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Development of commercial goat diet using low cost, locally available feed ingredients

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ABSTRACT

This study was conducted to develop a commercial goat diet using locally available, low cost feed ingredients. The pelleted feed were prepared with 14% crude protein 2400 kcal/kg Digestible energy and 70% TDN according to NRC recommendations. The experiment was conducted for a period of 15 weeks providing other standard management practices. Eight weeks old (Body weight 20-23 kg) Jamnapari weaning male goats (n=4) were selected for the experiment. In first step, 5 pelleted feeds were prepared and economically low cost feed was used to the field trial using 4 male goats. The goats were randomly assigned to 02 different groups as treatment group T1 (with pelleted diet) and control group T2 (without pelleted diet) as one goat for control group and three goats for treatment group. The T1 group was fed with ad-libitum forages and prepared low cost pelleted feed in three times per day and T2 group was fed only with forages in same time per day. The data was collected for 60 days on palatability and body weight. Average daily gain of the animals and FCR were calculated and economical feasibility also was measured. There was a significant difference between treatment and control group for body weight gain after 60 days period ($p>0.05$), But no significant difference was recorded within treatment group ($p<0.05$). Thus it can be concluded that goats reared at pelleted diet had better nutrient intake and growth performances, suggesting its potential as an alternative diet to natural grass hay at the farmer's management level as cost effectively

1. Introduction

Goats are domesticated small ruminants which are highly contributed to the livestock industry in Sri Lanka as well as worldwide, even though contribution is not accounted as much as cattle farming. This multipurpose animal provides meat, milk, milk products, and industrial uses such as hide, wool, breeding purpose and weed control (The et al. 2009). Goats are efficient browsers and prefer eating brushy plants along with some other woody and weedy plants found on the ranges. Goats are able to digest a large variety of fiber and roughage. The nutrient requirements of goats are differ according to their age, sex, breed, body size, production system, Physiological state, production level and climate etc. (Mamoon Rashid, M.Sc 2008).

Goat farming is one of the livestock industries which give a significant contribution to the agrarian economy of Sri Lanka. It is more important goat farming is possible to carry out in areas where dairy and crop farming are not economical (Mahusoon & Sivarajah 1999).This is because of goats are hardy ruminants which can exist in harsh environments in which other livestock species would perish (Nutrition & Box 2011).So that goats play an important role in the livelihood of large proportion of small and marginal scale farmers and landless labours in Sri Lanka (Mahusoon & Sivarajah 1999). According to the FAO stat Sri Lanka has a goat population of 0.299 million (FAO stat,2014) of which majority is concentrated in the dry and intermediate zone of country. Jaffna, Kilinochchi, Mannar, Batticaloa, Anuradhapura, Trincomalee and Ampara are the districts in dry zone where large population of goat concentrated while Kurunegala, Puttalama and Badulla are the intermediate zones having large populations of goats (Mahusoon & Sivarajah 1999).

Although goats are raised for various purposes, goat production mainly focused on meat and milk. There are several kinds of goat breeds in the world and Table 1 sows the goat breeds available in the world which is according to the purpose of the

rearing of animals. In Sri Lanka it has been slaughtered 70,000 heads of goats for meat production in 2013 and production was accounted as much as 1400 tons in the same year. At the same time according to the FAO estimation for milk purpose 193500 goats were raise in year 2013 and 5805 tons of milk was produced. In the world 438.3 million heads of goats has been slaughtered and meat production was 5.37 million tons in year 2013.In the same year for the milk production 200 million goats were raised in the world and the total milk production was 17.9 million tons in the same year (Anon 2014)

Table 1. Goat breeds in the world according to purpose of they are rearing.

Meat	Milk	Wool
Boer	Saanen	Angora
Spanish	Nubian	Asmari
Jamnapari	Alpine	Australian cashmere
Savanna	Nigerian Dwarft	Chyangra
kiko goats	Toggenburg	
Irish	Lamancha	

(Nutrition & Box 2011)

As in the other livestock framing in goat management also goat feeding is the important management practice. In averages 45% of the variable cost of an operation including labor costs or is about 64% of the variable cost of an operation excluding labor is accounted for feeding (Solaiman 2006).Goats are ruminants which means they can derive a substantial portion of nutrients from plants. They are selective browsers, eating a wide variety of shrubs, woody plants, briars and even weeds. Goats should be fed good quality forages along with the needed supplemental nutrients to achieve desired goals such as meat, milk or any other. In the feeding it is important to meet the goats requirement including water, protein, energy (carbohydrates and fat),minerals and vitamins but at the same time it should minimize the cost to maximize the profit (Yami 2008).

