Total milk yield in T_1, T_2 and T_3 groups was 58.48, 65.80 and 54.39 litres (L), respectively, but values did no differ significantly (P>0.05). The overall average daily milk yield was 0.65 L. The fat content for T_3 group was lower (4.15%) and differed significantly (P<0.05) from the other treatment groups. Conversely, protein and lactose were lower at 2.77 and 4.30%, respectively, in T_1 in comparison to other groups. Total milk yield is positively correlated with UL, TL, UV and DBT. However, among udder morphological parameters, UL was significantly highly correlated (P<0.01) with total milk yield.

Table 1. Milk yield and composition of Rohilkhandi goats

Group	ADMY (L)	TMY (L)	Fat (%)	SNF (%)	Protein (%)	Lactose (%)
T_1 (n = 10)	0.65 ± 5.60	58.48 ± 0.04	5.89^b ± 0.21	7.75 ± 0.18	2.77^a ± 6.21	4.30^a ± 0.62
T_2 (n = 6)	0.73 ± 9.52	65.80 ± 8.52	5.88^b ± 0.16	8.02 ± 0.10	2.88^{ab} ± 4.61	4.43^{ab} ± 5.78
T_3 (n = 9)	0.60 ± 6.41	54.39 ± 5.63	4.15^a ± 0.45	7.95 ± 0.15	2.98^b ± 4.94	4.66^b ± 0.11
Overall	0.65 ± 3.88	58.77 ± 3.47	5.26 ± 0.25	7.89 ± 9.33	2.87 ± 3.60	4.46 ± 0.11

^{ab}Means with different superscripts in each column differ significantly (P<0.05).
ADMY = Average daily milk yield; TMY = Total milk yield; SNF = Solid non-fat. T_1 = Weaning group, kids completely separated from doe after two days of colostrum feeding; T_2 = Udder bag method group, kids remained with the dam but no access to milk; T_3 = Milk test day group, kids remained with dam but separated from their mother in evening before milk test day.

Reference

Anonymous, 2010**.** Basic animal husbandry statistics, AHS series-12. Government of India, Ministry of Agriculture, Department of Animal Husbandry Dairying and Fisheries.

Paper 49

Dairy Goat – A Potential Candidate for the Dairy Science Park Peshawar, Pakistan

Qureshi, M.S., S. Khan, N.A. Khan & K.B. Marwat*

Faculty of Animal Husbandry and Veterinary Sciences, Weed Sciences Department, Agricultural University, Peshawar-25120, Pakistan
**Email of corresponding author: drmsqureshi@aup.edu.pk*

Introduction

Pakistan has been blessed with rich livestock resources. Cattle, buffaloes, sheep and goats are major food animals producing 46.4 billion kg milk and 3.1 billion kg meat, at a value of US$ 28.5 billion per annum. The population of the four species of animals showed respective growth of 141, 143, 61 and 269%, with goats recording the highest growth rate, reaching the present population of 158 million heads (Economic Survey, 2011) (Figure 1). The distribution of the goat population in the provinces of Punjab, Sindh, Khyber Pakhtunkhwa, Balochistan and Northern Areas (+FATA), is 39.5, 21.7, 13.5, 22.4 and 2.8%, respectively. Goats and sheep contribute a significant share (19%) of meat produced in the country (Figure 2). The Khyber Pakhtunkhwa, the Northern Province of Pakistan with its arid and hilly nature inhabits majority of the small ruminants. These animals are kept by the farmers on small scale under extensive farming system. Sheep and goats, being small-sized ruminants, are capable of integrating into the dissimilar socio-economic situations that is prevailing in Pakistan.

Potential

Pakistan has several goat breeds (Khan et al., 2003). Beetal goat is the most popular milk breed, found in the central Punjab, possessing a massive head, Roman nose, long, broad and pendulous ears, well-developed udder and long teats. Milk yield of Beetal goats has been recorded at 190 L in 150-day lactation period. The goat is fertile with more than 50% twining or triplet births. Male Beetal goats having body weights of 70 to 80 kg are being raised especially for sacrifice on Eid-ul-Azha. Dera Din Panah goat is found in Muzaffargarh and Multan Districts. It has a large head and Roman nose. Milk yield has been recorded at 160 L in 150-day lactation period. Twin births are common in this breed. Hairy goat is a milk breed while Kajli (Pahari) goat is a meat breed of Southern Punjab. Nachi and Pothowari goats are meat breeds of Southern and Teddy is of the Northern Punjab. In the Sindh province, Chappar, Bari, Bugri, Tapri and Desi meat breeds and Jattan, Kamori and Pateri milk breeds are found. Damani is a dual purpose while Gaddi and Kaghani are meat breeds of the Khyber Pakhtunkhwa province. In Baluchistan, Kurasani goat is a dual purpose breed and Lehri is a meat breed.

Goats survive well under the rural environment. They are acclimatised to the diverse agro-climatic conditions and manifest higher fertility and short generation interval, and thus are the animal of farmers' choic. Because of their low maintenance cost, quick return on capital and low capital investment risk, goats are ideally suited for the poor rural folk especially the marginal and landless labourers. To cut cost of production, goats are usually taken care by engaging family members, especially children and women.

Opportunities and challenges

Goats are spread throughout the four provinces of Pakistan. This animal has the highest growth rate among food animals, thus goat rearing is a profitable enterprise for the local community. Goats are preferred over sheep due to its higher fertility rates and tasty mutton. The price of goat meat is also higher than beef or poultry providing goat farmers with good income.

The federal government of Pakistan is presently executing several projects in livestock sector at an estimated cost of Rs 8.8 billion (Economic Survey, 2011). These projects focuse on promoting milk and meat production/marketing; strengthening of extension services and delivery system to livestock farmers; prevention and control of livestock and poultry diseases; up-gradation of animal quarantine services and provision of veterinary services at farmer's door step. During the 2009 to 2010 period, technical and financial assistance were provided to farmers, totaling 13,171 fattening operations involving 381 678 animals under the Meat Development Project. Goat has been an important species of these development programmes.

The International Workshop on Dairy Science Park was held at the Agricultural University Peshawar (Qureshi et al., 2011). The conference was attended by more than 450 delegates from all the four provinces of the country belonging to a variety of segments of the society. Various activities have been proposed for productivity enhancement and industrial applications.

Some projects have been identified for implementation at Agricultural University Peshawar. Besides the support already provided to the Faculty of Animal Husbandry and Veterinary Sciences, this University is also willing to sponsor some additional activities. It provides a liaison office to The Khyber Pakhtunkhwa Chamber of Commerce and Industry for supporting commercially viable projects. The provincial government and other local and international donors are expected to sponsor some viable projects. Goats are being considered as small enterprises targeted at self employment, food security and export to the Halal food market. Local and international investors are being invited to establish partnership with the Dairy Science Park.

