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Full Length Research Paper

Supplementing effect of grazing sheep with molasses-urea feed block in gaining weight and economic return under management of farmers' condition

Abebe Kebede*, Bogale N, Demeke Meseret and A Bogale

Bahir Dar University, Bahir Dar.

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Abstract

Sheep fattening with Molasses-urea feed block (MUB) was undertaken in Adami Tulu Jido Kombolcha District at Aneno and Arba villages for 87 days during both dry (from 22 March to 17 June) and during wet season (from 19 August to 10 November, 2009). A study was conducted to determine the performance and profitability obtained from MUB supplemented grazing sheep. Molasses, urea, wheat bran, finely ground haricot bean haulm, salt, and bindinder (cement and termite mould) were used as ingredients to produce three different MUBs; Treatment two (T2), Treatment three (T3) and Treatment four (T4) with 17.72, 20.96 and 24.6% CP, respectively. Six sheep were randomly allotted to each of T1, T2, T3 and T4 during both dry and wet seasons at each village. Sheep in T4 had higher overall average daily weight gain (ADWG) (74.8 ± 11.13 g/head/day followed by T2, T3 and T1 (72.88 ± 9.27, 58.5 ± 12.98 and 33.67 ± 3.03) g/head/day, respectively. Over all total body weight gain (TBWG) of T4 was higher (6.26 ± 0.53) kg, followed by T2, T3 and T1 (6.13 ± 0.46, 4.92 ± 0.64 and 2.83 ± 0.39) kg, respectively. Differences (P<0.05) between control (T1) and T4; between T3 and T4, between T1 and T2, between T3 and T2 in overall ADWG and TBWG were significant (P<0.05) but differences between T1 and T3, between T2 and T4; not significant (P>0.05). ADWG (67.96 ± 10.31) g/head/day and TBWG (5.91 ± 0.87) kg of sheep at Aneno village was significantly (P<0.05) higher than the ADWG (51.79 ± 9.41) g/head /day and TBWG (4.51 ± 0.75) kg of sheep at Arba village. Significant difference (P<0.05) in ADWG and TBWG was observed between seasons with the higher gain during wet season (67.33 ± 11.43) g/head/day growth rate and 5.86 ± 0.43 kg total weight gain as compared to dry season (52.07 ± 8.3) g/head/day growth rate and 4.53 ± 0.39 kg total weight gain. The interaction of season by village was not significantly influenced both ADWG and TBWG of sheep. Marginal rate of return of T2 is higher (123.46) followed by T3.77.16) and T4 (65.64). From the biological and economic data analysis, we can conclude and recommend that MUB with 17.72% CP could be used as supplement for sheep fattening in mid rift valley of Ethiopia.

Key words: Feed block, crude protein, weight gain, growth rate, return.

INTRODUCTION

In Ethiopia allocation of land for cultivation of plant legumes for animal feeding is given least priority among farmers because of population growth and land scarcity.

Shrinkage of grazing land due to cultivation, low protein and high fiber content of natural pastures and crop residues results in low nutrient availability, low Digestibility and low voluntary intake of animals feed (Adugna et al., 2000; Adugna, 2007). In addition to the mentioned problems restricted use of grains for fattening sheep because of financial and socio-economic reasons highly limited income that can be derived from sheep in mid rift valley of Ethiopia. To sustain and improve sheep production inexpensive and locally available feed resources that can enhance digestion of low quality feed resource and supply main nutrients to animal are possible alternatives for farmers.

Molasses-urea block is an excellent supplementary feed that can be formulated and used to increase digestion of roughages, provide protein and energy to ruminant animals. Molasses-urea block is the most successful supplements enhance rumen microbial growth and voluntary feed intake of animals fed low quality roughages (FAO, 2007; Adugna et al., 2000). Coupling fermentable nitrogen (urea) with a source of readily fermentable energy, such as molasses in molasses-urea block feed helps the growth of micro-organism in the rumen, increases the digestion and consumption of fibrous feeds, allowing the animal to maintain, and often increase productivity of ruminant animals (Bensalem and Nefzaoui, 2003). Urea in molasses-urea block is converted to ammonia by microflora in the rumen. Microorganisms in the rumen use this ammonia to make microbial proteins, which are then digested by the animals (LPP, 2005).

