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Research Article

Effect of supplementation of different level of cassava (*Manihot esculenta Crantz*) foliage on growth performance of male yearling local goat in Dilla substation, Southern Ethiopia

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Abstract

In accessibility and increase in price of commercial concentrates as a supplement for ruminants laid a way to look for other options in hand. The aim of current study was to identify the optimum level supplementing cassava leaf meal (CLM) as a replacement for protein on growth performance and economic efficiency of local goats. Twenty four intact yearling bucks with an average initial body weight of 13.92 ± 1.03 kg were purchased from Balela local market and assigned to one of the four treatment feeds in a completely randomized block design as: T_1= Grazing + 100gm WB + 150gm CLM, T_2 = Grazing + 100g WB + 200g CLM, T_4= Grazing + 100g WB + 250g CLM (T_4= Grazing + 300g Concentrate mix). All animals were allowed access to water ad libitum and the experiment was undertaken for 90 days live weight gain, DM intake, FCR and cost-benefit analysis were parameters studied during experiment. The chemical composition of feed samples was conducted immediately before commence of actual experiment showed that cassava leaf meal has high protein content which is above the minimum requirement level for optimal rumen microbial activity (22.94%) and low fibres content which are readily digestible (30.37%) indicating that it can be potentially used as supplemental feed for ruminants in areas where other sources are not available and/or are expensive. Supplemental feeding of 250gm of air dried CLM and 100gm of WB in current experiment positively influenced the economic efficiency and growth performance of animals by providing higher feed intake and greater weight gain as compared to T_1 group and T_2. The results from daily live weight gain were 63.1g, 69.9g, 93.22 and 103.78g for T_1, T_2, T_3 and T_4 respectively. Bucks in T_3 and T_4 (positive control) gained better than (93.22 and 103.78g/day) bucks in T_1 & T_2. Whereas the results from DMI were, 3.3kg, 3.0kg, 3.5kg and 3.7kg for T_1, T_2, T_3, and T_4 respectively. Even though goats in T_4 performed relatively better than all other treatment groups, supplementation of air CLM (T_3) was economically feasible, profitable. Therefore, supplementing goats those which graze on natural pasture with 250g of dried CLM and 100gm of WB will be feasible for optimum production. Further study on maximum inclusion level of dried cassava leaf meal has to be studied in grazing goats.

Keywords: Cassava leaf; weight gain; cost-benefit analysis; concentrate-mix

Introduction

In Ethiopia there is a gap between animal requirements and the available feeds, especially during the dry season. So, there is a need to look for cheap and available animal feed to feel the nutritional gap. Goats are amongst the commonest farm animal species which sustain the livelihoods of smallholder farmers, pastoralists and agro-pastoralists. They fulfil various functions such as generating cash income, serving as household security, accumulating capital, and fulfilling cultural obligations (Workneh, 2000; Grum, 2010; Dhaba et al. 2012; Feki, 2013). Goats play an important role in all production systems due to their low initial capital investment, ability to produce multiple products (meat, milk, skin, manure etc.) at low input costs, high rates of reproduction, and high turnover rates due to the short time they take to attain maturity.

However, goat production in Ethiopia suffers from feed shortages at all levels with an estimated 40% deficit in the national feed balance. This is aggravated by seasonal availability of forage and crop residues in the highlands and by recurrent and prolonged drought in the lowlands. FAO (2001) estimated that average dressed carcass output per individual goat in Ethiopia is 8kg, which is among the lowest in African countries. Because of the poor quality of natural pasture and crop residues, substantial weight loss of animals is encountered, especially during dry seasons. Supplementing the required nutrient from other sources is critical to generate the desirable product form the ruminants.

It is well recognized that the productivity of goats increases by concentrate feeding or supplying good quality forage (Madibela and Segwagwe, 2008). However, feed stuffs for animals are getting progressively expensive, thus necessitating minimization of feed cost, which could be achieved through the incorporation of relatively cheap and non-conventional feed ingredients (Asratet al., 2008). Leaves of root crops like cassava are rich in most essential nutrients such as proteins and minerals and tend to be more digestible than the grasses and crop residues.

Cassava is one of the most drought tolerant crops and can be successfully grown on marginal soils, giving reasonable yields where many other crops can't do well. Cassava leaves have been found to have high nutritional value which can effectively boost the nutrition of small ruminants when preserved as hay, thereby assisting in formulating and processing of simple, adoptable and low cost feed resource strategy for small ruminants during the dry season when there is scarcity of forage (Wanapat et al., 2000).