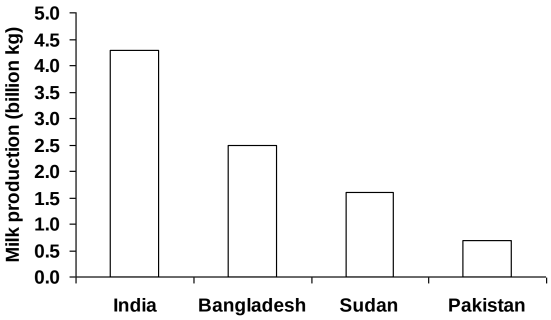

Figure 1. Pakistan's ranking in goat milk production

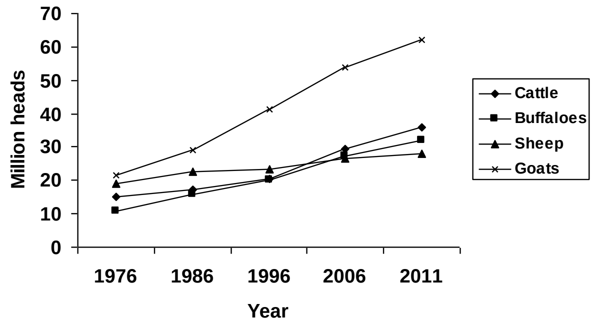

Figure 2. Change in livestock population

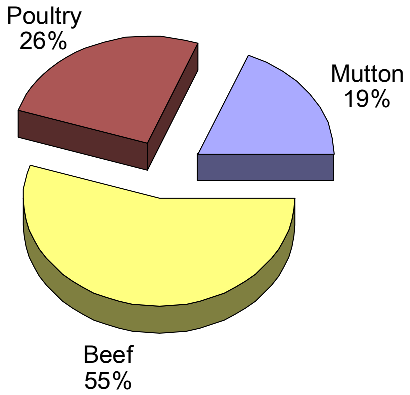

Figure 3. Meat production by food animals

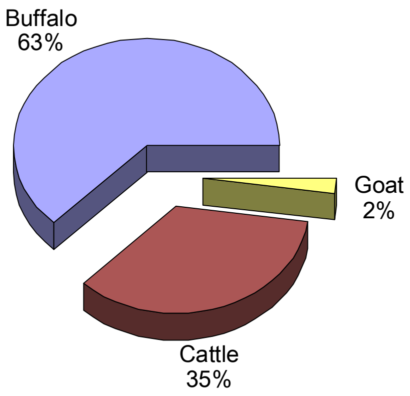

Figure 4. Milk production by food animals

References

Economic Survey, 2011. Government of Pakistan, Economic Affairs Division, Islamabad.

Khan, B.B., A. Iqbal and M.I. Mustafa, 2003. Sheep and goat. Production. Department of Livestock Management, University of Agriculture Faisalabad.

Qureshi, M.S., 2011. Proceedings, International Workshop on Dairy Science Park - Peshawar - Nov 21–23. Managing editor. Agricultural University, Peshawar, Pakistan.

Paper 50

Trends in Goat Production in Islamic Republic of Iran

Amirinia, C.[*] *& M.A. Kamali*

Animal Science Research Institute, Beheshti Ave., Postal code 3146618361, Karaj, Iran
[*]*Email of corresponding author: amirinia@hotmail.com*

Animal production in Iran composes of traditional, semi-industrial and industrial system with the majority in the form of traditional rearing by private and cooperative farmers. Based on archeological findings, hilly region of Sarab in Iran was the origin of the world wool sheep which dated back to 6000 years ago. Iranian sheep and goats ranked sixth and fifth, respectively in the world for their meat and milk quality.

Sheep and goat populations are 54 and 27 million heads, respectively, accounting for a GDP equivalent to US$ 7.6 million. The distribution of goat breeds by regions in Southern, Central and Northern Iran is approximately 9, 12 and 6 million respectively. Most Iranian goat breeds were primarily developed through natural selection and adaptation to environmental condition. These breeds are traditionally named after their breeding tribes or geographic origin. Less than 14% of goats are genetically pure and 86% are categorised as either scrub and mixed or undescript. Different goat breeds are raised for their meat, milk and wool. The more populous and famous breeds are “Raeini” and “Siahmouie”, while the less populous ones are “Marghoz”, “Najdi” and “Tali”. Systems such as traditional, nomadic and semi-nomadic are the major farming systems identified. Normally, the nomads and rural communities are farmers that practice traditional system. Semi-intensive farming system is predominantly practiced by farmers involved in fattening and breeding of sheep and goats, while the intensive system is practiced by sheep farmers or farms run by public holdings and large cooperatives. Different production systems as practiced by goat farmers is shown in Table 1

Table 1. Production systems associated with the different breeds of goats in Iran

Breed	Production system
Marghoz	Families managing their herd together
Najdi	Semi-nomadic, mixed crop livestock and village
Native Black	Nomadic, semi-nomadic and village
Raeini	Nomadic and semi-nomadic
Tali	Mixed crop-livestock and small flocks managed by a family

Over the past two decades, no significant change has been observed in the proportion of sheep or goats production at the national scale. Due to prevailing climatic, socio-economic and environmental conditions together with government considerations, there are greater opportunities for developing semi-industrial system when compared with the traditional or the industrial farming systems.

Paper 51

Impact of Prompt Delivery of Veterinary Services on Morbidity and Mortality Rate in the Flocks of Indigenous Goat Farms in Central Punjab, Pakistan

Khan, M.A.[1], A. Rehman[1], A. Mahmood[1], M.Younus[2], M. Naeem[3], F.M. Hassan[3], A.Maqbool[1] & F. Nazir[3]*

[1]Department of Epidemiology and Public Health, [2]Department of Pathology, University of Veterinary and Animal Sciences
[3]Department of Livestock and Dairy Development, Government of Punjab Lahore, Pakistan
[*]Email of corresponding author: dratharkhan@yahoo.com

Introduction

Livestock health service delivery in many developing countries (Anonymous, 1992) is undergoing privatisation as part of an international restructuring for economic development. One widely publicised initiative to refocus livestock health service delivery has been the introduction of community-based animal health workers (Haan and Nissen, 1985; Catley et al., 2002). The objective of the current study was to evaluate the effect of prompt delivery of veterinary services on morbidity, mortality and case-fatality due to different diseases on goat farms as compared to those where these services were not available.

Materials and Methods

A total number of 108 goat farms comprising of 8130 indigenous goats were registered in seven districts of central Punjab i.e. Lahore, Kasur, Okara, Sheikhupura, Gujranwala, Sialkot and Narowal. Each farm-owner was asked to participate in the study for the provision of prompt delivery of veterinary services on payment basis to treat and vaccinate their animals for one year (January to December 2009).

Fifteen goat farm owners consented to the study as paying participants and were provided prompt veterinary services. The other 93 goat farm owners did not consent to participate as paying participants but agreed to provide data on morbidity and mortality on their farms on monthly basis. The latter group was the one without prompt provision of the veterinary services. This group received veterinary services by state-owned public system.

