The Journal of Animal & Plant Sciences, 28(4): 2018, Page: 1002-1006
ISSN: 1018-7081

REPLACING CORN GRAINS WITH VARYING LEVELS OF CANE MOLASSES: POST WEANING INTAKE, GROWTH PERFORMANCE AND STRUCTURAL DEVELOPMENT OF NILI RAVI BUFFALO (*BUBALUS BUBALIS*) FEMALE CALVES

E. U. Khan[1], T. N. Pasha[1], M. Aleem[2] and M. A. Rashid[1,*]

[1]Department of Animal Nutrition, University of Veterinary and Animal Sciences, Lahore, Pakistan
[2]Department of Theriogenology, University of Veterinary and Animal Sciences, Lahore, Pakistan.
[*]Corresponding author's e-mail: drafzal@uvas.edu.pk

ABSTRACT

Sugar cane molasses (SCM) is an easily available and a cheaper source of energy for livestock. Aim of this experiment was to evaluate the inclusion level of SCM in concentrate diet during post weaning period and its effect on feed intake, growth performance, structural measurements, feed efficiency (FE) and cost per unit gain in Nili Ravi female buffalo calves. A total of n=18, 90 ± 3 days old, weaned Nili Ravi buffalo female calves weighing 69 ± 3.57 kg were randomly assigned to one of the three concentrate treatments (n=6 calves/treatment): 1) low molasses (LM) containing 4% SCM, 2) medium molasses (MM) containing 12% SCM, 3) and high molasses (HM) containing 20% SCM on DM basis. Calves were given an adaptability period of 14 days and then shifted to treatment diets with a forage to concentrate ratio of 40:60 on DM basis. Duration of data collection was 98 days. Diets were iso-nitrogenous, iso-caloric and fed at 3% of weekly BW and orts were collected daily. Animals were weighed at the start and then on bi-weekly basis. Whereas, body measurement: wither height (WH), heart girth (HG) and hip width (HW) were measured at start and afterwards on fortnightly basis. The results revealed that increasing level of SCM had no influence ($P > 0.05$) on ADG, WH, HG and HW. Similarly, average daily DMI was not affected ($P > 0.05$) by increasing the level of SCM in the diet. However, feed efficiency and the cost per unit gain was lower ($P < 0.05$) in the HM compared to the calves fed on the LM and MM based diets. In conclusion, similar growth performance, improved feed efficiency and low cost per unit gain suggest that SCM can be included up to 20% in the concentrate feed of weaned buffalo female calves.

Key words: Sugar cane molasses, growth performance, buffalo calves, post weaning, feed efficiency.

INTRODUCTION

In agriculture sector of Pakistan, livestock is imperative and integral segment. Among livestock population of Pakistan, 38.8 million buffaloes are contributing the sector through considerable milk and meat production (Anonymous, 2018). Nili Ravi buffalo is ranked among the best milk producing buffalo breeds of the world (Warriach *et al.*, 2008) with ability to thrive in hot humid conditions and convert low quality feed stuffs into valuable products like milk and meat.

Heifer rearing is important in terms of animal future productivity and production sustainability at farm. Typically, buffalo heifer rearing is characterized by lower growth rates, and consequently delayed age at puberty mainly due to poor nutrition (Sarwar *et al.*, 2002; Jabbar *et al.*, 2006; Fiaz *et al.*, 2012). Studies on heifer production have shown that feeding cost share is 63% to 84% of the total inputs suggesting importance of nutritional management in heifer rearing (Moore *et al.*, 2000; Razzaque *et al.*, 2010).To ensure optimal growth performance a complete system of heifer rearing is required (Anjum *et al.*, 2012) which can make the base of profitable buffalo farming.

Regarding Nili Ravi buffalo calves, early weaning strategies have been used successfully to reduce the cost of feeding in milk fed calves (Rashid *et al.*, 2013). Growing calves between 2-6 months of age experience dietary transition from milk and starter based diet to forage based diet. Optimal growth rates during this phase are critical to achieve the recommended body weight (BW) for sexual maturity (Silva *et al.*, 2002; Le Cozler *et al.*, 2008). This period of transition, if not properly managed, can induce stress resulting in high morbidity and mortality. Drackley (2008) reported that a smooth transition increased average daily gain (ADG) and reduced the incidence of morbidity in weaned cattle calves.