Few decades ago goat farming was one of high profitable livestock industry in Sri Lanka but collapsed. According to FAO stat, goat population of the world and Sri Lanka from 2005 to 2014 is shown in the Figure 1 and 2 respectively. As shown in Figure 1, goat population of the world has increased considerably from 2005 to 2014. In 2005, there were 883.2 million of heads but in 2014 it has increased from 123.5 million heads within 10 years up to 1.01 billion. As shown in Figure 2, goat population of Sri Lanka has declined during last 10 years. In 2005, there were 394960 heads, but in 2014 there were 299050 heads. So that Goat population of Sri Lanka Has decline from 95910 heads within 10 years. This is because of limited range of lands due to population growth, constructions and other agricultural uses etc. Therefore non availability of high quality forages in year around is a major constrain for goat farming directing goat farmers to seek alternative resource to feed their animals with cost effective.

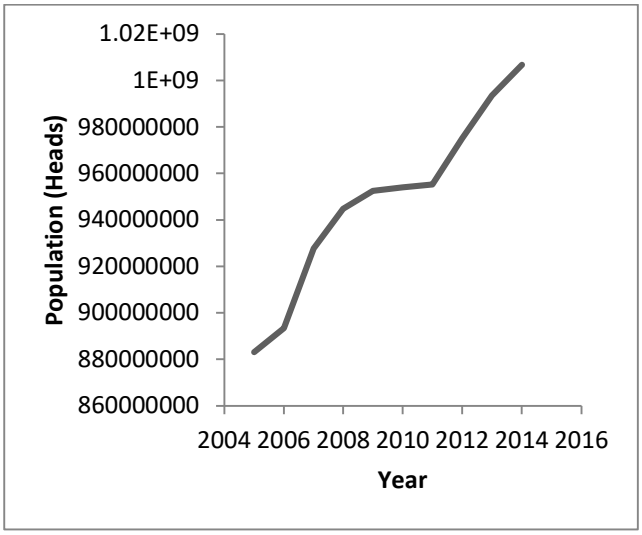

Figure 1. Goat population of world from 2005 to 2014.

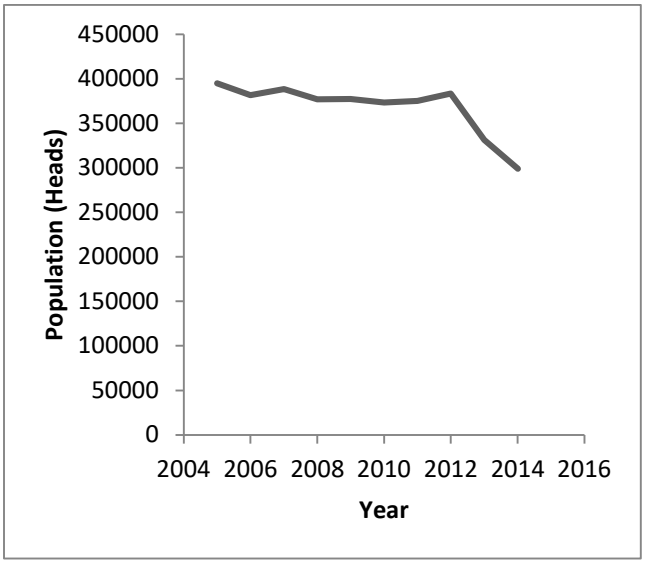

Figure 2. Goat Population of Sri Lanka from 2005 to 2014.

To carry out the goat production in a commercial level it is difficult to provide forages in large quantities that is sufficient for such production because of limited land availability. Therefore, this study was designed to produce low-cost commercial feed using locally available feed ingredients such as maize, rice, rice polish, coconut poonac, soy bean meal, skim milk powder, hall bran and bakery by-products as a solution for above problem. In this study several feed rations were developed and palatability and growth performance were checked).

2. Methodology

This study was carried out at the Goat Animal unit, Department of Livestock and Avian Sciences, Faculty of Livestock, Fisheries and Nutrition, Wayamba University of Sri Lanka. Nearly equal weight (Average weight about 20 -25 kg) four male jammunapary goats were selected for this experiment which are 08 weeks of age. They were assessed after 15 weeks of period providing same conditions for them. Such as temperature, ventilation, water supply, and also space conditions.

