Research article

COMPARATIVE STUDY ON FATTENING PERFORMANCE OF DIFFERENT GOAT BREEDS SUPPLEMENTED WITH COMMON FODDER TREES IN MID HILLS OF NEPAL

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ABSTRACT

Goat (*Capra hircus*) is important meat animal of the country. Fattening performance of different breeds of goats with common mid hill fodder trees was conducted in Completely Randomized Design with 4×5 factorial arrangements at Goat Research Station, Tanahun. The first factor was breed of goats and second factor was species of fodder trees. The main parameters monitored included dry matter (DM) intake, fattening performance and average daily gain (ADG) of goats with respect to different fodders. Results showed that DM intake by breeds of goats and species of fodder trees were highly significant ($p<0.001$). Weight gain of different breed of goats and species of fodder trees were significantly different ($p<0.01$) with Boer cross and *Listea monopetala* having higher weight. The ADG of Boer cross, Jamunapari cross, Khari and Barbari cross were 70.93g, 59.35g, 53.38g and 45.36g, respectively and highly significant ($p<0.01$). Likewise, ADG of *L. monopetala*, was higher than other fodder trees. The interaction effects of breeds of goat and fodder species on ADG were similar up to 8 weeks and later observed significantly different ($p<0.01$). *L. monopetala* and *Ficus lacor* were better fodders in terms of fattening performance of different breeds of male goats. From the experiment of blood serum analysis, phosphorus content of *F. lacor* was significantly higher ($p<0.01$). Results of subsequent short term intake rate (STIR) measurement in order to find out the preference of fodders trees revealed that significantly higher ($p<0.05$) intake was obtained for *L. monopetala*, followed by *F. lacor*, *Ficus glaberrima*, *Melia azedarach* and mixed fodders (0.45g, 0.39g, 0.38g, 0.34g and 0.33g DM min^{1} per kg metabolic body size), respectively. The results of this study revealed that Boer crosses were more potential for fattening in terms of weight gain and voluntary intake. Likewise, *L. monopetala* and *F. lacor* were found better in fattening the male goats compared to other fodders.

Keywords: Dry matter, average daily gain, mixed fodders, short term intake rate

INTRODUCTION

Goat is one of the important commodities for meat production in Nepal. Total meat production of Nepal in 2018/19 was 357,082 mt. in which goats' contribution is 20.69 (MoALD, 2020) and occupied second place after buffalo in nations meat supply in Nepal. The value of this species especially to the small farmers and landless agricultural workers can be attributed to special characteristics which include: small body size, inquisitive feeding habits, and high digestive efficiency of food utilization, high fertility and short generation interval. These special features of goats provide significant economic, managerial and biological advantages. Apart from their main use, goats are also useful in several ways to the farmers, as an insurance against failure of crops, slaughter during the religious (Rauniyar, *et al.*, 2000), customary and festive occasions. Also, goat meat is very popular and is preferred over other meat throughout the country (Dhakal *et al.*, 1985).

Nutrition is the most important factor influencing high cost of production of goat under controlled managemental condition (Devendra, 1984). Khari is the principal breed of the goats in hilly region which is hardy in nature, prolific and smaller in body size. Whereas, Jamunapari×Khari (F_1), Barbari×Khari (F_1) and Boer×Khari (F_1) are the breeds recommended for fattening in mid hill region of the country by NARC.

Utilization of trees and shrubs has been recognized as the most effective means of improving both supply and quality of forage in smallholder livestock systems, during the dry season (Gutteridge and Shelton 1994; Robinson 1985). The contribution of the fodder tree in the mid hills varies from 8 to 60% of the total fodder supply depending on the management of the ruminants (Pariyar, 2008). More than 200 species of fodder trees and shrubs are being used as fodders in the country (Shrestha and Pradhan, 1995). Priority on

green fodder could be the better strategy to reduce the cost of production of goat meat as those fodder trees do supply most of the essential nutrients like carbohydrates, proteins, vitamins and minerals. Some fodders like *Ficus lacor*, *Litsea monopetala*, *Melia azedarach* and *Ficus glaberrima* are the source of those roughages commonly used during lean season in the hills.

Goats spend 90% of their total eating time on browsing and only 10% on grazing (Acharya, 1986). This means that leaves and other parts of shrubs and trees make a great part of their feed intake. Fodder trees and shrubs are the only naturally occurring feed available in the dry tropics and have therefore been utilized for a long time. But they could also be used to a greater extent in other parts of the world as the sub-humid and humid tropics (Speedy *et al.*, 1991).

