Paper 30

Conjugated Linoleic Acid (CLA) Content in Ferment Goat Milk

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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.

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Paper 31

Composition and Quality of Hand- and Machine-Milked Goat Milk

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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	$4.75^{a} \pm 0.24$	$4.72^{a} \pm 0.18$	$4.71^{a} \pm 0.06$	$3.90^{a} \pm 0.42$	$4.60^{a} \pm 0.12$	$4.43^{a} \pm 0.74$
	Machine	$3.50^{b} \pm 0.03$	$5.06^{a} \pm 0.08$	$3.32^{b} \pm 0.14$	$3.49^{b} \pm 0.10$	$4.39^{a} \pm 0.06$	$3.90^{b} \pm 0.33$
Protein (%)	Hand	$4.01^{a} \pm 0.03$	$3.89^{a} \pm 0.14$	$3.92^{a} \pm 0.02$	$3.67^{a} \pm 0.05$	$3.85^{a} \pm 0.02$	$3.83^{a} \pm 0.24$
	Machine	$3.72^{b} \pm 0.02$	$3.92^{a} \pm 0.01$	$3.60^{b} \pm 0.01$	$3.64^{a} \pm 0.02$	$3.77^{a} \pm 0.10$	$3.78^{a} \pm 0.23$
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	$8.83^{a} \pm 0.04$	$8.61^{a} \pm 0.28$	$8.68^{a} \pm 0.06$	$8.27^{a} \pm 0.05$	$8.53^{a} \pm 0.03$	$8.54^{a} \pm 0.38$
	Machine	$8.42^{b} \pm 0.03$	$8.70^{a} \pm 0.02$	$8.21^{b} \pm 0.03$	$8.26^{a} \pm 0.02$	$8.41^{a} \pm 0.02$	$8.50^{a} \pm 0.41$
pH	Hand	$6.66^{a} \pm 0.08$	$6.76^{a} \pm 0.06$	$6.50^{a} \pm 0.03$	$6.55^{a} \pm 0.02$	$6.55^{b} \pm 0.01$	$6.66^{a} \pm 0.08$
	Machine	$6.57^{b} \pm 0.03$	$6.77^{a} \pm 0.02$	$6.64^{a} \pm 0.03$	$6.62^{a} \pm 0.01$	$6.6^{a} \pm 0.01$	$6.57^{b} \pm 0.03$
Total acidity (%)	Hand	$0.253^{a} \pm 0.19$	$0.227^{a} \pm 0.16$	$0.264^{a} \pm 0.17$	$0.271^{a} \pm 0.12$	$0.268^{a} \pm 0.20$	$0.253^{b} \pm 0.19$
	Machine	$0.267^{a} \pm 0.21$	$0.231^{a} \pm 0.11$	$0.235^{b} \pm 0.15$	$0.241^{b} \pm 0.18$	$0.264^{a} \pm 0.25$	$0.267^{a} \pm 0.21$
Specific gravity	hand	$1.031^{a} \pm 0.001$	$1.031^{a} \pm 0.001$	$1.031^{a} \pm 0.001$	$1.029^{a} \pm 0.001$	$1.030^{b} \pm 0.001$	$1.031^{a} \pm 0.001$
	Machine	$1.032^{a} \pm 0.001$	$1.030^{a} \pm 0.001$	$1.029^{b} \pm 0.001$	$1.029^{a} \pm 0.001$	$1.032^{a} \pm 0.001$	$1.031^{a} \pm 0.001$

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	$4.0^{b} \pm 2.11$	$6.0^{a} \pm 0.01$	$5.65^{a} \pm 0.41$	$5.85^{a} \pm 0.47$	$4.1^{a} \pm 0.01$	$4.6^{a} \pm 2.11$
	Machine	$4.6^{a} \pm 0.52$	$5.0^{b} \pm 0.01$	$4.8^{b} \pm 0.42$	$5.15^{b} \pm 0.34$	$4.0^{a} \pm 0.32$	$4.0^{b} \pm 0.52$
Resazulin (grade)	Hand	$4.0^{a} \pm 1.83$	$5.9^{a} \pm 0.32$	$4.7^{a} \pm 0.32$	$3.8^{a} \pm 0.42$	$4.4^{a} \pm 0.70$	$4.0^{a} \pm 1.83$
	Machine	$3.9^{a} \pm 0.32$	$5.0^{b} \pm 0.01$	$4.1^{b} \pm 0.48$	$3.0^{b} \pm 0.01$	$4.0^{b} \pm 0.47$	$3.9^{a} \pm 0.32$
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	$1312^{b} \pm 345$	$1481^{b} \pm 101$	$941^{a} \pm 491$	$2209^{b} \pm 832$	$1596^{a} \pm 330$	$1,587^{a} \pm 515$
	Machine	$578^{a} \pm 541$	$325^{a} \pm 129$	$868^{a} \pm 543$	$1103^{a} \pm 515$	$1509^{a} \pm 320$	$1,532^{a} \pm 4.59$
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.

