USE OF SORGHUM BRAN AND GROUNDNUT HAULMS IN SORGHUM STOVER BASED DIETS FOR GROSSBRED COWS

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ABSTRACT

Results are reported of a feeding in 1986/87 in which a total of 62 half-bred Simmental (SX) three-quarter Simmental (SSX) and half-bred Friesian (FX) milking cows were fed sorghum stover supplemented with sorghum bran, groundnut haulms or lablab hay.

During the wet season animals were grazed under conditions similar to communal area situations.

Average milk yields per lactation (kg) for SX, SSX, and FX were 702.5, 739.0 and 825.5, respectively, and did not differ significantly (P>0.05) : neither were there significant differences in duration of lactation between or within breeds fed the different diets. Average dam live weights at parturition and at 7 and 10 months post-partum were 480, 470, 483, kg for SX; 483,456, and 466 kg for SSX; and 465, 459, 452, for FX; differences were not significant (P > 0.05). Average birth weights and adjusted 7 and 10-month liveweights of SX calves were 38Kg, 178Kg, 216kg, of SSX calves 36, 154, and 200 kg and of FX calves 36, 148, and 206 kg. Diet supplementation with sorghum bran did not result in differences in calf liveweight gains within or between breeds.

During the lactation period 7 of the cows and 5 calves died. 40% of calves born suffered from Kerato conjunctivitis, but later recovered after treatment.

INTRODUCTION

In order to reduce large quantities (75 %) of fresh milk and milk products imports the government of Botswana livestock research policy continues to place emphasis on the need to increase fresh milk production locally (National Development Plan vi 1985). The variable rainfall pattern in Botswana leading to seasonal milk production hampers commercial dairying. It has been suggested that a dual purpose beef/milk breed of cattle is more appropriate particularly to resource-poor small-scale farmers than

specialized milk breeds. Past research has shown that these farmers can produce more milk by keeping Simmental crosses and feeding them crop residues, lablab hay and sorghum bran (APRU 1986). The Tswana/Tuli breed of cattle have limited potential for milk production.

Farmers in Botswana produce reasonable amounts of crop residues even during drought years (Appendix Table 1). Most of this crop residue is left in the field and used randomly or indiscriminately by livestock with part of it being trampled by the animals or ploughed under by some farmers resulting in wastage of available feed resources. These residues can have an important impact on animal production if they are conserved as soon as the grain is harvested. At this stage the yield and nutritive value is relatively high (Mosienyane, B.P 1983). In addition to crop residues there are large quantities of Agro-industrial by-products available for livestock in Botswana (Appendix Table II). Generally, crop residues are low in nutritional value. Even the ruminants are not able to extract energy in sufficient amounts per day to grow or produce milk when fed these plant materials (Anderson 1978, Said, A. H and M.M. Wanyoike 1986, Dzowela, B. 1986). Thus there is need to supplement these materials with feedstuffs of higher protein and energy content.

Natural range deteriorates in nutritive quality and quantity during the dry season with protein being the most limiting factor (APRU 1972). In order to maintain productivity protein supplements must be fed during dry season. The relatively more available protein sources are lablab hay (Lablab purpureus), legume crop residues (cowpeas and groundnut) and sorghum bran

from sorghum milling. On-farm and on-station trials have demonstrated that, under drought conditions (Appendix Table III) lablab can yield up to 3.0 tons/ha dry matter.

Supplements evaluated in these experiment were sorghum bran, groundnut haulms, lablab hay and dairy concentrate. Dairy concentrate consisted of 2 parts sorghum bran and 1 part sunflower meal.

The objectives of the study were;

- to evaluate the productivity of half-bred Simmental (SX), three quarter-bred Simmental (SSX) and half-bred Friesian (FX) crosses as dual purpose animals under grazing conditions simulating small-scale communal area situations
- to examine the effect of various protein supplements on Simmental and Friesian crossbreds fed sorghum stover based diets during the dry season

METHODOLOGY

Sixty-two cows consisting of half-bred Simmental (SX), three-quarter bred Simmental (SSX) and half-bred Friesian (FX) crosses were used in the feeding experiment.