Despite the fact that *cassava leaf* is highly produced in many areas of low lands of Ethiopia including study area, system for its utilization as animal feed has not been developed and made available to small scale farmers. Moreover, the effect of feeding *cassava* leaf meal as a supplemental feed on place of as protein source not investigated in the diet of goats. Therefore, the study was designed to identify the efficient level of defoliated cassava on feed intake and weight gain of local goat fed on natural pasture.

Materials and Methods

Study area

The experiment was conducted at Dilla sub-station of Hawassa research center of Gedeo Zone Dilla sub-station is characterized by Orthic Luvisols soil, with an average annual rain fall and temperature of 1300 mm and 21°C, respectively. The average minimum and maximum temperature of the area are 13.10 and 28.05°C, respectively. It has an altitude of 1572 masl, and is located at latitude and longitude of 38°18'30'' E and 6°24'30'' N, respectively.

Management of experimental animals

A total of 24 yearling local bucks with an average initial body weight of 13.93 ± 0.97 kg were used. The goats were allowed to fed individually with concrete floor and corrugated iron roof. There was a preliminary period of 15 days general adaptation followed by 15 days of adaptation to the experimental feeds during experiment which lasted for 90 days. At the beginning of adaptation period, the animals were treated against internal parasite as prescribed by the manufacturer. The animals were weighed every two weeks after overnight fasting, before feeding in the morning to monitor body weight changes as well as linear measurements throughout the experimental period. At the beginning and end of the experiment, goats were weighed for two consecutive days and the average of the two were taken as initial and final weights, respectively.

Feeds and feeding management

Cassava leave was collected in 2019 dry season from Dilla research sub-station of Hawassa agricultural research center at its optimum stage of the plant. The leaves were dried under shed for 3-5 day depending on the severity of sunlight. After drying, the leaves were thoroughly variation and improve intake by experimental goats. Wheat bran was purchased from Abay livestock feed processing enterprise found in Hawassa city. Goats were allowed to graze 8:00 hours per day along with free access of water. The CLM was offered based on the proportions indicated in Table 1.

Treatments	Basal diet	Supplements		
		WB (g/d)	CLM (g/d)	CM(g/d)
T_1	GNP	100 gm	150 gm	-
T_2	GNP	100 gm	200gm	-
T_3	GNP	100 gm	250 gm	-
T_4	GNP	-		300

T1: Treatment 1, T2: Treatment 2, T3: Treatment 3, T4: Treatment 4, GNP: Grazing on natural pasture, CM: Concentrate mixture, WB wheat bran CLM: Cassava leaf meal and g/d: Gram per day.

Table 1: Experimental treatments.

Body weight change and feed efficiency

Animals were weighed within 15 days interval in the morning after overnight fasting using spring balance. The average weight gains (ADG) were calculated on a daily, monthly and final basis. It was calculated as the difference between final BW and initial BW divided by a number of feeding days. The feed efficiency of experimental animals was determined by dividing the ADG into the amount of feed consumed.

Chemical Analysis

Samples of treatment diets (CLM, WB, NP and CM) were ground to pass through a 1-mm sieve (Willy mill) for chemical analysis. These ground materials were stored individually in an airtight plastic bag till sent to Hawassa Univesity for chemical analysis. CLM sample was collected from Dilla research substation cassava cutting multiplication site and then dried on optimum sunlight prior to grinding. Dry matter, Organic matter and CP contents of NP, CLM, WB and CM were determined following the procedures described by AOAC (1990). The NDF, ADF and ADL contents were analyzed following the recommendations of Van Soest et al. (1991) using an ANKOM 200 fiberanalyzer and ANKOM F57 filter bags (ANKOM Technology Corp., Fairport, NY, USA).

Economic Analysis

Economic return analysis was computed to examine the economic profitability of substituting concentrate mixture with DWLM. The computation was done based on the average value of data obtained during the experiment. To examine the rate of return on annual bases, the annual financial rate of return (AFRR) to feeding was calculated using the formula (Baur et al., 1989): AFRR = [(R-C)/C*(365/t)]*100% where; AFRR = Annual financial rate of return; R = revenue from selling of the goat; C = purchase and other variable costs and; t= number of days the animal was fed. The AFRR to feeding is, thus, revenue less purchase cost of the animal and other variable costs, multiplied by the number of days in the year the animal was fed.

