Live and carcass measurements of steers castrated at three different ages and slaughtered at 2 or 3 years of age

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Forty-eight Sussex male calves were allotted at birth to the following three treatments: (i) castrated within 24 h after birth with elastrator rings and (ii) and (iii) castrated at 3 and 6 months using a burdizzo. Bodymass was maintained through winter using supplementary *Eragrostis curvula* hay and during summer the animals had free access to veld. Following a finishing period on a moderate level of nutrition, half the animals from each group was slaughtered either at 2 or at 3 years of age. There was a linear decrease in height at withers as the age at castration was delayed. There was no significant difference in final live bodymass, carcassmass, slaughter percentage, marbling, and fat thickness on the eye muscle between the three castrated groups. However, it was obvious that the 3-month-old castrates had the poorest performance throughout the trial. Possible reasons for the poor performance of the 3-month castrates are discussed. An economic analysis revealed that R4,3 million more could be generated should all the producers either castrate their bull calves soon after birth or at 6 months of age.

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Agt-en-veertig Sussex-bulkalwers is by geboorte toegeken aan die volgende drie behandelings: (i) gekastreer binne 24 uur na geboorte met rubberringe en (ii) en (iii) gekastreer op 3- en 6-maande-ouderdom met 'n burdizzo. Lewende massa van die osse is gedurende die winter deur die byvoeding van *Eragrostis curvula*-hooi gehandhaaf. Gedurende die somer het hulle vrye toegang tot veldweiding gehad. Die helfte van elke groep osse is onderskeidelik op 2 of 3 jaar geslag, voorafgegaan deur 'n vetmestingsfase (matige voedingspeil). 'n Lineêre afname in skofhoogte is waargeneem namate die ouderdom van kastrasie vertraag is. Daar was geen betekenisvolle verskille tussen die drie gekastreerde groepe t.o.v finale liggaamsmassa, karkasmassa, slagpersentasie, marmering en vetdikte op die oogspier nie. Daar was egter 'n neiging vir die osse wat op 3 maande gekastreer is, om deurgaans die swakste te presteer. Moontlike redes vir die swak prestasie van die osse wat op 3 maande gekastreer is, word bespreek. 'n Ekonomiese analise het getoon dat R4,3-miljoen meer verdien kan word indien alle produsente landswyd hul bulkalwers óf kort na geboorte, óf op 6-maande-ouderdom kastreer.

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Introduction

The history of castration is probably almost as old as the history of the domestication of animals by man to fulfil his requirements for meat, animal products and draft power (Turton, 1969). In South Africa the majority of beef male calves are castrated between the ages of 2 and 6 months whereas the occasional producer castrates his male calves within the first 7 days of age.

Although feedlotting *per se* plays an important role in the production of high quality beef, the majority of beef consumed in this country is off grass. Therefore, depending on the production system followed, steers are marketed at either 14 – 16 months (intensive rye grass pastures) or as late as 3 – 4 years (natural veld grazing). The importance of castration is thus evident.

An important consideration in deciding upon the age at castration is the availability of manpower and/or proper handling facilities for restraining calves. It is obvious that the longer castration is delayed, the more manpower is required. Furthermore, beef producers are generally of the opinion that later castration (more than 3 months) favours growth and development of the steers compared with early castration (less than 1 month). Therefore, the objectives of this study were to compare the growth and development, feedlot performance and carcass measurements of steers castrated either within 24 h after birth, at 3 months, or at 6 months, and slaughtered at either 2 or 3 years of age.

Experimental procedure

Animals and Treatments

Forty-eight Sussex male calves from one herd and similar nutritional background were allotted at birth to the following three treatments, half of each group was slaughtered at either 2 or 3 years of age:

Group 1: Castrated within 24 h after birth using elastrator rings.

Group 2: Castrated at an average age of 3 months using a burdizzo.

Group 3: Castrated at an average age of 6 months using a burdizzo.

Throughout the suckling period the cows remained in the same herd and after weaning the steers received similar treatment. When the steers were approximately 21 months of age, each of the three groups was randomly subdivided in two sub-groups with half the steers from each group put into feedlot whereas the remainder of the steers returned to the veld. The latter steers were put into feedlot the following

year when they were approximately 33 months of age.

Because it was accepted that nutrition *per se* would have no effect on treatment within the year of assessment, a programme of overwintering was followed that would ensure maintenance. Therefore, those steers on veld during the winter received a protein supplement, and from approximately July they received limited quantities of *E. curvula* hay in addition to the veld and until such time as green grazing was available.