The base breed was Tswana/Tuli cows. Each breed was divided into 2 groups and fed different supplements. Supplements used were sorghum bran, groundnut haulms, lablab hay and dairy concentrate. All cows were left to graze and fed sorghum stover ad lib. Animals had free access to a mineral mixture consisting of either bone meal:salt (1:1 ratio) or dicalcium phosphate:salt (1:1 ratio).

Sorghum bran was fed at 1 kg/kg of milk produced while dairy concentrate was fed at 0.5 kg/kg of milk produced. Groundnut haulms and lablab hay were mechanically chopped to facilitate ease of handling and reduce wastage. Both supplements were fed to meet approximately the requirement of a 450 kg cow producing 5 kg of milk/day of 3.5 % butterfat in terms of total digestible energy and crude protein (NRC 1978). Cows fed groundnut haulms received
5 kg/day and cows fed lablab hay received 3.5 kg/day.

Cows were milked by hand twice daily (6.00 am and 3.30 pm) with calves present to stimulate milk let-down by initial suckling for approximately 1 minute. Calves were left to suckle for 30 to 60 minutes after milking.

Calves born to these cows were divided into 2 groups. Calves in group 1 were each supplemented with 1 kg of sorghum bran/day.

Calves in group 2 were not supplemented. All calves had access to grazing in separate calf paddock.

Milking stopped when a cow produced less than 3 kg milk per week. Calves were weaned at the end of lactation.

Two Simmental bulls were used in a continuous breeding system during the experimental period.

Routine vaccinations against brucellosis, anthrax, blackquarter, botulism, pasteurella, deworming and tick spray against ticks were administered. All calves were vaccinated

ainst calf-paratyphoid within 7 days after birth.

The following records were kept:

-daily milk yield

-calf birth weights, 7 months and 10 months liveweights

-~~cow parturition weight~~

-cow weight at parturition, 7 months and 10 months post-partum

-breeding

Samples of individual dietary supplements and sorghum stover were taken and analysed in duplicate for dry matter, organic ter, crude protein, crude fibre, ash, according to methods approved by AOAC (1985) and in vitro dry matter (IVDMD) and organic matter digestibility (IVOMD) according to procedures by Tilley and Terry (1963).

Statistical analysis using the t-test (Snedecor and Cochran, 1967) was conducted on the data obtained from lactating cows and calves that completed the trial.

RESULTS

Chemical analysis results showed that crude protein percentages were 9.3, 11.5, 19.9, 16.4 and 6.4 in groundnut haulms, sorghum bran, dairy concentrate and lablab hay respectively (table 1). Sorghum stover contained about 6.4% C.P..

TABLE 1

Chemical composition of the feedstuffs used in the experimental diets.

Item	Composition of dry matter (%)				In Vitro	
	Organic matter	Crude protein	Crude fibre	Ash	DMD	OMD
Sorghum bran	97.3	11.5	3.2	2.7	54.4	47.2
Groundnut haulms	90.5	9.3	24.3	9.5	55.0	50.3
Sunflower meal	92.8	36.5	21.4	6.7	55.8	54.0
Lablab hay	90.8	16.4	27.7	9.2	59.9	57.1
Sorghum stover	91.6	6.4	32.5	8.4	59.8	54.8
Dairy conc.[1]	95.8	19.9	9.2	4.0	54.9	49.4

[1] two parts of sorghum bran to one part of sunflower meal

Table 2 shows the mean milk yield and lactation length of cows used in this study. Amongst different breeds supplemented with sorghum bran the half-bred Friesian crosses (FX) had the highest mean milk yield (827kg), compared to half-bred Simmentals (SX) (740kg) and three-quarter bred Simmentals (SSX) (762kg). Mean lactation length for SX, SSX, and FX supplemented with sorghum bran were 36, 30, and 34 weeks respectively. However, there was no significant difference ($p>0.05$) in milk yield and mean lactation length between different breeds supplemented with sorghum bran only. Half-bred Friesians supplemented with groundnut haulms produced 824kg over a 36 week lactation period.

Overall average milk yields (kg) for SX, SSX and FX (excluding milk left over for calf) were 702.5, 739.0, and 820.5 respectively, but did not differ significantly ($p > 0.05$). Neither were there significant differences in duration of lactation between or within breeds fed the different diets.