In mid rift valley of Ethiopia where the climate is extremely variable and unpredictable, and the quantity and quality of natural pasture fluctuated rapidly with subsequent periods of critical nutrient deficiency, using molasses-urea block because of its many advantage is one option to improve the growth performance and reduce market age of grazing sheep. Adami Tulu Jido Kombolcha district is near to the towns Modjo and Adama where molasses-urea block ingredients can be easily obtained, which is an additional advantage for farmers and cottage feed industry to manufacture MUB for ruminants. Therefore, this project was designed to study the performance of sheep supplemented with different protein contents of MUBs during dry and wet seasons and to study the profitability of fattening grazing sheep with molasses-urea block in mid rift valley of Ethiopia.

MATERIALS AND METHODS

Description of the study area

The experiment was conducted in Adami Tullu Jiddo-Kombolcha district, located in the Southern Oromia Regional State, in mid rift-valley of Ethiopia. The district has semi-arid type of climate and its altitude range from 1500 to 2000 mete above sea levels (m.a.s.l). The experiment was done in Aneno Shisho and Arba kebeles (peasant association).

Aneno Shisho is located at 7°49.427`N and 38°41.062`E and has an altitude 1666 m.a.s.l. while Arba is located at 7°43.721`N and 38°38.884`E and has an altitude 1626 m.a.s.l. The district has bimodal rain fall that extends from February to September. Dry period is May-June that separated the preceding short rain fall from the following long rain fall (from June to the end of September). Annual rainfall of the year (experimental time) was 716 mm. The mean maximum and minimum temperatures of the year were 28.5 and 12.9°C, respectively (Adami Tulu Research center metrological data, 2009). Mixed crop-livestock farming system characterizes the type of agriculture in the district. Open wood land that consists of mainly Acacia tree species and others characterizes the vegetation cover of the area.

Experimental feed management

Feed block ingredients such as wheat bran, haricot bean haulm, cement and salt were purchased from local markets. Molasses was purchased from Wonji sugar factory. Termite mould that used for binding was collected from the study area. The percentage of ingredients used in MUB indicted in Table 1 below.

Order of mixing and moulding of the mixture

Molasses and urea needed for each experimental diet (block) making were mixed and stored over night in plastic container to provide for enough time for urea to dissolve in molasses. To second large container contained wheat bran and chopped haricot bean haulm, the overnight the mixture of molasses and urea was added and mixed by hand, followed by mixture of salt, cement and termite mound kept in other medium size containers and further mixed by hand. Final mixture was transferred to the moulding equipment 29.5 centimetre length, 9.5 centimetre width and 9 centimetre height made up of metal. Then it was closed and

Pressure was applied manually by hand to shape the block. Moulding equipment was opened and removed from the block after 10 to 15 min and dried in 3 to 5 days on sun and became ready for feeding.

Experimental animal management

Twenty-four yearling Arsi-Bale sheep with similar body weight (17.56 ± 2.28) kg and body condition were purchased from local market by participant farmers during dry season at each village and the trial was repeated with another 24 sheep of similar conditions during the wet season. Age was determined by dentition. Sheep were dewormed with 300g Albendazol as soon as they arrived at the experimental sites. The experimental animals were ear tagged and divided in to four groups and randomly assigned to the experimental diets. The sheep were provided with 3 kg molasses-urea feed block every day when they return from grazing natural pasture. The pasture consisted mostly, *Dactyloctenium aeypticum, Cynodon dactylon, Chlors pycnothrix, Eluesine coracana, Sporoblus pyramidalis and Eragrostis tenuifolia*. They grazed on natural pas-ture for 8 h and freely accessed to drinking water from grazing area and addition water given them at experimental sites. Left-over feed was weighed next day in the morning.

Body weight was measured using suspended spring balance. Linear body measurements such as body length was measured with a tape and was measured as the distance from the external occipital protuberance to the base of the tail, height at wither as the distance from the surface a platform to the wither and heart girth as the circumference of the chest using meter according to Hamayun et al. (2006). Body condition was assessed every two weeks in the morning before animals left for grazing by visual observation and

Table 1. The composition (g/100 g fresh basis) of the ingredients used in molasses-urea feed block that were fed to grazing Arsi-Bale sheep.

