MOLASSES UREA BLOCKS AS SUPPLEMENTARY FEED RESOURCE FOR RUMINANTS IN BOTSWANA

A.A.Aganga , P.Lelata and M.V.Tsiane
Botswana College of Agriculture, Private Bag 0027,
Gaborone, Botswana.

ABSTRACT

The aims of this study were to produce low cost, high quality feed supplement for improving the performance of ruminants, and to determine the nutrients composition of the molasses urea blocks (MUB). In study 1 the same level of molasses (45%) and urea (15%) were used in three treatments of blocks, except for the fourth treatment (control) where molasses and urea were not included. Chemical analyses showed that the blocks with molasses and urea had the highest nutritional composition and all the blocks had various amounts of both major and trace elements. In study 2, MUB were used for supplementing Tswana sheep in a feeding trial that lasted 62 days. The sheep were divided into two groups of eight each, the control was given 100% veldt grass while the treatment group was given veldt grass plus MUB as supplement. The MUB increased growth rate of the supplemented Tswana sheep by 94%.

INTRODUCTION

In Botswana, about 75% of the livestock population are reared extensively and they depend on natural rangelands for their feeds, which consist of grasses, shrubs, forbs and browsable trees. There is a great variation in feed quality and availability due to seasonality, which depends on vegetation zone and, most important, on rainfall distribution and quantity. Rainfall in Botswana is erratic and is not evenly distributed. This influences the quantity and quality of natural rangeland forages.

During extended dry seasons or drought, there is low quality forages in rangelands leading to slow growth and/or low milk production; therefore, providing adequate nutrients would improve production. Under intensive and semi-intensive livestock production, a large proportion of costs of producing livestock are feed costs. In this situation, livestock rations can vary widely in their efficiency, nutritional values and production costs. In practical commercial livestock feeding, the farmers are concerned with growing and raising livestock for profits. As a result, it is necessary to try to increase efficiency of livestock production by using less expensive feed, providing adequate nutrients and thus, improving production by increasing growth rate and milk production.

Molasses urea block has been fed successfully in other parts of the world (Preston and Leng, 1987; Ho Quang Do et al., 2002; Clarke et al., 1972 and Hadjipanayiotou et.al., 1993). Molasses urea block can be an important supplementary feed which can improve livestock production in Botswana. The block could provide nutrients required by cattle, sheep and goats during dry season. In developing countries, the feeding regimes aim to incorporate molasses and straw as the principal component of the diet because they are available locally, and the use of grain for livestock feeding is restricted for financial, political and socio-economic reasons. The objectives of this study were to produce some low cost, high quality feed supplements which could be used to improve the performance of ruminants and to determine the nutrients composition of the molasses urea blocks .

MATERIALS AND METHODS

Study 1

Composition of Molasses Urea Blocks

The ingredients used in molasses urea blocks and their levels of inclusion are listed in Table 1. The same level of molasses of 45% was included for three treatments and there was no molasses and urea in the control. Urea (15%) was included, cement powder at 10 percent. was used as binder type in this trial. Five replicates of each molasses treatment were made. Elemental sulphur was used to supply sulphur at 0.5 percent level. Dicalcium phosphate was added at 2%. Sodium chloride was included in levels of 3% in all treatments. One type of bran, either sorghum, maize or wheat bran was included in each treatment at 17.5 percent for wheat and maize bran and sorghum at 16.5 percent. Due to the dustiness of the sorghum bran particles, grass hay was included to improve consistency at 7% for treatments with wheat and maize bran but 8% for sorghum bran.

Order of mixing

The mixture was put together in the order listed in Table 1. Molasses was weighed and put in a trough and urea was added to molasses, mixing as the ingredients were added. The other ingredients followed strictly in the order of dicalcium phosphate, sodium chloride, cement, sulphur, bran and, finally, hay. Cement was first mixed with water at the ratio (w/w) 100 parts of cement to 50 parts of water and then added along with other ingredients.