In the Nepalese goat farming system, deficit of green fodders become most critical in winter and early summer season. The fodder trees become an alternate source of good quality green roughages in this period. But limited fodder-animal interface researches have been done in assessing the fattening potential of those fodder trees to the goats. So, present investigation intended to assess the fattening performance of some species of fodder trees to different breeds of goats which can be useful to construct the appropriate package of production of goat fattening in the mid-hill region of Nepal.

MATERIALS AND METHODS

Fattening experiment with relative preference of fodders by goat was carried out during July to October (for three months). For fattening, male goats of four different breeds (Khari, Jamunapari×Khari, Barbari×Khari, Boer×Khari) were taken and fattening was done with respect to common fodder trees. Relative preference of fodders by goat was identified by short term intake rate (STIR) measurement of different fodder trees. All the experiments were conducted in metabolic cages of Goat Research Station, Bandipur, Tanahun.

The experiment was conducted in Completely Randomized Design (CRD) with factorial arrangement (4×5). The first factor was the breed of the goat, viz Khari, Jamunapari×Khari (F_1), Barbari× Khari (F_1) and Boer× Khari (F_1) and the second factor was species of fodder trees, viz Kabro (*Ficus lacor*), Kutmiro (*Litsea monopetala*), Bakaino (*Melia azedarach*), Pakhuri (*Ficus glaberrima*) and mixed. All together 20 treatments in combinations of different levels of two factors, were tested. Kids were kept in separate metabolic cage and concentrate feed was offered @ 1% of their body weight, and fodder was offered *ad-libitum*. The fodder offered in the day was 15% more than fodders consumed in previous day. Deworming was done 15 days prior to the experiment with the albendazole and Ivermectin (@ 1 ml/50kg) for internal and external parasites. Adaptation period of one week was carried out prior to the initiation of the experiment.

Data of daily feed intake, daily fodder offered and refused and weekly weight gains were recorded. Body weights of goats were monitored in every two weeks. The compositions of fodders were analyzed in Animal Nutrition Division laboratory, Khumaltar for nutrient analysis. The laboratory analysis was done by using the AOAC (1995) and Van Soest *et al*. (1991). Nutrient compositions of different fodders used in the experiment are presented in the Table 1.

Table1. Nutrient compositions of different species of fodder trees in GRS, Bandipur, Tanahun

Fodder name	DM	CP	OM	TA	NDF	ADF	Cellulose	HC
Melia azedarach	29.69	16.54	91.21	8.79	62.47	42.36	20.11	12.57
Ficus lacor	36.37	14.89	86.86	13.14	84.88	76.76	8.12	30.34
Litsea monopetela	30.74	15.71	89.91	10.09	80.90	67.51	13.39	24.01
Mixed fodder	21.01	15.26	88.48	11.52	71.32	47.21	24.11	24.58
Ficus glaberrima	34.91	13.15	86.07	13.93	66.12	48.37	17.75	20.36

DM = Dry matter, TA = Total ash, OM = Organic matter, CP = Crude protein, NDF = Neutral detergent fiber, ADF = Acid detergent fiber, HC = Hemi-cellulose (Source: Laboratory analysis, 2013)

STIR measurements were done to find out the relative preference of common species of fodder trees used in the experiment through STIR protocol. The STIR values were estimated by using the equation modified and used by Hogan *et al.* (1985), Romney and Gill (1998), Rymer (2005), and Ghimire (2007).

$$\text{STIR (g DM/min/kg metabolic body size)} = [((W_1\text{-}W_2) \times \text{Proportion of DM in feed/T})]/M^{0.75}$$

Where,

W_1 and W_2 are the amount of feed offered and refused respectively (g fresh weight), T is the time spent actively eating (min) and M is goat live weight (kg).

Data obtained was analyzed using Analysis of Variance procedure for CRD design. GenStat Discovery Edition 4 (2011), Microsoft Excel, Sigma plot (2000), statistical computer packages were used for the data analysis. The means thus obtained was compared by using Least Significance Difference (LSD) value of 0.05.

RESULTS AND DISCUSSION

DM intake

Dry matter intake of fodders by different breeds of goats is presented in Table 2. Intake of fodder DM by different breeds of goats was significantly different from first week to twelve weeks ($p<0.05$). Fodder DM intake was highest in Jamunapari cross goats from 1 to 5 week and from 7 to 10 week with 441.3 g, 429.7 g, 429.8 g, 463.6 g, 491.4 g, 528.1 g, 518 g, 524.6 g and 536.2 g day^{-1}, respectively followed by Boer cross in every week. However, for 6, 11 and 12 week, fodder DM intake was highest in Boer cross bred with 514.4 g, 569.7 g and 581.6 g day^{-1}, respectively. Higher DM intake by Boer cross and Jamunapari cross might be due to larger body size and high voluntary intake of fodders by these breeds. Least DM intake was found in Barbari cross goats in every observation week having smaller body size than other breeds.