Ingredient	Treatment diet			
	T 1	T 2	T3	T4
Natural pasture	Grazing	Grazing	Grazing	Grazing
Molasses	-	42.00	38.00	33.00
Urea	-	3.00	5.00	8.00
Wheat bran	-	36.00	33.00	30.00
Haricot bean straw	-	9.00	14.00	19.00
Salt	-	5.00	5.00	5.00
cement	-	2.50	2.50	2.50
Termite mould	-	2.50	2.50	2.50
Total	-	100	100	100

T = Treatment, g = gram

hand-on appraisal following 0 to 5 scoring scale according to the guide by Richard and Church (1998). The design was a random factorial arrangement that consist of two villages, two seasons with four treatment diets as independent variables.

Statistical analysis

Analysis of variance of total body weight gain, average daily body weight gain, body condition score, total body length, total height at wither and total heart girth gain were analysed according to the general linear model (GLM) procedure of the Statistical Analysis System (SAS, 2001). When the results were significant, mean comparisons were made using Turkey multiple range test procedure of the SAS package.

Economic analysis

Partial budget analysis was perform by considering variable costs (sheep purchase price, price of total MUB intake, price of feed transportation, veterinary cost, moulding equipment cost, labour cost) and total revenue from sales of sheep. Net income obtained from the experiment was calculated as the difference of total revenue (total returns) and total variable costs according to the formula developed by CIMMT (1988); Ehui and Rey (1992) and Ibrahim and Olaloku (2000).

$NI = TR - TVC$

$\Delta NI = \Delta GR - \Delta TVC$

$MRR = \Delta NI/\Delta TVC$

Where, NI = net income, TR = Total return, TVC = Total variable cost, ΔNI = change in net income, ΔGR = change in gross return, ΔTVC = change in total variable cost, MRR = marginal rate of return.

RESULTS AND DISCUSSION

Chemical composition of supplementary blocks

The nutritional composition of the MUB used for Arsi-Bale sheep in both villages during both seasons are shown in Table 2. Dry matter, crude protein, organic matter, ash and fiber content of the block used in the study was similar with those used by Aganga (2005), Bensalem et al. (2007), Bensalem and Nefzaoui (2003).

Molasses-urea feed block intake

Mean daily molasses-urea block intake was significantly affected by season, village and treatment diets and given in (Table 3).

Scarcity of grazing feed resource increased ($P<0.05$) MUB intake during the dry than the wet season. Alemayehu (2003) indicted that the grazing lands of the country are in poor to very poor condition and will deteriorated and seasonal feed shortage is evident that agree with the finding of the current study. The availability of good grazing feed resource during wet season highly reduced intake of MUB which agree with the report of Habib (2007).

Molasses-urea feed block intake in the current study at Aneno and Arba villages is similar with intake reported for Tswana sheep by Aganga (2005), but higher than that reported by Sansoucy et al. *(*2005) and than the recommended amount for small ruminant by Chestworth (1992) probably due to different breed of animal used, availability of grazing feed resource and block quality used. Even if the higher urea content of T4 increased its protein content it resulted in significantly ($P<0.05$) lower MUB intake as compared to T2 and T3 because urea is not naturally palatable. Similar to the current study Sansoucy et al. (2005) reported that MUB intake by sheep decreased when the percentage of urea in the block increased. Molasses-urea block consumption decreased linearly with increasing levels of urea in blocks due to low palatability and excessive ammonia concentration in the rumen (Habib, 2007; Sansoucy et al*.,* 2005) in agreement with the current finding.

Growth rate of experimental sheep

Total body weight gain, average daily weight gain and final body condition scoring of sheep fed MUB at Aneno and Arba village during both dry and wet season are given in Table 4**.** Two sheep were removed from control group due to diarrhea and mange during each season from each village. One sheep was also removed from treatment four from each village during dry season due to diarrhea. Most probably parasite ingested with grasses cause diarrhea which commonly observed on treatment and control group and results for the removal sheep from the experiments.

