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Atta M., El Khidir O.A.

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The effect of feeding molasses or sorghum based diets on some reproductive and productive traits of Nilotic ewes

M. Atta* and O.A. El Khidir**
*University of Juba, P.O. Box 321/1, Khartoum, Sudan
**Animal Production Research Centre, P.O. Box 1355, Khartoum N., Sudan

SUMMARY – Forty two multiparous (PF) and 27 young (YE) Nilotic ewes were used. Each age group was subdivided into sorghum (So) and molasses (Mo) based diet groups. The two diets were iso-nitrogenous (21.7% CP) with approximately the same metabolisable energy content [12.2 (So) and 11.4 MJ/kg DM (Mo)]. Each diet group consisted of six subgroups of similar weights. The data were collected for two successive lambing seasons. The overall means of birth weight, weaning weight, pre-weaning weight gain, age and weight at lambing for the two YE diet groups were 2.3 ± 0.5 kg, 11.7 ± 2.4 kg, 104 ± 26.2 g/day, 410.6 ± 60.4 days and 29.3 ± 4.2 kg, respectively. Ewes of the PF groups had higher indices of total weight of weaned lambs/ewe than the YE groups. It is concluded that molasses can be safely fed up to 50% of the diet of Nilotic ewes with satisfactory results of growth and reproduction.

Keywords: Nutrition, molasses, sorghum, Nilotic sheep, productivity indices.

RESUME – *"Effet de la distribution de régimes à base de mélasse ou de sorgho sur certains caractères reproductifs et productifs chez les brebis Nilotic". Quarante-deux brebis multipares (PF) et 27 jeunes brebis (YE) de race Nilotic ont fait l'objet d'étude. Chaque groupe d'âge était subdivisé en groupes d'alimentation à base de sorgho (So) et de mélasse (Mo). Les deux régimes étaient iso-azotés (21,7% PB) et avaient environ la même teneur en énergie métabolisable [12,2 (So) et 11,4 MJ/kg MS (Mo)]. Chaque groupe alimentaire était composé de six sous-groupes de poids similaire. Les données ont été recueillies pendant deux saisons d'agnelage successives. Les moyennes générales pour le poids à la naissance, poids au sevrage, GMQ pré-sevrage, âge et poids à l'agnelage pour les deux groupes alimentaires YE étaient de 2,3 ± 0,5 kg, 11,7 ± 2,4 kg, 104 ± 26,2 g/j, 410,6 ± 60,4 j et 29,3 ± 4,2 kg, respectivement. Les brebis des groupes PF avaient des indices plus élevés de poids total des agneaux sevrés/brebis que les groupes YE. La conclusion est que les mélasses peuvent être distribuées sans risque jusqu'à constituer 50% du régime des brebis Nilotic avec des résultats satisfaisants de croissance et de reproduction.*

Mots-clés : *Nutrition, mélasse, sorgho, ovins Nilotic, indices de productivité.*

Introduction

Livestock in Sudan depends mainly on natural range grazing with limited sorghum supplementation. El Khidir *et al.* (1988) reported that molasses is a good substitute to sorghum grains in the diets of ruminants. The Nilotic sheep (southern Sudan breed), which descend from the same ancestors of the West African dwarf (Williamson and Payne, 1978), are distributed in an area of natural and political conditions that prohibited availability of information about their production potentials. However many surveys speculated this type of sheep to have good meat production potentials. The objectives of this Study are: (i) to examine the efficiency of urea and molasses incorporation in the diet as a substitute to conventional diets based on sorghum grain and groundnut cake; and (ii) to study some of the reproductive and productive characteristics of the Nilotic ewes under intensive system of management and feeding.

Materials and methods

This study was conducted at the Animal Production Research Centre, Khartoum North at the latitude 15º 36' north and the longitude 32º 33' east. The flock of the parent ewes and rams used in this study (Nilotic sheep) were purchased from Upper Nile state at the latitude 09º 33' north and the longitude 31º 39' east. Pregnancy and lactation performance of 42 parent ewes (PF groups) and 27 ewe lambs of their offspring (YE groups), covering a period from conception to the second lambing

were collected. Data of pre-and post-weaning performance of ewe lambs born from PF and YE groups (51 animals), were collected, starting from birth to the age of sexual maturity.