Active Disease Surveillance

Animals in all the districts were surveyed for this descriptive epidemiological study. The survey was conducted by 21 trained interviewers to collect data on morbidity and mortality for each farm on monthly basis. Besides making the cell-phone calls, monthly visit was mandatory for the veterinary assistant/data collector. The paying participants provide information on disease status on their farms to their respective Project Manager or the interviewer. The Project Manager in turn advised the participants on the arrangement for prompt veterinary services at their door-step. Treatment was given to the paying participants immediately upon receipt of disease complaint. If needed, medication was provided free of charge, however, not all animals were dewormed because of the high cost. The morbidity and mortality data were collected and recorded from both the paying and non-paying farmers for a period of one year. Deworming and vaccination services were provided to the area with prevalent disease either on need basis or according to schedule. The diagnostic tests on the samples collected were performed in various laboratories at the University of Veterinary and Animal Sciences Lahore, Veterinary Research Institute Lahore and Punjab University Lahore.

Results and Discussion

The distribution of goats at 108 goat farms according to their age and sex is given in Table 1. Disease incidence for one year period on farms without prompt veterinary services is presented in Table 2**.** In a total population of 7,200 goats, 396 suffered from enterotoxaemia, and 316 of them died. The percent morbidity, mortality and case-fatality of enterotoxaemia were 5.5, 4.4 and 80, respectively. The highest incidence was observed due to idiopathic diarrhea (35%) followed by Peste Des Petites Ruminants (PPR) (28%) and fasciolosis (15%). For foot and mouth disease, the male adult goats had an incidence of 2% (10/500) while the female adult goats had an incidence of 2.16% (98/4530). There was no morbidity and mortality in young stock before weaning. A cumulative morbidity of 0.96% and 0.68% was recorded in male and female goats, respectively. The morbidity, mortality and case-fatality due to abortion in adult goats were 0.44% (20/4530), 0.22% (10/4530) and 50% (10/20), respectively. Among the female adult goats 0.86% were infertile and unable to produce kid in a period of one year. The highest mortality was recorded in enterotoxaemia (4.4%) followed by insecticide poisoning (3.4%), PPR (2%) and idiopathic diarrhea (2%). The case-fatality was highest in sudden death (100%) followed by enterotoxaemia (79.8%), insecticide poisoning (79.36%), abortion (50%) and foot and mouth disease (45.37).

Table 1. Age- and sex-wise distribution of goats on non-paying and paying farms

Stock Type	Goat farms			
	Non-paying (n = 93)		Paying (n = 15)	
	No.	% of total goats	No.	% of total goats
Young male & female goats (<6 months old)	1340	18.6	200	21.5
Young male & female goats (6 months to 1-year old)	830	11.5	150	16.1
Adult females (>1-year old)	4530	63.0	512	55.1
Adult males (>1-year old)	500	7.0	68	7.3
Total	**7200**	**100**	**930**	**100**

Table 2. Mortality, morbidity and case-fatality of different diseases in indigenous goats on farms without prompt veterinary services in central Punjab, Pakistan

Disease	No. of goats	Morbidity		Mortality		Case-fatality	Morbidity Ranking
		No.	%	No.	%	%	
Enterotoxaemia	7200	396	5.5	316	4.4	79.8	4
Idiopathic diarrhea	7200	2520	35	144	2.0	5.71	1
Fasciolosis	7200	1080	15	-	-	-	3
Abortion	4530	20	0.44	10	0.22	50	9
Foot and mouth disease	7200	108	1.51	49	0.68	45.37	6
Infertility	4530	39	0.86	-	-	-	7
Peste Des Petites Ruminants	7200	2016	28.0	144	2.0	7.14	2
Sudden death	7200	50	0.69	50	0.69	100	8
Insecticide/poisoning	7200	315	4.3	250	3.4	79.36	5

Table 3. Mortality, morbidity and case-fatality of different diseases in indigenous goats on farms with prompt veterinary services in central Punjab, Pakistan

Disease	No. of goats	Morbidity		Mortality		Case-fatality	Morbidity Ranking
		No.	%	No.	%	%	
Peste Des Petites Ruminants	930	279	30.2	9	1.0	3.22	1
Foot and Mouth disease	930	3	0.34	-	-	-	4
Enterotoxemia	930	-	-	-	-	-	-
Fasciolosis	930	-	-	-	-	-	-
Idiopathic diarrhea	930	106	11.4	-	-	-	2
Abortion	512	-	-	-	-	-	-
Infertility	512	-	-	-	-	-	-
Sudden death	930	4	0.5	4	0.5	100	3
Insecticide/poisoning	930	-	-	-	-	-	-

The results on the morbidity, mortality and case-fatality rate of different diseases on 15 goat farms where prompt delivery of veterinary services were available are given in Table 3. It was found that the highest morbidity was observed due to Peste Des Petites Ruminants (30%) followed by idiopathic diarrhea (11.4%), sudden death (0.43%) and foot and mouth disease (0.34%). It was also revealed that the mortality was very low in almost all the diseases. The highest mortality was 1% due to Peste Des Petites Ruminants. Furthermore, the mortality due to different diseases on farms where prompt delivery of veterinary services were not available was quite high (13.37%) as compared to those in farms (1.39%) that received the prompt delivery of veterinary services. The case-fatality rate was also very high on goat farms where prompt delivery of veterinary services were not available as compared to those farms that got prompt delivery of veterinary services.

Conclusions

It was concluded that the morbidity, mortality and case fatality were lower on goat farms where the prompt delivery of veterinary services were provided on payment basis as compared to other farms where prompt veterinary services were not available.

References

Annon. Idara-e-Kissan pattoki (1992). Livestock Production Project Pak. *Journal Technical Cooperation* pp: 1–41.

Haan, C. and N.J Nissen, 1985. Animal health services in Sub-Saharan Africa: Alternative approaches. Washington, D.C., World Bank.

Catley, A., 2002. Monitoring and assessment of community-based animal health projects. In: Catley, A., Blakeway, S. and Leyland, T. (eds.), *Community-based Animal Healthcare: A Practical Guide to Improving Primary Veterinary Services*. ITDG Publishing, London. pp 183–239.

Paper 52

Heat Tolerance Coefficient of Pregnant and Nonpregnant Dairy Goat in Hot Environment

Busono, W., * *E. Setyowati & I.M.S. Karana*

Faculty of Animal Husbandry, Brawijaya University, Indonesia
**Email of corresponding author: wbusono@yahoo.com*

Animals need to have comfortable environment to produce optimally. The comfort zone for dairy goats is between 55 and 70 degrees Fahrenheit (Purdue Dairy Goat Informations). High temperature gives heat stress to animals. Heat stress is usually measured with Heat Tolerance Coefficient (HTC). Differences in temperature and physiological status will affect HTC. This research was aimed to compare the HTC of pregnant, non-pregnant and lactating Ettawah crossbred goats in the hot environment.

This research was conducted on a dairy goat farm in Blitar, East Java, Indonesia from 11 September to 11 October, 2011. The minimum temperature and relative humidity in the animal houses recorded at 0800h were 25.3ºC and 88.6%, respectively. The maximum temperature and relative humidity occurred 1300h, with values of 29.4ºC and 87%, respectively. Twelve females Ettawah crossbred goats comprising of 4 young (1-year old) female goats, 4 lactating goats, and 4 pregnant goats were used in the study using the One Way Layout model. The treatment groups were goats of different physiological status, that is non-pregnant, lactation and pregnant, with 4 animal in each group. The study showed that average HTC of pregnant goat (2.13) was highest, followed by non-pregnant (1.98) and lactating goats (1.90) (Table 1).