Even though, both study areas are located in the same agro-ecology and the same supplementary feeds were used total body weight gain and average daily body weight gain were significantly higher ($P<0.05$) at Anenno than Arba. Occurrence of diarrhea, grazing with other classes of livestock and competing for poor grazing feed resource and lower MUB intake (Table 3) at Arba village contributed to lower sheep performance. As observed

Table 2. Nutritional compositions of MUB used for feeding of Arsi-Bale sheep.

TR Diet	Nutrient (%)								
	DM	Ash	OM	NDF	ADF	Lignin	CP	IVOMD	ME(MJ/Kg/DM
T2	92.47	23.93	76.07	26.75	13.73	2.28	17.72	79.51	11.93
T3	90.79	20.86	79.14	29.08	13.53	1.78	20.96	78.16	11.72
T4	90.41	22.59	77.41	27.85	12.65	1.98	24.6	81.97	12.29

ME calculated as ME, 0.15xDOMD % (MAFF, 1984); TR, Treatment; DM, Dry matter; OM, Organic matter; NDF, Neutral detergent fiber; ADF, Acid detergent fiber; CP, Crude protein; IVOMD, In vitro organic matter digestibility; MJ, Mega joule; Kg, kilo gram.

Table 3. Molasses- urea feed block intake of Arsi-Bale sheep (g/day).

Main effect	Molasses-Urea block intake	
	Mean	SE
Seasons: Dry	245[a]	3.20
Wet	192[b]	3.16
Village: Aneno	238[a]	2.68
Arba	198[b]	3.83
Overall treatment: 2	230[a]	4.19
3	218[ab]	4.08
4	206[b]	4.20

Means followed by different superscript for the given main effect are significantly different (P<0.05).

Table 4. Least square mean and standard error of body weight gain and final body condition scoring of Arsi-Bale sheep Supplemented with MUB.

Main effect		TBWG		ADBWG		FBCS	
	NO	Mean	SE	Mean	SE	Mean	SE
Village: Over all	86	5.21	2.26	59.87	25.90	2.59	0.27
Aneno	43	5.91[a]	0.87	67.96[a]	10.31	2.64	0.14
Arba	43	4.51[b]	0.75	51.79[b]	9.41	2.55	0.49
Season: Wet	44	5.86[a]	0.43	67.33[a]	11.43	2.63	0.07
Dry	42	4.53[b]	0.39	52.07[b]	8.30	2.54	0.06
Over all treatment (T): 1	16	2.83[b]	0.39	33.67[b]	3.03	2.31[b]	0.06
2	24	6.13[a]	0.46	72.88[a]	9.27	2.71[a]	0.05
3	24	4.92[b]	0.64	58.53[b]	12.98	2.56[a]	0.06
4	22	6.26[a]	0.53	74.80[a]	11.13	2.70[a]	0.05
Village X season: Arba wet	22	5.32	0.57	60.70	10.20	2.66[a]	0.06
Arba dry	21	3.82	0.60	41.82	8.63	2.45[b]	0.05
Aneno wet	22	6.40	0.64	73.66	12.66	2.61[a]	0.07
Aneno dry	21	5.12	0.48	63.74	7.97	2.63[a]	0.07

TBWG, Total body weight gain; ADBWG, Average daily body weight gain; FBCS, Final body condition scoring.
Means followed by different superscript for the given main effect are significantly different (P<0.05)

relatively around Aneno village the distribution rain fall during short rainy season was good and improved availability grazing pasture as compared to Arba which might have caused differences in response to experimental diet. Habib (2007) conducted a similar study using MUB in two different areas for sheep fattening and reported different growth rates (38 g/day and 133 g/day) in Pakistan due to differences in grazing condition in agreement with the current finding.

Adami Tullu Agricultural Research Centre (ATARC, 1998) reported that during the dry season in the mid rift valley of Ethiopia the palatable species of grasses and legumes are depleted leading to reduction in productivity of livestock in agreement with the current finding of significantly (P<0.05) lower performance of sheep during the dry season as compared to the wet season. Responses to MUB are related to the quality of basal diets and grazing conditions as Habib (2007) reported in agreement with the current finding. With the advancing dry season, nutritional quality of natural pasture declines because of increasing fibre content and lignifications and reduced crude protein (CP), ash and DM digestibility (Smith, 1991) which lower performance of animals. The lignin content of pastures might be low during wet season, thus rumen micro organisms could use most of the cellulose for microbial protein synthesis thus protein and energy provided by MUB could be efficiently utilized for sheep growth and improved body condition of sheep.