There are four jamnaparicweaning male goats used to the experiment and they were named as 3383, 3363, 3440 and 3454 by using ear tagging and they were randomly assigned to 02 different groups as treatment groups (T1) and a control group (T2), with three animals in treatment group and one animal in control group. Also animals were corralled in separated cages named as A, B, C and D in slatted floor house.

In the experiment, there are 5 commercial diets were prepared using different kind of locally available low cost feed ingredients. The ingredients of the each diet were shown in Table 2.

Each bulk feed ingredients were ground form because it is easy to pelleting feeds and digestibility for goats. In here, molasses were dissolved in water before added to the mixture of the ingredients.

Each goat diets were prepared based on goat's daily nutrition requirement recommended by NRC (Table 3).

According to this standard the calculation was carried out to find out the amounts of each feed ingredients that can fulfill goat's daily nutrient requirement and ingredients were weighed accordingly following proper mixing. Pelleting was done by using pellet machine. Prepared pellet feed was sun dried for 1 day and stored in a dry environment.

Data collection was done by giving ad-libitum feed for all goats for 60 days from 02/05/2016 to 30/06/2016. T1 group was fed with ad-libitum pellet feed at 8.00 a.m. and forages at 1.00 p.m. and 5.00 p.m. in each day during data collection. T2 group was fed with only forages at same time period of the day. Each animal was allowed to feed during whole day and the weight of remaining feed and the body weight were measured by using two separate spring balances at following day morning.

Table 2. Feed Ingredients of each Commercial Goat Diets

Feed No 1	Feed No 2	Feed No 3	Feed No 4	Feed No 5
Maize	Maize	Maize	Maize	Maize
Rice	What Flour	Bakery Byproducts	What Flour	Rice
What Flour	Rice Polish	Rice Polish	Rice Polish	Rice Polish
Soy bean Meal	Skim Milk Powder	Soy bean Meal	Dhal bran	Dhal bran
Coconut Poonach	Coconut Poonach	Coconut Poonach	Coconut Poonach	Coconut Poonach
Molasses	Molasses	Molasses	Molasses	Molasses
Dicalcium Phosphate	Dicalcium Phosphate	Dicalcium Phosphate	Dicalcium Phosphate	Dicalcium Phosphate
Salt	Salt	Salt	Salt	Salt
Urea	Urea	Urea	Urea	Urea

Table 3. Nutrition requirement of goats in each weight stages.

Live Weight (kg)	10	20	30	40	50
Expected Daily Weight Gain (g)	300	350	450	500	550
Digestible Energy (kcal/kg)	700	1180	1590	1980	2340
Metabolize Energy (kcal/kg)	570	960	1300	1610	1910
Crude Protein (%)	15	15	15	14	13
Dry Matter Intake (g/day)	240	400	540	670	790
Ca (%)	1	1	2	2	3
P(%)	0.7	0.7	1.4	1.4	2.1

Data analysis was done by using SAS 9.2 and Microsoft Excel software. Two sample t-tests was carried out using SAS 9.2 to analyze and compare the average weight gain of the animals between T1 and T2 group as well as ANOVA was carried out to compare the average weight gain of the animals within T1 group. Average daily weight gain and FCR value of the animals were calculated using Microsoft excel and also palatability of the goats (daily feed intake) was graphically illustrated by using Microsoft Excel. The costs of the each experimental diet were calculated based on the existing price of the ingredients during the experimental period. Cost of production / treatment, was calculated considering expense on goats, feed, ingredient and constructing on the basis of market price and profit margin also calculated

3. Results and Discussion

The biometric measurements are used to assess several characteristic of animals. These measurements provide important evidences for the growth of the breed and the properties that change with environmental effects and feeding factors. In addition, body measurements are important data sources in terms of reflecting the breed standards and are also important in giving information about the morphological structure and development ability. Body measurements differ according to the factors such as breed, gender, yield type and age (Pesmen & Yardimci 2002).

In this study 5 commercial pelleted goat diets were prepared using locally available, low cost feed ingredients according to calculated goat's nutrition requirement. Then proximate analysis of each feed ingredient was carried out to determine the nutritional composition of each pelleted feed. The results of the proximate analysis are shown in Table 4. Analysis of cost for feed preparation was carried out to identify the lowest cost feed to continue the research. During the experiment, palatability and growth performance of the animals was measured. Feed intake was measured after an ad-libitum feeding on fallowing day. In here concentrate feed intake and forage intake were measured separately in T1 and T2 groups. Figure 2 shows the average concentrate feed intake of T1 group.