Energy sources can play a vital role in the development of rumen epithelium and hence the ability of animal to handle roughage based diets at an early age. Sugar cane molasses is an easily available and a cheaper source of energy. Assefa and Nurfeta (2013) reported no difference in growth performance when molasses level was increased up to 30% in growing heifer diet. To date, information on use of sugar cane molasses (SCM) in post-weaning diets of buffalo calves is scarce. Therefore, primary objective of current experiment was to evaluate appropriate inclusion level of SCM in concentrate diets.

Other objectives were to determine the effect of increasing levels of SCM on performance measures and feed efficiency during post weaning period.

MATERIALS AND METHODS

Experimental Animals and Management: The present study was conducted at Buffalo Research Institute (BRI), Pattoki, Pakistan. Experimental protocol was in accordance with guide lines stipulated by ACUC-UVAS, Lahore, Pakistan. Individual feed allowance and free choice water availability was ensured during the entire experimental period. At the start of experiment, calves were injected Ivomec® (Ivermectin, 1% sterile solution, Merial) as dewormer against internal and external parasites. Vaccination and sick animal treatment was performed according to farm protocols.

Experimental Design and Feeding Management: Eighteen weaned Nili Ravi buffalo female calves of age 90 ± 3 days and weighing 69 ± 3.57 were randomly assigned to one of the three treatments (n = 6 / treatment) under CR Design. Three treatments were concentrate diets: 1) low molasses (LM), medium molasses (MM), and high Molasses (HM) containing 4%, 12% and 20% SCM on DM basis, respectively. Formulated diets were iso-nitrogenous and iso-caloric and increasing levels of SCM was included by replacing corn grain in the rations (Table 1). An initial period of 14 days feeding was given to each animal for adaptability to new diets. Individual DM allowances were adjusted on weekly basis at 3% of their live BW. During entire data collection period of 98 days, calves were individually fed twice daily at 7 am and 4 pm with a forage to concentrate ratio of 40:60 on DM basis. Furthermore, individual orts were recorded daily for daily DMI calculations.

Data Collection and Parameters Studied: Dry matter intake was recorded on daily basis. Body weights were recorded on start and weekly basis; whereas, structural measurements including withers heights (WH), heart girth (HG) and hip width (HW) were conducted on start and bi-weekly basis.

Laboratory Analysis: The approved procedures of AOAC (2002) were used to analyze feed samples for proximate analysis; Samples of concentrate and oats silage were collected fortnightly, dried in hot air oven for 24 hours at 55ºC, ground to average particle size of 1mm using Willy mill ("Arthur H. Thomas, Philadelphia, USA"). For DM determination the samples were further placed in hot air oven (105ºC for 4h). Crude protein contents were estimated as N x 6.25 and N determined by using Kjeldahl apparatus ("Gerhardt Kjeldatherm, Germany"). Soxhlet Petroleum Ether Extractor was used to measure Ether Extract (EE) contents ("Dalton DS-115K, Japan"). For determination of ash contents, samples were processed in a muffle furnace for 4h at 550ºC. All these analyses were performed in laboratory of Department of Animal Nutrition, UVAS Lahore, Pakistan.

Statistical Analysis: Experimental data were analyzed through one way ANOVA technique using SPSS (IBM® SPSS® Statistics, Version 21). Results with P-value < 0.05 were considered significant and compared through Tukey's Post Hoc multiple comparison test.

RESULTS AND DISCUSSION

Dry matter intake: The results for DMI in response to increasing SCM level in treatment diets are presented in the Table 2 as Means ± SEM. Total DMI during entire trial was not (P > 0.05) affected by increasing inclusion level of SCM in post weaning diets of calves. Animal performance and production efficiency has a close association with DMI and molasses retain proficiency to enhance palatability (Nutrition, 1983). Our results are in agreement with the studies of Sibanda *et al.* (1987) and Tuyen *et al.* (2015) who reported that molasses inclusion at 30% and 50% had no negative impact on DMI in growing beef steers and heifers. In the stated studies molasses was used to improve the nutrient digestibility and availability from given diets which might have been the same phenomenon applied in our study. Contrary to our observations, studies in cattle calves documented a depression in DMI when level of SCM was increased in calf diet (Lesmeister and Heinrichs, 2005). Authors evaluated molasses in calf starter diet and concluded that 5% inclusion is optimal for a better DMI. In their study molasses might have played limited function in 6 week old milk fed calves where rumen development is still in progress. Whereas, in our experiment calves were transitioned from 12 week weaning experiment with probably more developed rumen helping buffalo calves to handle diets with high molasses level.

