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Full Length Research Paper

Effects of molasses level in a concentrate mixture on performances of crossbred heifer calves fed a basal diet of maize stover

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This study was conducted to evaluate the growth performance and feed intake of crossbred (Boran x Holstein Friesian) female calves fed different levels of molasses in concentrate mixture using 24 yearlings calves with average initial weight of 142.4±20.7 kg which lasted for 90 days. The calves were assigned into treatments having 0 (T1), 15 (T2), 30 (T3) and 50% (T4) molasses which replaced wheat bran in concentrate mixture using randomized complete block design into six blocks of four animals. The dry matter (DM) degradability was determined by incubating 3 g of feed samples in fistulated steers fed natural pasture hay *ad libitum* supplemented with 2 kg of concentrate. The total DM and organic matter (OM) intake for T2 and T3 diets were higher (P< 0.05) than those fed T1 and T4 diets. The stover DM and OM intake for T2 and T3 diets were higher (p<0.05) than for other treatments. The highest (p<0.05) crude protein intake was observed in calves fed T3 diets. Metabolizable energy (ME) intake was higher (P<0.05) for calves fed on T2 and T3 diets, respectively. Calves fed on T2, T3 and T4 diets had higher average daily gain compared to those fed T1 diet. The DM degradability after 4, 8, 24, 48, and 96 h of incubation was higher (P < 0.05) for T4 than that of T1. Based on intake of DM, OM and ME and growth performance, 15 and 30% molasses could be used as a replacement to wheat bran in the ration of heifers fed maize stover with good performance.

Key words: Molasses, performance, crossbred, calves, maize stover, Ethiopia.

INTRODUCTION

Livestock industry is an important and integral part of agriculture sector in Ethiopia. Livestock farming is vital for the supply of meat and milk; serves as a source of additional income both for smallholder farmers and livestock owners' (Ehui et al., 2002). Livestock are fed with diverse feed resources in Ethiopia. The major feed resources are the crop residues and grass hay which contains poorly digestible nutrients. To ensure better body condition of the animals under such situation, it is advisable that additional sources of readily fermentable carbohydrate and nitrogen be included in the diet of the ruminants thereby improving the utilization of crop residues, which is mainly attained through the supply of energy and nitrogen to rumen microbes (Osuji et al., 1995). Results of studies by Van Soest (1988) and Zhang et al. (1995) have indicated that crop residues are low in available nutrients, taking longer lag time and have slow microbial degradation.

Supplementation of ruminant animals fed on low quality roughages with carbohydrate and protein feed such as molasses-urea could be used to improve the digestibility and bioavailability of nutrients (Dass et al., 1996). Efforts were made previously regarding crossbred calves focusing on improving feeding regime of pre weaned calves to increase performances (Tadesse and Yohannes, 2003; Tadesse et al., 2004). In addition, post weaning calf management is crucial, because it determines the overall performance of an animal to attain early and long productive and reproductive life. It is also

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Table 1. The composition of experimental diets (%).

Treatment	Maize stover	Wheat bran	Cotton seed cake	Molasses	Urea	Bole	Salt
T1	*ad libitum*	50	47	0	0	2	1
T2	*ad libitum*	35	46	15	1	2	1
T3	*ad libitum*	20	45	30	2	2	1
T4	*ad libitum*	0	44	50	3	2	1

important to ensure recommended body weight at maturity. However, it is difficult to achieve such recommendations in areas where animals are dependent on crop residues. For example, maize (*Zea Mays)* stover is the major feed sources in Adami Tullu district (Tesfaye et al., 2001) which makes it difficult to meet the standard recommendations. Maize stover is poor in quality to allow sufficient nutrient intake to support potential rate of weight gain in growing calves. One of the problems with regard to the utilization of crop residues is that farmers cannot afford to supplement with high quality concentrate supplements due to their high price. Therefore, it is important to use supplementary feeds which are available and affordable by farmers. One of such ingredient is molasses, which is a relatively cheap sources of energy and can still replace conventional concentrate feeds like wheat bran to improve the feeding values of crop residue for ruminants. There is little information available with regards to crossbred claves from post weaning until the age of maturity which evaluated the feeding of wheat bran and molasses in different proportions. Therefore, the current study was conducted with the objectives to evaluate growth performance of crossbred heifer calves fed different levels of molasses in concentrate mixture.

