

## FATTENING ZEBU AND CROSSBRED CATTLE ON MAIZE RESIDUES AND CONCENTRATE

P B O'Donovan<sup>1</sup> & A Gebrewolde

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Results are reported from two group-feeding experiments with 40 Zebu (Boran) and 15 cross-bred (Simmental, Friesian and Jersey x Zebu) cattle. In experiment 1, in which roughages comprised 40% of the diets, animals fed the maize silage control ration gained faster ( $P < 0.01$ ) than those on all the other treatments. Daily gains did not differ significantly between maize stalks and maize cobs. There was a tendency for bulls to outgain steers. In the second experiment Zebu and crossbred bulls were given diets in which maize stalks and cobs each comprised 35 and 50% of the total. Crossbreds gained (0.91 kg/d) significantly faster ( $P < 0.01$ ) than Zebu bulls (0.68 kg) and converted feed more efficiently to liveweight gain. The average daily gains for maize stalks and maize cobs, averaged over levels, were 0.76 and 0.83, while gains on the 35 and 50% roughage levels were 0.80 and 0.79 kg respectively.

Key words: maize silage, maize residues, crossbred, Zebu, steers, bulls, liveweight gain

Maize is an important crop in Ethiopia with the grain forming part of the staple diet. Besides the grain, the maize crop yields a number of residues, the predominant ones being maize stalks and cobs. Previous research (Gebrewolde et al 1978) has shown that crossbred bulls gain satisfactorily on diets in which maize stalks constitute 30 - 50% and maize cobs 40%, of fattening rations. The objectives of the present study were two-fold: (a) to compare a variety of crop (including maize) residues, with maize silage serving as a control and (b) to compare the value of maize stalks and cobs, each fed at two levels.

### Materials and Methods

Two fattening trials were conducted, for 84 and 112 days, respectively in the maize growing area of Awassa (Sidamo province of Ethiopia). All the roughages were available locally and were given separately with the molasses. The maize stalks were chopped while the maize cobs were softened by soaking them in water overnight; the haricot bean haulms (*Phaseolus vulgaris* L.) and teff (*Eragrostis abyssinica*) straw were given in the unchopped form.

Animal weights were recorded between 0800 and 1000 h, twice both initially and finally (successive days) and at 28 day intervals during the experiments. They were group fed in roofed pens with an uncovered loafing area where water was available. They were previously drenched (internal parasites) and adjusted to their respective rations for two weeks. The feed offered was maintained at 5 - 10% above appetite and the daily intake was recorded for each group.

<sup>1</sup> FAO Animal Nutrition Officer, c/o Personnel Officer, AGA Division, FAO Via delle Terme de Caracalla, 00100 - Rome, Italy

*Experiment 1:* The 15 bulls and 9 steers, all Boran, were arranged in descending order of liveweight and randomly allotted to treatments; 4 bulls and 2 steers were in each of the first 3 treatments and 3 bulls and 3 steers were in the fourth. Their ages were estimated to range from 3 to 7 years and averaged 4.8, 4.9, 4.5 and 4.8 years for treatments 1 - 4 respectively.

3 of the diets fed (Table 1) contained 40% roughage from maize silage,

Table 1:

Composition of the diets fed in Experiments 1 and 2<sup>a</sup>

Ingredients %	Experiment 1				Experiment 2			
	1	2	3	4	A	B	C	D
Maize silage	40	-	-	-	-	-	-	-
Maize stalks (chopped)	-	40	-	-	35	50	-	-
Maize cobs	-	-	40	-	-	-	35	50
Teff straw	-	-	-	20	-	-	-	-
Harri cot bean haulms	-	-	-	20	-	-	-	-
Cane molasses	20	15	15	15	10	10	10	10
Cracked maize	12	12	12	12	20	-	20	-
Sunflower cake	25	30	30	30	32	37	32	37
Meat and bone meal	-	-	-	-	2	2	2	2
Bone meal	2	2	2	2	-	-	-	-
Salt	1	1	1	1	1	1	1	1

<sup>a</sup> A trace mineral/vitamin supplement was added to the concentrate part (excluding roughages and molasses) of each diet at the rate of 1 kg/ton in Experiment 1; at 1 kg (diets B and D) and 770 g (diets A and C) per ton in Experiment 2.