Conventional (sorghum based – So) and non-conventional (molasses based – Mo) concentrate diets were formulated in order to be isonitrogenous (21.7% CP) and approximately isocaloric (12.2 and 11.4 MJ/kg DM, respectively). The former diet consisted of 50% sorghum grains, 25% groundnut cake, 22% wheat bran, 2% limestone powder and 1% common salt. The latter diet consisted of 50% molasses, 10% cotton seed cake, 34% wheat bran, 3% urea, 2% limestone powder and 1% common salt. The concentrate diets offered at a daily level of 0.75 kg/head. Sorghum straw was also offered as roughage. Orts were daily weighed to estimate average group intakes.

At the commencement of the experiment ewes of the PF groups were blocked by live weight and randomly allocated to the dietary treatments groups (So and Mo) of 21 animals each divided into three subgroups of five animals and three of two animals housed and fed in separate pens. Ewes of the YE groups were successively introduced into the experiment when they reached sexual maturity and successfully served. Ewes of these groups were admitted to the same dietary treatments of their dams. When all YE ewes were accommodated into the experiment, there were of 15 So and 12 Mo sheep. Each YE dietary group was divided into six subgroups managed and fed in separate pens. The former So group comprised three subgroups of three animals and all the remaining subgroups of two animals each. At the start of the experiment, subgroups of the two dietary treatments had similar age and live weights. Adult rams of the same breed were put with each experimental subgroup (PF and YE), for 3 hours daily and mating was closely observed and recorded. The succeeding conception was determined by non return of oestrus signs. Milk yield recording started one week after parturition. The ewes were milked once a week after separation of lambs for 12 hours from sunset to the following morning. The milk obtained was considered 50% of total daily yield. The ewes were weighed on the day of service, lambing and at dry-off. The net energy of milk and body gain of lactating ewes were estimated according to AFRC (1993).

The ewe lambs born from the experimental YE ewes were weaned at three months of age and then were divided according to the diet treatment of their dams into So and Mo groups of 15 and 12 animals, respectively. The two groups were further divided into six subgroups each. Three of the So diet subgroups were composed of 3 animals and the remaining subgroups were of 2 animals each having the same average live weight. The two experimental diets and sorghum straw were offered to the ewe lambs at the rate of 40 and 60% of their total daily allowances, respectively. The age and weight at first oestrus and first lambing were recorded.

On the basis of performance data, productivity indices were calculated as follows:

$$\text{Index 1, total weight of weaned lambs/ewe/year} = \frac{\text{total weight of weaned lambs} \times 365}{\text{lambing interval period}}$$

$$\text{Index 2, the total weight of weaned lambs/kg of ewe weight/year} = \frac{\text{index 1}}{\text{postpartum ewes weight}}$$

$$\text{Index 3, the total weight of weaned lambs/kg}^{0.75}\text{ of ewe weight/year} = \frac{\text{index 1}}{\text{postpartum ewes weight}^{0.75}}$$

The data of the dams (PF and YE ewes) were analysed to test the effect of the diet treatment and the ewes' age using 2-way analysis of variance and the significance of difference between means was tested with the Duncan Multiple range test according to StatSoft (2001). The pooled data of the ewe lambs were analysed using the t-test.

Results and discussion

The diet treatment had no significant effect on DM, ME and protein intakes during gestation (Table 1). DM, ME and CP intakes of ewes during gestation were lower than during lactation. This is probably due to the rapid expansion of rumen wall after lambing. This effect was more evident in

mature (PF) than young sheep (YE) as expected according to Russel (1983). The ME and CP intakes during gestation and lactation were higher than that postulated by AFRC (1993) for ewes of the same weight and production.

Table 1. Pregnancy and lactation performance of Nilotic mature (PF) and primiparaous (YE) ewes admitted to either a sorghum (So) or molasses (Mo) based feeding regimen