MATERIALS AND METHODS

Description of the study area

The study was conducted at Adami Tullu Agricultural Research Center which is located at 167 km south of Addis Ababa, Ethiopia, at an altitude of 1650 meter above sea level. The center is situated at latitude of 7° 9' N and 38° 7'E longitude. The soil type is fine, sandy loam with sand, clay in the proportion of 34, 48 and 18%, respectively. The average pH is 7.88 (ATARC, 1998).

Experimental animals and management

A total of 24, Borana-Holstein Friesian crossbred (25:75 %) heifer calves born at Adami Tullu Agricultural Research Center aged between 11 to 14 months with an average weight of 142.4± 20.7 kg were used for the experiment. Animals were drenched with 1200 g broad-spectrum antihelminthes (Albendazole) as recommended by the manufacturer and sprayed with acaricide before the commencement of the experiment. The calves were individually stall fed in loose house barn with corrugated iron roof and concrete floor.

Experimental feeds and treatment diets

The stover was manually harvested and chopped to 2 to 5 cm length using tractor operated chopper. Ingredients of concentrate mixtures that were assumed to be sufficient for the experimental period were procured and thereafter stored carefully to protect it against the rodents and to avoid any contamination. Wheat bran (WB), cotton seed cake (CSC), sugar cane molasses, urea, table salt and Bole (mineral supplement) were the ingredients used to formulate the ration.

The treatment rations were formulated to contain 0, 15, 30, 50% molasses as a substitute to wheat bran. To make the treatment diets iso-nitrogenous, urea was included at 0, 1, 2, 3% levels for T1, T2, T3 and T4, respectively. Ration formulation was assumed to meet the total protein (552 g CP/head/day) and metabolisable energy (40.86 ME MJ/head/day) requirements for maintenance and expected growth rate of 750 g/head/day as recommended by Kearl (1982).

Experimental design and treatment groups

The experimental animals were blocked in to six groups based on initial body weight and randomly assigned to one of the four treatment diet as indicated in Table 1.

A preliminary period of 14 days was given to allow adjustments of growing animals to the diet. This was followed by 90 days of feeding period. The animals were fed maize stover *ad libitum* on individual basis. Daily DM intake of calves was calculated to be 3% of their live weight and the amount of concentrate was calculated to be 40% of the daily DM intake. The daily amount of concentrate mixture was divided into two equal portions and provided individually at 8 AM and 4 PM. The design and size of the watering trough in each feeding pen was not convenient and enough to provide water freely. Hence, animals were allowed to drink water two times a day from watering trough in the feed lot which was constructed outside the pen. The amount of concentrate offered during the experiment was adjusted to animals' body weight change on a weekly basis.

Voluntary feed intake and *in vitro* dry matter digestibility

The amounts of feed offered and refused by animals were measured daily to calculate intake. Based on OM intake and *in vitro* organic matter digestibility (IVOMD) of the diets, total digestible organic matter intake was determined on individual basis. The metabolisable energy contents of the feeds were estimated from *in vitro* organic matter digestibility as described by McDonald et al. (2002): ME (MJ/kg) = 0.016 DOMD, where, DOMD = digestible organic matter in dry matter.

In vitro dry matter digestibility was determined by two stage method developed by Tilley and Terry (1963). Rumen fluid was collected from three rumen fistulated steers before the morning feeding. The steers were fed *ad libitum* natural pasture hay supplemented

Table 2. Dry matter, chemical composition (% of DM), *in vitro* organic matter digestibility and energy value of feed as used in the experiment.

Feed types and treatment	DM	Ash	CP	NDF	ADF	Lignin	ME (MJ/kg DM)	IVOMD (%)
Maize stover	92.6	9.2	7.4	72.5	44.9	6.2	8.2	56.3
Wheat bran (WB)	90.7	5.6	17.5	47.4	29.8	-	11.0	87.1
CSC	92.6	5.8	29.2	65.1	31.0	6.7	8.9	60.4
Molasses	74.3	18.4	4.2	-	-	-	14.5	99.6
T1	91.7	8.4	26.6	31.8	17.0	4.75	10.5	72.8
T2	91.3	10.1	26.0	27.2	15.8	3.74	11.1	77.1
T3	91.7	10.6	28.0	22.6	13.2	2.9	11.2	78.2
T4	92.0	11.5	27.5	20.1	13	2.08	11.1	78.6

DM, Dry matter; CP, crude protein; NDF, neutral detergent fiber; ADF, acid detergent fiber; IVOMD, *in vitro* organic matter digestibility; ME, metabolisable energy; CSC, cotton seed cake;T1= 50% WB + 47% CSC + 2% bole + 1% salt;T2= 35% WB + 46% CSC + 15% molasses + 1% urea + 2% bole + 1% salt;T3= 20% WB + 45% CSC + 30% molasses + 2% urea + 2% bole + 1% salt;T4= 0% WB + 44% CSC + 50% molasses + 3% urea + 2% bole + 1% salt.

with 2 kg concentrate once per day.