It was concluded that in the hot environmental temperature, the physiological status of goats affect the HTC value. Hot temperatures have the greatest stress effect on pregnant goats followed by young non-pregnant and lactating goats. It is suggested that to reduce heat stress, the environment should be cooled with water showers.

Table 1. Heat Tolerance Coefficient of Female Crossed Ettawah goat in different physiological status

Physiological status	HTC value	
	at the morning	At noon
Young (nonpregnant) goat	$1.96^{b} \pm 0.06$	$2.00^{b} \pm 0.02$
Lactating goat	$1.88^{a} \pm 0.02$	$1.93^{a} \pm 0.03$
Pregnant goat	$2.10^{c} \pm 0.05$	$2.17^{c} \pm 0.18$

Values are mean ± std error.
[a.b.c]Within columns means with different superscripts differ significantly at $P<0.05$

References

Purdue Dairy Goat Information. http://www.ansc.purdue.edu/goat/factsheet/housing.htm (Accessed on 19 March 2012).

Paper 53

Association between Growth Hormone Gene and Post-Weaning Body Weight Gains in Savanna Goats

Amie Marini, A.B.[1], K., Aslinda[1], R. Mohd. Hifzan[2], A.B. Muhd. Faisal[2], S. Shanmugavelu[1] & K. Mussaddin[1]*

[1]Strategic Livestock Research Centre, MARDI Headquarters, 43400 Serdang
[2]Strategic Livestock Research Centre, MARDI Station, Kluang, Johor Bharu
[*]Email of corresponding author: amieza@mardi.gov.my

Introduction

Growth performance of animals is an important economic parameter in the livestock industry. Growth hormone (GH) plays an important role in several biological processes such as reproduction, metabolism, mammary development and growth of livestock animals (Jiang and Lucy, 2001). Other factors that influence the growth and body mass of animals include growth hormone receptors (GHR) and insulin-like growth factor-1 (IGF-1) (Ge et al., 2000). Therefore, GH is a promising gene marker for improving growth, meat and milk production. The objectives of this study were to screen for GH gene variants and to associate the polymorphism of GH with performance traits in Savanna goats recently introduced into Malaysia with a potential to contribute to the local chevon production.

Materials and Methods

A total of 73 Savanna goats raised at the Malaysian Agricultural Research and Development Institute (MARDI) Research Station, Kluang, Johor were used in the study. Average daily gain (ADG), body length (BL), body height (BH), body girth (BG) and body weight (BW) of the goats were recorded from birth until 11 months of age. Genomic DNA was obtained from blood samples and amplified by PCR-RFLP using five growth hormone genes (GH1, GH2, GH4, GH5 and GH6). Phenotypic and genotypic data were correlated using SAS v9.1 software.

Results and Discussion

The present study showed the presence of two variants in growth hormone (GH1 and GH5) with different genotypic patterns. The GH1 gene revealed polymorphisms with three genotypes AA (366, 56 bp), AB (422, 366, 56 bp) and BB (not observed), while GH5 revealed three genotypes GH (228, 150, 78 and 53 bp), GG (228, 78, 53 bp) and HH (150, 78, 53 bp). The highest genotype frequency in GH1 was AB while in GH5 was GG. Statistical analysis identified the combination of ABGG genotype as significant ($P = 0.05$) for post-weaning average daily body weight gain (ADG) in the goats. The percentage of combined ABGG genotype expressed for post-weaning ADG was 78.6%.

Table 1. Association between production parameters and gene expression in Savanna goats.

Parameter	Genotype												*P*
	AAGG		AAGH		AAHH		ABGG		ABGH		ABHH		
	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM	
BW (kg)													
Day old	3.8	0.15	4.1	0.17	3.3	0.25	4.0	0.09	4.1	0.17	3.3	0.25	0.35
3 months	19.6	1.02	17.8	1.55	23.8	2.10	18.6	0.69	17.8	1.55	23.8	2.10	0.40
11 months	36.5	0.93	35.9	1.68	36.3	1.25	36.4	0.69	35.9	1.68	36.3	1.25	0.99
BL (kg)													
Day old	31.5	0.51	32.0	0.60	31.5	0.50	31.6	0.36	32.0	0.60	31.5	0.50	0.99
3 months	52.7	1.03	51.0	1.48	52.0	1.00	52.4	0.74	51.0	1.48	52.0	1.00	0.92
BG (cm)													
Day old	34.3	0.56	33.8	0.54	33.5	0.50	34.3	0.38	33.8	0.54	33.5	0.50	0.97
3 months	57.9	1.20	56.2	1.59	58.5	0.50	57.5	0.85	56.2	1.59	58.5	0.50	0.94
BH (cm)													
Day old	34.0	0.49	34.2	0.85	35.0	0.00	33.9	0.36	34.2	0.85	35.0	0.00	0.98
3 months	51.9	1.07	51.4	1.61	55.0	3.00	51.3	0.74	51.4	1.61	55.0	3.00	0.87
ADG (g)													
Pre-weaning	173.8	11.21	151.8	16.93	221.0	19.90	162.5	7.62	151.8	16.93	221.0	19.90	0.32
Post-weaning	69.9	3.37	75.6	2.73	51.1	13.75	73.8	1.90	75.6	2.73	51.1	13.75	0.05
Mean	98.1	2.64	96.6	5.12	98.0	4.45	97.8	2.00	96.6	5.12	98.0	4.45	0.99

The present study showed a close relationship ($P = 0.05$) between ABGG genotype and post-weaning ADG. It is possible that the relationship can be further strengthened with a larger population of goats.

References

Jiang, H. and M.C. Lucy, 2001. Variants of 5' prime untranslated region of the bovine growth hormone receptor mRNA isolation, expression and effects on translational efficiency. *Gene* 265: 45–53.

Ge, W., M.E. Davis, H.C. Hines, and K.M. Irvin, 2000. Rapid communication: Single nucleotide polymorphisms detected in exon 10 of the bovine growth hormone receptor gene. *J. Anim. Sci.* 78: 2229–2230.

Paper 54

Production of Black Goats by the Embryo Transfer Technique

Anakkul, N.[1], J. Suwimonteerabutr[1], S. Panyaboriban[1], S. Khunmanee[2], N. Thanomsuksinchai[2], T. Tharasanit[1] & M. Techakampu[1]*

[1]Faculty of Veterinary Science, Chulalongkorn University, Bangkok 10330, Thailand,
[2]The Office of the Commission on Agricultural Resource Education, Chulalongkorn University, Nan 55000, Thailand
[*]Email of corresponding author: noon_doradora@hotmail.com

Introduction

In Thailand, black skin goats are in demand and are more expensive compared to goats of other colours. Due to the recessive eumelanin which controls black colour, mating between black and black goats produces black offsprings whereas mating between black and goats of other colours results in variable coat colours (Asdell and Smith, 1926). Australian Melaan (AM) is a black goat breed genetically developed in Australia. The breed is considered hardy, disease resistant and highly productive. Black Bengal (BB) is a small breed black goat found in Bangladesh and North-eastern India. Its soft skin and good quality meat are the main characteristics (Amin et al., 2000). It is anticipated that crossing BB with AM could enhance milk, meat and fibre production of BB. The objective of this study was to produce black skin goat of BB X AM using the laparoscopic artificial insemination (LAI), super-ovulation as well as embryo transfer (ET) techniques.