Trait	PF		YE		SE	Effect
	So	Mo	So	Mo		
No. of animals	21	21	15	12	-	-
Initial body weight, kg	16.3	16.5	16.4	15.8	0.40	NS
No. of conceived ewes	19	21	15	12	-	-
Conception weight, kg	20.3	18.5	23.8	22.9	0.96	NS
Lambing weight, kg	29.4^{a}	25.4^{b}	30.3^{a}	28.1^{ab}	0.589	S*diet
Gestation period, days	151.2	150.7	150.3	153.7	0.404	NS
Gestation gain, g/day	60.6^{a}	45.9^{b}	52.6^{ab}	33.6^{c}	2.319	*diet,
Litter birth weight, kg/ewe	2.6	2.3	2.4	2.5	0.072	NS
Litter size, no. of lambs/ewe lambed	1.16	1.05	1.00	1.13	0.037	NS
Gestation DM intake, g/day	1095.9	1102.9	1065.2	1085.0	12.2	NS
Gestation ME intake, MJ/day	11.201	10.830	10.944	10.899	0.123	NS
Gestation CP intake g/day	132.0	131.3	130.7	144.2	1.80	NS
Postpartum anoestrus period, days	46.4	40.8	38.7	38.5	2.164	NS
Lambing interval period, days	204.0	204.2	202.5	215.8	2.966	NS
No. of lactating ewes	19	19	14	11	-	
Lactation end eight, kg	30.9^{ab}	26.5^{c}	33.1^{a}	29.6^{bc}	1.193	S*diet
Daily lactation gain, g/day	16.9	14.5	17.6	17.1	2.076	NS
Net energy of gain, MJ/day	0.400	0.346	0.419	0.409	0.050	NS
Lactation DM intake, g/day	1219.8^{a}	1275.4^{a}	1057.0^{b}	1036.8^{b}	12.49	S*age
Lactation ME intake, MJ/day	12.470^{a}	12.495^{a}	11.093^{b}	10.554^{b}	0.127	S*age
Lactation CP intake, g/day	147.3	152.0	142.7	146.5	2.028	NS
Total milk yield, kg/lactation	38.764^{a}	22.790^{b}	38.480^{a}	17.893^{b}	2.325	S*diet
Lactation period, days	96.2	97.1	104.5	89.1	4.405	NS
FCM yield, kg/lactation	39.5^{ab}	24.1^{bc}	43.5^{a}	18.2^{c}	2.730	S*diet
Milk production efficiency, g DMI/kg FCM yield/day	3.837^{bc}	6.441^{a}	3.597^{c}	5.250^{ab}	0.287	S*diet
Weaning weight, kg/ewe	16.3^{a}	11.5^{b}	11.9^{b}	9.9^{b}	0.445	S*diet, S*age
Index1	29.2^{a}	20.3^{b}	22.1^{b}	17.3^{b}	0.857	S*diet, S*age
Index2	0.998^{a}	0.827^{b}	0.712^{bc}	0.623^{c}	0.028	S*diet, S*age
Index3	2.312^{a}	1.838^{b}	1.679^{bc}	1.426^{c}	0.625	S*diet, S*age

S*diet = Means on the same row are significantly different due to diet fed.
S*age = Means on the same row are significantly different due to age of ewe.
NS = Means on the same row are not different (P> 0.05).
a, b, c = Means on the same row of different superscripts are significantly different.

The gestation, post partum anoestrous and lambing interval periods were not affected significantly by ewes' age or diet (Table 1). Forbes and Robinson (1967) stated the stability of gestation period within breeds. The values of postpartum anoestrus period were comparable to 52.4 days reported for West African dwarf ewes (Charray *et al.*, 1992). The lambing interval period was comparable to 207 $\pm$ 14 days, reported for West African dwarf ewes (Fall *et al.*, 1982) and shorter than 426 days reported for Sudan desert ewes, (Sulieman *et al.*, 1990).

The litter birth weight was not affected by age of the dam or type of diet (Table 1). The birth weight when calculated as a percentage of the postpartum dam weight were 8.8 (PF-So), 9.1 (PF-Mo), 7.9 (YE-So), and 8.9% (YE-Mo). These values were overall similar to 8.25% estimated by AFRC (1993). Table 1 also shows that sorghum diet significantly ($P<0.05$) increased the milk yield and improved efficiency of feed utilization for milk production. This observation may be attributed to the lower efficiency of utilization of molasses when compared to starch sources (McDonald *et al.,* 1985). The lactation period showed no significant differences among treatments (Table 1). This may be due to that most experimental ewes stopped milk production within the same week of lambs' weaning.

Ewes' productivity indices are listed in Table 1. The age of ewes and the experimental diets affected these indices with higher values in PF-So than the other groups ($P<0.05$). This probably resulted from higher twining rate of this group. Index 1 was superior to that of Sudan desert ewes, 16.8 kg, (Sulieman *et al.*, 1990) and that of West African dwarf ewes, 8.7 kg, (Fall *et al.*, 1982). The superiority of the Nilotic ewes' index 1 values resulted from their shorter lambing interval period. The values of indices 2 and 3 were overall higher than the corresponding indices (0.419 kg and 1.14 kg) of Sudan desert ewes (Sulieman *et al.*, 1990) and (0.360 kg and 0.850 kg) of West African dwarf ewes, (Fall *et al.,* 1982).