TABLE 2

Mean milk yield and lactation length of half-bred Simmental (SX), three-quarter Simmental (SSX) and half-bred Friesian crosses (FX) fed sorghum bran (S), dairy concentrate (D), lablab hay (L) and groundnut haulms (G) as supplements

Breed	Supplement	Number of Cows	Mean milk yield (Kg)	Mean lactation length (Weeks)
SX	S	9	740±246	36±6
SSX	S	8	762±132	30±4
FX	S	6	827±257	34±5
SX	L	10	665±240	30±8
SSX	D	10	716±328	30±9
FX	G	7	824±208	36±8

Average parturition weight was above 450kg for all cows used in this study (Table 3), and similar for all breeds. There was also no significant difference ($p > 0.05$) in 7 and 10 months post-parturition weights for the three breeds supplemented with sorghum bran although the SX cows tended to gain weight, while the SSX lost weight at 7 months post-partum, but maintained weight thereafter. The FX cows tended to gain weight at 7 months, but lost weight at 10 months post-partum. Amongst the SX groups, those fed sorghum bran were significantly heavier ($p > 0.05$) than those fed lablab hay at 10 months post-partum.

TABLE 3

Mean dam parturition weight, 7 and 10 months post-partum liveweights (Kg) of half-bred Simmental (SX), three-quarter Simmental (SSX), and half-bred Friesian crosses (FX) fed sorghum bran (S), dairy concentrate (D), Lablab hay (L) and Groundnut haulms (G) as supplements

Breed	Supplement	Number of cows	Parturition weight (Kg)	7 month weight (Kg)	10 month weight (Kg)
SX	S	10	486±46	490±73	512±50
SSX	S	10	490±52	465±50	469±35
FX	S	6	458±38	470±53	458±53
SX	L	11	473±46	449±27	454±29
SSX	D	13	476±46	446±40	462±65
FX	G	9	472±52	448±36	446±26

($P > 0.05$)

Overall the liveweights of the crossbreds fed the different supplements tended to decrease during the lactation period.

Table 4 shows the mean calf liveweights at birth, 7, and 10 months according to calf diets and dam. Calves birth weights were similar across breeds. There were no significant differences ($p > 0.05$) in liveweight gains between calves supplemented with sorghum bran and those not supplemented. This may be due to adequate suckling and a light stocking rate for all calves in the calf paddock. Therefore supplementation did not result in increased liveweight gains. Average calf liveweights at 7 and 10 months indicate that calf growth was satisfactory.

TABLE 4

Mean birth weights, 7 and 10 month live weights (Kg) of calves according to dam breed and supplement.

Breed	Number of calves	Supplement	Calf birth weight (Kg)	7 month weight (Kg)	10 month weight (Kg)
SX	9	S	36±4	174±42	210±50
SX	10	nil	40±6	183±33	223±33
SSX	8	S	37±5	149±23	211±29
SSX	14	nil	35±8	160±19	190±26
FX	8	S	36±5	146±33	217±36
FX	5	nil	36±3	151±41	194±46
All	27	S	36±4	155±35	212±41
All	29	nil	37±7	167±30	204±34

There were several cases of kerato conjunctivitis, cancer eye and sweating sickness. Kerato conjunctivitis and cancer eye were more likely to occur in calves with unpigmented eye surroundings. Provision of shade and reduction of dust reduced the occurrence of eye diseases.

Seven cows died in the trial period. The causes of mortality by breed and diet were:

Three SX cows supplemented with lablab; one due to abscess in the jaws, and two due to undiagnosed diseases.

Three SSX fed dairy concentrate; one due to calving difficulty, and two due to wire ingestion, resulting in penetration to the heart via the rumen cud.

One SSX cow supplemented sorghum bran was killed by thieves.

Seven cases of stillbirths were recorded:

Two from SX cows fed lablab;

Two cases from SSX cows fed sorghum bran.

Two cases from SSX fed dairy concentrate.

One case from an FX cow fed sorghum bran.

Six of these stillbirths occurred between September 1987 and November 1987. Although specimen samples were submitted, veterinary diagnostic reports did not show any diseases causing stillbirths.

