

Energy supplementation of yearling steers at different stocking rates on Nile grass pasture

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Forty-eight yearling steers (average live mass = 192.8 and standard deviation = 3.7 kg) were blocked by mass and breed [Sussex ($n = 32$) and Simmentaler ($n = 16$)] and within blocks allocated randomly to one of four treatments (supplementation with 0, 1, 2 and 4 kg maize meal/day), each at one of two stocking rates [light stocking rate (LSR: 6 steers/ha) and heavy stocking rate (HSR: 10 steers/ha)]. Live mass gain/steer was 54.1 ± 4.3 , 73.5 ± 5.4 , 100.0 ± 6.1 and 118.1 ± 7.4 kg over the grazing period of 124 days, at supplementation levels of 0, 1, 2 and 4 kg maize meal/steer/day, respectively. Over all supplementation levels, live mass gain was 93.5 ± 7.6 kg and 79.3 ± 4.8 kg for the LSR and HSRs respectively. While the level of supplementation had a significant influence on fat thickness ($P \leq 0.01$), stocking rate did not ($P > 0.05$).

Agt en veertig jaaroud osse (gemiddelde lewende massa = 192.8 en standaardafwyking = 3.7 kg) is geblok volgens massa en ras [Sussex ($n = 32$) en Simmentaler ($n = 16$)] en binne elke blok ewekansig aan een van vier behandelings toegeken (supplementering met 0, 1, 2 of 4 kg meliemeel/dag), elkeen teen een van twee veebeladings [ligte veebelading (LSR: 6 osse/ha) en swaar veebelading (HSR: 10 osse/ha)]. Die lewendemassa-toename/os was 54.1 ± 4.3 , 73.5 ± 5.4 , 100.0 ± 6.1 en 118.1 ± 7.4 kg oor die weiperiode van 124 dae teen supplementeringspeile van 0, 1, 2 en 4 kg meliemeel/os/dag, respektiewelik. Oor alle vlakke van supplementering, was die lewendemassa-toenames 93.5 ± 7.6 en 79.3 ± 4.8 kg vir die LSR en HSR, respektiewelik. Peil van supplementering het vetdikte betekenisvol beïnvloed ($P \leq 0.01$), maar veebelading het nie ($P > 0.05$).

Keywords: Energy supplementation, growth rates, subtropical pastures.

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Introduction

Results obtained at the Dundee Agricultural Research Station indicated that although good carcass gains per unit area could be achieved by steers grazing Nile grass (*Acroceras macrum*) pastures for summer fattening, good carcass grades are wanting. This could be due to a number of factors. t'Mannetje (1981) states that a low nutritive value during most of the period of active pasture growth results in poor animal performance. However, selective grazing may result in the chemical composition of the herbage ingested by the animal differing considerably from that of the pasture grazed (Bredon *et al.*, 1970). Ulyatt *et al.* (1980) concluded that the voluntary intake of feed, that is, feed with up to 70% digestibility, is the main determinant of feeding value. They continue, saying that, when a supplementary feed is supplied, substitution of the basal diet will take place. This is especially so if the supplementary feed is preferred by the animals. Jones *et al.* (1988) showed that there was substitution of the basal diet when hay was supplemented with grain.

Chase & Hibberd (1987) state that feeding 2 or 3 kg of a grain-based supplement formulated to meet the total protein requirement may decrease forage utilization to the extent that overall energy status of mature cows on low quality feeds is not improved. Work done on steers by Vanzant *et al.* (1990) seemed to show the same result for younger animals, although increased gains were achieved with increased energy supplementation.

The primary objective of this trial was to find ways to improve carcass quality in steers grazing Nile grass. Lower stocking rates did not seem economically viable because there would be a lower return from pastures with a relatively

high input cost. Therefore, the effect on animal performance, carcass quality and its consequent effect on economic returns from the additional input of energy supplementation was investigated.

Experimental procedure

Pasture management

Nile grass pastures were grown on 6.2 ha of a soil form classified as Longlands (MacVicar *et al.*, 1977) at the Dundee Research Station. The altitude at the research station is 1219 m and it is situated at latitude 28° 10' S and longitude 30° 19' E. Mean annual rainfall is 777.3 ± 150.6 mm, which falls predominantly during the summer.

The pasture was established in 1983 and used in two previous trials. It was therefore decided to aerate the pasture during June 1990. Dolomitic lime, at a rate of 1 ton/ha, was applied immediately prior to aeration.