Table 2. Fodder dry Matter intakes by different breeds of goats in weekly basis

Breed	Total dry matter intake of goats in gram day^{-1}												
	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	Mean
Barbari cross	359.80	375.80	340.50	358.40	397.50	439.60	452.30	438.00	485.40	480.60	513.30	519.30	430.04
Boer cross	425.00	413.90	419.80	424.20	467.60	514.40	524.90	500.80	512.40	535.20	569.70	581.60	490.79
Jamunapari cross	441.30	429.70	429.80	463.60	491.40	504.60	528.10	518.00	524.60	536.20	543.60	546.60	496.46
Khari	423.10	408.30	367.20	374.20	430.30	466.90	488.30	481.80	498.90	507.70	539.60	541.80	460.68
F probability	*	**	***	***	***	***	***	***	***	***	***	***	
SEM	16.16	10.00	6.23	9.17	9.50	8.84	6.82	8.80	5.33	9.52	6.82	6.87	
$LSD_{0.05}$	47.83	29.60	18.45	27.13	28.13	26.17	20.18	26.05	15.78	28.18	20.18	20.32	

Note: ***, ** and * denotes significant at 0.001, 0.01 and 0.05. W=Week, SEM=Standard error of mean, $LSD_{0.05}$=Least significant difference at 5% level

Dry matter intake of different species of fodders by goats is presented in Table 3. The DM intake of different species of fodders were significantly different ($p<0.001$) in every observation week. The DM intake of *Litsea monopetala* was highest from first week to twelve weeks followed by *Ficus lacor.* Least DM intake was of the goats fed with *Melia azedarach* in the early stage from first to fourth week (291.2 g, 262.1 g, 252.8 g, 322.7 g) and with mixed fodders from fifth weeks to twelfth weeks (380.4 g, 430.3 g, 449.9 g, 422.8 g, 437.5 g, 426.6 g, 436.3 g and 452 g, respectively).

The fodder DM intake of *Litsea monopetala* and *Ficus lacor* by goats were higher than other fodders as the voluntary intake of these fodders by goats were significantly higher ($p<0.001$) than others fodders.

Table 3. Amount dry matter intakes of different fodder species by goats in weekly basis

Fodder	Total dry matter intake of goats in gramday^{-1}												
	W1	**W2**	**W3**	**W4**	**W5**	**W6**	**W7**	**W8**	**W9**	**W10**	**W11**	**W12**	**Mean**
Meliaazedarach	291.20	262.10	252.80	322.70	397.90	443.70	472.10	491.90	517.00	525.00	536.50	542.70	421.30
Ficuslacor	464.50	469.70	428.20	430.00	480.80	502.00	507.90	473.80	527.20	565.10	603.60	608.00	505.07
Litseamonopetala	562.30	478.40	513.40	539.20	556.10	570.20	580.20	578.30	567.90	589.00	606.30	607.50	562.40
Mixed	412.30	452.70	390.80	355.50	380.40	430.30	449.90	422.80	437.50	426.60	436.30	452.00	420.59
Ficusglaberrima	331.00	371.60	361.40	378.00	418.30	460.50	481.90	456.40	476.90	468.90	525.10	526.30	438.03
Fprobability	***	***	***	***	***	***	***	***	***	***	***	***	
SEM	18.07	11.18	6.97	10.25	10.63	9.89	7.62	9.84	5.96	10.64	7.62	7.68	
$LSD_{0.05}$	53.48	33.09	20.63	30.34	31.45	29.26	22.56	29.13	17.64	31.50	22.56	22.72	

Note: ***, ** and * denotes significant at 0.001, 0.01 and 0.05. W=Week, SEM=Standard error of mean, $LSD_{0.05}$=Least significant difference at 5% level

The interaction effects of different breeds of goats and species of fodders in fodder DM intake is presented in Table 4. The interaction effect was significant ($p<0.05$) in first week and was highly significant ($p<0.001$) from second to twelve week. In Boer cross bred, highest DM intake was obtained fed with *Ficus lacor* fodders followed by *Litsea monopetala* and least DM intake was for mixed fodders. Among Jamunapari cross bred, highest DM intake was found for *Litsea monopetala* up to 10 weeks, and was highest for *Ficus lacor* in 11 and 12 weeks. Similarly in case of Khari and Barbari cross goats highest DM intake was in the case of *Litsea monopetala* followed by *Ficus lacor*. From the interaction *Ficus lacor* and *Litsea monopetala* had shown higher fodder DM intake in the case of every genotype of goat.