Acknowledgements

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Paper 32

Using Ultraviolet Irradiation in Combination with Pasteurisation to Reduce Microorganism Content and Extend Shelf Life of Goat Milk

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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.

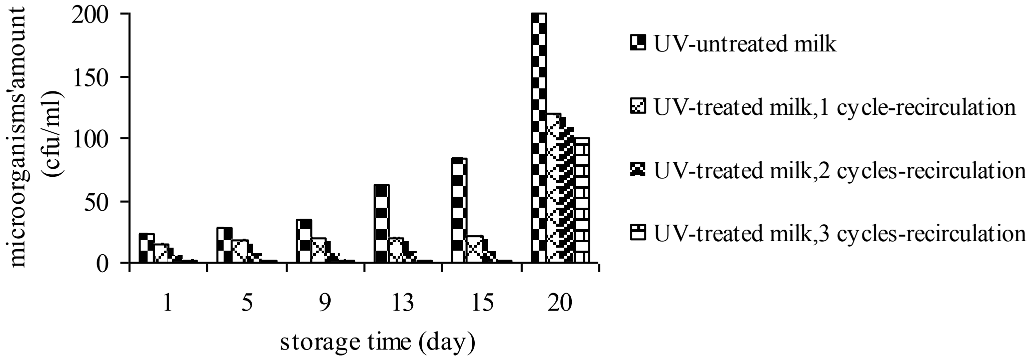

Figure 1. Microorganism *c*ontent of pasteurised goat milk after ultraviolet treatment at a flow rate of 0.85 mL/s

Conclusions

The study showed that UV radiation in combination with pasteurisation has potential to reduce microbial content and extension shelf life of goat milk.

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Paper 33

Goat Milk Production and Utilisation in Nomadic Pastoral Society of Kerman Province of Iran

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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.

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Paper 34

Effect of Feeding Cassava Peel Chips on Nutrient Consumption and Milk Production in Dairy Goats

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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.

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Paper 35

Comparison of Nutrition Quality between Cow and Goat Dairy Products: A Meta-analysis

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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.

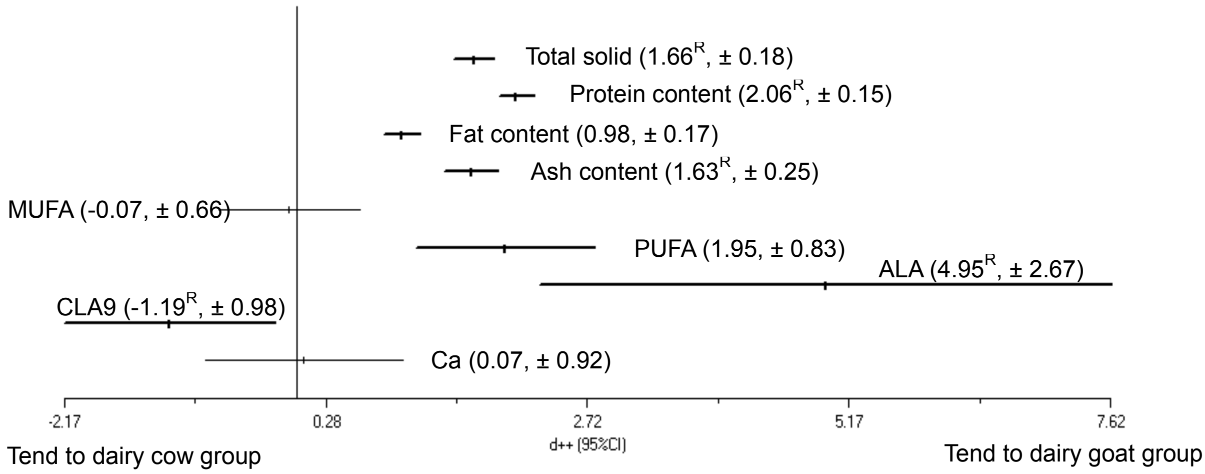

Figure 1. Forest plot of cumulative effect size and 95% CI of some parameters as the prediction for comparing the nutritional quality of cow and goat dairy products. The bold lines indicate the significant proofed analysis and the robust model

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.