Superphosphate (10.5% P) and potassium chloride (KCl; 50%) were applied during November 1991 at rates to maintain the soil P and K levels at 20 and 150 mg/l, respectively. Nitrogen was applied using limestone ammonium nitrate (LAN) at a rate of 210 kg of N/ha/annum, in three equal applications. The first application was at the beginning of November 1991, the second at the beginning of December 1991 and the third application on 20 February 1992.

At the outset, based on experience gained during the preceding trials on this pasture, it was decided that grazing would start at a pasture height of 10 cm and end the week before the Easter weekend irrespective of steer live mass, in order to exploit the relatively high beef prices usually prevalent at that time of year. Grazing commenced on 28 Novem-

ber 1991 and was terminated on 31 March 1992. This period comprised 124 grazing days. Continuous grazing was applied in all treatments.

The trial area was divided into eight paddocks, four comprising 0.97 ha and the remainder 0.58 ha each. By allocating six steers to each paddock, two stocking rates (SRs) were achieved, namely, a light stocking rate (LSR) of 6 steers/ha and a heavy stocking rate (HSR) of 10 steers/ha. Within each stocking rate, the paddocks were randomly allocated to one of four supplementation treatments.

Treatments

All steers received 40 g dicalciumphosphate and 40 g salt/day and were subjected to supplementation with 0, 1, 2 and 4 kg maize meal/steer/day while grazing Nile grass at both the LSR and HSR respectively. The respective supplementation levels at the LSR were numbered T1 to T4 and at the HSR, T5 to T8.

Animal management

Forty-eight yearling steers, with a mean live mass of 192.8 ± 3.7 kg, were blocked by mass and breed [purebred Sussex ($n = 32$) and Simmentaler ($n = 16$)] after which they were randomly allocated within block to one of the eight treatments.

The steers were dewormed and dipped at the commencement of the trial and dipped once every three weeks during the grazing period. They were weighed full-fed at weekly intervals. At the commencement and termination of grazing mass was recorded after 18 hours of fasting.

On 6 April 1992 the steers were railed to the abattoir (Cato Ridge) and were slaughtered on 7 April 1992.

Carcass evaluation

The following carcass measurements were taken in the section between rib ten and eleven (Dr A. van Niekerk — pers. comm., 1990):

1. Measurement A: The medio-lateral width of the eye muscle (*latissimus dorsi*).
2. Measurement B: The dorso-ventral depth of the eye muscle.
3. Measurement C: Subcutaneous fat thickness on the eye muscle. This was measured just lateral to the muscle overlaying the eye muscle, that is, the *musculi spinalis et semi-spinalis*.
4. Measurement D: Subcutaneous fat thickness halfway between the point where measurement C was taken and the attachment of the diaphragm to the rib cage.

Eye muscle area was taken as the product of A and B, and fat thickness as the mean of C and D.

Carcass grades recorded as Super A, A1 and A3 were taken as equivalent to and were reported as A3, A2 and A1, respectively, in the 1992 beef carcass classification system.

Statistical analysis

The treatment design included two factors (stocking rate and level of supplementation) providing a 2×4 factorial arrangement of treatments.

Factorial analysis of variance was used to compare live mass gain, average daily gain (ADG), eye muscle area and fat thickness between treatments. Final (fasted) live mass and cold carcass mass were compared between treatments with

initial live mass as covariate.

Results

Mass changes

An examination of the live mass changes (full-fed) at the LSR (Figure 1) over time indicated that live mass gain improved rapidly as level of supplementation increased. The rapid increases in live mass gain in the supplemented animals appeared to start between day 42 and day 54 after grazing commenced.

For the HSR treatments (Figure 2), the supplemented steers continued gaining whereas the control group started losing mass after day 81. Steers supplemented at a rate of 4 kg maize meal/day (T8) had poor live mass gains up to day 36 of grazing, from which time a rapid improvement in live mass gain occurred.

As level of supplementation increased, live mass gain/steer increased at both the LSR and HSR (Table 1). Live mass gain/steer was 93.5 ± 7.6 and 79.3 ± 4.8 kg/steer for the LSR and HSR respectively, a significant ($P \leq 0.01$) difference of 14.2 kg, resulting in a final live mass of 285.9 ± 9.5 and 272.6 ± 8.5 kg, respectively (Table 1).