During the feedlot phases of the trial (both started in July) all the animals received a daily diet of maize silage *ad lib.* plus 0,5 kg of a high protein concentrate mixture (CP = 40%, urea free) plus 3,5 kg maize meal.

Carcass assessment

In order to eliminate the effect of age at slaughter, the fattest four animals from each group were killed first and the remainder 2 weeks later. Selection of these animals for slaughter was done by the same person and solely by visual appraisal.

After quartering between the 10th and 11th ribs, the eye muscle area and thickness of the fat cover on the eye muscle (average of three measurements across the eye muscle) was measured. Marbling of the eye muscle was subjectively scored on the scale 1 to 5. All the carcasses were sold by public auction.

Body measurements

At approximately 3, 6, 12, 18, 26, and 31 months of age, bodymass, body length, withers height and chest depth measurements were recorded. Body measurements were determined by using a 2-m long steel caliper with one fixed and one sliding arm. Measurements were taken only when the calves were standing evenly on their feet and their heads firmly secured in a head clamp. Body length was measured from the pin bone to the dorsal anterior part of the scapula. The other measurements are self-explanatory.

Mean differences in data were compared by least squares analysis of variance.

Results and Discussion

Body measurements

Apart from height at 12 months of age, none of the variables (bodymass, height, depth and length of animal at 3, 6, 12, 18, 26, or 31 months of age) was significantly affected by age at castration (Table 1). However, it is obvious from Table 1 that live bodymass, height, depth and length of body for

Table 1 Average live body measurements of steers castrated either within 24 h after birth, at 3 or at 6 months of age and half of which were slaughtered at either 2 or 3 years of age

Average measurements/ animal	Age at castration: Within 24 h Group 1	3 months Group 2	6 months Group 3	Level of significance[a]
Number of animals	16	16	16	
Live measurements				
3 months of age				
Bodymass (kg)	123,9 ± 21,6	116,6 ± 19,3	123,6 ± 16,1	NS
Height (cm)	85,3 ± 4,1	83,7 ± 4,5	85,1 ± 3,6	NS
Depth (cm)	42,2 ± 2,9	41,0 ± 2,7	41,7 ± 1,9	NS
Length (cm)	93,9 ± 5,0	92,8 ± 5,8	95,4 ± 5,2	NS
6 months of age				
Bodymass (kg)	201,0 ± 26,1	193,4 ± 22,4	205,6 ± 22,2	NS
Height (cm)	97,6 ± 3,9	95,1 ± 3,2	97,1 ± 2,9	NS
Depth (cm)	49,3 ± 2,2	48,6 ± 1,8	48,8 ± 1,6	NS
Length (cm)	110,7 ± 5,1	110,2 ± 5,2	112,1 ± 3,7	NS
12 months of age				
Bodymass (kg)	226,3 ± 31,0	210,5 ± 27,7	224,8 ± 23,5	NS
Height (cm)	106,3 ± 3,3	103,0 ± 4,5	105,7 ± 2,9	1,3 > 2
Depth (cm)	53,4 ± 2,4	52,3 ± 2,2	53,2 ± 1,8	NS
Length (cm)	118,0 ± 4,2	116,9 ± 4,0	120,2 ± 4,3	NS
18 months of age				
Bodymass (kg)	314,4 ± 33,2	303,6 ± 31,9	313,8 ± 21,8	NS
Height (cm)	112,7 ± 3,2	110,0 ± 4,2	112,1 ± 2,7	NS
Depth (cm)	59,1 ± 2,2	58,0 ± 2,5	58,5 ± 1,9	NS
Length (cm)	128,3 ± 3,9	129,1 ± 5,3	131,2 ± 5,3	NS
Number of animals	8	8	8	
26 months of age				
Bodymass (kg)	361,5 ± 33,5	342,3 ± 33,7	361,3 ± 25,0	NS
Height (cm)	119,5 ± 3,1	116,4 ± 5,4	117,0 ± 2,8	NS
Depth (cm)	62,9 ± 2,1	61,3 ± 4,1	62,7 ± 1,9	NS
Length (cm)	137,6 ± 2,6	133,8 ± 4,0	135,9 ± 5,5	NS
31 months of age				
Bodymass (kg)	414,4 ± 36,5	387,5 ± 41,4	404,9 ± 24,2	NS
Height (cm)	122,1 ± 2,3	120,6 ± 3,8	121,5 ± 2,9	NS
Depth (cm)	65,4 ± 2,6	65,2 ± 3,1	65,3 ± 2,4	NS
Length (cm)	143,4 ± 4,1	140,6 ± 5,5	141,0 ± 6,6	NS

[a]NS = Not significant; $P < 0,05$

the steers castrated at 3 months of age was consistently lower than those castrated within 24 h or at 6 months of age. This was evident for all the recordings, i.e. from 3 months to 31 months of age. Had there been more animals per treatment it may be postulated that more differences would have differed significantly, because in some cases the differences did approach significance (Table 1). These results are in agreement with an earlier study by Meaker & Liebenberg (1982) where more animals were used, but where the animals were slaughtered at between 12 and 13 months.