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Paper 36

Prevalence of Gastrointestinal Parasites and Efficacy of Anthelmintics in Dairy Goats in Pakistan

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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).

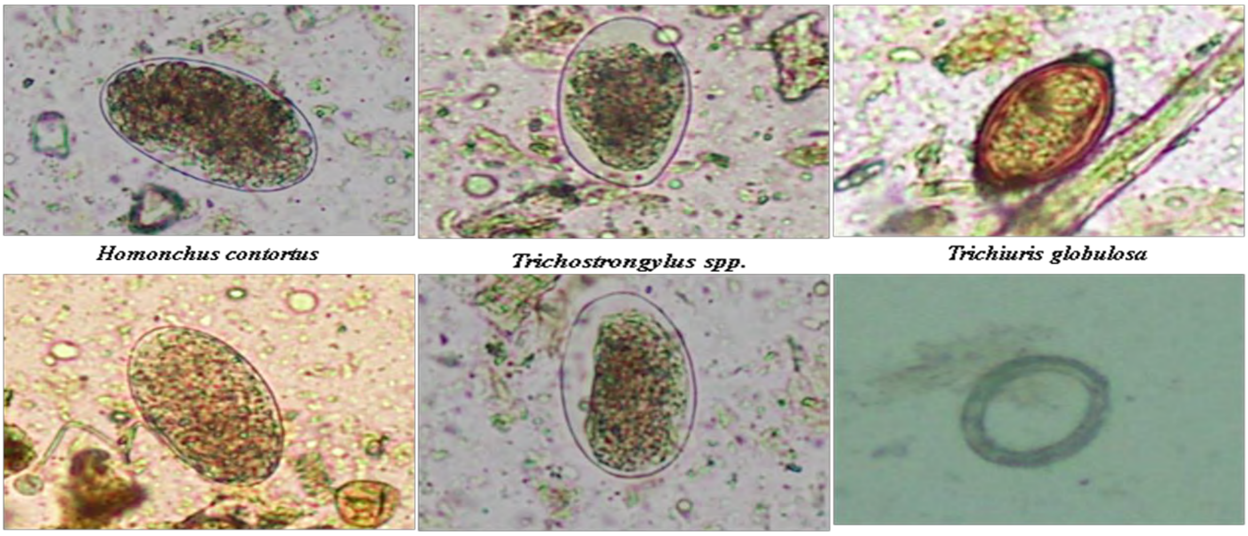
Table 1. Infection rate of gastrointestinal parasites in dairy goats

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 ($p<0.01$)



Homonchus contortus | *Trichostrongylus spp.* | *Trichiuris globulosa*

Dicrocoelium dendriticum | *Fasciola hepatica* | *Monezia spp*

Figure 1.Various gastrointestinal parasites in dairy goats

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Paper 37

Phylogenetic Analysis of Serotype Asia 1 Foot-and-Mouth Disease Virus: Asia Diversity and the Iran Perspective

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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.