A significant interaction ($P \leq 0.01$) between stocking rate and level of supplementation was observed, with live mass gain increasing at a greater rate at the light stocking rate with increasing levels of energy supplementation than at the heavy stocking rate (Figure 3). Live mass gain/ha was greater at the HSR than the LSR at all levels of supplementation.

Carcass attributes

At supplementation levels of 0, 1, 2 and 4 kg maize meal/day, carcass mass was 99.6 ± 6.2 , 119.3 ± 10.1 , 140.9 ± 7.0 and 160.4 ± 8.9 kg at the LSR and 104.5 ± 9.0 , 124.7 ± 9.8 , 125.9 ± 5.2 and 141.1 ± 10.3 kg at the HSR, respectively (Table 2).

Level of supplement significantly increased fat thickness ($P \leq 0.01$; Table 2), but the effect of stocking rate on fat thickness was non-significant. Fat thickness at slaughter was 0.087 ± 0.108 , 0.198 ± 0.042 , 0.212 ± 0.028 and 0.350 ± 0.029 at the LSR and 0.093 ± 0.015 , 0.185 ± 0.026 , $0.178 \pm$

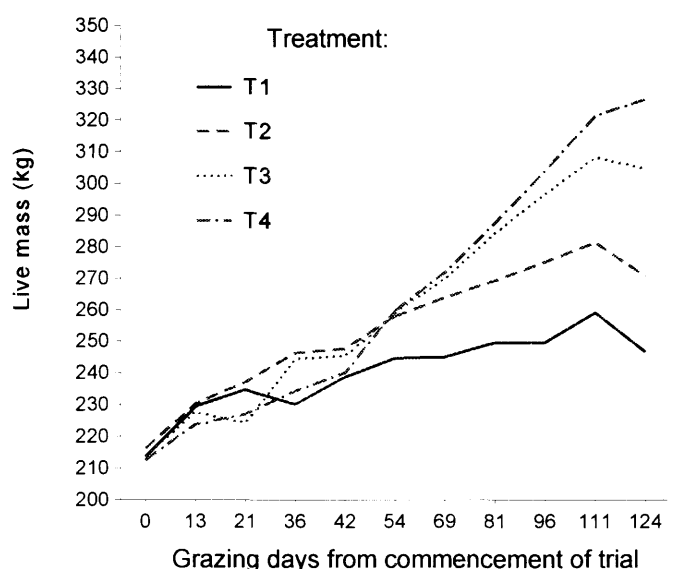


Figure 1 Influence of treatment (supplementation with 0, 1, 2 & 4 kg maize meal/day; T1, T2, T3 & T4 respectively) on live mass in steers grazing Nile grass pasture at a stocking rate of 6 steers/ha

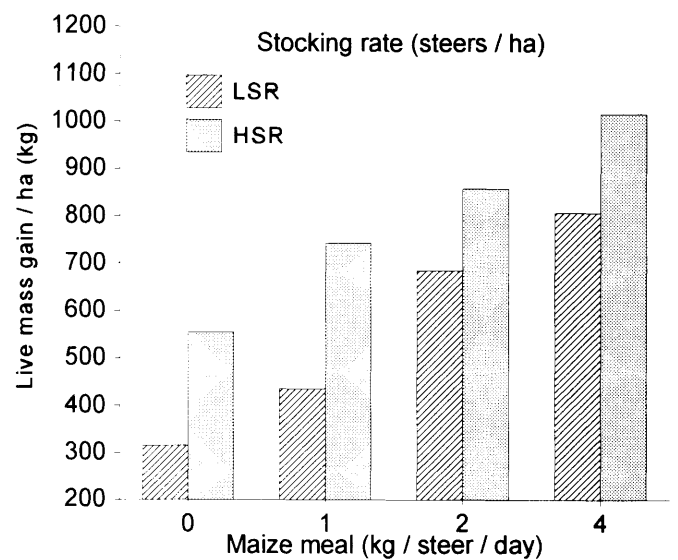
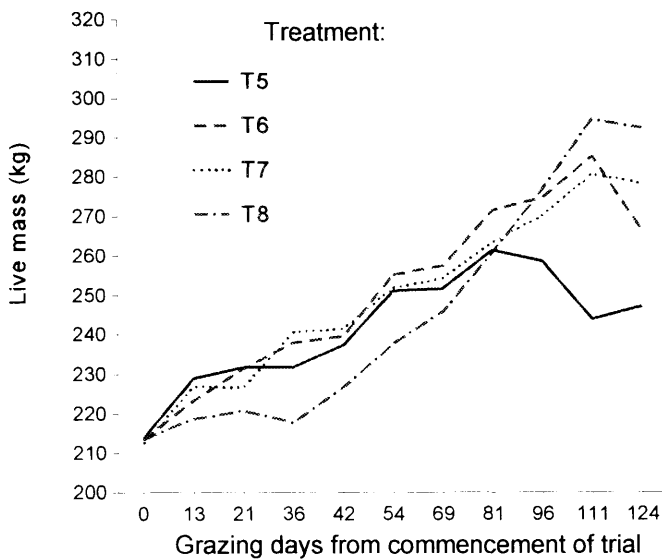