Materials and Methods

Two crossbreeding programmes were tested: Programme I, AM male X BB female, Programme II, BB male X F1 (AM + Saanen)

Superovulation and estrous synchronisation: The females (n = 10), serving as embryo donors, were superovulated by the protocol modified from Lehloenya and Greyling (2010). At the beginning, the estrus cycles of the donors were controlled using an intra-vaginal progesterone sponge for 14 days. Two hundred mg of follicle stimulating hormone (FSH), divided into 8 doses were administered to each goat at 12 h intervals. The first dose was 50 mg (3 days before sponge removal) and all the others were at 25 mg. Pregnant-mare serum gonadotropin (PMSG) (150 IU) was administrated at the first FSH administration and 200 IU of human chorionic gonadotropin (HCG) was administrated at the last FSH injection to induce ovulation. The goats were inseminated laparoscopically with the frozen semen 48 h later. The recipient goats (75% Saanen crossbreed) (n = 18) were synchronised with the donors for 13 days with intravaginal progesterone sponge. A single injection of 400 IU PMSG was given at sponge removal.

Embryo transfer: The reproductive tract of a donor was accessed through a mid-ventral incision. Embryos at 4–8 cells stage (day 3) were collected by oviductal flushing. The fresh embryo was transferred into the oviduct at the ipsilateral side where the corpus luteum is located. A polyethylene tube was inserted into the oviduct via the infundibulum and 2 embryos were then transferred to the recipient. Pregnancy was confirmed at 45 d after ET by ultrasonography (5 MHz). The skin colours and birth weights of kids were noted.

The data were reported using descriptive statistical analysis, presented as mean ± SD, the percentages of pregnancy, as well as the frequency of black kids.

Results and Discussion

All donors and 75% (12/16) of recipients came into estrus after synchronisation. The embryo collection rates varied from 0 to 100%. All 24 embryos from 8 donors were transferred to the 12 recipients. The pregnancy rate was 25% (3/12). Only one recipient gave birth to a twin. All kids were healthy and black in colour (Figure 1) with 2.03 ± 0.95 kg birth weights.

Figure 1. Black skin kids were born from embryo transferred to crossbred White Saanen

Conclusions

Laparoscopic artificial insemination with frozen semen in combination with ET could be used to produce high value black offspring goats. The combination of the above techniques provides valuable practical opportunities to improve reproduction efficiency and to enhance the genetic improvements.

Acknowledgements

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References

Amin, M.R., S.S. Husain and A.B.M.M. Islam, 2000. Evaluation of Black Bengal goats and their cross with the Jamunapari breed for carcass characteristics. *Small Rumin. Res.* 38: 211–215.

Asdell, S.A. and A.D.B. Smith, 1926. Inheritance of color, beard, tassels and horn in the goat. *J. Hered.* 425–430.

Lehloenya, K.C. and J.P.C. Greyling, 2010. The ovarian response and embryo recovery rate in Boer goat does following different superovulation protocols, during the breeding season. *Small Rum. Res.* 88: 38–43.

Paper 55

Fermentation of Ensiled Rice Straw in an *in Vitro* system containing rumen microbes

Oskoueian, E.[1] *& N. Abdullah*[2,3*]

[1]*Department of Microbiology,* [2]*Department of Biochemistry, Faculty of Biotechnology and Biomolecular Sciences,* [3]*Institute of Tropical Agriculture, Universiti Putra Malaysia, 43400, Serdang, Selangor, Malaysia*
[*]*Email of corresponding author: norhani@biotech.upm.edu.my*

Introduction

The shortage of feedstuffs has become a limiting factor for sustainable animal production. Rice straw, which is produced in abundance, should be considered as an alternative source of feed. Its low nutritive value can be improved by biological pre-treatment. Microbial fermentation of lignocellulosic materials using different microorganisms have been shown to improve the nutritive values of lignocellulosic materials (Chen et al., 2007). The current study was therefore aimed to improve the nutritive value of rice straw by ensiling with different species of lactic acid bacteria (LAB). The effects of ensiling were determined by *in vitro* fermentation studies. Parameters measured include dry matter degradability, fermentation pattern and methane production.

Materials and Methods

The isolation and identification of LAB from caecal contents of adult broiler chickens and rumen samples of fistulated Kedah–Kelantan male cattle were carried out according to Taheri et al. (2009). Ensiling of rice straw was conducted in small batches (2 kg) using 0.5 L Scott bottle. Chopped rice straw (8–10 cm) with moisture content adjusted to 70%, was inoculated with different LAB species at 10^6 cfu g^{-1} dry matter (DM) and ensiled for 30 d at ambient temperature (28–32°C). Control silage was without LAB inoculation. At the end of the ensiling period, silages were freeze-dried, ground into 1 mm particle size and used in the *in vitro* rumen fermentation system as described by Menke and Steingass (1988). The *in vitro* dry matter (DM) degradability, volatile fatty acids (VFAs), pH and methane production were determined after 24 h incubation. Treatment and analyses were done in triplicate. Data were analysed using the general linear models (GLM) procedure of SAS in a completely randomised design and the means were compared by Duncan's Multiple Range test.

Results and Discussion

The results are presented in Table 1. The DM degradability, total VFAs, acetic acid and propionic acid production were significantly (P<0.05) higher in the ensiled rice straw than in control. The total gas, methane production and butyric acid were significantly reduced (P<0.05). However, pH and ammonia nitrogen did not differ significantly.

Table 1. Dry matter degradability and fermentation pattern of rice straw ensiled with different LAB species in the *in vitro* rumen fermentation system

	Control*	*L. plantarum*	*L. salivarius*	*L. reuteri*	*L. brevis*	*S. bovis*	SEM
DM degradability (%)	22.2^{d}	29.4^{a}	26.4^{c}	26.4^{c}	27.4^{bc}	28.4^{ab}	0.68
Total gas (mL/24 h)	45.0^{a}	37.5^{d}	41.0^{bc}	40.0^{bc}	42.0^{b}	39.5^{cd}	0.84
pH	6.9	6.9	6.8	6.8	6.8	6.8	0.03
NH_3-N (mg/100 mL)	15.6	15.9	15.8	15.5	15.6	15.7	0.48
Total VFA (mM)	67.5^{d}	79.7^{a}	76.1^{b}	74.5^{c}	78.3^{a}	78.9^{a}	1.07
Acetic acid (mM)	44.5^{d}	54.4^{a}	49.7^{c}	51.6^{b}	52.7^{ab}	53.5^{a}	0.48
Propionic acid (mM)	12.7^{b}	12.9^{ab}	13.0^{a}	13.2^{a}	13.6^{a}	13.3^{a}	0.32
Butyric acid (mM)	4.6^{a}	1.7^{b}	2.4^{b}	2.1^{b}	2.1^{b}	1.2^{b}	1.01
CH_4 (mL/g DM)	7.9^{a}	4.1^{c}	5.9^{b}	4.6^{c}	5.4^{b}	5.2^{b}	0.26

L. = *Lactobacillus*; S. = *Streptococcus*; ^{a,b} Means in each row with different superscripts are significantly different (P<0.05); *Ensiled rice straw without LAB

The increase in the DM degradability of ensiled rice straw could be due to the hydrolysis of cellulose or hemicellulose present in the rice straw by LAB. It has been reported by Garde et al. (2002) that some LAB species produce hemicellulase. The increase in total VFAs, acetic and propionic acid was associated with the increase in DM degradability. The lower volume of total gas observed in the ensiled rice straw and higher DM digestibility suggests higher efficiency of rumen microbial protein synthesis which is consistent with the reduction in methane production. The results showed that LAB treatment improved the nutritive value of rice straw and that LAB in particular *L. plantarum* and *S. bovis* were found to be promising bacterial inoculants for rice straw ensiling.

