Due to the importance of natural service in the beef cattle industry and the fact that growth rate and scrotal circumference are both considered in the selection of young bulls, information on the relationship between growth and scrotal circumference would be helpful. Body weight affects scrotal circumference and is a function of birth weight, preweaning and postweaning growth rate, and age, all of which may influence testis development. It is evident that the preweaning stage is the most critical period for testicular development. Consistency of testes, a minimum scrotal circumference and previous level of nutrition can be taken into account when evaluating bulls. Scrotal circumference is easily measured, highly heritable and favourably related to semen quality. Scrotal circumference has little influence on libido. Scrotal circumference is a more reliable parameter for sexual development in B. indicus than in B. taurus breeds.

INTRODUCTION

Recently, emphasis on the natural service ability of breeding bulls has increased. Scrotal circumference as an indicator of testes size, is highly correlated with sperm production in growing bulls. (Coulter, 1982; Curtis and Amann, 1981). Bosman (1981) reported highly significant correlations of $r = 0.69$ between scrotal circumference and semen quality and $r = 0.81$ between scrotal circumference and quantity of sperm produced. A soft consistency of the testes can be related to semen quality and sperm production and is clearly related to testicular size in young bulls (Hahn, Foote and Cranch, 1969). Scrotal circumference is an important component in examining beef bulls for breeding soundness. Many factors such as breed, age, season and body weight influence testes size or scrotal circumference (Fields, Burns and Warnick, 1979; Makarechian, Farid and Berg, 1984; Venter, van Zyl and Tami, 1984). Body weight affects scrotal circumference and is a function of birth weight, preweaning- and feedlot growth rate, and age, all of which may influence testes development. A large variation in pregnancy rate as a result of differences in bull fertility was indicated (Parish, Wiltbank, Smith and Morris, 1979). The main factors causing variation in bull fertility were lack of libido, small scrotal circumference and unsatisfactory semen. Much greater selection pressure is put on growth rate and feed efficiency. Information on the relationship between growth rate and scrotal circumference would be helpful because growth rate and testes size are both considered in the selection of young bulls. The objective of this review is to discuss the relationship between growth parameters and scrotal circumference in young beef bulls.

THE INHERITANCE OF FERTILITY

In farm animals genes determining female characteristics appear mainly on the x-chromosome while male characteristics are transmitted through genes on the y-chromosome. In addition, genes on the autosomes including modifying genes as...
well as genotype environment interaction may play a role. It is accepted that genes may affect fertility in three general ways:

(a) Single gene pairs with great effect like hypoplasia or aplasia of the gonads or parts of the reproductive tract.
(b) Heritable endocrine disturbances or the predisposition to such disturbances like the eunochoidal bull.
(c) Many gene pairs contributing in an additive and/or non-additive manner towards the general constitution, health and fertility of the animal.

It follows that grades of masculinity and fanility could be expected in a population and hence the importance of clear sexual dimorphism in fertility evaluation. The genetic basis and heritability of male fertility characteristics are reasonable well researched and it can be concluded that sires and age had a significant influence on most of the semen traits like the concentration, vigor and normal sperm. (Brinks, 1962). Heritability values appear to be well above those reported for fertility estimates in the female, which stresses the importance of male fertility evaluation in promoting herd fertility. Semen characteristics has been reported to be favourable heritable, with estimates ranging from 0.17 for percentage sperm alive to 0.28 for semen concentration (Brinks, 1962). Most of the physical soundness traits are highly heritable, with estimates around 0.60 for scrotal circumference, defects of the prepuce, testicles, epididymis as well as feet and leg defects (Brinks, 1962; Latimer, Wilson, Cain and Stricklin, 1982). As scrotal circumference is related to breeding capacity, therefor applying a minimum culling level is reasonable. An attempt can be made to recommend the culling of bulls with a circumference smaller than 30 cm above 12 months of age.

**SCROTAL CIRCUMFERENCE AND SEMEN QUALITY**

Various factors may influence testicular development and semen quality. Breed differences in testicular growth and consistency was reported (Coulter, Larson and Foote, 1975) while the heritability for scrotal circumference was 0.67 and for testicular consistency 0.34. (Coulter, Rounsaville and Foote, 1976). One of the most important factors that influence semen quality is under-development of the testes.