The higher body weight gain of MUB supplemented sheep in the current study agree with finding of Forsberg et al. (2002). In China productive performance of grazing sheep was significant with much higher weight gain in the MUB supplemented animals than in the control group (Jian-xin et al., 2007) which agrees with the current finding. Njwe et al. (1990) reported that when rumen microbial populations are supplied with adequate dietary nitrogen, body weight gain of sheep was improved which could be used as supporting evidence in MUB supplementation. Sena et al. (2006) also reported supporting evidence that feed supplemented with MUB increased microbial activity and increased in nitrogen, minerals and energy supplies as compared to non-supplemented group.

The significantly higher (P<0.05) body weight gains registered by T4 and T2 as compared to T1 agree with the finding of Aganga et al. (2005) where 3.88 kg heavier body weight and 91.7 g daily gain were recorded from MUB supplemented Tswana sheep as compared with non-supplemented Tswana sheep. Anindo et al**.** (1998) observed that Menz rams supplemented with MUB were 4 kg heavier than control rams (25.7 ± 0.5 versus 21.7 ± 0.5 kg, *P* < 0.05) after 6 months in agreement with the current finding.

Results similar to the current study were reported by Bensalem et al. (2007) where sheep fed on *Acacia cyanophlla* leaves and supplemented with MUB increased weight gain by 47 g/day. It is most likely that higher growth rate obtained by sheep fed T2 and T4 might be due to higher IVOMD and ME values of MUB. Contrary to the expec-tation animals on T3 did not show appreciable weight gain and this is perhaps due to lower estimated energy 11.72 ME (MJ/Kg DM) and lowers IVOMD (Table 2).

Non significance (P>0.05) difference in body condition scoring were observed among MUB supplemented sheep. However, animals on the control group (T1) had significantly (P<0.05) lower body condition. Sheep in T2, T3 and T4 scored moderate body condition according the body condition scoring guidance/manual given by Gatenby (2002) and Richard and Church (1998). Even if, the body condition of supplemented sheep was improved, it was lower than the body condition scored of Menz rams supplemented with MUB (Anindo et al**.,** 1998) most likely due to different breed of animal used, different block quality and different location. The body condition of the animals reflect the proportion of body fat and muscles of carcasses and it is a more reliable indicator of animal`s nutritional status (ILCA, 2003). The moderate body condition scoring of T2, T3 and T4 showed the good feed value MUB in mid rift valley of Ethiopia. Under Ethiopian conditions animals with good body condition are preferred on market and fetched higher returns so by supple-menting grazing sheep with MUB it is possible to produce animals that are eagerly sought on the market. The interaction effect of village by season was significant on final body condition scoring with Arba dry season having significantly (P<0.05) lower final body condition scoring compared with other village by season combinations. Low rain fall during the short rainy season of the dry season reduced availability of grazing feed resource and accompanied with high grazing intensity at Arba were causes of poor body condition scoring.

Linear body measurement of experimental sheep

Village (location) exerted a significant effect on total body length gain. Village by season significantly influenced total height at wither gain.

Total heart girth gain was significantly influenced by village, season, and treatment diet and by the interaction of between village and season (Table 5).

Aneno experimental lambs had gained significantly higher (P<0.05) total body length and heart girth as compared to Arba experimental sheep because of higher molasses-urea block intake (Table 3) that contributed to higher body weight gain (Table 4).

Significantly (P<0.05) higher total heart girth gain during wet season because there was more grazing feed resource that improved response of sheep to MUB. Total body length and total body height gain did not differed significantly (0>0.05) deferent among MUB supplemented group. There was a significant difference (P<0.05) bet-ween control and supplemented group in total heart girth gained but there is no significant difference (P>0.05) among supplemented group. Significantly higher total heart girth gained in supplemented group agrees with the report of Tayeb (1991) and Negwa and Tawah (1992). Significantly greater total heart girth gained in the supplemented group from the current study showed that supplementary MUB caused muscle and fat cover accumulation around the vertebrae in the loin region and

Table 5. Least square mean and standard error of linear body measurements (cm) of Arsi- Bale sheep supplemented with MUB.

