Short Communications

Whole maize *versus* ground maize in fattening diets for beef steers

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Two groups of nine animals each, were fed either a conventional diet based on ground maize or whole maize and roughage – protein – additive – mineral pellets in a cafeteria system. Both groups were fed *ad libitum* for a period of 105 days. No statistically significant differences could be found between the groups in any of the feedlot parameters used to evaluate growth and efficiency. An interesting protein-sparing effect was found on the free-choice whole maize and pellets cafeteria system, as opposed to the conventional diet or NRC recommendations.

Twee groepe van nege diere elk, is met of 'n konvensionele mieliemeel-gebaseerde afrondingsdieet of 'n heelmieliegraan en ruvoer – proteïen – bymiddel – mineraal korrels kafeteria sisteem gevoer. Beide groepe is vir 105 dae teen *ad libitum* peile gevoer. Geen statisties betekenisvolle verskille, in terme van groei- en doeltreffendheidsparameters, kon tussen die twee groepe aangetoon word nie. 'n Interessante proteïenbesparingseffek is op die heelmieliegraan en korrels sisteem gevind. Proteïeninname, ten spyte van vergelykbare groei tussen die diëte, was veel laer as dié van die konvensionele mieliemeel dieet asook dié van die NRC-aanbevelings.

Keywords: Maize, beef steers, fattening diets, feeding system

Since its inception the South African feedlot industry regarded maize grain, particularly the ground form, as the primary energy source in fattening diets for beef steers. However, since the principle of minimum input in relation to maximum output is the most important object of any production system, considerable interest is aroused by studies directed at minimizing mixing and processing. Morgan (1980 — personal communication) calculated that up to 15% of total feed costs can be attributed to mixing and processing.

The use of whole grain in fattening diets has therefore been researched extensively. Some controversy resulted as some workers found an increase in average daily gain as well as better feed conversion ratio's when cattle were fed whole grain and limited or no roughage (Hixon, Hatfield & Lamb, 1969; Wiechenthal & Webb, 1969; Foster & Woods, 1970; Bonsembiante, Bittante & Cesseli, 1981; Anonymous, 1982; Van Niekerk & Tarr, 1982), while others maintained that some processing should take place as this aids digestion (Hale, 1973; Broadbent, 1976; Nordin & Campling, 1976; Aerts, Cottyn, De Brabander, Boucqué & Buysse, 1978; Liebenberg, Meissner & Pienaar, 1979; Ørskov, 1980). The suspected lower digestibility of the whole maize in comparison to the ground maize could thus lead to reduced feedlot performances. Many of these differences in opinion resulted from the feeding method used, which was not always optimal for a particular form of grain.

It was shown by van Niekerk & Tarr (1982) that the concept of feeding whole maize grain in a cafeteria system with additional protein, roughage, additives and minerals in pellet form, gave better feed conversion ratio's (4,8%) but lower average daily gains (4,7%) when compared to a conventional complete feed based on ground maize. Anonymous (1982) found that using the cafeteria system with whole maize and pellets also showed an advantage over other systems of whole maize feeding.

Eighteen, approximately one-year-old steers were randomly divided into two groups of nine animals each. The first group received whole maize and seperately fed protein – roughage – additive – mineral pellets in a cafeteria system. The second group received a conventional complete feed based on ground maize. The composition of the pellets and the complete feed is shown in Table 1. The crude protein contents of the pellets, maize and complete feed, were 29,1%; 8,2% and 14,9%, respectively.

Table 1 Composition of the pellets fed with whole maize and the complete feed

Component	Pellets	Complete feed
[a]*Eragrostis curvula* hay	50,0	18,0
Ground maize	–	68,0
Sunflower oilcake meal	30,1	10,2
Molasses	7,0	–
Salt	3,2	0,9
Limestone	3,9	1,0
Urea	4,8	1,6
Sulphur	0,46	0,15
Vitamins and minerals	0,36	0,10
Monensin	99 ppm	33 ppm
Zinc bacitracin	30 ppm	10 ppm

[a]13 mm hammer-milled.

The animals received the diets *ad libitum* for a period of 105 days. This feeding period included a 21-day adaptation period for the diet based on ground maize, while no adaptation was used in the whole maize feeding system. The animals were weighed weekly. Orts were collected before each new meal (twice daily). The dry matter and organic matter content of the orts were determined on bulked weekly samples. All animals were slaughtered at the end of the experiment and carcass characteristics noted.

The relevant performance data of the two groups, *i.e.* whole maize plus pellets (WM + P) and the conventional ground-maize based diet (GM), are presented in Table 2.

From Table 2 it is evident that the WM + P group had a marginally higher average daily gain (2,54%) than did the GM group. This difference was, however, not statistically significant. The higher average daily gain, together with the

Table 2 Performance of steers

	WM + P	GM	Significance
Number of steers	9	9	–
Initial live mass (kg)	285 ± 18	278 ± 12	NS
Final live mass (kg)	412 ± 22	403 ± 18	NS
Feeding period (days)	105	105	–
DM intake (kg/day)	7,12	7,83	–
ADG (kg/day)	1,21 ± 0,15	1,18 ± 0,14	NS
FCR (kg DM/kg live mass)	5,87	6,26	–
[a]Initial carcass mass (kg)	139 ± 8,9	136 ± 6,1	NS
Final carcass mass (kg)	229 ± 11,8	225 ± 13,0	NS
Dressing percentage	55,7 ± 1,44	55,8 ± 1,38	NS
Carcass gain (kg/day)	0,86 ± 0,08	0,84 ± 0,11	NS
FCR (kg DM/kg carcass)	8,29	9,32	–
Grading: Super A	6	4	–
A1	3	5	–

[a]Calculated as 49% of live mass.

lower dry matter intake (10%) of the WM + P group, resulted in a 6,6% improvement in the live-mass feed conversion ratio. The carcass-feed conversion ratio favoured the WM + P group to the extent of 12,4%. This is in accordance with van Niekerk & Tarr (1982) who quoted values of 4,8% and 10,7% for live-mass- and carcass-feed conversion ratio's, respectively. Considering the grading of the carcasses it is also evident that the WM + P group had a larger percentage of animals in the top grade (Super A) while the GM group produced seemingly leaner carcasses. Thus, we conclude that although none of the parameters showed statistically significant differences, the WM + P group seemed to perform slightly better than the GM group.