The return was decomposed into its compounds (price, weight and their interaction) to examine the relative contribution of the components in the gross return. All the components are expressed as percentages of the financial margin. To disaggregate the gross margin into its components the following formula was used: 100% = {(DP*Wi + DWPi + DP*DW)/M}*100% where; DP= the difference between sale price and purchase price; DW= the difference between final weight and initial weight at purchase; Pi = purchase price; Wi = initial weight at purchase. Sensitivity analysis was also done to capture the likely change in prices of input (feed) and fattened goat. Price variation can occur in input and output. Thus, these variations were considered in the sensitivity analysis.

Statistical Analysis

Data on weight gain, body measurements and economic efficiency were analyzed using one-way ANOVA procedure of the Statistical Package for the Social Science Version (25). Duncan's multiple range tests was used to differentiate the significant differences between

treatment means. Statistical analysis was not done on chemical composition. The model used for analysis of the data on measured parameters was: $Y_{ij} = \mu + t_i + b_j + e_{ij}$ where Y_{ij} = dependent variables, μ = overall mean, t_i = the effect of the i^{th} treatments, b_j = effect of the j^{th} block and e_{ij} = random error of i_{th} treatment in the j^{th} block.

Results and Discussion

Chemical Composition

The chemical composition of feed components consisting treatment diets is presented in Table 2. Almost similar amount of dry matter (DM) is obtained in the feed components of the treatment diet. Higher crude protein (CP) content was recorded in CM and CLM than natural pasture (NP). CLM, WB and CM showed similar lower fiber (NDF, ADF and ADL) contents than NP. The concentrate mixture had better nutritive value (cumulative result) as compared to DWLM and NP (Table 2). The chemical composition of the DWLM was within the range reported in the literature for browse forages (Osuga et al 2006; Abdulrazak et al 2000). The role of this browse forage as source of nitrogen for ruminants, especially during lean periods, is the major contribution in many parts of the tropics where other sources may not be readily available and/or are expensive.

The high CP content, which is above the minimum required level for optimal rumen microbial activity (80 g/kg DM) and low fiber content which are readily digestible, justifies the use of *Cassava* leaf in small quantities in order to supplement poor quality pastures and crop residues. In addition to this, *Cassava* had low content of fibre which is a positive attribute of the plant since the voluntary DM intake and DM digestibility are dependent of the cell wall constituents especially the NDF and lignin (Bakshi and Wadhwa 2004). Therefore, the fibre of *cassava* has been shown to be more digestible (El Hassan et al., 2000) than that of natural grasses and crop residues. This study is consistent on chemical composition basis with studies conducted by (Samuel et.al. 2013) on cassava leaf and (Milkiaset.al, 2022) on *Terminalia brownie Fresen* leaf for goat feeding.

The crude protein content of the CLM in the present study was within the range of values reported by Wanapat (2001, 1999), and Wanapat et al. (2000), who reported values ranging from 200g/kg DM to 300g/kg DM. A similar value was reported by Duong (2004), with a crude protein content of 226g/kg DM. Other authors had reported CP content of cassava leaf meal of 188g/kg DM (Man and Wiktorsson, 2001) and 211g/kg DM (Man and Wiktorsson, 2002). The NDF content in this study was higher whereas the ADF content was lower than that reported by Wanapat (1999, 2001), and Wanapat et al. (2000), which were 296g/kg for NDF and 241g/kg for ADF. In the current study relatively lower NDF and ADF were reported in contrary to (A. O. Oni et.al, 2010) who reported more than 55% of NDF and ADF content study conducted on four varieties of cassava, this might be due to stage of harvesting and also varietal effect.

Nutrient	***CLM***	***WB***	***Natural Pasture***	***Concentrate mix***
Dry matter (DM) (%)	91.65	90.15	91.94	90.21
Organic matter (% DM)	90.41	87.43	82.59	90.13
Ash (% DM)	9.37	12.42	17.41	10.43
Crude protein (% DM)	22.94	15.61	3.92	24.24
Neutral detergent fibre (% DM)	42.48	42.74	67.74	36.58
Acid detergent fibre (% DM)	30.37	31.56	3538	25.15
Acid detergent lignin (% DM)	7.68	15.23	15.11	11.21

CLM: Cassava Leaf Meal; DM: Dry matter and %: Percentage.

Table 2: Chemical composition of feeds.

Weight changes, feed intake and conversion efficiency

The Mean weight gains, daily dry matter intake (DMI) and Feed conversion efficiency (FCE) of bucks fed on different level of CLM diet as a protein source was presented in Table 3. The mean daily weight gain of bucks in the experiment shown significant difference at ($p<0.05$) having higher daily weight gain (103.5gm) in the treatment group supplemented by CM/T4 followed by treatment group supplemented CLM/T_3 (94.54gm) than other treatment groups (T1 and T2). Relatively lower daily weight gain (62.95gm) and (72. 43gm) was observed in T1 and T2 respectively. Similarly there was also significant difference on monthly weight gain of bucks at ($p<0.05$) among treatments in the experiment having higher body weight gain (3.11kg in the treatment group supplemented CM and lower body weight gain (1.89kg) in the treatment group(T1).