Table 4. Proximate analysis results of each pelleted diets.

Feed No:	1	2	3	4	5
Energy (Kcal/kg)	2516	2492	2510	2509	2485
Crude Protein(%)	14.75	14.77	14.69	14.69	14.71
Ca(%)	0.88	0.99	0.95	1.02	0.72
Available P(%)	0.67	0.81	0.77	0.82	0.58
Crude Fiber(%)	4.60	7.56	7.98	7.23	8.53
Crude Fat(%)	3.61	7.67	8.23	7.41	6.94
Ash(%)	4.83	7.28	7.00	7.17	8.01
TDN(%)	71.33	68.22	66.64	68.21	70.38

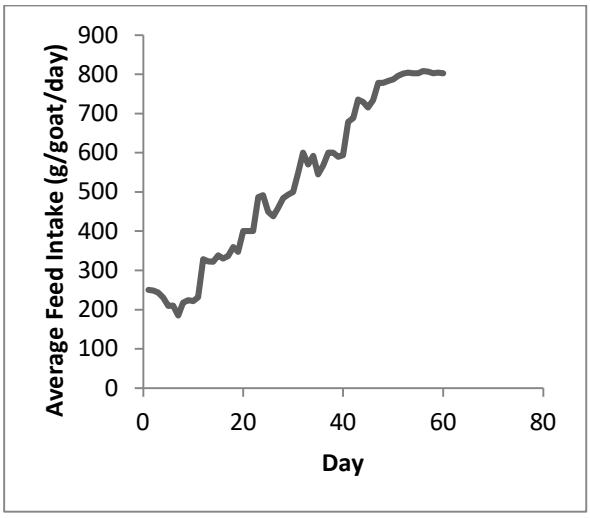

Figure 3. Average concentrate feed intake of T1 group.

According to figure 3, concentrate feed intake of T1 group was low as much as 250 g/goat/day and it was gradually increased up to around 800 g/goat/day within 50 days. After 50 day concentrate feed intake was constant at around 800 g/goat/day. Although goats' preference for concentrate feed increases with the time, after a certain amount they limited their feed intake because they fulfill their maximum feed intake for a day according to their body weight resulting constant amount of 800g. Figure 4 shows the average forage intake of T1 group.

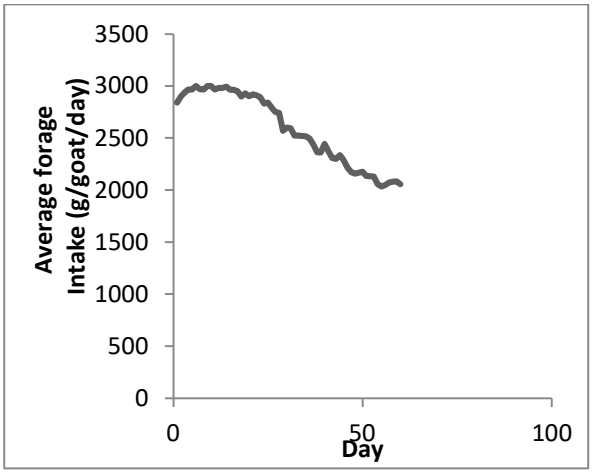

Figure 4. Average forage intake of T1 group.

As shown in the graph, forage intake of the T1 group was high as much as 2800-3000 g/goat/day. But it was gradually declined up to 2000-2100 g/goat/day at the completion of 60 days. Based on above two graphs (Figure 3 and 4) it can be concluded that with the increase of concentrate feed intake, forage intake of T1 group has declined. Initially goats were not adapted to feed on concentrate feeds. But their palatability for pelleted feed was increased gradually. Since their daily dry matter requirement was fulfill from the concentrate feed, the requirement of forages was gradually declined.