Table 4. The interaction effect of different breed of goats and species of fodders on fodder DM intake g day^{-1}

Breed	Name of Fodder	Total dry matter intake of goats in g day^{-1}												
		W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	Mean
Barbari Cross	*Melia azedarach*	257.1	237.3	195.8	245.3	325.5	372.5	376.2	396.0	446.4	443.9	471.7	481.7	354.1
	Ficus lacor	402.8	413.7	357.4	373.3	427.7	464.1	461.9	431.6	524.5	536.7	565.1	575.1	461.2
	Litsea monopetala	453.9	431.9	441.5	455.6	478.0	490.8	510.0	538.1	546.9	554.5	575.4	580.4	504.8
	Mix	446.7	482.9	405.1	377.1	393.5	440.8	464.5	392.7	434.1	386.8	403.0	408.0	419.6
	Ficus glaberrima	238.6	313.1	302.9	340.7	362.7	429.6	448.8	431.3	475.0	480.9	551.2	551.2	410.5
Boer Cross	*Melia azedarach*	332.6	248.2	303.2	350.2	434.0	505.8	528.1	513.2	563.1	577.9	579.0	594.0	460.8
	Ficus lacor	496.1	525.2	480.4	481.3	565.1	601.5	626.4	584.0	640.7	689.2	746.7	749.2	598.8
	Litsea monopetala	605.8	505.7	505.7	526.2	539.1	569.9	567.7	565.1	522.0	557.8	625.9	625.9	559.7
	Mix	311.0	412.2	362.2	324.2	351.9	397.4	411.8	371.6	351.3	363.6	359.2	401.2	368.1
	Ficus glaberrima	379.3	378.2	447.8	439.0	448.0	497.4	490.5	470.1	484.8	487.7	537.6	537.6	466.5
Jamunapari Cross	*Melia azedarach*	331.9	235.1	245.4	341.9	440.4	452.8	479.4	509.1	497.0	519.2	501.7	501.7	421.3
	Ficus lacor	534.4	469.5	473.7	471.3	510.5	492.4	534.2	482.7	525.8	577.3	620.6	620.6	526.1
	Litsea monopetala	589.5	526.0	620.0	696.8	652.8	663.1	659.9	618.9	622.7	627.8	572.7	572.7	618.2
	Mix	385.9	431.8	381.0	354.7	365.0	417.5	466.0	460.7	463.3	442.3	481.4	496.4	428.8
	Ficus glaberrima	364.6	485.9	429.2	453.3	488.4	497.1	501.3	518.7	514.3	514.3	541.4	541.4	487.5
Khari	*Melia azedarach*	243.3	327.7	267.0	353.5	391.7	443.7	504.8	549.4	561.5	559.0	593.4	593.4	449.0
	Ficus lacor	424.6	470.3	401.5	394.2	419.9	450.3	408.9	396.8	417.9	457.3	481.9	486.9	434.2
	Litsea monopetala	600.1	450.2	486.6	478.1	554.5	557.1	583.3	591.0	580.1	616.0	651.1	651.1	566.6
	Mix	505.8	484.0	415.1	366.1	411.1	465.4	457.3	466.1	501.3	513.6	501.5	502.5	465.8
	Ficus glaberrima	341.7	309.2	265.8	278.9	374.3	417.9	487.0	405.6	433.5	392.8	470.2	475.2	387.7
F-value		*	***	***	***	***	***	***	***	***	***	***	***	
SEM		36.14	22.36	13.94	20.5	21.25	19.77	15.25	19.68	11.92	21.29	15.24	15.35	
LSD 0.05		106.96	66.18	41.25	60.67	62.9	58.52	45.13	58.26	35.29	63.01	45.12	45.45	

Note: ***, ** and * denotes significant at 0.001, 0.01 and 0.05. W=Week, SEM=Standard error of mean, $LSD_{0.05}$=Least significant difference at 5% level

Fattening performance of goats

Body weight gain of different breeds of goats

The body weight gain of different breeds of goats is presented in Figure 1. The weight gains of Boer crosses were observed substantially higher from early weeks to twelve weeks of age. During the twelve weeks of study period, the growth of Boer cross, Jamunapari cross, Khari and Barbari cross were 5.95 kg, 4.98 kg, 4.48kg and 3.81kg, respectively.