Figure 2 Influence of treatment (supplementation with 0, 1, 2 & 4 kg maize meal/day; T5, T6, T7 & T8 respectively) on live mass in steers grazing Nile grass pasture at a stocking rate of 10 steers/ha

Figure 3 Live mass gain/ha in steers grazing Nile grass pastures at two stocking rates (LSR; 6 steers/ha and HSR; 10 steers/ha) at different levels of supplementation of maize meal

0.038 and 0.325 ± 0.041 cm at the HSR at supplementation levels of 0, 1, 2 and 4 kg maize meal/steer/day, respectively (Table 2).

Carcass class is primarily determined by fat thickness, whereas carcass grade is a function of fat cover and conformation. Perhaps the increase ($P < 0.01$) in fat thickness with increased supplementation was not sufficient to improve the grade or conformation had a greater effect on grade than imagined. Only at the highest level of supplementation was carcass class (grade) improved (Table 2).

Economics

Gross margin/steer was calculated with a pasture cost of R563.17/ha (Combud, 1992), a maize price of R495.00/ton, a steer buying price of R2.40/kg live mass and a weighted mean carcass price. The weighted mean carcass price was calculated as the mean of the price/grade multiplied by the number of carcasses of a grade in each treatment (Table 3).

Discussion

At all levels of supplementation, animal performance as reflected in live mass gain, ADG, final live mass, live mass gain/ha as well as fat thickness in supplemented animals was better than in the control (unsupplemented) animals. This result is in agreement with previous trials (Jones *et al.*, 1988; Vanzant *et al.*, 1990). Surprisingly, the response to increasing levels of energy supplementation was greater at the LSR than the HSR. At the HSR, as supplementation level increased above 1 kg maize meal/steer/day, gross margin/steer declined. At the LSR gross margin/steer peaked at 2 kg maize meal/steer/day (Table 3).

The drop in live mass gain toward the end of the grazing period in most of the treatments (Figure 1 and Figure 2) indicates that the pasture was depleted in the relevant treatments. If grazing had been terminated at 111 days instead of 124 days, a higher final mass would have resulted in these respective treatments.

Table 1 Initial live mass, final live mass, live mass gain and average daily gain (ADG) at four levels of energy supplementation (0; T1 & T5, 1; T2 & T6, 2; T3 & T7, 4; T4 & T8 kg maize meal/steer/day) and two stocking rates (LSR; 6 steers/ha and HSR; 10 steers/ha) in steers grazing Nile grass pasture

Stocking rate	Mean		LSR				HSR				LSD	
	LSR	HSR	T1	T2	T3	T4	T5	T6	T7	T8	$P \leq 0.01$	$P \leq 0.05$
Treatment			T1	T2	T3	T4	T5	T6	T7	T8		
Initial live mass (kg)	193.8 ± 4.3	191.8 ± 5.4	194.0 ± 8.8	198.0 ± 10.0	190.8 ± 6.4	192.5 ± 10.9	191.7 ± 11.5	192.2 ± 16.5	192.7 ± 7.0	190.8 ± 9.6		
Final live mass * (kg)	285.9 ± 9.5	272.6 ± 8.5	245.0 ± 12.5	263.5 ± 18.6	307.8 ± 11.6	327.5 ± 16.1	248.8 ± 17.4	267.4 ± 17.7	278.7 ± 12.8	295.3 ± 17.8	27.5	19.3
Live mass gain (kg)	93.5 ± 7.6	79.3 ± 4.8	52.7 ± 5.7	72.7 ± 10.5	114.2 ± 5.9	134.5 ± 7.3	55.5 ± 7.0	74.3 ± 4.1	85.8 ± 7.0	101.7 ± 8.9	32.7	23.0
ADG (kg/day)	0.754 ± 0.062	0.640 ± 0.039	0.425 ± 0.046	0.586 ± 0.085	0.921 ± 0.048	1.085 ± 0.059	0.447 ± 0.056	0.600 ± 0.033	0.692 ± 0.057	0.820 ± 0.072	0.264	0.186