The sorghum based diet group had higher ($P<0.05$) DM and ME intakes and improved feed conversion ratio (Table 2). The DM intake of the present two diet groups of ewe lambs as a percentage of body weight was 4.55%. This value was comparable to that of Sudan desert lambs (4.2-5.2%) according to El Khidir *et al.,* (1988).

Table 2. Pre and post-weaning performance of ewe lambs admitted to either sorghum (So) or molasses (Mo) based feeding regimen

Items	So	Mo	SE±	Effect
No. of animals	27	24	-	-
Birth weight, kg	2.2	2.4	0.098	NS
Weaning weight, kg	11.8	11.5	0.459	NS
Pre-weaning weight gain, g/day	106.4	101.6	4.805	NS
Initial body weight, kg	14.3	13.9	0.654	NS
Weight at puberty, kg	20.1	18.1	0.528	S
Age at puberty, days	190.8	206.8	5.540	S
Post-weaning weight gain, g/day	85.6	58.4	4.574	S
DM intake, g/day	911.6	837.1	22.993	S
ME intake, MJ/day	9.779	8.595	0.225	S
CP intake, g/day	128.2	121.2	3.164	NS
Feed conversion ratio, g DMI/g wt gain/day	11.191	21.166	2.368	S
First lambing age, days†	407.4	414.8	17.548	NS
First lambing weight, kg†	30.3	28.1	1.192	NS

S = Means on the same row are significantly ($P< 0.05$) different
† = Number of animals are14 and11 for D. group and M. group respectively

The birth weight values (Table 2) were comparable to the 2.3 kg of West African dwarf sheep, (Charray *et al.*, 1992). The age at puberty of the ewe lambs was within the ranges of 7.5 – 10 months reported for West African dwarf (Charray *et al.,* 1992). The weight at puberty onset was lower than the 35.8 kg reported for Sudan desert ewe lambs (Sulieman *et al.*, 1990). The pubertal weight was found to be 65.4% of the adult ewe weight in consistency with the range of 50-70% stated by Lawrence and Fowler (1997).

The maintenance energy requirement of ewes is the intercept (a) of regression of the daily ME intake (y) on the daily body gain (x) (McDonald *et al.,* 1985). The pooled ME intake, MJ/metabolic body weight ($kg^{0.75}$) were regressed on: (i) the daily gram live body weight gain during gestation; (ii) the total daily MJ of energy produced as milk and body gain during lactation; and (iii) the daily gram

post-weaning weight gain of ewe lambs. All the regressions were found to be significant ($P<0.05$) as shown below:

$y = 0.988(\pm 0.052) + 0.001(\pm 0.0003)x$ $R^2 = 0.32$ (i)
$y = 0.968(\pm 0.087) + 0.121(\pm 0.039)x$ $R^2 = 0.30$ (ii)
$y = 0.796(\pm 0.077) + 0.002(\pm 0.0005)x$ $R^2 = 0.37$ (iii)

The ME requirement for maintenance of ewe lambs studied was higher than the 0.499 MJ ME/kg $wt^{0.75}$ reported for Sudan desert ram lambs (El Khidir *et al.,* 1988). This is attributable to the smaller body size of the Nilotic sheep (Lawrence and Fowler, 1997). The daily maintenance requirements during gestation and lactation were much higher than 0.70 MJ ME/kg $wt^{0.75}$ stated by Maxwell *et al.* (1979). They were also higher than that obtained by McDonald *et al.* (1985) as ME, MJ = 1.4+0.15W; where W is the body weight. The latter authors' equation was obtained from data of heavy breeds with sheep weighing at least 60 kg body weight.

Conclusions

It is concluded that molasses and urea are good alternative to sorghum grains and oil seed cakes, as energy and protein sources respectively, as being of low production cost and non competitive with human and poultry. This can counterbalance the overall lower performance and efficiencies of molasses based diet as compared with conventional sorghum based feeding regimens The study also concluded that the Nilotic sheep is a light breed of performance similar to that of West African dwarf sheep and are early maturing animals that possess good potentials for meat production.

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