Live weight measurement

Live weights of animals were recorded weekly in the morning before the daily meal. The animals were weighed on two consecutive days at the beginning and end of the experiment and the average of the two were taken as initial and final weights, respectively. The daily live weight gains were calculated as the differences between final and initial live weight divided by number of experimental days.

In sacco DM degradability

The basal diet and concentrate feed samples were milled to pass through 2 mm sieve size for *in sacco* DM degradability study. The DM degradability was determined by incubating 3 g of dry feed samples in fistulated steers fed natural pasture hay *ad libitum* supplemented with 2 kg concentrate (55% wheat bran, 44% noug (*Guizotia abyssinica*) seed cake and 1% salt) once per day in the morning. To determine the DM degradability, the samples were incubated in the rumen for 4, 8, 24, 48, 72 and 96 h. After each incubation period, the bags were removed and hand washed under a running tap water until the water becomes clear. To determine undegraded DM, two bags were dried at 65°C for 48 h. Washing loss was similarly determined by washing duplicated feed samples that were not incubated in the rumen. The duplicated bags were dried in the same way to determine DM contents of the feed samples.

The degradability constants were determined using the exponential equation $P = a + b\,(1-e^{-ct})$ as described by Ørskov and McDonald (1979) using the Neway Excel-program (Chen, 1995), where P = DM degradability at a time t. The degradation characteristics of the feed were defined as A= washing loss (readily soluble fraction); B= (a + b)-A, representing insoluble but fermentable fraction; c= the rate of degradation of B (Ørskov and Ryle, 1990). Potential degradation (PD) of DM was estimated as (A + B), while ED was calculated according to Dhanoa (1988) using the formula $ED = A + [Bc/(c + k)]$ at rumen outflow rates (k) of 0.03 h^{-1}.

Chemical analysis

Nutrient composition of feed offered and refusal was analyzed for DM and ash according to AOAC (1990). Nitrogen (N) content was determined by Kjeldahl method and CP was calculated as N x 6.25. Neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) were analyzed according to the method developed by Van Soest and Robertson (1985).

Statistical analysis

Data from live weight change, feed intake and *in vitro* digestibility were subjected to the analysis of variance (ANOVA) procedure for the general linear model (GLM) Statistical Analysis System (SAS, 2001). The treatment means were separated by least significant difference (LSD).

RESULTS AND DISCUSSION

Chemical composition of the experimental feeds

The chemical composition of the experimental feeds used in the study is presented in Table 2. The ash contents of the ingredients used in the study varied from 5.6% in wheat bran to 18.4% in molasses. The CP contents of the feeds ranged from 4.2 % in molasses to 29.2% in cotton seed cake. The lower CP content of molasses as observed in the present study is in agreement with the works of Nega et al. (2006) and Zewdie (2010) who reported 3.5 and 3.99% CP, respectively. The CP contents of maize stover as obtained in the present study was comparable to the value of 5.6% CP reported by Nega et al. (2006) in the same district but higher than the values (3.7, 2.66 and 3.5% CP) reported by Adunga et al. (1998), Yitaye (1999) and Zewdie (2010) in other parts of Ethiopia, respectively. The CP content of wheat bran as assessed in the present study was similar to the reports of Getinet (1998) and Tesefaye et al. (2001) who obtained 16.3 and 17.19% CP, respectively. Maize stover had the highest NDF and ADF contents off all ingredients used in the present study which is comparable to the reports of Adunga et al. (1998) who obtained 78.9% NDF

Table 3. Mean DM and nutrient intakes of crossbred heifer calves fed different levels of molasses in concentrate mixture.