BW Gain and ADG: Effect of feeding concentrate with varying level of SCM on the growth performance of weaned Nili Ravi buffalo calves are given in Table 2. A non-significant (P > 0.05) difference in BW gain and ADG was found in all three treatments. Numerically ADG was 9.2% lesser in the LM as compared to the MM and HM treatments. However, numerically BW gain was higher in calves fed on the HM diet than those fed on LM (52.82 kg *vs.* 48.39 kg, respectively). Comparatively better performance in later treatments can be attributed to establishment of suitable ruminal environment for microbes through provision of readily available carbohydrates in HM molasses treatment (Sibanda *et al.*, 1987). In this study, authors replaced 20% corn grains with cane molasses in diet of growing beef animals. Similar values of ADG were reported when buffalo calves were fed conventional concentrate ration and

specialized starter rations containing SCM 10% and 20%, respectively (Ahmad *et al.*, 2004). In a recent study Tuyen *et al.* (2015) documented that inclusion of SCM as high as 50% with a good fermentable protein source in the diet lead to production of efficient microbial crude protein in rumen suggesting that high molasses is not a limiting factor for intake and performance in growing ruminants. Similar BW gain and ADG in this experiment might also be attributed to iso-energetic and iso-nitrogenous nutrient composition of diets ensuring similar nutrient supply across treatment groups.

Feed Efficiency: The results for nutrient efficiency in terms of feed efficiency (FE) are presented in the Table 2. Feed efficiency was higher ($P < 0.05$) in the HM fed calves than that of the LM and MM treatment calves. Current data on FE is in range to those documented previously in growing calf experiments suggesting a positive impact of molasses inclusion. Improved FE in HM calves may be the result of better utilization of nutrients through a suitable ruminal environment generated by highly fermentable carbohydrates of molasses (McDonald *et al.*, 2002; Merera *et al.*, 2005). In another work Assefa and Nurfeta (2013) reported that FE was higher in heifer calves fed on 30% molasses based diet compared to those fed on diet without molasses.

Body Growth Measurements: Means of structural measurements including WH, HW and HG are presented in Table 3 as Mean ±SEM. Results revealed that initial, final and gain in structural growth parameters were not different ($P > 0.05$) among dietary treatments. Appropriate structural growth development is important parameter for quality heifer due to its impact on future reproductive and productive performance (Le Cozler *et al.*, 2008). Similar structural development may be related to similar DMI and ADG in this experiment. The studies conducted by Anderson *et al.* (2015) and Whitlock *et al.* (2002) also found no difference in frame sizes of heifers when fed high fat diets *vs.* lower fat diets and diets with varying levels of protein percentage, respectively.

Table 1. Composition and analysis of concentrate diet on dry matter basis.

	Treatments[1]		
	LM	**MM**	**HM**
Ingredients	**%**	**%**	**%**
Corn Grains (Ground)	30.0	22.0	14.0
Wheat Bran	18.5	18.5	16.5
Rice Polish	17.0	16.0	16.0
Sugar Cane Molasses	4.0	12.0	20.0
Veg Oil (Canola)	2.0	2.0	2.0
Soybean Meal	10.0	12.0	12.0
Rape Seed Meal	9.0	9.0	10.0
Sunflower Meal	7.0	6.0	7.0
Limestone	0.5	0.5	0.5
Min Mix *	2.0	2.0	2.0
Nutrient Composition			
DM, %	89.1	88.6	88.1
CP, %	18.2	18.3	18.2
ME (Mcal/Kg)[2]	2.8	2.8	2.8
Fat, %	6.9	6.6	6.8
Ash, %	5.9	6.7	7.2
Ca, %	0.9	0.9	0.9
P, %	0.3	0.3	0.3

[1]Treatments; LM= Low molasses; MM= Medium Molasses; HM= High molasses based concentrate diets

[2]ME= Metabolizeable Energy, calculated using the equation of NRC (2001)

*100 kg Mineral mixture included DCP 70.81Kg, NaCl 18.91Kg, $MgSO_4$ 8.64Kg, $FeSO_4$ 0.89Kg, $MnSO_4$ 0.49Kg, $ZnSO_4$ 0.22Kg, $CuSO_4$ 0.03Kg, KI 8.77gm, $CoCl_2$ 0.89gm and $NaSiO_3$ 1.50gm.