Main effect		TBLG		THWG		THGG	
	NO	Mean	SE	Mean	SE	Mean	SE
Village:Over all	86	3.75	3.20	3.37	2.92	4.22	2.44
Aneno	43	4.93[a]	0.76	3.21	0.59	5.01[a]	0.53
Arba	43	2.56[b]	0.54	3.61	0.62	3.40[b]	0.51
Season: Wet	44	4.09	0.52	3.79	0.40	5.14[a]	0.48
Dry	42	3.39	0.51	2.93	0.52	3.27[b]	0.32
Over all treatment (T): 1	16	2.70	0.76	2.84	0.38	2.84[b]	0.38
2	24	4.63	0.64	4.80	0.52	4.80[a]	0.52
3	24	3.04	0.80	4.02	0.69	4.02[a]	0.68
4	22	4.32	0.65	4.82	0.66	4.82[a]	0.66
Village X Season: Arba wet	22	2.36	0.54	3.40[ab]	0.51	3.40[b]	0.51
Arba dry	21	2.47	0.55	3.40[ab]	0.51	3.41[b]	0.52
Aneno wet	22	5.82	0.73	6.80[a]	0.63	6.86[a]	0.63
Aneno dry	21	4.14	0.78	3.15[b]	0.43	3.15[b]	0.43

MUB= molasses-urea block, T = Treatment, TBLG = Total body length gain; THWG = Total height at wither gain; THGG = Total heart girth gain.*Means followed by different superscript for the given main effect are significantly different (P<0.05)

Table 6. Overall economic analysis Arsi-Bale sheep fed molasses-urea block under farmers' management condition.

Parameter	Experimental diet			
	T1	T2	T3	T4
Sheep purchase price (EB/head)	147.5	153.54	154.17	159.20
Total feed price (EB)	0.00	25.63	25.64	26.76
Total non-feed cost (EB)	4.83	17.10	17.01	17.10
Total variable cost(EB)	152.33	196.27	196.82	203.06
GR (EB/head)	174.10	272.29	252.92	258.13
NR (EB/head)	21.77	76.02	56.1	55.07
NROC (EB/head)	-	54.25	34.33	33.30
MRR (%)	-	123.46	77.16	65.64

T = Treatment, EB = Ethiopian Birr, GR = Gross return, NR = Net return, NROC = Net return over control, MRR= Marginal rate of return

improved body condition.

Profitability of using molasses-urea feed block for Sheep feeding

Money obtained from sale of sheep was the source of farmers` income at the end of the experiment but manure that was used as fertilizer was not included in total revenue calculation because sheep manure selling is not common in the study area. Fixed costs such as feeding troughs, feeding pen were constructed previously by the Ethiopian sheep and goat productivity improvement program (ESGPIP) for on-farm experiment and its cost were not included in calculation. Communal grazing land was free of charge and common for all experimental sheep and was not considered for partial budget analysis. The economic analysis of the experiment was computed and described for each treatment (Table 6).

The major cost that determined the profitability of using Molasses-urea block for sheep feeding is the feed cost as compared to the non-feed cost (Table 6). Solomon et al. (1991) reported that feed input is the major component of sheep production costs in agreements with the high feed costs of the current finding. Similar to the current study Aganga et al. (2005) reported that under intensive and semi-intensive livestock production a large proportion of costs are feed costs. For each Ethiopian birr invested on MUB farmers obtained additional 1.2346, 0.7716 and 0.6564 Ethiopian birr from T2, T3 and T4, respectively.

CONCLUSION AND RECOMMENDATION

Molasses-urea feed block intake was influenced by block hardness, level of urea in it, quality and quantity of basal diet and seasons. Partial budget analysis indicated that marginal rate of return (MRR) of T2 is higher than the rest group. It can thus be concluded that MUB with 17.72% CP could be recommended as a supplement for fattening grazing sheep in mid rift valley of Ethiopia.

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