The relationship between withers height and the age at castration demonstrated by Meaker & Liebenberg (1982) was also confirmed in his study. Early castration (within 24 h after birth) clearly resulted in greater withers height at 1, 2 and 3 years of age. This is in agreement with Bonsma (1973) who stated that the ossification of the epiphysis of the long bones is dependent upon the secretion of testosterone in the case of the bull. Thus, the secretion of testosterone in the male causes the long bones to ossify and the overall growth of the animal is stopped. On the other hand, if ossification is delayed, the animal continues to grow and becomes taller and taller (Bonsma, 1973).

Similarly to the live body measurements, with the exception of marbling at 3 years of age, there was no significant difference between feedlot performance and carcass measurements for steers that were castrated within 24 h after birth, at 3 months, or at 6 months of age, and slaughtered either at 2 or 3 years of age (Table 2). However, it would appear from Table 2 that early castration (within 24 h after birth) resulted in the carcasses having a higher marbling score and greater fat thickness on the eye muscle. In fact, if the actual carcass grades recorded in this trial are pooled for each treatment and then considered (16 carcasses per group), it was found that 12, 11 and 8 carcasses attained the highest rating (SA/PB) for steers castrated within 24 h after birth, at 3 months and at 6 months of age, respectively. It is obvious therefore that early castration not only improved the marbling score but also carcass grading. These results agree with the findings of Meaker & Liebenberg (1982) where the animals were slaughtered at 12 to 13 months. Champagne, Carpenter, Hentges, Palmer & Koger (1969) in a comparable study found birth castrates to have the most fat cover over the eye muscle but, although insignificant, the marbling score was lower than for the 2- and 7-month castrate groups. Therefore, except for the 3-month castrates in this study, it would appear that there was no difference in carcass characteristics, feedlot performance and live body measurements attributable to age at castration.

Possible reasons for the 3-month castrates to consistently show the poorest growth rates when compared with the other two castrated groups are difficult to find because it is probably due to an interaction between the adenohypophyseal hormones, growth or somatotropic hormone and hormones secreted by the adrenal cortex.

The interstitial cells of Leydig in the testicles which produce testosterone are not numerous in a child, but they are numerous in a newborn infant and also in the adult male. At both these times the testes secrete large quantities of testosterone (Guyton, 1967). It may be possible that the same conditions exist in the beef animal. Therefore, it may be postulated that,

Table 2 Average feedlot performance and carcass measurements of steers castrated either within 24 h after birth, at 3 or at 6 months of age and half of which were slaughtered at either 2 or 3 years of age

Feedlot performance and carcass measurements per animal	Age at castration			Level of significance
	Within 24 h Group 1	3 months Group 2	6 months Group 3	
Number of animals	8	8	8	
Age at slaughter				
2 years of age				
Initial live bodymass (kg)	316,8 ± 45,3	300,6 ± 35,1	317,8 ± 23,1	NS
Final live bodymass (kg)	456,1 ± 42,3	440,3 ± 36,3	441,9 ± 21,6	NS
Average daily gain (live) (kg)	1,33 ± 0,14	1,35 ± 0,17	1,30 ± 0,20	NS
Initial calculated carcassmass (kg)	158,4 ± 22,7	150,3 ± 17,6	158,9 ± 11,5	NS
Final carcassmass (kg)	234,8 ± 21,9	231,1 ± 18,8	234,9 ± 16,9	NS
Average daily carcass gain (kg)	1,51 ± 0,24	1,47 ± 0,26	1,66 ± 0,17	NS
Carcass length (cm)	125,9 ± 5,1	124,5 ± 4,3	127,8 ± 2,6	NS
Eye muscle area (cm^2)	55,9 ± 8,2	58,1 ± 3,4	58,7 ± 5,5	NS
Marbling (5 points)	2,56 ± 0,94	1,94 ± 0,86	1,75 ± 1,10	NS
Fat thickness on eye muscle (cm)	1,20 ± 0,24	1,15 ± 0,29	0,90 ± 0,21	NS
Gross return (R)	514,10 ± 48,03	506,16 ± 41,18	514,38 ± 36,95	NS
3 years of age				
Initial live bodymass (kg)	412,9 ± 41,9	393,3 ± 42,8	412,0 ± 23,4	NS
Final live bodymass (kg)	522,4 ± 33,7	493,9 ± 42,3	516,0 ± 24,7	NS
Average daily gain (live) (kg)	1,69 ± 0,20	1,57 ± 0,24	1,63 ± 0,35	NS
Initial calculated carcassmass (kg)	206,4 ± 20,9	196,6 ± 21,4	206,0 ± 11,7	NS
Final carcassmass (kg)	258,6 ± 19,8	249,0 ± 21,0	253,8 ± 19,0	NS
Average daily carcass gain (kg)	0,81 ± 0,09	0,81 ± 0,14	0,75 ± 0,23	NS
Carcass length (cm)	125,6 ± 2,6	122,5 ± 4,4	126,1 ± 2,1	NS
Eye muscle area (cm^2)	62,5 ± 6,3	61,5 ± 4,8	63,0 ± 7,3	NS
Marbling (5 points)	2,75 ± 0,93	1,81 ± 0,59	1,63 ± 0,83	1 > 3
Fat thickness on eye muscle (cm)	1,14 ± 0,33	0,98 ± 0,28	0,98 ± 0,26	NS
Gross return (R)	556,19 ± 45,69	531,85 ± 39,39	531,54 ± 38,48	NS