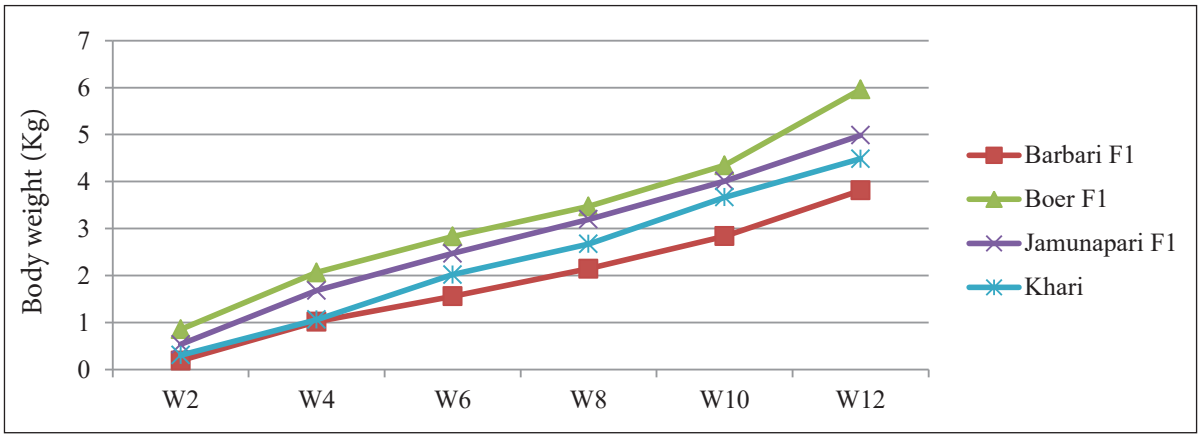

Figure 1. Body weight gain of different breeds of goats

Body weight gain of goats supplemented with different fodder species

The body weight gain of goats fed with different species of fodders is presented in Figure 2. From the figure, *Litsea monopetala* and *Ficus lacor* had similar growth curve up to six weeks of age and from six weeks onwards *Litsea monopetala* has shown better results than *Ficus lacor*. This might be due to high voluntary intake of *Litsea monopetala* than *Ficus lacor*. Similarly, the lopping time of *Litsea monopetala* was during the experimental period and *Ficus lacor* feeding became slightly latter than its lopping time during the later weeks. Among other three fodders, *Melia azedarach* and *Ficus glaberrima* had shown similar pattern of growth up to four weeks. From four weeks onwards, *Melia azedarach* was observed superior than *Ficus glaberrima* as the voluntary intake, DM intake and fresh fodder intake of *Melia azedarach* was lower than *Ficus glaberima* in early observation weeks but it became higher in later weeks. Mixed fodders had least growth rate than others as the DM intake was lower. During twelve weeks study period *Litsea monopetala, Ficus lacor, Melia azedarach, Ficus glaberrima* and mixed fodder had 6.3±0.18 kg, 5.93±0.18 kg, 4.88±0.18 kg, 3.86±0.18 kg and 3.076±0.18 kg of weight gain in goats, respectively.

In a study *Ficus lacor* performance was found better than Sal (*Sorea robusta*) and Katus (*Castanopsi indica*) with 4.07±0.15 kg body weight gain of goats during three months experimental periods (Anon, 2010). But, in this study the body weight gain of goats were higher (5.93±0.18kg) than in the previous results in *Ficus lacor* supplementation for twelve weeks of experiment.