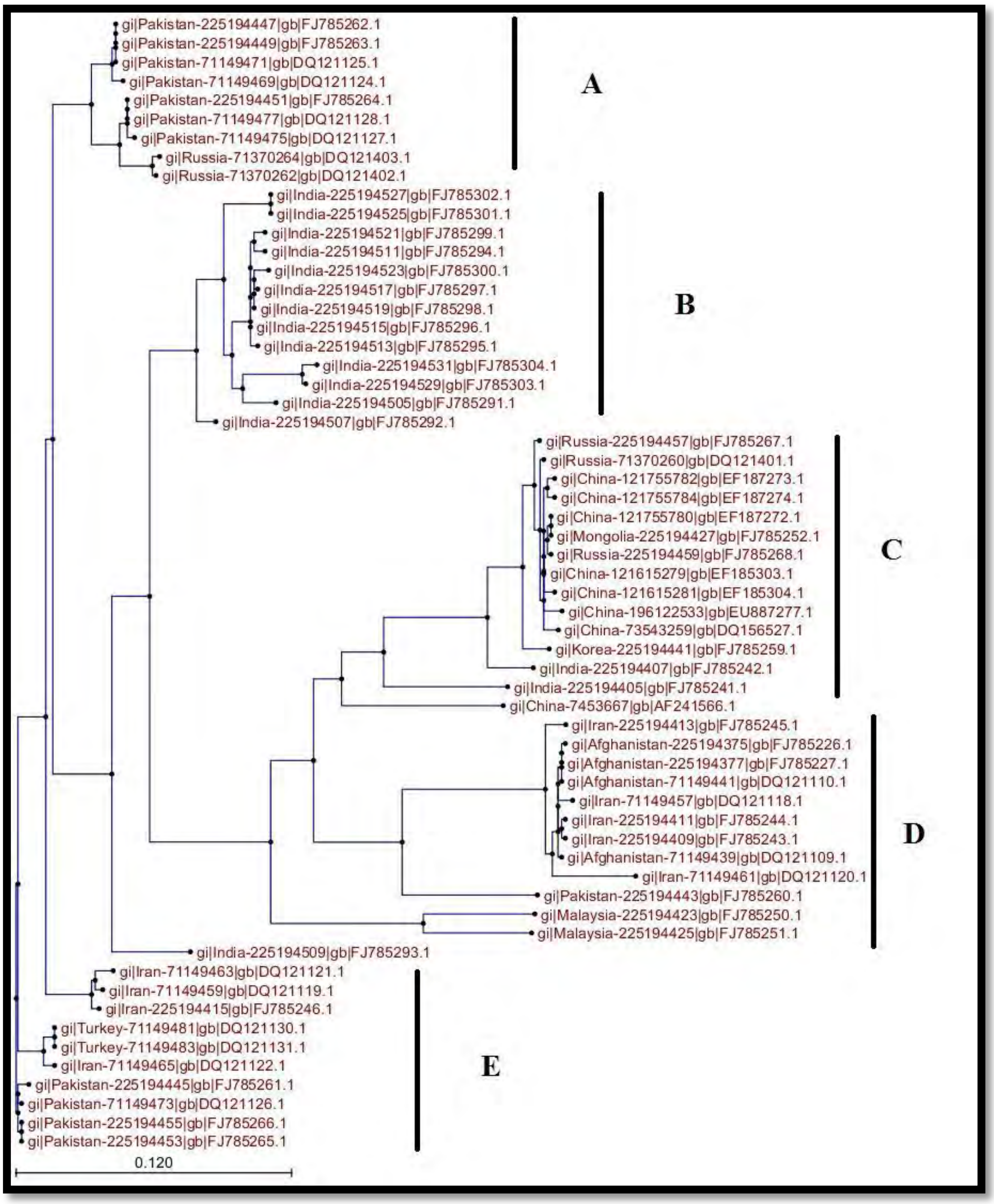

Figure 1. Nucleotide sequence similarity tree based on comparison of FMDV type Asia 1 isolates, established with VP1 coding sequences (633 bp)

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Paper 38

Johne's disease in Goats: A Histopathological and Serological Study

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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