Moulding of the mixture

The mixture was poured into plastic buckets lined with cellophane bags, measuring 25 cm x 45 cm x 30 cm. The cellophane bag was to facilitate removal of the molasses urea block when formed.

Table 1: Ingredients (%) of molasses urea blocks

INGREDIENTS	TREATMENTS			
	1	**2**	**3**	**Control**
Molasses	45	45	45	-
Urea	15	15	15	-
Dicalcium Phosphate	2	2	2	4
Salt (Na Cl)	3	3	3	6
Cement	10	10	10	30
Sulphur	0.5	0.5	0.5	1
Wheat Bran	17.5	-	-	-
Sorghum Bran	-	16.5	-	33
Maize Bran	-	-	17.5	-
Hay (grass)	7	8	7	26
TOTAL	**100**	**100**	**100**	**100**

The blocks were exposed to sun drying. Care was taken to ensure that they were not touched by rain drops. The method was chosen to simulate the drying conditions which prevail under extensive management. On the fifteenth day after the blocks were moulded, all the replicates of blocks in all the treatments were tested for their strengths by placing a slab block weighing 47.45kg on top of each block for five minutes. The blocks were offered to grazing Tswana sheep and goats at the Botswana College of Agriculture Farm to observe acceptability.

Study 2

The ingredients used in the molasses-urea blocks in this study are listed in Table 2.

Chemical and Statistical Analysis

Representative samples were obtained from the bales of hay and from the molasses-urea blocks in sampling bags. The feed samples were weighed before being placed in the oven at $70^{O}C$ for 48 hours. The oven-dried samples were weighed to obtain DM content. The hay samples were ground using a grinder while those of molasses-urea blocks were ground using a pestle and mortar.

The block mixture were analyzed for their nutrients composition, that is, dry matter, crude protein, Ash, neutral detergent fibre (NDF), acid detergent fibre (ADF), acid detergent lignin (ADL), In vitro true digestibility (IVTD) and mineral contents such as calcium, phosphorus, magnesium, sodium, potassium, copper, zinc, Iron and manganese, (AOAC, 1996). Crude protein was obtained by wet digestion using sulphuric acid then the digest was used to determine nitrogen using kjeldahl procedure and % N multiplied by 6.25 to get %CP. Ash content of the dried ground feed was determined according to AOAC (1996) method in which the samples were weighed and placed in the muffle furnace at 550^{o}C for 4 hours after which the remaining ash was weighed. A flame photometer and atomic absorption spectrophotometer were used in the determination of minerals. Fibre constituents (NDF, ADF, and ADL) were determined and in vitro digestibility was determined using the modified procedures of Tilley and Terry (1963).

Table 2: Percentage composition of molasses urea blocks used in Tswana Sheep feeding trial.

INGREDIENTS	%
Molasses	47.5
Urea	15
Dicalcium phosphate	2
Salt	3
Cement	7.5
Sulphur	0.5
Sorghum bran	16.5
Grass hay	8
TOTAL	**100**

Housing and Feeding

The animals were individually housed under a common roof in pens of 1.5 m x 1m with concrete floors and half walls that allowed for free ventilation. The feeding trial lasted for 62 days. The first group (control) was fed only veldt grass at 4% body weight of each individual animal. They were randomized into two treatment groups of eight animals balancing for weight and sex such that the average initial weights per group were not statistically different. The treatment group was offered veldt grass hay at 4% body weight and also the Molasses-Urea blocks as free choice. Feeds and left over-feeds were weighed every day. The blocks were weighed on a daily basis. Daily water intake of each sheep was measured using measuring cylinder. Animals were weighed every two weeks. Statistical analysis of differences in nutrient composition and sheep performance was calculated using ANOVA (SAS, 1995).