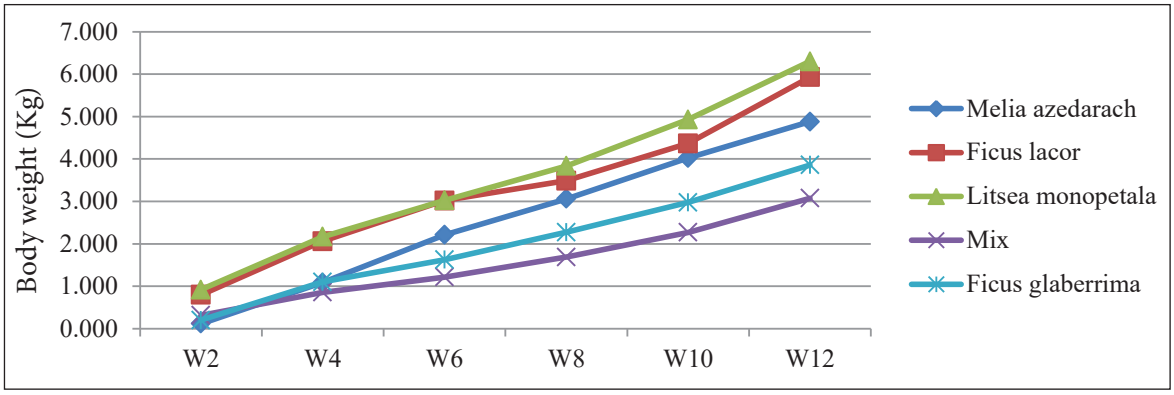

Figure 2. Body weight gains of goats supplemented with different fodder species

Interaction of weight gain of different breeds and fodder species

The interactions effects of different breeds of goat with different species of fodders on body weight were observed non-significant ($p>0.05$) from second week to eight weeks. The difference were highly significant ($p<0.01$) in ten and twelve weeks. From the interaction effect, it was observed that *Litsea monopetala* and *Ficus lacor* had attained larger body weight gain for all four experimental breeds of goats than any other fodders. From (Anon, 2010), *Ficus lacor* had increases the weight of goats up to 4.07 kg during three months experimental period. In this experiment Barbari cross, Khari, Jamunapari cross and Boer cross have 4.2±0.36 kg, 5.39±0.36 kg, 6.57±0.36 kg and 7.56±0.36 kg, respectively within 12 weeks of experimental period.

Average daily weight gain of goats

Average daily weight gains of different breeds of goats

The average daily gains (ADG) of different breeds of goats are presented in Table 5. Highest average daily gain was observed in Boer cross goats, 61 g, 73.7 g, 67.4 g, 62 g, 62.1 g and 70.93 g from week second to week twelfth, respectively. Similar growth pattern was revealed in Jamunapari cross 38.2 g, 60.0 g, 58.8 g, 57.1 g, 57.3 g and 59.35 g from week second to week twelfth, respectively. Average daily gain of Khari goat was 21.8 g, 37.9 g, 48.1 g, 47.7 g, 52.4 g and 53.38 g from week second to week twelfth, respectively. Similarly, least average gain was in Barbari cross goat 13.4 g, 36.4 g, 37.1 g, 38.3 g, 40.5 g and 45.36 g from week second to week twelfth, respectively.

The ADG of different breeds generally had lower daily gain in second week than other observation week. This might be due to not properly adapted to the environment of the metabolic cage. From fourth week ADG pattern became similar up to twelfth week. The ADG of Boer cross bred (70.93 g) and Jamunapari cross bred (59.35 g) were above the average of other breeds of goats which might be due to higher DM intake and high voluntary intake of fodders. The average daily gain of different breeds of goat was significantly different ($p<0.05$) in second week and the differences were highly significant ($p<0.001$) from fourth week to twelfth week.

Boer goats are considered as a fast growing goat compared to other goat breeds. Growth rate of the first 12 months can be 200 g day^{-1} under good pastoral conditions. Average growth rates were recorded as 291, 272, 245, and 250 g day^{-1} from birth to 100, 150, 210, and 270 days of age in male goats and were 272, 240, 204, and 186 g day^{-1} in female goats, respectively (Christopher, 2002).

Similarly, Boer and Spanish crosses were reported to have higher dry matter intake, average daily gain than Spanish goats (Cameron *et al.,* 2001). During the 15 weeks experiment from post weaning to 24 weeks of age, average daily gain was increased by 30% through the cross breeding between Boer and Spanish goats, but the 154.00 g day^{-1} gain was below the 200 g day^{-1} normally observed in Boer goats. Dry matter intake was also higher in Boer and Spanish crosses goats. Feed efficiency, average daily gain per dry matter intake, was higher in Boer and Spanish cross. The result of the authors supports the result of the present study. In another study by Brown and Machen (1997), birth weight, weaning weight and average daily gain were improved by crossing Spanish, Nubian, or Angora with Boer goats. Similarly in a study, Boer and Khari had higher growth rate than other breeds with higher birth weight and weaning weight (Adhikari *et al.*, 2012). From this experiment also Boer crosses were found to be superior to others with significant difference and the present finding was supported by the above literature.

Table 5. Average daily gains of different breeds of goat

Breed	Average daily gain of goats in g day^{-1}					
	W2	W4	W6	W8	W10	W12
Barbari cross	13.40	36.40	37.10	38.30	40.50	45.36
Boer cross	61.00	73.70	67.40	62.00	62.10	70.93
Jamunapari cross	38.20	60.00	58.80	57.10	57.30	59.35
Khari	21.80	37.90	48.10	47.70	52.40	53.38
F probability	*	***	***	***	***	***
SEM	9.54	4.92	3.39	2.72	2.32	1.92
$LSD_{0.05}$	28.23	14.58	10.04	8.06	6.86	5.67

Note: *** and * denotes significant at 0.001 and 0.05. W=Week, SEM=Standard error of mean, $LSD_{0.05}$=Least significant difference at 5% level.