Acknowledgment

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References

Chen, X.L., J.K. Wang, Y.M. Wu and J.X. Liu, 2008. Effects of chemical treatments of rice straw on rumen fermentation characteristics, fibrolytic enzyme activities and populations of liquid- and solid-associated ruminal microbes *in vitro*. *Anim. Feed Sci. Tech.* 141: 1–14.

Garde, A., G. Jonsson, A.S. Schmidt and B.K. Ahring, 2002. Lactic acid production from wheat straw hemicellulose hydrolysate by *Lactobacillus pentosus* and *Lactobacillus brevis*. *Bioresource Tech.* 81: 217–223.

Menke, K.H and H. Steingass, 1988. Estimation of the energetic feed value obtained from chemical analysis and *in vitro* gas production using rumen fluid. *Anim. Res. Dev.* 28: 7–55.

Taheri, H.R., H. Moravej, F. Tabandeh, M. Zaghari and M. Shivazad, 2009. Screening of lactic acid bacteria toward their selection as a source of chicken probiotic. *Poult. Sci.* 88: 1586–1593.

Paper 56

Quality of Caprine Sex-Separated Spermatozoa Obtained by Free-Flow Electrophoresis

Somarny, W.W.M.[1], K. Aslinda[1], S. Mat Tasol[1], K. Musaddin[1] & A.W. Hafiz[2]*

[1]Strategic Livestock Research Centre,
[2]Muadzam Shah MARDI Station,
Malaysian Agricultural Research and Development Institute,
43400 Serdang, Selangor, Malaysia
[*]Email of corresponding author: zsomarny@mardi.gov.my

Introduction

The free-flow electrophoresis technique can be used to separate the X- and Y-chromosome bearing spermatozoa through the charge from the anode or cathode (Kaneko et al., 1984, Engelmann, 1988). This procedure is inexpensive, fast and capable of spermatozoa separation (Engelmann et al., 1988). Studies by Blottner et al. (1994) have shown that this method provides a high percentage of motile spermatozoa (50–90%) in anodic and cathodic fractions. To date, there has been no research in caprine spermatozoa sex-separation by free flow electrophoresis. Thus, the aim of this study was to determine the quality of caprine spermatozoa separated by this technique.

Materials and Methods

Semen samples were collected twice a week using an artificial vagina from three fertile bucks and evaluated immediately under the microscope to determine the quality of samples, which included wave of semen, motility and concentration of spermatozoa per ejaculation using sperm analyser (IVOS, Hamilton Thorne). The clean chamber was filled with BioXcell buffer (IMV Technologies, France). Approximately, 300 µL of fresh semen at a concentration of 1×10^9 spermatozoa/mL was layered in the chamber containing buffer under electric field to separate X- and Y-chromosome bearing spermatozoa at 24 to 26°C. In this study, the separation of spermatozoa was employed under 3 V for 1.5 hours. Post-motility and concentration of sex-separated spermatozoa were subsequently determined using the sperm analyser.

Statistical analysis

Statistical analysis using SAS GLM was performed to determine the significant differences in the sex-separated spermatozoa motility from both anodic and cathodic fractions. A probability of $P<0.05$ was considered significant for all the statistical tests.

Results and Discussion

In the present study, semen samples were selected for the sex-separation based on the initial semen attributes of wave semen (4–5), motility (above 70%) and an ejaculate volume above 500 µL. The semen sample was directly introduced to the electric field without washing and centrifugation to minimise prolonged exposure to the environment. According to Manger et al. (1997) the use of washed spermatozoa resulted in improved sex-separation but caused a reduction in spermatozoa motility.

In this study, the motility rates reached up to 90% and the number of spermatozoa was reasonably high. Fractions near the cathode had high motility rates (79.46 ± 9.6%) and number ($37.7 \pm 53.34 \times 10^6$ cell/mL) of spermatozoa. The motility rate and number (48.09 ± 29.7% and $7.73 \pm 6.83 \times 10^6$ cell/mL respectively) of spermatozoa separated at 3 V was significantly lower ($P<0.05$) at the anode than the cathode. The results were in general agreement with that reported by Manger et al. (1997), who showed that cell motility varied from 85% in a fraction near the cathode to 4 to 10% near the anode. However, Masuda et al. (1989) found that most motile bovine spermatozoa were near the anode rather than the cathode. At this juncture the migration characteristic of caprine spermatozoa to the cathode and anode is still not clear. A real-time PCR (qPCR) analysis needs to be performed to validate the spermatozoa populations in both anodic and cathodic fractions, as well as to determine the accuracy of the free-flow electrophoresis spermatozoa sex-separation technique.

References

Blottner, S., H. Bostedt, K. Mewes and C. Pitra, 1994. Enrichment of Bovine X and Y Spermatozoa by Free-Flow Electrophoresis. *J. Vet. Med. A* 41 (1-10): 466–474.

Engelmann, U., F. Krassnik, H. Schatz and W.B. Schill, 1988. Separation of human X and Y spermatozoa by free-flow electrophoresis. *Gam. Res.* 19: 151–160.

Manger, M., H. Bostedt, W.B. Schill and A.J. Mileham, 1997. Effect of sperm motility on separation of bovine X- and Y-bearing spermatozoa by means of free-flow electrophoresis. *Andrologia* 29: 9–15.

Kaneko, S., S. Oshio, T. Kobayashi, R. Iizuka and H. Mohri, 1984. Human X- and Y-bearing sperm differ in cell surface sialic acid content. *Biochem. Biophys. Res. commun.* 124 (3): 950–955.

Masuda, H., M. Takahashi, M. Sekino, K. Kawakura, T. Fukushima and M. Nishimura, 1989. Sex ratio of calves from insemination of bovine spermatozoa separated by free-flow electrophoresis. *Japan J. Zootech. Sci.* 60: 409–413.