NS = Not significant; $P < 0,05$

if an animal is castrated soon after birth, this may trigger or stimulate the adrenal cortex to produce larger quantities of androgenic hormones, which would exhibit the same effects in the body as the male sex hormone testosterone. On the other hand, should an animal be castrated at 3 months, the interstitial cells in the testes have greatly decreased in number and little stimulation of the adrenal cortex has taken place, resulting in less testosterone and adrenal androgens being produced. Castration at 6 months, however, allows for sufficient testosterone to be produced to increase musculature and to unite the epiphyses of the long bones with the shafts so that further growth of the bones cannot occur. This phenomenon was evident in the study conducted where the 6-month castrates were consistently smaller (height at withers, Table 1) than the other two castrate groups.

The reasons discussed for the below-average performance of the 3-month castrates may at this stage be partially theoretical. Therefore, it is important for more basic research to be conducted, which should include the monitoring of hormone levels, to investigate the complex mechanisms by which hormones govern growth in the castrated animal.

Although an economic analysis may seem inappropriate because the majority of variables under investigation did not differ significantly, it would seem obvious from these results as well as those recorded by Meaker & Liebenberg (1982) that the growth performance to weaning of the 3-month castrates were consistently inferior to the other two castrate groups. In fact, the bodymass improvement to weaning varied between 4,5% (castrated at 6 months, 1983) and 10,2% (castrated within 24 h after birth in 1980). For the purposes of this calculation, the improvement in growth rate to weaning attributable to castration at 6 months or soon after birth compared to 3 months, will be 5%. Furthermore, as this economic analysis is based on many assumptions it is only fair to be conservative throughout.

According to the Department of Agriculture Economics and Marketing (1984) there were 3,0767 million beef cows over 2 years in white areas in South Africa at 31 August 1984. On a national basis and assuming a 50% weaning rate, 50% male to female ratio, 50% of producers castrating at approximately 3 months of age and an estimated weaning mass of 180 kg per steer, this would result in 69 225 000 kg live weaner mass produced. Assuming a 5% improvement if these steers are castrated soon after birth as compared to 6 months, an additional 3 461 250 kg or R4,3 million (at 125c/kg live bodymass) would be generated for the primary producers.

References

BONSMA, J.C., 1973. Judging for functional efficiency. In: Factors Affecting the Calf Crop. University of Florida Press, Gainesville.

CHAMPAGNE, J.R., CARPENTER, J.W., HENTGES, J.F., PALMER, A.Z. & KOGER, M., 1969. Feedlot performance and carcass characteristics of young bulls and steers castrated at four ages. *J. Anim. Sci.* 29, 887.

DEPARTMENT OF AGRICULTURAL ECONOMICS AND MARKETING, 1984. Composition of herd for livestock in white areas of the RSA as at the 31 August 1984. Directorate Agricultural Economic Trends, Pretoria.

GUYTON, A.C., 1967. Textbook of Medical Physiology. W.B. Saunders Company, Philadelphia.

MEAKER, H.J. & LIEBENBERG, G.C., 1982. Live and carcass characteristics of bulls and steers castrated at three different ages. *S. Afr. J. Anim. Sci.* 12, 375.

TURTON, J.D., 1969. The effect of castration on meat production from cattle, sheep and pigs. In: Meat Production from Entire Male Animals. J. & A. Churchill Ltd., London.