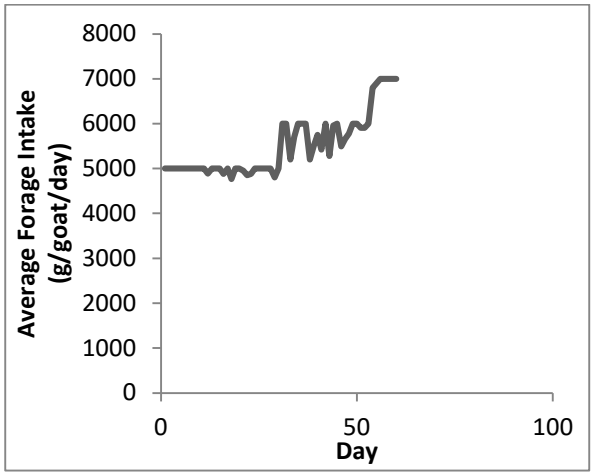

Figure 5. Average forage intake of T2 group.

According to the above graph, forage intake of T2 group was constant at about 5000 g/goat/day within initial 25 days. After that amount was irregularly increased up to 7000 g/goat/day until 55th days and finally forage intake was constant at around 7000 g/goat/day during rest of the time. Initially feed intake of goats were low and this might be because of goats were trying to adapt to new environment. But after few days it seems to be their feed intake was increased as they were properly adapted to the environment and to fulfill their daily dry matter requirement corresponding to the weight gain. But since they are selective feeders the increase of feed intake was irregular. As they obtained their maximum feed requirement which is corresponding to the body weight, feed intake was constant. Figure 6 clearly shows the difference of feed intake of two groups through the average dry matter intake (DMI).

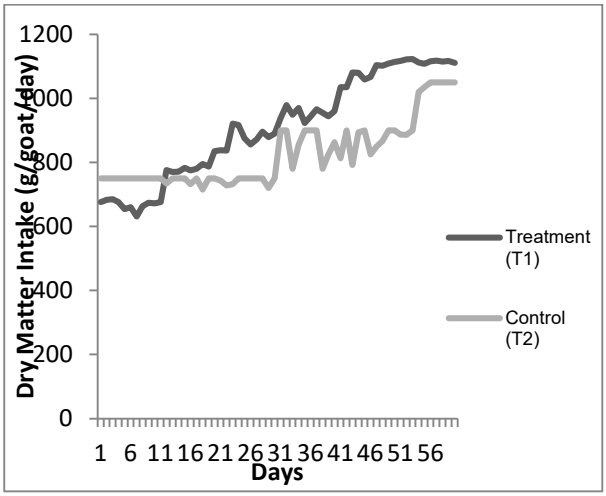

Figure 6. The average Dry Matter Intake of T1 and T2 groups.

As shown in above graph, initially the average DMI of T2 group was higher than T1 group and this was because of the goats may not properly adapted to the pelleted feed and with the time they may highly prefer concentrate feed than the forages. Therefore average DMI of T1 was increased at the end of experimental period.

While measuring feed intake of the goats, body weight of the goats also measured. The body weight gain of the T1 and T2 groups are shown in figure 7.

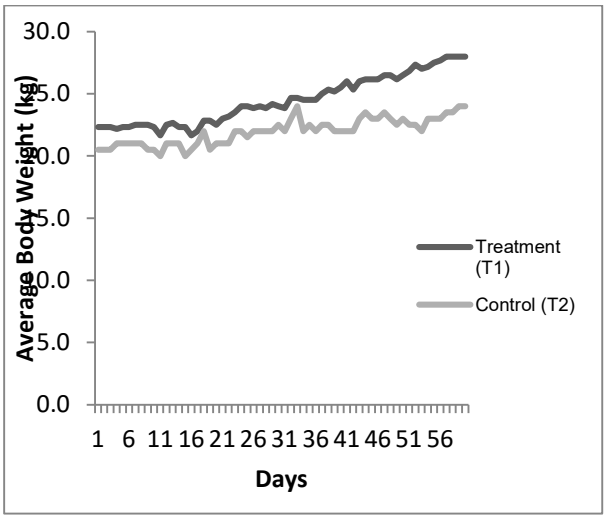

Figure 7. The average body weight of T1 and T2 groups.

According to figure 7, weight gain of both groups was slightly increased with the time. But increment of feed intake of T1 group was higher than T2 group.

Table 5. Effect of the concentrate feed on the body weight gain of T1 and T2 groups.