Shah *et al*. (2012) found that average daily gain of 47.38 g, 53.09 g, 54.76 g, 44.76 g and 58.33 g during 10 weeks experiment in Khari goats supplemented with different rations. This result supports the average daily gain of Khari goats as 53.38±1.916 g during 12 weeks experimentation. Similarly, Kadariya and Joshi (1994) recorded 43.50 g day^{-1} weight gain in hill goats (Khari) supplemented with concentrate ration and minerals.

Average daily body weight gains of goats supplemented with different fodder species

The ADG of goats supplemented with different species of fodders are presented in Table 6. The biweekly average daily weight gains of goats supplemented with different fodders were highly significant ($p<0.001$) in every observation week. Average daily gain of *Litsea monopetala* was consistently higher than other fodders having 65.6 g, 77.50 g, 72 g, 68.5 g, 70.4 g and 75 g from 2 to 12 week, respectively. *Ficus lacor* has also similar growth rate below *Litsea monopetala.* The final average daily gain of *Ficus lacor* is 70.6 g, followed by *Melia azedarach* (58.11 g), *Ficus glaberrima* (45.94 g) and mixed fodders (36.62 g). Consistently higher average daily gain of *Litsea monopetala* and *Ficus lacor* might be due to higher voluntary intake and better palatability. Mixed fodders had consistently lower average daily gain than others which might be due to poor palatability of these fodders and some of these mixed fodders might content higher amount of anti-nutritional factors like tannins, indigestible lignin, polyphenols etc.

Average daily gain of 70 g day^{-1} was observed in castrated goats supplemented with 200 g concentrate; *ad-libitum* fodder foliage and 200 g stylo grass (Pandey *et al.,* 2007). Similar result was obtained from present study by supplementation of *Litsea monopetala* and *Ficus lacor* with one percent concentrate of body weight. But performances of other fodders (*Melia azedarach, Ficus glaberrima* and mixed) had attained lower average daily gain than the study of Pandey *et al*. (2007).

Table 6. Average daily gains of goat supplemented with different fodder species

Fodder	Average daily gain of goats in g day^{-1}					
	W2	W4	W6	W8	W10	W12
Melia azedarach	8.50	38.80	52.70	54.70	57.50	58.11
Ficus lacor	57.10	73.70	71.90	62.30	62.40	70.60
Litsea monopetala	65.60	77.50	72.00	68.50	70.40	75.00
Mix	22.40	30.60	28.90	30.20	32.40	36.62
Ficus glaberrima	14.40	39.40	38.80	40.60	42.50	45.94
F probability	**	***	***	***	***	***
SEM	10.66	5.51	3.79	3.05	2.59	2.14
$LSD_{0.05}$	31.56	16.30	11.23	9.02	7.67	6.34

Note: *** and ** denotes significant at 0.001 and 0.01. W=Week, SEM=Standard error of mean, $LSD_{0.05}$=Least significant difference at 5% level.

Study from Joshi *et al*. (2004), average daily gain of local goats offered 50% and 40% of concentrate were significantly higher (67.7±6.4 g and 60.7±4.5 g day^{-1}, respectively) than those supplemented only with 25% concentrate (43.9±5.8 g day^{-1}). But from the study, supplementation of good quality fodders could give higher growth rate than those supplemented with high level of concentrate.

In an experiment by Upreti *et al*. (2006) with four treatments, supplementation of fodder trees with 75 g concentrate, fodder tree and 100 g stylo with 75 g concentrate, fodder tree and 300 g stylo with 75 g concentrate and tree leaves and 500 g stylo with 75 g concentrate found that average daily gain of local Khari goats were 53 g, 62.5 g, 66.33 g and 56.83 g day^{-1}, respectively. But the supplementation of *Litsea monopetala* and *Ficus lacor* had higher average daily gain than all these treatments.

From the experiment of Khanal (2012), in the growth performance of hill goats (Khari), average daily weight gain of high hill goats with different species of fodder trees were 69.6 g day^{-1}. Similarly average daily gain in goats supplemented with fodder trees with maize floor 1% of body weight and fodder trees with concentrate 1% of body weight were recorded as 75.2 g and 81.7 g day^{-1}, respectively and the daily weight gains were non-significant between the treatments. The higher daily gain in supplementation of fodder trees with 1% concentrates might be due to difference in breed as well as mixing of different fodder trees species in high hills. Similarly, in the same experiment author found that average daily gain of goats on farmers practice were 53.5 g and 48.6 g day^{-1} in case of stall feeding with grazing and transhumance system.