Results

The consistency observed in the final block mixtures indicated the need for premixing the cement, which is the binder in water before adding to the mixture. This also tended to ensure an even spread of the cement in the feed mixture while facilitating an improved uniform hardening of the block. Hay and bran played a vital role in the consistency and fibre content of the block. The blocks dried after seven days when they were exposed to sunlight and free moving air. The blocks did not grow mouldy even when stored for two and half months after preparation, except for blocks without liquid molasses. They developed some moulds before they were removed from the plastic containers.

Table 3: Costs for ingredients and a 10kg molasses urea block

INGREDIENTS	QUANTITY (kg)	Costs (Pula)
Liquid molassesUrea	4.5	6.68
Urea	1.5	0.90
Dicalcium Phosphate	0.2	0.12
Salt (Na Cl)	0.3	0.09
Cement	1.0	0.44
Sulphur	0.05	0.11
Bran	1.75	0.98
Hay	0.7	0.00
TOTAL	**10.0**	**9.32**

Table 4: Nutritional composition of molasses urea block

	Treatment 1 (Blocks with wheat bran)	Treatment 2 (Blocks with sorghum bran)	Treatment 3 (Blocks with maize bran)	Control(Block without liquid molasses and urea)
% DM	95.23 ± 0.34[a]	94.51 ± 0.59[a]	94.90 ± 0.52[a]	83.925 ± 4.73[b]
% CP	30.64 ± 3.35[a]	27.46 ± 1.65[a]	27.30 ± 3.33[a]	6.68 ± 0.56[b]
% ASH	25.96 ± 3.42[b]	26.42 ± 1.78[b]	26.18 ± 1.70[b]	46.12 ± 6.51[a]
% NDF	33.66 ± 2.65[b]	35.00 ± 1.24[b]	30.20 ± 0.97[b]	54.60 ± 7.05[a]
% ADF	17.44 ± 0.77[b]	24.52 ± 4.35[a]	25.58 ± 4.38[a]	26.40 ± 2.68[a]
% ADL	2.16 ± 0.36[a]	3.24 ± 0.77[a]	3.64 ± 0.59[a]	6.88 ± 2.49[a]
% IVTD	57.86 ± 6.52[b]	55.14 ± 5.66[b]	47.98 ± 10.36[b]	41 ± 8.65[a]

± std error

Means with different letters within the same row are significantly different at P<0.05

Table 5: Mineral composition of prepared molasses urea block

	Treatment 1 (Blocks with wheat bran)	Treatment 2 (Blocks with sorghum bran)	Treatment 3 (Blocks with maize bran)	Control(Block without liquid molasses and urea)
Major Elements in Percentage (%)				
% P	0.36 ± 0.02[a]	0.47 ± 0.01[a]	0.44 ± 0.29[a]	0.40 ± 0.04[a]
% K	0.29 ± 0.03[a]	0.29 ± 0.01[a]	0.28 ± 0.03[a]	0.11 ± 0.05[b]
% Na	0.014 ± 0.01[a]	0.014 ± 0.00[a]	0.020 ± 0.01[a]	0.022 ± 0.01[a]
% Ca	0.044 ± 0.02[a]	0.048 ± 0.02[a]	0.051 ± 0.01[a]	0.15 ± 0.17[a]
% Mg	0.0029 ± 0.00[a]	0.0037 ± 0.00[a]	0.0034 ± 0.00[a]	0.004 ± 0.00[a]
Trace Elements in parts per million (ppm)				
Fe	339.80 ± 23.78[a]	300.40 ± 24.00[a]	346.20 ± 21.64[a]	339.50 ± 36.02[a]
Zn	15.16 ± 2.62[a]	20.33 ± 2.02[a]	12.21 ± 0.66[a]	16.88 ± 6.20[ab]
Cu	10.60 ± 0.89[a]	11.60 ± 1.51[a]	9.60 ± 0.89[b]	13.25 ± 2.63[a]
Mn	36.40 ± 5.32[a]	35.00 ± 0.58[a]	35.20 ± 3.96[a]	39.75 ± 7.50[a]

mean ± std error

Means with different letters within the same row are significantly different at P<0.05