maize stalks and maize cobs whilst the fourth ration contained 20% each of teff straw and haricot bean haulms. The roughages were given first each morning and cane molasses, diluted with water, was sprayed over them in the feed trough; one half of the concentrate was then fed and the remainder was given in the afternoon. Maize silage had 8.7% crude protein in the dry matter and the entire ration had 13.8% while the corresponding values for rations 2 and 3 were 3.7, 13.7 and 2.8 and 13.3%, Teff straw and haricot bean haulms had 7.7 and 7.3% crude protein, respectively, and the diets had 15.2%.

*Experiment 2:* 16 Zebu and 15 crossbred bulls were used. 8 Zebu (4 Boran and 4 Barca) ranging in age from 9 - 21 months and 8 Boran bulls purchased locally with about the same liveweight (ages unknown). The crossbreds (9-14 months of age) consisted of 8 Simmental, 2 Friesian and 5 Jersey crosses, Boran and Barca dams being the Zebu breeds represented. The bulls within each category, following stratification according to breed type and age, were randomly allotted to the 4 diets until each treatment (except 3 crossbred and 4 Zebus on diet D) had 4 crossbred and 4 Zebu bulls and these groups were penned and fed separately.

Two types of maize residues (stalks and cobs) were evaluated, each being fed at 35 and 50% of the diets (diets A - D, Table 1), the remainder

of the diet consisting of cane molasses and concentrate. Overall crude protein percentages were 15.2, 15.8, 14.9 and 15.4 for diets A to D, respectively. Initially all the roughages and molasses were given in the morning but, as the consumption increased, one half was fed in the morning and the remainder in the afternoon; the premixed concentrate was fed twice daily.

In both experiments, samples of the roughage and concentrate ingredients, as well as those of the mixed concentrates, were taken at regular intervals for analysis.

*Statistical analysis:* In both experiments the method of unweighted means was used in the analysis of variance. In the second experiment the degrees of freedom among treatments were orthogonally partitioned to meaningful contrasts.

## Results

*Experiment 1:* Results (Table 2) indicate that Zebu cattle fed maize silage gained significantly more ( $P < 0.01$ ) than animals on all other treatments, daily gains being 1.18, 0.71, 0.84 and 0.86 kg for all diets containing maize silage, maize stalks, maize cobs and teff straw/haricot mixture respectively. Daily gains with the teff straw/haricot bean haulms were significantly greater ( $P < 0.05$ ) than those with maize stalks; there were no significant differences between teff straw/haricot bean haulms and maize cobs or between maize stalks and maize cobs.

Feed intake was also highest for cattle fed maize silage (Table 2), with only minor differences between the other diets. There was a direct relationship between rate of gain and feed conversion, with maize silage-fed cattle being the most efficient (8.1 kg feed/kg gain), followed by teff straw / haricot bean haulms (8.9), maize cobs (10.0) and maize stalks (11.0)). Respective daily gains (kg) for bulls and steers on diets 1 - 4 were: 1.29, 0.97; 0.80, 0.52; 0.87, 0.78; 1.05, 0.67.

*Experiment 2:* While there was a slight decrease in daily gain (Table 2) when maize stalks were increased from 35 to 50%, no such effect was found with maize cobs; the slightly better gains with the higher percentage of cobs was observed for both crossbred and Zebu bulls.

Crossbreds gained significantly faster ( $P < 0.01$ ) than Zebu bulls (Table 2), average daily gains being 0.90 and 0.68 kg, respectively. Daily gains on maize stalks and maize cobs, averaged over levels, were 0.76 and 0.84 kg while gains for the 35 versus 50% roughage were 0.80 and 0.79 kg, respectively. The decrease in daily gain associated with the increase in roughage was more pronounced for the crossbreds than for the Zebus. The latter gained even faster when the maize cobs percentage was increased. The interaction, however, was not significant.