Of further interest is the mean daily intake of pellets as a percentage of the total intake. Tarr & van Niekerk (1982) found that the mean intake of pellets, expressed as a percentage of the total intake, varied between 18,9% and 12,9% depending on the roughage source used in the formulation of the pellets. Although *Eragrostis curvula* hay was used in this experiment, which was not used by Tarr & van Niekerk (1982), this was not the sole reason for the lower mean daily intake of pellets (7,6%) recorded. From Table 1 it can be seen that the protein – roughage – additive – mineral pellets were formulated in such a manner as to ensure adequate amounts of nutrients on a total diet basis. The fact that the high levels of monensin (99 ppm) and possibly also urea, could depress intake was overlooked. The pattern of pellet intake (see Figure 1) although at a lower level was, however, similar to that found by van Niekerk and co-workers (personal communication).

Anonymous (1982) also mentioned initial intake problems with the pellets and this may be the reason for the increase in the pellet intake during the first two weeks of the experiment. The increase in the whole maize intake and the corresponding decrease in pellet intake has important implications on the total protein intake. In Figure 2 the total protein intake curves (g/day) of both the WM + P and GM groups, together with tabulated recommended levels (NRC, 1976), are shown.

From Figure 2 it is evident that in spite of a 16,6% lower than recommended protein intake, the WM + P group gained

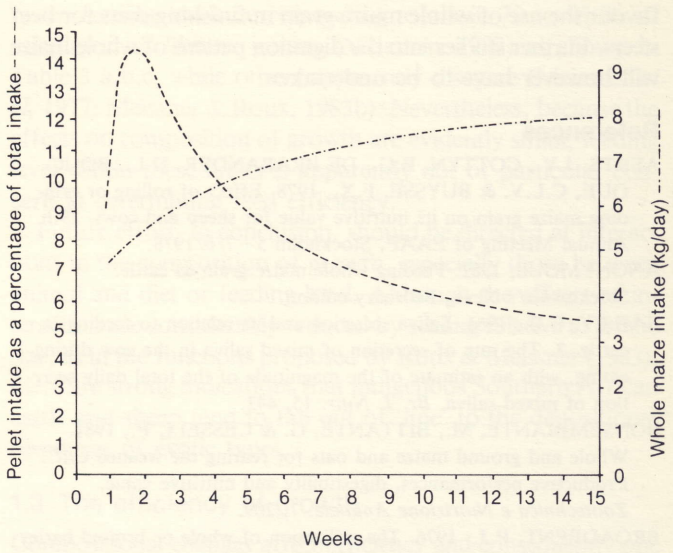

Figure 1 Patterns of pellet and whole maize intake.

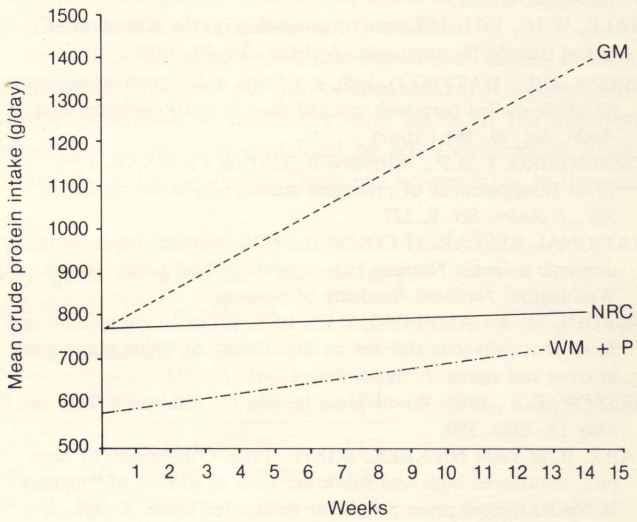

Figure 2 Mean crude protein intake (g/day) of the WM + P and GM groups as compared to the level recommended by the NRC (1976).

to the same extent. The GM group, however, had a crude protein intake which was 38,2% higher than that recommended by the NRC and 65,7% higher than that of the WM + P group. In spite of this highly significant increase in crude protein intake, the average daily gains were similar. This therefore suggests that the WM + P group used the available nitrogen more efficiently than expected. The reason for this is uncertain, but may be linked to several factors. One being the fact that more readily fermentable carbohydrates (starches) in the rumen seem to stimulate ammonia transport across the rumen wall (Owens, 1983 personal communication). This leads to microbial growth-rates equal to those of the GM diet where ammonia levels posed no problem as adequate amounts of crude protein were available. Another factor which may also contribute to higher microbial growth-rates is pH. It can be hypothesized that an increase in mastication and rumination on the WM + P diet could increase rumen pH (Bailey, 1961). It is, however, evident that this phenomenon requires further investigation.

In conclusion, it can be said that the whole maize plus pellets system performed equally well to that of the complete diet based on ground maize. The added advantage of savings in processing of the maize, protein and roughage would therefore

favour the use of whole maize grain in finishing diets for beef steers. Further studies into the digestion pattern of whole maize will however have to be undertaken.

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