Paper 57

Morphological Characteristics of Shami Goat in Malaysia

Salleh, S.I, A.R. Mohd-Hafiz, M.A. Ernie-Muneerah, Y. Mastura & S.Z. Lai*

National Institute of Veterinary Biodiversity, Bukit Dinding, 27000 Jerantut, Pahang
**Email of corresponding author: berryaissi@yahoo.com*

Introduction

Dairy goat has good potential to increase milk production in the country. Dairy goats are easier to handle than dairy cows or buffaloes due to the smaller size and require less feed (Salleh et. al, 2010). Shami goat is a dual-purpose goat that originated from Syria and is widely distributed in Cyprus, Jordan, Turkey, Israel and other Mediterranean countries (Mavrogenis et. al, 2006). The breed is considered as one of the best dual-purpose breeds of the Middle East under semi-intensive or intensive production systems. These goats are of the Nubian type and are usually reddish or brown but may also be seen in pied or grey, and sometimes black (Aaron and Idan, 2003). Withers measurement is about 78 cm; body circumference is about 97 to 99 cm. Adult live weight is about 65.5 ± 5.0 kg for females and 75 ± 5 kg of males.

Materials and Methods

Three Shami goat farms from three different locations were chosen, namely the National Institute of Veterinary Biodiversity Jerantut Pahang (NIVB), a government farm practicing semi-intensive system; the Makmur Dairy Farm (MDF), Muadzam Shah and the Belzi Izyan Farm (BIF) in Rembau, Negeri Sembilan. Goats in the latter two farms were managed under intensive system. A total of 233 heads of Shami goats were used for this study: 48 animals from NIVB, 47 from MDF and 138 from BFI. Thirty-seven heads of Saanen goats from the Infoternak Farm, Perak (IFT) were also used as reference in this study. Body weight of animals was taken using a hanging scale. Six body measurements (heart girth, withers height, rump height, total body length, stance and body circumference) were recorded using ruler tape. Six qualitative traits (wattle, horn, coat colour, hair type and eye colour) were also obtained. Age was determined by counting the number of permanent incisors present. Only animals aged 1 year and above were evaluated. Data were analysed using Statistical Package for Social Science (Ver. 17.0). Mean linear body measurements according to sex were compared between males and females and between farms.

Results and Discussion

The body weights of Shami and Saanen goats are summarised in Table 1. Table 2 summarises the average linear body measurements for six characteristics of Shami and Saanen goats. Tables 3 and 4 summarises the qualitative and wattle traits, respectively.

Table 1. Body weight of Shami and Saanen dairy goats

Farm		Body weight (kg)		
		N	Mean	Std. Dev.
Shami				
NIVB	Total	48	42.08	5.47
	Male	3	47.07	0.40
	Female	45	41.73	5.49
MDF	Total	47	44.09	8.82
	Male	4	49.83	16.30
	Female	43	43.56	7.92
BIF	Total	138	56.81	16.35
	Male	16	61.63	26.92
	Female	122	56.18	14.47
All	Total	233	51.21	15.02
	Male	23	57.67	23.84
	Female	210	50.50	13.62
Saanen				
IFT	Total	37	51.96	14.11
	Male	4	80.50	6.61
	Female	33	48.50	10.29

NIVB = National Institute of Veterinary Biodiversity Jerantut, Pahang; MDF = Makmur Dairy Farm, Muadzam Shah, Pahang; BIF =Belzi Izyan Farm in Rembau Negeri Sembilan; IFT = Infoternak Farm, Perak

Table 2. Body Linear Measurements of Shami and Saanen Goats

	Linear measurement (cm)					
	Body Length	Stance	Withers Height	Rump Height	Girth	Body Circumference
Shami (N = 233)						
Mean	94.92	56.75	77.07	78.59	84.72	99.97
Std. Dev.	22.97	6.47	6.12	7.12	8.89	10.78
Saanen (N = 37)						
Mean	114.41	58.59	77.14	78.77	87.22	102.30
Std. Dev.	7.80	3.30	9.35	6.24	7.17	8.44

For Saanen goat, all the samples showed uniformity in hair type (medium), hair colour (white), eye colour (black), horn (polled), except for the wattle traits.

Table 3. Qualitative traits for Shami Goats

	Frequency	%
Hair Type		
Long	126	47.2
Medium	94	35.2
Short	47	17.6
Hair Colour		
Brown (B)	26	9.7
Black (Bl)	6	2.2
Dark Brown (Db)	202	75.7
Light Brown (Lb)	31	11.6
Cream	2	0.7
Eye Colour		
Brown (B)	115	43.1
Dark Brown (Db)	41	15.4
Light Brown (Lb)	73	27.3
Cream	38	14.2
Horn Type		
Horned	258	96.6
Polled	9	3.4

Table 4. Wattle traits for Shami and Saanen Goats

	Frequency	%
Shami (N = 172)		
Wattle	73	42.4
No Wattle	99	57.6
Saanen (N = 37)		
Wattle	17	45.9
No Wattle	20	54.1

Both sexes of Shami Goat and Saanen goats were observed to have wattles. Horns were present on both sexes. There were variations in eye colour in the Shami goats, from dark brown to brown and cream. Other colours such milk white, pinkish brown and black were also found (Aaron and Idan, 2003). These eye colour variations have a close relationship with milk production in Shami goats (Keskin and Bizer, 2003). Blue eye coloration is a bit rarer and was not found in this study. All males have horns while females can be horned or polled. In the Saanen goat farm, all females appeared polled although many were born with horns. Thus, the incidence of horned and polled in Saanen goats cannot be determined as most were dehorned at an early age at the country of origin for economic and safety reasons. There was also diversity in coat colour and coat type of Shami Goats. Although black colour can sometime be found in this goat population (Aaron and Idan, 2003), it was not observed in our study. All Saanen goats were white regardless of sex.

Sex is another important source of variation in body weight and body linear measurements. In this study, the bucks were heavier than does as full grown adults. This finding was in agreement with that of Samuel Fajemilehin and Salako (2008). However, does were found to be superior in terms of weight and body measurements than bucks at the early ages of 0 to 2 years old.

Conclusions

Body weight and linear body measurements are important traits in goats especially for goats of meat and dual-purpose type. The body measurements provide data on quantitative measurements of body size and shape that are desirable, which could provide a basis for genetic selection in herd improvement. However, further research is needed to determine the relationship between body linear measurements with body weight in goats under various management and feeding systems. Selection could be based on these qualitative criteria after the relationship between the qualitative traits with the milk or meat production has been determined.

References

Salleh, S.I., M.A. Ernie-Muneerah, A.R. Hafiz, A.K. Raymond, I. Zawawi, M.I. Kamarulrizal, A.M. Hafizal, M.D. Safaruddin, M.A. Abu-Hassan and M. I. Kamaruddin, 2010. *Bioprospecting Of Cyprus Shami Goats For Dairy Production In Malaysia*. 2nd National Agrobiodiversity Conservation and Sustainable Utilization. 139–141.

Mavrogenis, A.P, N.Y. Antoniades and R.W. Hopper, 2006. The Damascus (Shami) Goat of Cyprus. *Animal Genetic Resources Information* 38: 57–65.

Keskin, M. and O. Bizer, 2003. Relationship between eye Colour and Milk Yield in Shami Goats. *J. Anim. Vet. Adv.* 2 (1): 1–3.

Samuel Fajemilehin, O.K. and A.E. Salako, 2008. Body Measurement Characteristics of The West African Dwarf (WAD) Goat in Deciduos Forest Zone of Southwestern Nigeria. *African J. Biotechnol.* 7 (14): 2521–2526.