Table 6: Dm Content (%), Chemical Composition (%) of Feeds Formulated and Veldt Grass

	Molasses urea blocks	Veldt grass
DM	93.21	91.83
CP	28.59	9.29

ADF	25.41	25.27
NDF	33.11	36.27
ADL	3.72	3.30
ASH	26.24	10.22

Table 7 Mineral composition of veldt forage and molasses urea block used in sheep feeding trial

	Macro minerals (%)					**Micro minerals (ppm)**			
Feed	Ca	P	Mg	Na	_K	Cu	Fe	Mn	Zn
Veldt grass	0.55	0.23	0.19	0.11	1.70	11.5	872.5	97.5	16.5
Molasses urea block	0.046	0.49	0.0039	0.013	0.29	12.34	303.61	39.08	21.67

Table 8: Intake and response of Tswana sheep during the feeding trial

Feed types	Control 100% veldt grass	Treatment 1 Veldt grass + MUB
Initial body weight (kg)	20.37 ?2.97	20.37 ?3.47
Final body weight (kg)	24.5 ?2.46a	28.375 ?2.57b
Average weight gained (kg)	4.125?1.09a	8?1.49b
Average daily weight gained (g)	97.3?2.63a	189.0?3.9b
Average daily grass intake (g)	538.82±22.93a	608.92 ±20.74b
Average daily MUB intake (g)	0.00a	195.2±23.90b
Average daily water intake (ml)	1116.68±67.72a	1295.43±59.85b

Ab Means with different letters in the same row are significantly different. P <0.05.

DISCUSSION

The nutritional composition of the blocks (Table 4) and the mineral composition (Table 5) were influenced by the chemical composition of the individual ingredients and their percentage proportions in the finished blocks. Ten percent cement in the molasses urea blocks gave satisfactory and well finished blocks whereas the control without urea and molasses required higher proportion of cement as binder to produce the finished block. This is in line with the findings of Hadjipanayiotou et al. (1993) who reported that more than 10% binder was required to make good blocks without molasses in Syria. Hardening of blocks increased with advancing storage period. The blocks with cement binder and molasses managed to withstand a slab block weighing 47.45 kg, placed on it for five minutes and did not crumble. Also, for ruminants to have access to the nutrients in molasses urea blocks, licking action with their tongues that is sort of abrasion can be practised. Their saliva would dissolve the block gradually thus, preventing over supply of urea or molasses to the animals. This quality is useful when blocks are given to range animals. (Onwuka, 1999).

Storing the urea blocks for long periods without growing any mould implies that when the blocks are prepared towards the end of the rainy season, they could be used up till the beginning of the next rainy period, when more feed would be available to the ruminants.

The method of sun and air drying completely dry the blocks hence ideal to be used in rural areas in Botswana where drying machines are not available and small scale farmers cannot afford to purchase such machines. The costs of ingredients and hence, cost of one block is relatively inexpensive thus, it is cheap for a farmer to mould molasses urea blocks using local feed resources. The sheep and goats consumed the blocks after grazing daily when the animal acceptability test was carried out.