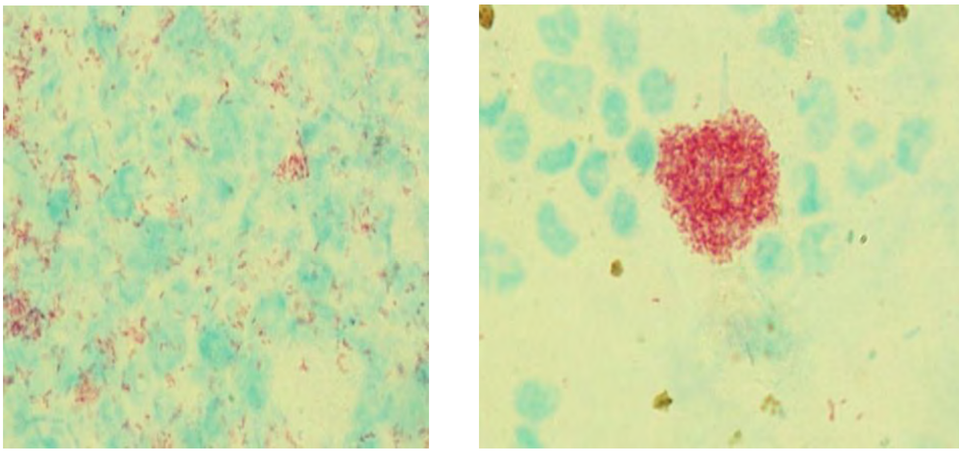

Figure 1. Small intestine of Goat. Hard pressed Impression smears prepared from the mucosa of ileum. A multibacillary form (clearly seen in right side picture) in which the ruptured cells were filled with acid fast bacilli of *Mycobacterium avium sub sp. paratuberculosis*. The bacilli appear as rose-red rods with blue background. ZN (Magnification: 800X).

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Paper 39

Sero-epidemiological Investigation and Risk Factor Analysis of Brucellosis in Small Ruminants and Their Owners in a District Of Pakistan

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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.

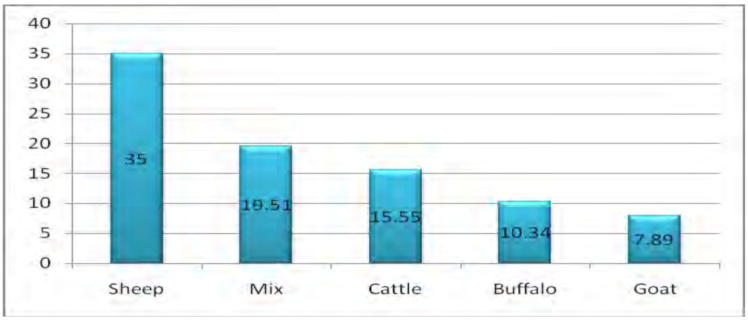

Figure 1. Herd level prevalence in %

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.

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Lead Paper 4

Improvement in Rural Livelihood through Dairy Goat Farming in India

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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	% 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)	% 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.

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Paper 40

Housing Advancements for Smallholder Dairy Goat Farming in the Tropics

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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.

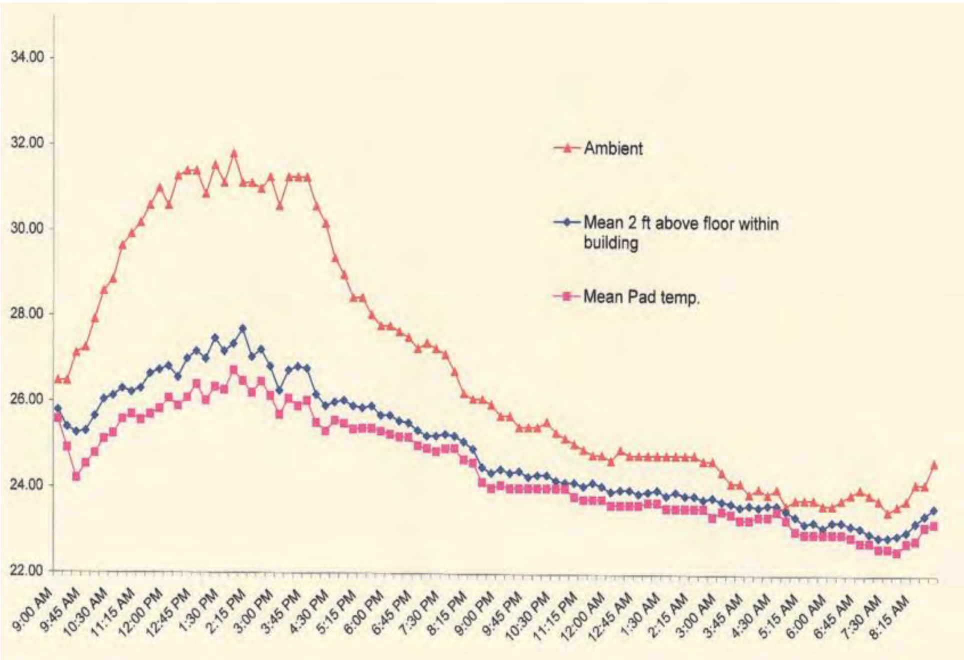

Figure 1. Mean temperature (^{o}C) at one metre above floor in the building

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.