Variable	Treatment*				
	T1	T2	T3	T4	SEM
DM intake (kg head^{-1} day^{-1})					
Stover	2.77^{b}	3.46^{a}	3.55^{a}	2.53^{b}	0.09
Concentrate mixture	1.93	1.92	1.93	1.93	
Total	4.70^{b}	5.21^{a}	5.48^{a}	4.46^{b}	0.10
% Stover DM in diet	58.7	64.2	64.8	58.8	
% Molasses DM in diet	0.00	5.38	10.6	21.6	
OM intake (kg head^{-1} day^{-1})					
Stover	2.51^{b}	3.14^{a}	3.23^{a}	2.30^{b}	0.09
Concentrate mixture	1.77	1.73	1.72	1.72	
Total	4.28^{b}	4.90^{a}	4.99^{a}	4.07^{c}	0.08
DOM intake (kg head^{-1} day^{-1})					
Stover	1.29^{b}	1.60^{a}	1.65^{a}	1.18^{b}	0.04
Concentrate	1.16	1.20	1.21	1.20	
Total	2.45^{b}	2.80^{a}	2.86^{a}	2.38^{b}	0.09
CP intake (g head^{-1}day^{-1})	719^{c}	755^{b}	803^{a}	717^{c}	0.01
ME intake (MJ head^{-1}day^{-1})	39.2^{b}	44.8^{a}	45.7^{a}	38.0^{b}	0.67

Means with different superscript in the same row are significant (p<0.05). DM, dry matter; OM, organic matter; DOM, digestible organic matter; CP, crude protein; ME, metabolasiable energy; *treatment descriptions are as indicated in Table 2.

and 39.9% ADF.

The ME values of the feed in the study ranged from 8.2 in maize stover to 14.5 MJ/kg DM in molasses. The ME contents of maize stover as obtained in the present observation is consistent with the values of 8.8 and 8.9 MJ/kg DM reported by Tesfaye and Musimba (2006), and Nega et al. (2006), respectively, but higher than the value (6.6 MJ/kg DM) reported by Zewdie (2010). The values of ME for wheat bran, cotton seed cake and molasses as observed in this study are similar to the value reported by Nega et al. (2006) and Zewdie (2010).

The fiber fractions (NDF, ADF) and lignin values of the concentrate feeds showed a decreasing trend from T1 to T4 across the treatment. The NDF fraction was highest for T1 (50 % wheat bran) and lowest for T4 (0 % wheat bran) at which wheat bran was totally replaced. The decrease in fiber fraction for concentrate feeds across the treatment can be related to the decreased level of wheat bran. The NDF content in the present study ranged from 20.1 in T4 to 31.8% for T1. The observations by Miessner et al. (1991) indicated that higher values of NDF (above 55 to 60%) may affect efficiency of the rumen environment and thus led to a decrease in feed intake. The ADF content of concentrate mixture as assayed in the study ranged between 13 to 17% which is less than the ranges of 19 to 21% recommended as ideal in ruminant diets (NRC, 1989).

In vitro organic matter digestibility (IVOMD) and ME contents of concentrate mixtures used in this trial are indicated in Table 2. The IVOMD as assessed in the current study ranged between 72.79 to 78.58%. The IVOMD as observed in T1 was lower compared with the other treatment groups. The concentrate mixtures, which contained molasses, had higher IVOMD which may be related to the lower cell wall fractions observed as the levels of molasses increased in concentrate mixture.

Feed intake

The mean dry matter (DM) and nutrient intake of crossbred heifer calves fed different level of molasses are presented in Table 3. The total DM and organic matter (OM) intake for T2 and T3 diets were higher (P< 0.05) than those heifers fed T1 and T4 diets. The stover DM and OM intake for T2 and T3 diets were higher (p<0.05) than for other treatments. The DM intake from maize contributed to 58.71 to 64.81% of the total DM intake of the diet.

In present study, the level of molasses in T2 and T3 improved (p<0.05) stover DM and OM intake. The lower feed intake in T1 may be related to the lower DM degradability as feed intake is related to digestibility of feeds which in turn affect the rate of feed passage and intake. Adding molasses in concentrate mixture by replacing wheat bran as in T2 and T3 increased DM intake in the current study which is in agreement with the observations of Broderick and Radloff (2004) who reported

Table 4. Live weights, average daily gain, and feed conversion efficiency of calves fed different levels of molasses in concentrate mixture.