Interaction of average daily weight gains of goat breeds and fodder species

Interaction effects on ADG of goat breeds and fodder species were non-significant ($p>0.05$) from second to eighth week and were highly significant ($p<0.01$) in tenth and twelfth week. The interaction showed that, ADG of all four breeds by *Litsea monopetala* and *Ficus lacor* were superior to other fodders. Mixed fodder had lower ADG than others.

Calcium and Phosphorus level in blood serum

Naturally, the calcium and phosphorus levels in blood serum of goats remain 8.9 to 10.6 mg dl^{-1} and 3.2 to 9.8 mg dl^{-1}, respectively. From the laboratory analysis of serum samples of goat fed with different fodders, the goats fed with *Ficus lacor* had higher phosphorus (7.05 mg dl^{-1}) level than any other species of fodders. Calcium level in different fodders were similar but phosphorus level were significantly different ($p<0.01$). Serum Calcium and Phosphorus level in goats supplemented with different fodders are presented in Table 7.

Table 7. Serum Calcium and Phosphorus level in goats supplemented with different fodders

Fodder	Calcium (mg dl^{-1})	Phosphorus (mg dl^{-1})
Melia azedarach	12.06	5.14
Ficus lacor	14.39	7.05
Litsea monopetala	9.40	4.79
Mixed fodders	11.65	6.59
Ficus glaberrima	13.39	5.36
F probability	NS	**
SEM	1.351	0.443
$LSD_{0.05}$	4.074	1.336

Note: ** denotes significant at 0.01. NS = Non significant, SEM=Standard error of mean, $LSD_{0.05}$= Least significant difference at 5% level.

Short term intake rate (STIR) measurement

Ficus lacor and *Ficus glaberrima* had higher DM content, 36.37% and 34.91%, respectively among the tested fodders. *Litsea monopetala* and *Melia azedarach* had 30.74% and 29.69% DM content whereas mixed fodder had least DM content 21.01%.

The result in relation to short term intake rate (five minutes intake) observed for uncastrated male goats, is presented in Table 8. The table showed significantly higher (P<0.05) STIR value for *Litsea monopetala* (0.45 g DM min^{-1} per $kg^{0.75}$) followed by *Ficus lacor* (0.39 g DM min^{-1} per $kg^{0.75}$), *Ficus glaberrima* (0.38 g DM min^{-1} per $kg^{0.75}$), *Meliaazedarach* (0.34 g DM min^{-1} per $kg^{0.75}$) and mixed fodders (0.33 g DM min^{-1} per $kg^{0.75}$). The result revealed that *Litsea monopetala*, *Ficus lacor* and *Ficus glaberrima* were more prefered by the goats.

Upreti *et al*. (2006) had reported that among the different major fodder trees tested to find out the relative preference of the goats through cafeteria trials, *Ficus lacor* was preferred by most female goats. Similarly, *Ficus semicordata* was preferred by male goats and least preferred was *Castanopsis indica.* Among the six fodders tested, preference ranking follow the order of *Ficus semicordata, Ficus lacor, Magnifera indica, Ficus glaberrima, Shorea robusta* and *Castanopsis indica*.

Table 8. Short term intake rate (5 minutes duration) of different species of fodders

Fodder	Fresh intake(g)	DM %	DM intake (g)	STIR (g DM min^{-1} per $kg^{0.75}$)
Melia azedarach	63.25	29.69	18.779	0.347
Ficus lacor	57.00	36.37	20.731	0.393
Litsea monopetala	79.25	30.74	24.361	0.456
Mixed fodders	83.25	21.01	17.491	0.329
Ficus glaberrima	59.25	34.91	20.684	0.380
F probability				*
SEM				0.027
$LSD_{0.05}$				0.075

Note: * denotes significant at 0.05. SEM=Standard error of mean, $LSD_{0.05}$=Least significant difference at 5% level.

CONCLUSION

The results of the study revealed that fodder trees could be the best source of roughages for fattening of goats in the mid hills. Supplementation of fodder trees along with one percent concentrate mixture to the goats could be used as a better practice for goat fattening. Among the different breeds of goat used in the experiment, Boer cross resulted comparatively higher growth potential than other breeds. So, Boer cross bred can be the promising breed of goat in the mid hills. *Litsea monopetala* and *Ficus lacor* were obtained as best fodders from the aspect of voluntary intake, short term intake rate measurement and palatability. In mid hills of Nepal, fattening of Boer crosses with *Ficus lacor* and *Litsea monopetala* could be one of the best practices for farmers in order to obtain better fattening performance from the goats.

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