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Paper 41

Rural Farmer Preferences Regarding Purpose of Rearing and Choice of Body Coat Colour in Indian Rural Goats

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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

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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.

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Paper 43

Normative Pen Mating Behaviour in Local Goats of the Rohilkhand Region

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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

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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

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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

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Paper 46

Integration of Etawah Crossbred Dairy Goat with Cocoa in East Java Province, Indonesia

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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.

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Paper 47

Dairy Goat Feeding Characteristics in Malang District East Java, Indonesia

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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.

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Paper 48

Lactation Performance of Local Goats of Rohilkhand Region, India under Semi-intensive System

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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.

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Paper 49

Dairy Goat – A Potential Candidate for the Dairy Science Park Peshawar, Pakistan

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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.

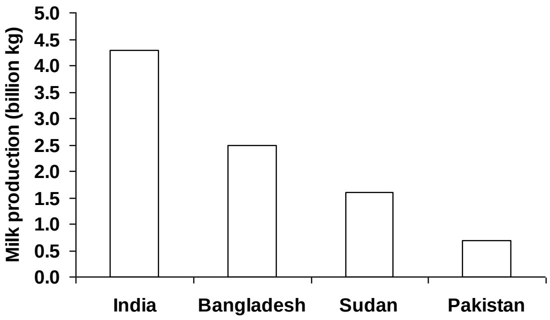

Figure 1. Pakistan's ranking in goat milk production

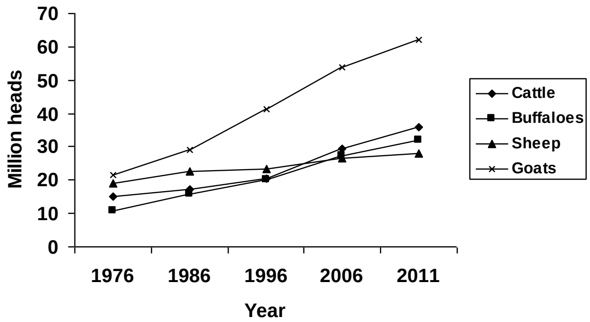

Figure 2. Change in livestock population

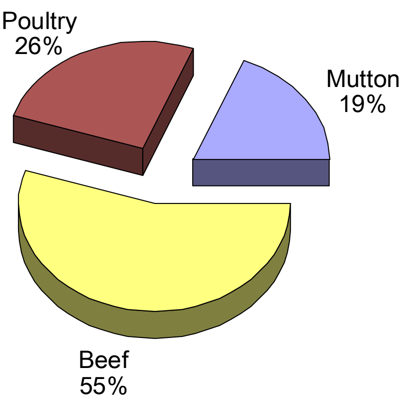

Figure 3. Meat production by food animals

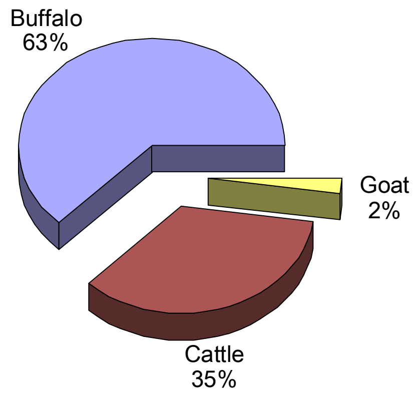

Figure 4. Milk production by food animals

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Paper 50

Trends in Goat Production in Islamic Republic of Iran

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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

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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.

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Paper 52

Heat Tolerance Coefficient of Pregnant and Nonpregnant Dairy Goat in Hot Environment

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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

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Paper 53

Association between Growth Hormone Gene and Post-Weaning Body Weight Gains in Savanna Goats

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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.

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Paper 54

Production of Black Goats by the Embryo Transfer Technique

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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.

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Paper 55

Fermentation of Ensiled Rice Straw in an *in Vitro* system containing rumen microbes

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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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Paper 56

Quality of Caprine Sex-Separated Spermatozoa Obtained by Free-Flow Electrophoresis

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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.

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Paper 57

Morphological Characteristics of Shami Goat in Malaysia

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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.

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Paper 58

Preliminary Study on Mortality and Adaptability of Newly Imported Shami Breed in Malaysia

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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.

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