Aaron, K. and T. Idan, 2003. The Shami Goat.
http://www.goatworld.com/breeds/shami.shtml (Accessed on 26 March 2012).

Paper 58

Preliminary Study on Mortality and Adaptability of Newly Imported Shami Breed in Malaysia

Lai, S.Z.[1], S.I. Salleh[1], A.R. Mohd-Hafiz [1], M.A. Ernie-Muneerah[1], A.K.Saifullizam[2] & A.R. Hisham[1]*

[1]National Insitute of Veterinary Biodiversity, 27000 Jerantut, Pahang, Malaysia
[2]Division of Genetic Sources and Development, Department of Veterinary Service, Malaysia
[*]Email of corresponding author: berryaissi@yahoo.com

Introduction

Dairy goat has recently been recognised to play an important role in the livestock industry in Malaysia. Due to its smaller size, dairy goats are easier and cheaper to manage as they require less feed and smaller holding facilities compared to dairy cattle and buffaloes (Salleh et al., 2010). Furthermore the cost of feed, such as corn and soymeal, is on the increase, making cattle and buffalo farming expensive. Alsp development of dairy goat industry through the smallholder farmers can complement commercial milk production by cattle and buffalo (Devendra, 1980).

Shami goats, originated from Syria, are dual-purpose, for meat and milk. They are widely distributed throughout Cyprus, Jordan, and other Mediterranean countries. Shami goats have been recognized for their high milk yield and twinning. Over the last 40 years, this breed has been improved through genetic selection for milk and meat (Mavrogenis et al., 2006). The first batch of Cyprus Shami was brought into Malaysia and placed at the National Institute of Veterinary Biodiversity in October 2009 for bioprospect study (Salleh et al., 2010).

The aim of the present study was to determine the mortality rate and adaptability of the newly introduced Shami into tropical environment of Malaysia. Although the robustness and ability to adapt to new environment is higher in Shami goats compared to other goat breeds (Lurkait et. al., 2001), they can be predisposed to many diseases including parasites, Johnes' disease, septicaemia and metabolic diseases (Kahn, 2005).

Materials and Methods

Sixty-four heads of Cyprus Shami at the National Institute of Veterinary Biodiversity, Jerantut were used in this study. The goats included 60 does of between 9 to 12 months old and 4 bucks of between 12 to 24 months old. Upon arrival at the Institute, the animals were vaccinated against clostridia, tetanus, colibacilosis, enterotoxemia type D and chlamydia. They were housed in raised barn measuring approximately 30 x 90 ft under intensive system in early years to semi-intensive system thereafter. The goats were fed Guinea grass (*Panicum maximum cv common*) or Humidicola grass (*Brachiaria humidicola*), soy hull pellet and fortified energy supplement. Fresh water was offered *ad libitum.* The goats were also supplemented with essential vitamins, probiotic and minerals (Salleh et al, 2010) and screened bi-annually for small ruminant diseases such as meliodiosis, Johnes' disease, salmenollosis, tubercullosis (TB), brucellosis, foot and mouth disease (FMD) and leptospirosis. Animals which were positive for the diseases were rescreened for confirmation. If positive for brucellosis, TB, salmenollosis and Johnes' disease, the goats were either treated with antibiotic or culled. Faecal samples were constantly checked for helmithiasis and coccidiosis and positive animals were treated with anti-parasitic drugs. All animals were also vaccinated against FMD bi-annually. Another vaccination programme using Glavanac® 6 was introduced to the animals 6 months ago (mid 2011) to protect against caseous lymphadenitis, pulpy kidney diseases, tetanus, black diseases and malignant oedema. Routine deworming and deticking programmes were also introduced for prevention against helmithiasis, tick infestation and mange.

The kids were allowed to suckle the mother *ad libitum* from birth until weaning and were given free access to concentrates and roughages. Kid mortality was recorded from birth to three days old and from the fourth days old to weaning (90 days old).

Results and Discussion

Mortality rates of goats in the farm are presented in Table 1. In the first month, one female goat died from septicemia. Thirteen (44.82%) cases of mid-term abortion occurred. Initial investigations ruled-out all infectious diseases including *Brucellosis abortus* as the cause. Other foetal samples showed no infectious diseases that could cause the abortion. Further diagnostic results showed that these goats aborted due to non-infectious causes.

In the first 13 months, 9 mortalities occurred in adult animals and 8 in weaning kids and this occurred particularly after a massive storm and rainfall, which occurred in August 2010. Five of the dead goats showed either suppurative pneumonia or septicemia or both. Those that survived had nasal discharge and cough. One case was confirmed with pregnancy toxaemia/ketosis and another three with suspected metabolic acidosis. Only 8 cases of mortality were observed throughout 2011, five of which was due to nutritional imbalance and one due to septicaemia.

Table 1: Mortality rate in Shami goats

	Mortality			
	Year 1		Year 2	
	Number	%	Number	%
Adult	10	15.63	8	14.81
Stillbirth	13	44.82	8	27.59
Kid	8	50	3	14.29

Year 1: Oct 2009 – Dec 2010; Year 2: Jan – Dec 2011

In 2011, there were 8 cases of stillbirth. Most of these stillbirths were due to triplet and quadruplet kidding. This is consistent with a study conducted by Khaled et al. (2010), which showed that type of birth has a significant effect on kid mortality at birth. In single kidding, increase in mortality rates at birth may be due to kidding difficulties. The mortality rate after birth in multiple kidding can also be attributed to maternity capabilities and management practices.

The current study showed that there were only 3 cases of mortality of the 21 births involving kids at weaning. Most of these kids were affected with severe and complicated form of orf with loss in body weight and anorexia leading to immune suppression (Mazur and Machado, 1989).

Parity birth is a contributing factor to the survival and mortality of the kids during birth and at weaning (Khaled et al., 2010). The second parity of birth was better with 18 from 21 kids (85.71%) surviving.

Conclusions

Shami goat has good potential to be developed for meat and milk production in Malaysia because they can adapt to the environment. However, further studies need to be conducted to determine the cause of the pre-weaning, weaning and adult mortality in Shami goat.

References

Devendra, C., 1980. Milk production in goats compared to buffalo and cattle in humid tropics. *J. Dairy Sci.* (63): 1755.

Mavrogenis, A.P., N.Y. Antoniades and FR.W. Hopper, 2006. The Damascus (Shami) Goat of Cyprus. *Animal Genetic Resources Information* 38: 57–65.

Mazur, C. and R.D. Machado, 1989. Detection of CPD virus of goats in a severe outbreak. *Vet. Rec.* 125 (6): 419–420.

Salleh, S.I, M.A. Ernie-Muneerah, A.R. Hafiz, A.K. Raymond, I. Zawawi, M.I. Kamarulrizal, A.M. Hafizal, M.D. Safaruddin, M.A. Abu-Hassan and M.I. Kamaruddin, 2010. *Bioprospecting of Cyprus Shami Goats For Dairy Production In Malaysia*. 2nd National Agrobiodiversity Conservation and Sustainable Utilisation: 139–141.

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