Table 2. Effect of feeding varying levels of sugar cane molasses in concentrate diet on intake, growth performance and feed efficiency of Nili Ravi female buffalo calves

	Treatments[1]				
	LM	**MM**	**HM**	**s.e.m.**	***P value***
Initial BW, Kg	69.1	69.5	69.3	1.52	0.978
Final BW, Kg	117.48	122.37	122.24	2.25	0.286
Gain, Kg	48.39	52.82	52.96	1.79	0.166
ADG, Kg/Day	0.491	0.531	0.534	0.02	0.266
Total DMI, Kg	222.67	233.64	226.90	4.36	0.249
FE [2]	0.217^{a}	0.226^{ab}	0.233^{b}	0.08	0.049
Total Cost*	5,299	5,084	5,381	102.9	0.159
Daily Feeding Cost	67.80^{a}	51.88^{b}	54.90^{b}	1.68	0.001
Cost per unit gain [3]	138.06^{a}	106.13^{b}	112.77^{b}	6.13	0.006

[a-b]For each variable values without a common superscript within a column differ significantly ($P \leq 0.05$)

[1]Treatments LM= Low molasses; MM= Medium Molasses; HM= High molasses based concentrate

[2]FE= total weight gain/ total DMI

[3]Cost per unit gain = average daily feeding cost Pak Rs. /ADG (Kg/Day)

*Cost of concentrate (LM, MM and HM @Pak. Rs 29, 27.3 and 25.9 per kg, respectively) + silage consumed @ Pak. Rs 4/Kg

Table- 3. Effect of feeding varying levels of sugar cane molasses in concentrate diet on structural growth of Nili Ravi female buffalo calves

	Treatments[1]				
	LM	**HM**	**MM**	**s.e.m.**	***P value***
Wither Height, cm					
Initial	81.17	81.17	81.67	0.85	0.893
Final	90.67	90.67	91.08	0.84	0.923
Gain	9.50	9.50	9.42	0.48	0.991
Hip Width, cm					
Initial	27.67	27.67	28.67	0.52	0.373
Final	33.08	33.08	33.92	0.54	0.475
Gain	5.42	5.42	5.25	0.35	0.926
Heart Girth, cm					
Initial	97.17	97.17	96.92	1.50	0.991
Final	110.1	110.1	110.7	1.52	0.939
Gain	12.92	12.92	13.83	1.42	0.882

[1]TreatmentsLM= Low molasses; MM= Medium Molasses; HM= High molasses based concentrate

Conclusion: The findings of current study revealed that inclusion of sugar cane molasses in concentrate diet of weaned calves at 20% on DM basis resulted in numerically higher dry matter intake without any negative impact on growth rate and structural measurements. Further, diet with 20% molasses improved the FE with concomitant reduction in cost per unit gain. These finding can help buffalo farmers to reduce feeding cost by replacing costly energy ingredients like corn grain.

REFERENCES

Ahmad, F., M. A. Jabbar, I. Ahmad, and M. Rafique (2004). Comparative efficiency of calf starter and conventional rations in buffalo suckling calves. Pakistan Vet. J. 24: 169-176.

Anderson, J., K. Kalscheur, A. Garcia, and D. Schingoethe (2015). Feeding fat from distillers dried grains with solubles to dairy heifers: I. Effects on growth performance and total-tract digestibility of nutrients. J. Dairy Sci. 98(8): 5699-5708.

Anjum, M. I., A. Azim, M. A. Jabbar, M. A. Nadeem, and I. H. Mirza (2012). Effect of low energy followed by high energy-based total mixed diets on growth rate, blood haematology and nutrient digestibility in growing buffalo heifers. Pakistan J. Zool. 44(2): 399-408.

Anonymous. (2018). Economic survey of pakistan, 2017-2018. Economic Advisor's Wing, Finance Division, Government of Pakistan, Isalmabad.

AOAC. (2002). Official methods of analysis.17th edition. Assoc. off. Anal. Chem., Gaithersburg, MD.