Parameter	Treatment*				SEM
	T1	T2	T3	T4	
Initial weight (kg head^{-1})	142.7	142.2	142.2	142.5	2.2
Final weight (kg head^{-1})	214.0^{c}	227.5^{ab}	236.0^{a}	223.5^{b}	3.1
ADG (g head^{-1}day^{-1})	791.7^{c}	948.3^{ab}	1028.3^{a}	900.0^{b}	27.6
FCR (kg OMI kg^{-1}gain)	5.5^{a}	5.3^{a}	4.9^{b}	4.7^{b}	0.1

Means with different superscript in the same row are significant (p<0.05). ADG, Average daily weight gain; FCR, feed conversion ratio.

increased total DM intake due to replacement of liquid molasses for corn grain in feeding of dairy cow.

The higher DM intake observed in T2 and T3, which may be related to the moderate levels of soluble carbohydrate from molasses, might led to an increase in the amount of readily fermentable energy in the diet. This is in agreement with the reports of Sean et al. (2005). Studies (Rooke et al., 1987; Khalili and Huhtanen, 1991) indicated improvement in the utilization of NPN nitrogen in the rumen which in turn could increase the out flow rate of feed consumed and resulted in an increased feed intake from maize stover. The increase in DM intake at 5.38 and 10.56% of molasses in the diets is in agreement with the observations of Petit and Veira (1994) and Petit et al. (1994) who obtained an increase in total DM intake of silage based diets when molasses was incorporated at 7.5 and 15% of the total feed DM.

The increase in OM intake for T2 and T3 is in agreement with the findings of Lawer-Neville et al. (2006) who reported that steers fed on 10% dietary concentrate separator by-product (desugared molasses) consumed more OM than the non supplemented steers fed either corn stover or alfalfa based diets. Molasses is usually used as a supplement for low-quality forages to stimulate intake (McLennan et al., 1981) and improve animal performance (Stephenson and Bird, 1992).

The present study indicates that IVOMD of concentrate mixtures improved with the inclusion of molasses solution. Higher (p<0.05) stover DOM intake was observed in T2 and T3 diets which may be related to the inclusion of molasses which has more favorable effects on the rumimal environment especially for the fiber digestion compared with starch which is in agreement with the observations of Broderick and Radloff (2004) and Broderick et al. (2008).

The highest (p<0.05) CP intake was observed in calves fed on T3 diet compared to other treatments. The ME intake was significantly higher for calves fed on T2 and T3, respectively. The higher CP intake in T3 and higher ME intake observed in T3 and T2 were expected due to the higher feed DM intake observed in both treatments. The ME intake across the treatment was sufficient to meet the daily ME requirement (40.88 MJ/head/day) for crossbred heifers with 150 kg live weight and at daily weight gain of 750 g/head (Kearl, 1982). The ME intake of 44.83 and 45.71 MJ/head/day in T2 and T3 was higher than the recommended ME requirement. As recommended by Kearl (1982), the CP requirement of the experimental animal was 552 g/head/day for 750 g weight gain.

Growth rate and feed utilization

The body weight changes of crossbred heifer calves fed different levels of molasses in a concentrate mixture and its feed utilization efficiency are given in Table 4. The effects of supplementation of different levels of molasses had a significant effect (P < 0.05) on average daily gain (ADG) of crossbred calves than calves fed on concentrate mixture without molasses. Calves fed on T2, T3 and T4 diets had higher (P < 0.05) ADG when compared to that of T1.

The growth performance of animal is directly related to the protein and energy obtained from a given ration. Hence, the higher ADG observed in T2 and T3 can be explained by the higher daily CP and ME intake. Lower daily gain in T4 compared to T3 may be related to the higher (216 g per kg diets) molasses in T4 which is above the optimum level reported by Cullison and Lowery (1987) who indicated the optimum level of molasses to be from 100 to 150 g per kilo of diet . The same author also indicated that a further increase may upset rumen microbial activity and reduce the feeding value of the basal diet. In addition to the supplementation of molasses to stover, the availability of readily fermentable carbohydrate in the molasses with the presence of protein sources from cotton seed cake in the rumen might have increased the synthesis of microbial protein or the yield of undegradable protein in the lower gut as suggested by Osuji et al. (1995). Thus, a higher DM intake and the additional ME source due to the increased DOM intake may explain the significant increase in daily live weight gain which was found in response to supplementation of molasses.

Calves in T3 and T4 consumed less amount of OM per kg of weight gain compared to calves in T1 and T2. Calves fed on higher levels of molasses in concentrate

Table 5. In sacco DM degradability (%) and degradability characteristics of the experimental feeds.