## Discussion

Leask and Daynard (1973) reported that maize stalks (leaves, stems and husks) account for about 38% of the overground dry weight of the crop and the term "maize stalks" as used in this paper includes all three fractions; maize cobs comprise almost another 12%. Maize stalks *per se* is a very variable roughage, the stage at which harvesting takes place being one of factors contributing to this variability (Ranjan and Kariyar 1969; Leask and

Table 2 :  
Rate of gain, feed intake and feed conversion (Experiments 1 and 2)

	Experiment 1						Experiment 2				Mean	
	Treatments						Treatments					
	1	2	3	4	A	B	C	D	D			
No. of animals	6	6	6	6	8	8	8	8	7			
Av. initial wt. (kg)	201.0	209.2	208.3	212.9	205.5	197.4	192.4	192.4	212.1	201.8		
(SE)	(6.0)	(6.0)	(6.0)	(6.0)	(11.5)	(11.5)	(11.5)	(11.5)	(12.3)	(5.8)		
Av. final wt. (kg)	309.5	268.5	278.7	285.3	294.4	278.6	283.4	283.4	305.3	290.4		
(SE)	(10.8)	(10.8)	(10.8)	(10.8)	(15.5)	(15.5)	(15.5)	(15.5)	(16.6)	(7.9)		
Av. daily gain (kg)	1.18	0.71	0.84	0.86	0.79	0.72	0.81	0.81	0.83	0.79		
(SE)	(0.06)	(0.06)	(0.06)	(0.06)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.03)		
Crossbreeds					0.93	0.81	0.93	0.93	0.95	0.90		
Zebu					0.65	0.64	0.69	0.69	0.75	0.68		
Daily feed intake (kg)	9.6*	7.7	7.8	7.6	7.4	7.6	7.2	7.2	7.9	7.5		
Crossbreeds					8.1	8.0	7.2	7.2	8.0	7.8		
Zebu					6.6	7.3	7.1	7.1	7.8	7.2		
Kg feed/kg LW gain	8.1	11.0	10.0	8.9	9.3	10.5	8.8	8.8	9.5	9.5		
Crossbreeds					8.6	9.8	7.7	7.7	8.5	8.6		
Zebu					10.2	11.4	10.3	10.3	10.5	10.6		

\* Adjusted to 90% dry matter to be comparable to the other diets

Daynard 1973; Berger et al 1979). The latter reported that steers fed early-harvested maize stalks gained 0.18 kg more daily and were 19% more efficient than those fed the late-harvested material. In interpreting the performance results, therefore, it is important to bear in mind the roughage quality fed. Maize cobs are unlikely to be subject to the same reduction in quality as maize stalks.

Satisfactory silage can be made from maize stalks with a variety of additives (Colenbrander et al 1971a) or when the stalks are ensiled with different combinations of whole corn and poultry excreta (Keys and Smith 1981a and b). The other alternative is to allow them to dry out in the field and to harvest (80-90% dry matter) and stack them ready for chopping and feeding. This was the practice adopted for the present experiment and, although it is easy and inexpensive to do at farm level, the quality is lower as evidenced by the 3.7% crude protein. Should it be feasible and economic to grind maize stalks, a further improvement in performance can be realised, mediated through a higher dry matter intake (Morris and Mowat 1980).

In both experiments the rate of gain was lower on the diets of maize stalks compared to those containing maize cobs. The former were partially grazed by cattle before harvesting for the first experiment and were unnecessarily stemmy and low in quality. The slightly mouldy stalks, following rain, fed in Experiment 2 very likely accounted for the sub-optimum rate of gain. With average to good quality maize stalks, the rate of gain is expected to equal or surpass that which is possible with maize cobs.

The average gains of Zebu cattle fed 40% maize silage in Experiment 1 was very satisfactory (1.18 kg). Colenbrander et al (1971b) reported that Holstein heifers gained 0.89 kg daily on a ration of maize silage and supplement, approximating the gain (0.81 kg) of Holstein heifers fed 88.4% whole maize which had been ensiled with 11.6% dried poultry excreta (Keys and Smith 1981b). A mixture of teff straw and harricot bean haulms (included because of their local availability and importance) proved to be next best, a reflection, perhaps, of their higher crude protein and quality.