Five calves died:

Three from SX cows; one due to a broken leg, one due to sweating sickness, and one due to diarrhoea.

SSX cows lost two calves; one killed by thieves, and one due to weakness which resulted from lack of colostrum milk and death of the dam.

Kerato conjunctivitis infected 40% of all calves born. The disease occurred mostly between December 1987 and April 1988, which coincided with the longest day length and relatively higher seasonal rainfall.

DISCUSSION

The nutrient content of sorghum stover is low; hence this feed fed alone is not sufficient to maintain an animal let alone production of milk unless it is supplemented with feed sources of higher nutrient quality and quantity.

Large quantities of sorghum bran and other agro-industrial by-products are available in Botswana, and are less costly compared to dairy concentrates imported from neighbouring countries. More interest is developing in the agricultural sector to try to use these by-products to supplement crop stover- or grass

hay-based diets. Most of the agro-industries are situated in and around urban areas, where most of the fresh milk consumers are situated. This makes it convenient for some small-scale dairy farmers around urban areas to buy and utilise these by-products by feeding them to dairy animals.

The variation in milk yield within breeds and across breeds could be due to the fact that the base breed, Tswana or Tuli, has not historically been selected for milk production. There were also not sufficient numbers of cows per treatment.

The mean milk yield for the Friesian crosses was higher than that of other breeds, reflecting the high milk potential of the pure Friesian cows if kept under good management conditions.

With daily milk production of about 3.0 Kg/cow/day (excluding milk taken by the calf), and at the current producer price of P0.70/Kg ($0.36), a farmer would make about P2.10/cow/day ($1.07) less costs. On-farm feeding trials showed that the average daily milk production values obtained from half-bred Simmental crosses fed lablab hay and sorghum bran under similar management conditions were 3.1Kg and 3.4Kg respectively (APRU 1987), while the Tswana cows on similar diets produced 1.4Kg and 1.6Kg respectively. The average lactation length for SX (285 days) was longer than that for Tswana cows (202 days). On average, SX cows produced 2.8 times more milk per lactation than Tswana cows.Therefore the rationale for using dual-purpose animals such as Simmental crossbreds in this type of production system is justified.

The fact that, on average, cows fed the supplements maintained weight during the lactation period is essential for dual-purpose beef/dairy cows such as the crosses used in this study. The crossbred steers could be sold to the already well established Botswana Meat Commission (BMC) at premium prices. This would compensate for the relatively low milk yield in crossbreds compared to that of pure-bred cows. If locally available protein and energy rich materials such as lablab hay and sorghum bran could be incorporated in a dairy diet, milk production could be increased. Lablab hay and crop residue could be produced on-farm with low inputs; the major cost being the cost of labour for harvesting and storage. Sorghum bran which is also produced on-farm and from Commercial Sorghum Mills appears to be an adequate alternative to imported expensive concentrates in this production system (APRU 1986).

It was not easy to quantify the amount of milk suckled by the calf during milk let-down and after milking. Non significant differences ($p > 0.05$) in calf weights ~~of calf weights~~ of the non supplemented and supplemented groups could be due to enough grazing in the calf paddock, light stocking rate and reasonable amount of milk consumed by the calf. Most of these calves were calved after the drought. With green lush pastures and reasonable amount of milk consumed by the calf one would expect the sorghum bran supplement will have little effect in improving liveweight gains.

By using the locally available materials as feedstuffs for their livestock farmers would not only be helping our developing industries but they would be fulfilling the national objective

of self-sufficiency in food production. More farmers are expected to engage in arable crop and dairy production knowing they have industries and cosumers where they can sell and have their produce processed. This will not only reduce the enormous importation but also reduce the unemployment problem.

Farmers are encouraged to form cooperative societies. These helps dairy farmers to work together as a group, have milk collection points and thus reduce the cost of each individual farmer transporting his milk daily to the milk packaging and processing centres. Through Financial Assistance Policy (FAP) and other government programmes both the individual and cooperative farmers can get financial help from the government to improve their farming enterprizes and thus their welfare.

Although research/extension linkages are not as strong as it ought to be, linkages are established through meetings held periodically. At these meetings extention staff brief researhers on problems on the field and researchers brief extension on what research programmes are currently conducted on-station as well as on-farm.