Incubation time (h)	Concentrates				Stover	S.E.M
	T1	T2	T3	T4		
4	38.8[b]	45.4[ab]	45.7[ab]	57.4[a]	24.3[c]	3.73
8	49.5[c]	58.4[ab]	62.8[ab]	64.9[a]	24.1[d]	1.51
24	54.1[b]	63.4[a]	65.4[a]	66.0[a]	27.2[c]	2.47
48	65.8[b]	75.4[ab]	79.1[a]	83.5[a]	48.3[c]	3.06
72	80.5[a]	81.9[a]	83.3[a]	83.5[a]	50.8[b]	3.24
96	80.8[d]	84.4[c]	87.3[b]	89.6[a]	58.3[e]	0.67
Rumen degradability parameters						
A	3.00[d]	25.23[c]	31.53[b]	46.43[a]	13.67[d]	1.27
B	9.17[a]	63.50[ab]	56.57[ab]	50.87[b]	73.03[ab]	6.75
C	0.015	0.026	0.092	0.009	0.011	0.034
A+B	92.20	88.43	88.13	97.30	86.70	6.90
ED 0.03h^{-1}	51.8[c]	59.73[b]	62.9[ab]	66.33[a]	29.97[d]	1.17
RSD	5.3	4.2	7.9	5.4	6.4	1.65

Means with different superscript in the same row are significant (p<0.05). A, Washing loss; B, degradability of water insoluble; C, rate of degradation of water insoluble fraction; A + B, potential degradability; ED, effective degradability at out flow rate of 0.03 h^{-1}; RSD, residual standard deviation.

had higher feed conversion ratio when compared to the calves fed concentrate without molasses. The current result agrees with the reports of Jemal et al. (2004) and Chala et al. (2005) who reported increased feed conversion efficiency for Horro rams and Horro steers, respectively, as the quantity of molasses increased as a substitute to maize grain.

In sacco dry matter degradability

The results of the *in sacco* DM degradability and degradability characteristics of the feeds are presented in Table 5. The DM degradability after 4, 8, 24, 48, and 96 h of incubation was higher (P< 0.05) for T4 than T1. After 96 h of incubation, the highest (p<0.05) DM degradability was observed for T4 and the lowest was for T1. The DM degradability of concentrate mixture in the present study was higher (P<0.05) compared to maize stover and the result is consistent with the reports of Alemu et al. (1991) who indicated that since agro-industrial by-products are rich in energy and/or protein, and low fiber contents, they have high digestibility when compared with fibrous feeds. The lower DM degradability observed in T1 and maize stover could be attributed to the higher NDF content as *in sacco* DM degradability is negatively correlated to the levels of NDF in feedstuff (Vitti et al., 1999). The present observations are in accordance with the report of Broderick (2003) who reported that NDF concentration had a negative relationship with DM degradability. Generally, there is a negative correlation between NDF concentration of forage and intake, due to the long stay of forage in the rumen for further mastication and fermentation by microorganisms (Jung and Allen, 1995) which results in low degradability/digestibility.

The highest (p<0.05) rapidly soluble DM fraction (A) was observed in T4 and lowest in T1 and maize stover. The washing loss significantly increased (P<0.05) as the level of molasses increased in the concentrate mixture.

The effective degradability was higher (P<0.05) in T4 than in T1 and maize stover. *In sacco* degradability of feed can be affected by many factors such as sample particle size, procedure and methods followed in washing and it can also be affected more by chemical composition and the method used to process the feed (Olivera, 1998). Generally, the higher washing loss in T4 indicates the presence of more soluble fraction in a feed while the lower washing loss in T1 and stover may explain the proportion of soluble fraction in the feed. The higher degradation rate in T4 can be related to higher proportion of molasses which had significantly higher degradation rate than other feed used in the present study.

Conclusion

From this study, it can be concluded that supplementing molasses at 15 and 30% as a substitute for wheat bran in a concentrate mixture improved the intake of DM, OM, CP, ME and ADG of female crossbred heifer calves. Increasing the level of molasses in concentrate mixture improved *in vitro* digestibility of feed and feed conversion efficiency of calves. Therefore, there is an opportunity to increase the utilization of crop residue by substituting wheat bran with molasses and substitution of molasses for high price energy feeds can be considered under farmers condition for future study.

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