Butterworth et al (1970) showed that Zebu-Hereford steers gained 0.89 kg daily on a ration containing 55% maize stalks, a response which slightly exceeds that obtained with Zebu bulls and steers in Experiment 1. Maize stalk silage fed with a supplement to dairy heifers was sufficient for maintenance and up to 0.5 kg daily gain (Colenbrander et al 1971c). Maize cobs gave satisfactory results when substituting up to 60% of rations for dairy cows (Lassiter et al 1958), but not when a diet of 75% maize cobs and 25% cottonseed meal was given to fattening bulls (Raverso et al 1966). The superior gains of bulls versus steers agrees with the results of other investigations, conducted mainly in a temperate climate.

Crossbreds in Experiment 2 gained faster, consumed more feed and were more efficient in converting feed to liveweight gain than Zebus, trends also observed in previous experiments (O'Donovan et al 1978). Crossbreds maintained their superiority with the two kinds and levels of maize residues.

The experiments indicate that maize stalks and cobs can satisfactorily constitute up to 50% of balanced cattle fattening rations. Still better results can be expected if the green stalks are either fed fresh or conserved as silage at a more nutritive stage (Berger et al 1979). Over -

night soaking in water of the maize cobs, which were later fed with molasses, was instrumental in inducing the animals to consume readily the unground cobs. There are a variety of possible feeding systems with maize residues; the most suitable depends largely on the type and composition of the available supplementary concentrate.

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### References

- Berger L L, Paterson J A, Klopfenstein T J & Britton R A 1979 Effect of harvest date and chemical treatment on the feeding value of corn stalklage *Journal of Animal Science* 49: 1312-1316
- Butterworth M H, Rivas C J & Aguirre E L 1970 Fattening in confinement with rations high in fibre *Association Latino Americana de Produccion Animal Memoria* 5:27-34
- Colenbrander V F, Muller L D & Cunningham M D 1971a Effects of added urea and ammonium polyphosphate on fermentation of corn stover silages *Journal of Animal Science* 33:1097 - 1101
- Colenbrander V F, Muller L D, Wasson J A & Cunningham M D 1971b Effects of added urea and ammonium polyphosphate to corn stover silages on animal performance *Journal of Animal Science* 33:1091-1096
- Colenbrander V F, Muller L D, Wasson J A & Cunningham M D 1971c Corn stover silage supplemented with varying increments of energy for growing dairy heifers *Journal of Animal Science* 33:1306-1309
- Gebrewolde A, O'Donovan P B, Gebremariam H, Kebede B & Galal E S E 1978 Fattening studies with crossbred (European x Zebu) bulls 2. Rate and efficiency of gain on diets of maize residues and concentrate *Journal of Agricultural Science Cambridge* 90:431-434
- Keys J E & Smith L W 1981a Effects of poultry excreta and ground ear corn on growth, intake and digestion of corn stover silage diets by yearling dairy heifers *Journal of Dairy Science* 64:140-145
- Keys J E & Smith L W 1981b Effects of dried poultry excreta on growth, intake and digestion of corn stover silage diets by yearling dairy heifers *Journal of Dairy Science* 64:211-216
- Lassiter C A, Huffman C F & Duncan C W 1958 Ground corn cobs as a source of roughage for lactating dairy cows *Journal of Dairy Science* 41:176-181
- Leask W C & Daynard T B 1973 Dry matter yield, in vitro digestibility, percent protein and moisture of corn stover following grain maturity *Canadian Journal of Plant Sciences* 53:515-522
- Morris P J & Mowat D N 1980 Nutritive value of ground and/or ammoniated corn stover *Canadian Journal of Animal Science* 60:327-336
- O'Donovan P B, Gebrewolde A, Kebede B & Galal E S E 1978 Fattening studies with crossbred (European x Zebu) bulls 1. Performance on diets of native hay and concentrate *Journal of Agricultural Science Cambridge* 90:425-429
- Ranjan S K & Kariyar R C 1969 Yield, chemical composition and nutritive value of residual maize fodders (*Zea mays*) - when taken as dual purpose crop *Indian Journal of Dairy Science* 22:136-139
- Rovero E A, Velloso L, Rundisi A G A, Decker M, Caielli E L & Silveira J 1966 Sugar cane, rice straw and corn cob rations for fattening Nelore bulls *Proceedings World Congress on Animal Feeding Madrid Spain* pp7-15

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