Assefa, D. and A. Nurfeta (2013). Effects of molasses level in a concentrate mixture on performances of crossbred heifer calves fed a basal diet of maize stover. J. Cell Anim. Biol. 7(1): 1-8.

Drackley, J. K. (2008). Calf nutrition from birth to breeding. Veterinary Clinics of North America: Food Animal Practice 24(1): 55-86.

Fiaz, M., M. Abdullah, T. N. Pasha, M. A. Jabbar, M. E. Babar, J. A. Bhatti, and M. Nasir (2012). Evaluating varying dietary energy levels for optimum growth and early puberty in Sahiwal heifers. Pakistan J. Zool. 44: 625-634.

Jabbar, M. A., M. I. Anjum, S. Rehman, and W. Shahzad (2006). Comparative efficiency of sunflower meal and cottonseed cakes in the feed of crossbred calves for meat production. Pakistan Vet. J. 26(3): 126-128

Le Cozler, Y., V. Lollivier, P. Lacasse, and C. Disenhaus (2008). Rearing strategy and optimizing first-calving targets in dairy heifers: A review. Anim. 2(09): 1393-1404.

Lesmeister, K. E., and A. J. Heinrichs (2005). Effects of adding extra molasses to a texturized calf starter on rumen development, growth characteristics, and blood parameters in neonatal dairy calves. J. Dairy Sci. 88(1): 411-418.

McDonald, P., R. A. Edwards, J. F. D. Greehalgh, and C. A. Morgan (2002). Digestibility evaluation of foods. Animal nutrition. 6th ed. NY, USA: Longman Scientific and Technical: 1.

Merera, C., G. Gebre-Yohannes, D. Dhiba, T. Lemma, D. Geleti, G. Aboma, and A. Hirpha (2005). Growth performance of horro steers fed on different levels of molasses and maize grain at bako. ESAP Proceedings: 111.

Moore, R., J. Beiler, and G. Schnitkey (2000). The economics of heifer contracting. Factsheet Extension, Animal Sciences, Ohio State University, Columbus, OH.

Nutrition, M. I. A. (1983). Molasses in beef nutrition. National Feed Ingredients Association West Des Moines, Iowa.

Rashid, M. A., T. N. Pasha, M. A. Jabbar, A. Ijaz, H. Rehman, and M. S. Yousaf (2013). Influence of weaning regimen on intake, growth characteristics and plasma blood metabolites in male buffalo calves. Anim. 7(9): 1472-1478.

Razzaque, M. A., S. A. Mohammed, and T. Al-Mutawa (2010). Dairy heifer rearing in hot arid zone: An economic assessment. American J. Appl. Sci. 7(4): 466-472.

Sarwar, M., M. A. Khan, and Z. Iqbal (2002). Status paper feed resources for livestock in pakistan. Int. J. Agric. Biol 4(1): 186-192.

Sibanda, S., C. Chakanyuka, and N. Mlilo (1987). Effect of level of cane molasses in fattening diets on performance of beef steers and heifers. Page 62 in Proc. Utilization of Agricultural By-products as Livestock Feeds in Africa: Proceedings of a Workshop Held at Ryall's Hotel, Blantyre, Malawi, September 1986. ILRI (aka ILCA and ILRAD).

Silva, L. F. P., M. J. VandeHaar, B. K. Whitlock, R. P. Radcliff, and H. A. Tucker (2002). Relationship between body growth and mammary development in dairy heifers. J. Dairy Sci. 85(10): 2600-2602.

Tuyen, D. V., X. M. Tolosa, D. P. Poppi, and S. R. McLennan (2015). Effect of varying the proportion of molasses in the diet on intake, digestion and microbial protein production by steers. Anim. Prod. Sci.55(1): 17-26.

Warriach, H. M., A. A. Channa, and N. Ahmad (2008). Effect of oestrus synchronization methods on oestrus behaviour, timing of ovulation and pregnancy rate during the breeding and low breeding seasons in nili-ravi buffaloes. Anim. Reprod. Sci. 107(1): 62-67.

Whitlock, B. K., M. J. VandeHaar, L. F. P. Silva, and H. A. Tucker (2002). Effect of dietary protein on prepubertal mammary development in rapidly growing dairy heifers1. J. Dairy Sci. 85(6): 1516-1525.