DM intake was observed highest ($P < 0.05$) for T4 followed by T3 and lowest for T1 (Table 4). The goats in T4 and T3 had significantly ($P<0.05$) higher feed conversion efficiency than other goats in the rest treatment groups. Similarly, there was no significant ($P<0.05$) difference in both DM intake and FCR between T3 and T4.

Hence, it can be concluded that supplementation of CLM as a protein source in the diet of bucks had positive influence and improved weight gain, DMI and FCE while there observed no significant difference in measured all parameters between CLM and CM supplemented diets reflecting that CLM could be a possible replacement of CM in goat's diet. Similar observation has been reported on A.O.Ani. et. al, 2009, they reported that increased body weight, feed intake and FCE in in west African dwarf goats which fed on different level of cassava leaf. This study is in contrary to Ngo et al. (2005) who obtained reduced dry matter intake as the levels of cassava hay increased in the diet. Other study in washara lambs by Mekuriew and Asmare (2018) reported increased DMI and Body weight gain by feeding dried leaves of Ficus thonningii (Chibha).

Measurements	***Treatment***			
	T1	***T2***	***T3***	***T4***
LWG (kg)	5.67±0.68^b	6.51±0.68^b	8,52±0.68^a	9.31±0.68^a
ADG (g)	62.95 ±7.52^b	72.43±7.52^b	94.54±7.52^a	103.52±7.52^a
AMG (kg)	1.89±0.23	2.17±0.23	2.84±0.23	3.11±0.23
FCR	0.031^b	0.035.52^b	0.043^a	0.048.42^a
DM intake	3.15±0.03^b	3.28±0.04^b	3.42±0.02^a	3.76±0.05^a

Table 3: Mean body weight gain, DM intake (kg/day) and FCE of yearling local bucks goats fed CLM supplemented diets as protein source.

Economic Analysis

The results of economic analysis conducted to assess the benefit of different supplements fed to grazing local bucks are shown in Table 4. The total expenditure was observed highest (1113.2) in concentrate mix supplemented treatment groups (T4), lowest (813.67) in in 150gm CLM supplemented with 100gm of WB (T_1) and (983.10) CLM supplemented groups (T3). However, the average net income was observed highest (390.522) in the treatment group having 250gm CLM supplemented and lowest (303.038) in the treatment group having concentrate mixture supplement. An income 376 was obtained from treatment group that fed on concentrate mix. A similar experience has also been reported in aprevious study that used Arsi-Bale and Khari goats (Legesseet al., 2005; Singh et al., 2015; Ramchandra and Bigya, 2017).

Item	*Treatment*			
	T1	*T2*	*T3*	*T4*
Number of animals per treatment	6	6	6	6
Average initial body Wt	14.09	13.88	13.91	13.85
Average purchase price per head	704.67	702.75	705.67	701.25
Feed cost of CM per head(ETB)	0	0	0	412
Feed cost of CLM per head(ETB	37	46	55	0
WB cost	72	72	72	0
Average expenditure	813.67	820.75	832.67	1113.25
Average selling price per live weight	1116.71	1161.63	1223.19	1489.67
Average return (gross return)/head(ETB)	412.038	458.883	517.522	788.42
Average net return (NR)(ETB)	303.038	340.883	390.522	376.42

Table 4: Cost and economic return analysis (per animal) for yearling local buck supplemented CLM as supplement for protein source.

Conclusion

Although goats supplemented with positive control/ CM (T1) has shown relatively better performance than goats supplemented with 150gm and 200gm of CLM with additional 100gm of WB treatment groups. While Goats feed 250gm of CLM with 100gm of WB has shown comparable weight gain with those which supplemented by CM. Increased supplementary feeding of dried Cassava leaf meal (CLM) as a protein source resulted in increased weight gain, DMI and FCE which affected almost similar as CM supplementation. Though there was better weight gain observed in T4 economically supplementation of air dried CLM (T3) was dominant and thus is recommended for the initiation of growth of yearling local bucks based on the target of the producer. So, this study suggests youth and unemployed can make a cooperative and use dried cassava leaf as protein source for growing yearling bucks so as to be economically feasible. On the other hand carcass characteristics have to be seen with increasing rate of CLM.

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