* Adjusted for covariate initial live mass

Table 2 Carcass attributes of steers supplemented at four levels of maize meal (0, 1, 2 and 4 kg/steer/day; T1 & T5, T2 & T6, T3 & T7 and T4 & T8 respectively) at two stocking rates (LSR, 6 steers/ha; HSR, 10 steers/ha)

Treatment	Mean		LSR				HSR				LSD	
	LSR	HSR	T1	T2	T3	T4	T5	T6	T7	T8	$P \leq 0.01$	$P \leq 0.05$
Cold carcass mass * (kg)	130.1 ± 6.0	123.4 ± 4.9	99.6 ± 6.2	119.3 ± 10.1	140.9 ± 7.0	160.4 ± 8.9	104.5 ± 9.0	124.7 ± 9.8	125.9 ± 5.2	141.1 ± 10.3	17.5	12.3
Eye muscle area (cm ²)	50.4 ± 2.4	48.6 ± 1.9	40.6 ± 2.5	44.9 ± 5.5	55.5 ± 3.0	60.7 ± 3.1	39.4 ± 3.9	51.4 ± 3.0	51.5 ± 3.3	52.1 ± 2.5	15.0	10.7
Fat thickness (cm)	0.212 ± 0.024	0.195 ± 0.023	0.087 ± 0.108	0.198 ± 0.042	0.212 ± 0.028	0.350 ± 0.029	0.093 ± 0.015	0.185 ± 0.026	0.178 ± 0.038	0.325 ± 0.041	0.138	0.097
Carcass class (A3, A2, A1)			0,0,6	0,0,6	0,0,6	0,3,3	0,0,6	0,0,6	0,0,6	0,1,5		

* Adjusted for covariate initial live mass

Steers subjected to the HSR and fed 4 kg maize meal/steer/day performed poorly in the initial grazing period (Figure 2). This relatively long period of adaptation to the feed was possibly due to a subclinical acidosis resulting from the high levels of maize meal fed in relation to the amount of grass ingested. Ionophores could be used to overcome the problem of acidosis, or the supplement could be introduced gradually over several weeks. Adding lime or a similar buffer to the maize meal would appear to be a better prophylactic in view of the tendency of ionophores to have a negative effect on fat deposition. In a preliminary trial where an ionophore (lasalocid sodium) was included when supplementing steers with 2 kg maize meal/steer/day, although animal growth was improved, a significantly lower fat thickness was observed (W.D. Gertenbach — unpublished data).

It is noteworthy that fat thickness was not significantly improved at the LSR in comparison to the HSR, whereas, although carcass class was not improved, increased levels of energy supplementation significantly ($P \leq 0.01$) improved sub-cutaneous fat thickness. The hope that energy supplementation would result in a larger proportion of carcasses achieving the higher fat carcass classes (A2 and A3) was not realized (Table 2). Although carcass class was improved at the highest levels of energy supplementation, the number of carcasses placed in higher carcass classes were much lower than would be expected from the measured fat thickness. Thus, for Treatment 4, with a mean fat thickness of 0.347 mm, it could be expected that some carcasses would achieve the A3 class, which was not the case. It is possible that conformation, which is taken into account in the carcass grading system, was partly responsible for this discrepancy.

Table 3 Gross margin per steer at four levels of maize meal supplementation and two stocking rates (6 steers/ha; LSR and 10 steers/ha; HSR)

Supplementation (kg/steer/day)	Gross margin/steer (R)			
	0	1	2	4
Stocking rate:				
LSR	-21.62	13.78	86.32	80.82
HSR	47.90	94.40	38.30	6.84

Conclusion

The feeding of an energy supplement, in the form of maize meal up to 4 kg maize meal/day, to steers grazing Nile grass pasture increased livestock performance compared to steers grazing the pasture without supplementation. At lighter stocking rates with 1993 prices of pasture, maize meal and livestock, the level of supplementation must be higher to achieve optimum profit margins, whereas at higher stocking rates low levels of energy supplementation will improve animal performance as well as result in larger price margins over un-supplemented animals.

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