Treatment	Mean	Std Deviation	Std Error	Minimum	Maximum	Average Weight Gain (kg/60 days)
T1	24.49	2.2717	0.169	19	29.5	5.7
T2	21.96	1.0708	0.138	20	24	3.5

According to the results of SAS 9.2 which are shown in Table 5, the total average body weight gain of the goats in the treatment group (T1) and control group (T2) were 5.70 kg/60 days and 3.50 kg/60 days respectively. In comparison with the T2, there was an effect of the commercial pelleted goat diet on weight gain of T1 group until 60 days of experimental period at the 95% significant level.($P>0.05$).

According to the above results, the goats fed with both commercial pelleted diet and forages (treatment group, T1) shows higher growth performances than control group (T2) which fed only with forages during experimental period.

Table 6 shows performance characteristics of goats. In here live weight of animals, Feed Conversion Ratio (FCR), Average daily weight gain of animals were calculated.

Table 6. Performance characteristics of the goats during 60 days.

Performance Characteristics	Treatment (1)	Control (T2)
Average Initial Live Weight (kg)	22.3	20.5
Average Final Live Weght (kg)	28.0	24.0
Average Weight Gain (kg/60 days)	5.7	3.5
Average Total Concentrate Intake (kg)	31.405	0
Average Total Forage Intake (kg)	155.012	330.470
Average Total Dry Matter Intake (kg)	54.657	49.571
Survival Rate of Animals (%)	100	100
Feed Convesion Ratio (FCR)	1.96	2.07
Average Daily Weight Gain (g/day)	94.44	58.33

According to Table 6, FCR value of T1 group (1.96) is lower than T2 group (2.07). Therefore required amount of dry matter to increase the body weight of T1 group from 1kg is lower than T2 group. Thus, it is beneficial to feed animals using prepared concentrate feed to reduce the dry matter amount which is required to increase the body weight from 1 kg. At the same time the average daily weight gain of T1 group is higher than T2 group accounting 94.44 g/day and 58.33 g/day respectively.

Cost Analysis

Table 7. Cost analysis for concentrate feeding during experimental period.

Description	Unit
Cost for feed ingredients (LKR/100kg)	4085.00
For Electrisity (LKR/100kg)	75.00
For Transport (LKR/100kg)	500.00
Total cost for 100kg concentrate feed (LKR)	4660.00
Cost per 1kg of concentrate feed (LKR)	46.60
Average total concentrate feed intake during experimantal period (kg)	31.405
Total cost for concentrate feeding during experimental period (LKR)	1463.47

Table 8. Cost analysis for forage feeding during experimental period.

Description	Unit
Forage amount that can supply from 1 labor per day (kg)	250.0
Labor cost per day (LKR)	1000.00
Trasport cost for 250.0 kg of forages (LKR)	1500.00
Cost for 1 kg of forage feeding (LKR)	10.00
Total forage intake during experimantal period (kg)	485.482
Total cost for forage feeding during experimantal period (LKR)	4854.82

According to Table 7 and 8, Production cost of 1 kg of concentrate feed was LKR 46.60. It is tolerable amount to the farmer when comparison with other animal feed which are available in industry such as cattle feed, swine feed etc. When considering forage feeding, it is low amount that can spend to produce 1 kg of forages and it is accounted as LKR 10.00. But considering the dry matter amount of the each feeding methods in forage feeding, about 50 rupees should spend to produce 1 kg of dry matter.

Table 9. Cost analysis for feeding of T1 group during experimental period.

Description	Unit
Total cost for concentrate feeding during experimental period (LKR)	1463.47
Total forage intake during experimental period (kg)	155.012
Total cost for forage feeding during experimental period (LKR)	1550.12
Total feeding cost during experimental period (LKR)	3013.59

Table 10. Cost analysis for feeding of T2 group during experimental period

Description	Unit
Total forage intake during experimental period (kg)	330.47
Total feeding cost during experimental period (LKR)	3304.70

Table 9 and 10 shows total cost for feeding in each T1 and T2 groups. According to Table 9, total feeding cost during experimental period of T1 group is LKR 3013.59. According to Table 10, total feeding cost accounted as LKR 3304.70.

According to the above results, forage feeding of goats with concentrate feeds more profitable and effective than only forage feeding of goats

4. Conclusion

Since palatability of goats was in a high level it can be recommended concentrate feed for goat farming. It has a higher effect on body weight gain of goats by giving concentrate feed along with the forages instead of giving only forages. Since cost for supplying 1kg conventional feed (forages) is higher than producing 1kg of concentrate feed (pelleted feed), it is cost effective to use concentrate feed for a goat production which is carried out in a commercial level.

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