A significant difference ($p<0.05$) was observed in crude protein with blocks without liquid molasses having significant lower value (6.68%) as compared to that of blocks with wheat bran with the highest value (30.64%). The urea molasses blocks could maintain the animals during the dry season. Molasses forms the basis for most liquid protein supplements containing urea. It contains 1.2% to 2% calcium, 3% to 6% potassium and 0.04% phosphorus and is of good source of iron. Significant difference was also shown in ash content found in blocks without liquid molasses. There were significant differences in NDF, ADF and IVTD with highest values in blocks with liquid molasses; this is an indication of better digestibility in all blocks with liquid molasses. There was no significant difference in ADL, but the values were low ranging from 2.16 to 6.88 with blocks without liquid molasses having the higher values. For major minerals there is no significant difference for all the elements except for potassium with lowest value (0.11) in blocks without liquid molasses. In trace elements, Fe, Zn and Cu have significant difference but there is no significant difference in Mn content of the blocks. The sodium contents of molasses urea blocks ranges from 0.014 to 0.022 percent with blocks without liquid molasses and urea having the highest value (0.022). Therefore, this ensured that the animals cannot obtain excessive sodium from the blocks. The high nutritional composition ensures high rumen microbial activity, giving efficient utilization of feed. Various major and minor elements are available in the block to supply to the ruminant animal. A high protein count ensures maintenance of animals during drought.

In the feeding trial, data obtained shows that the amount of water consumed by the treatment group is higher than that of the control group. This is due to the fact that those sheep that consumed MUB require additional water for nitrogen digestion in the block. These sheep require more water for optimal digestion of the higher amount of consumed grass diet. Also, the treatment group ate more of the veldt grass possibly due to associative effect of nutrients available from the MUB leading to better digestion of basal diet and higher consumption rate. The initial body weight of the sheep in the 2 groups was 20.37kg, which was obtained as a result of random allocation of 16 sheep to 2 groups of 8 each. Sheep in the control group gained an average weight of 97.3g per day while the treatment group gained 189.0grams per day. Supplementation with MUB doubled the average daily gains of Tswana sheep, which shows that the performance of Tswana sheep can be enhanced with MUB feeding in addition to good quality basal grass diet. The control group ate a total of 538.82g of feed while the treatment group consumed a total of 608.92g of veldt grass and 195.2g of MUB.

CONCLUSION

Blocks with molasses and urea included in the treatment had the highest nutritional composition and all the blocks have various amounts of both major and trace elements to supply to ruminant animals. The amount of crude protein in blocks with molasses and urea included, guaranteed that the blocks could maintain the ruminant animals during dry season and drought phenomenon. The price per block computed shows that the blocks were non-expensive but of high quality supplements which could be used to improve the performance of grazing ruminants. Blocks could be made using a variety of cereal by-products depending on their availability.

REFERENCES

Clarke J., Preston T. R. and Zamora A. (1972) .***Molasses as an energy source in low fibre for milk production*** . Effect of varying the level of cereal grain .Urban Journal of Agricultural Science 6: 27 – 32.

Hadjipanayiotou M., Verhaeghe L., Allen M., Abd El – Rahman Knonfoleh, Alwadi M., Amin M., Naigm T., El-Said H and Abdul Kader Al – Haress (1993) ***Methodology of Block Making and Different Formulae*** Tested in Syria Livestock Research for rural Development 5:1-8.

Ho Quang Do , Vo Van Son and Preston ,T.R. (2002). ***Blocks or cakes of urea-molasses as supplements for Sindhi x Yellow growing cattle fed rice straw and cut grass or cassava foliage***. Livestock Research for Rural Development, 14:1-4.

Onwuka, C. F. I. (1999) – ***Molasses Block as Supplementary Feed Resource for Ruminants*** .Arch. de Zootecnia. 48:89 – 94

Preston T. R. and Leng R. A. (1987) .***Matching Ruminant Production Systems with Available Resources in the Tropics and Sub-Tropics*** . Penambul Books: Armidale

New Wales 2350Australia

Sansoury, R. (1986). ***The Sahel; Manufacture of Molasses urea blocks***. World Anim. Rev., 57: 40-48

SAS, (1995). User's Guide. ***Statistical Analysis System Procedures***. SAS Institute, Inc., Cary. NC.

Tilley, J.M.A. and Terry, R.A.(1963). ***A two stage technique for in-vitro digestibility of forage crops***. J.of Brit. Grassld Soc. 18 : 104 – 111.