Research results and recommendations are published and distributed to extension staff and farmers through Agrifacts ; a paper printed by Agricultural Information, of the Ministry of Agriculture.

Although the government tries to protect local farmers from outside market influx by issuing import permits, this has not been easy for the planners. One of the reasons is that farmers

do not inform the planners of the amount of milk produced on a regular basis.

In addition to on-station research,a Small-Scale Dairy project was initiated in 1985/86 to encourage milk production in peri-urban areas. At the moment the project is working with about 46 dairy farmers around Gaborone (DPR 1987). The project has been collecting and interpreting data on the technical and economic viability of introduced simmental crossbreds fed crop by-products based diet supplemented with legumes fodders (lablab hay) and/or sorghum bran. The milk yield data obtained from on-farm trials with 40 dairy participating farmers (1986/87) have been similar to those obtained from on-station trials. The on-station trials reported in this paper will therefore complement trials currently conducted in on-farm situations. The success of on-station trials will depend on the adoption of the technologies by farmers. The pilot dairy project will be the basis for establishing dairy herds throughout Botswana.

CONCLUSIONS

- Dry season feeding based on available farm crop stovers, supplemented with high crude protein lablab hay, groundnut haulms and milling by-products such as sorghum bran, is a practical approach for feeding lactating and in-calf cows in small-scale farm situations. These by-products are widely available on small-scale farms in Botswana.

- Dual purpose Simmental x Tswana crossbreds require less management, health care and feed than pure bred dairy animals. In addition to increased milk yield, these animals can be sold

at premium prices for beef as well as for use as draught animals.

- There were no differences ($P > 0.05$) in milk yield per lactation between half-bred Simmental (702.5Kg), three-quarter Simmental (739.0Kg), and half-bred Friesian (825.5Kg) fed stover-based diets supplemented with either sorghum bran or lablab hay, groundnut haulms or dairy concentrate (sorghum bran:sunflower meal, 2:1 ratio). There were, however, variations within SX and SSX breeds supplemented with different diets.

- Management of lactating cows, in-calf cows and calves, milking, animal health and record keeping procedures were appropriate to small-scale dairy farm conditions. The management system was adopted by participating dairy farmers.

- Forty percent of all Simmental calves born were infected with Kerato conjunctivitis but later recovered after treatment with Terramyacin.

- Calf growth in half-bred Simmental, three-quarter Simmental, half-bred Friesian were similar. During the trial, calves did not respond to sorghum bran supplementation, indicating that the quantity of milk suckled, and grazing conditions were adequate.

APPENDIX

Appendix Table I

Average production of different crop residues obtained during favourable rainfall and drought years in Botswana

Crop Residues (MT)	Favourable Rainfall (1980-1981) Area Harvested (Ha)	Favourable Rainfall (1980-1981) Prodn. (MT)	Drought Years (1982-1986) Area Harvested (Ha)	Drought Years (1982-1986) Prodn. (MT)
	000			
Sorghum stover	127.0	57.0	60.0	18.4
Maize stover	53.0	34.0	13.0	11.0
Millet stover	14.0	5.0	8.0	1.9
Pulses (beans)	14.0	5.0	4.0	0.9
Groundnuts	4.0	3.4	1.0	1.1

Source: 1986 Agricultural Statistics
(Ministry of Agriculture, Botswana)

Appendix Table II

Total production per year of different agro-industrial by-products in Botswana

By-Products	Production (MT. DM)
Sorghum bran	14,800
Brewers' grain[1] (Barley spent grain)	780
Brewers' grain[2] (Sorghum/maize spent grain)	2,128
Wheat bran	5,544
Hominy chop	10,000
Meat meal	2,949
Blood meal	318
Bone meal	1,031

[1] spent grain from beer malt brewing
[2] spent grain from "chibuku" malt brewing

Appendix Table III

Average rainfall in Botswana during normal and drought years

Year	Average Rainfall (mm)
1979	399
1980	412
1981	555
1982	373
1983	332
1984	302
1985	321
1986	442
1987	389

Source: Rainfall Unit, Department of Meteorological Services, Ministry of Works, Transport and Communications.

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