As in the human two main types of hypogonadism may be distinguished namely: Primary hypogonadism which is a defect of the testes proper and secondary hypogonadism as result of unsufficient gonadotrophic stimulation. In the latter case the bull will demonstrate the typical features of the eunochoid. Bulls with exceptional growth performance should carefully be scrutinized for testicular development.

The identification of obvious hypoplasms present no problem. Norms for the evaluation of bulls for maximum fertility however, means that factors affecting testicular growth should be considered carefully. Out of 224 Santa Gertrudis bulls, 1.8% had a scrotal circumference of less than 30 cm and few heifers exposed to these bulls became pregnant. Scrotal circumference has little influence on libido (Pahrish, Wiltbank, Genho and Sprott, 1979).

Various factors have been identified to affect testicular development.

**BREED, LIVEWEIGHT AND GROWTH**

The correlations between scrotal circumference and growth parameters for different breeds are presented in Table 1. The regression of scrotal circumference on
TABLE 1. The correlation coefficients for scrotal circumference with growth parameters in Simmental, Santa Gertrudis and Hereford bulls (Swanepoel, Heyps & Van Zyl, 1985).

<table>
<thead>
<tr>
<th>Growth Parameter</th>
<th>Correlation between scrotal circumference and growth parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Simmentaler bulls</td>
</tr>
<tr>
<td>Initial Mass</td>
<td>0,3214&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>ADG</td>
<td>0,1323</td>
</tr>
<tr>
<td>ADA</td>
<td>0,1473&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>FCR</td>
<td>0,0611</td>
</tr>
<tr>
<td>Final Mass</td>
<td>0,3879&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Age</td>
<td>0,1504&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

ADG = Average daily gain  
ADA = Average daily gain per day of age  
FCR = Feed conversion ratio  
a = p < 0,01  
b = p < 0,05  

Figure 1. Regression of scrotal circumference on body mass for Afrikaner, Hereford, Simmental, Bonsmara, Nelore and Santa Gertrudis bulls.
livemass for six breeds of beef bulls are presented in Figure 1.

Tami (1982) concluded that a smaller standard deviation for Afrikaner, Bonsmara and Nelore bulls indicates that scrotal circumference is a more reliable parameter for sexual development in B. indicus and synthetic breeds than in B. taurus breeds. According to the regression equations in Figure 1 breed type differences also exist in the rate of scrotal circumference increase. Both B. taurus (Hereford and Simmentaler) had a relatively low rate of scrotal circumference increase when compared to the B. indicus (Afrikaner and Nelore). The regression equations also demonstrate that differences exist between the two synthetic (Santa Gertrudis and Bonsmara) breeds. The Bonsmara follows the B. indicus with a relatively high rate of scrotal circumference increase, while the Santa Gertrudis follows the B. taurus. These differences may be due to the genetic composition of the two breeds, the Bonsmara 5/8 B. indicus and 3/8 B. taurus, while the Santa Gertrudis is the opposite.

Regarding the results presented in Table 1 it is evident that highly significant correlations (P<0.01) exist between the initial body mass and scrotal circumference and between final mass and scrotal circumference for the different breed of bulls. Significant correlations (P<0.05) exist between scrotal circumference and age and between scrotal circumference and average daily gain per day of age (ADA), which can be explained because ADA is a function of age and, in addition, body weight and age are positively correlated in young animals.

Although the relationships of scrotal circumference with average daily gain (ADG) and feed conversion ratio (FCR) respectively seems to be non-significant, it can not be disregarded from a biological point of view, seeing that ADG influenced testicular growth and contributed to the higher association between final mass and scrotal circumference for Hereford, Simmentaler and Santa bulls. Johnson, Robinson and Dillard (1974) reported a high association between preweaning growth and testicular development in beef bulls. The results indicated that it would be unlikely for beef bulls with small testes to be selected for breeding when preweaning gain was considered in the selection program. This also explains the significant correlation between scrotal circumference and average daily gain per day of age (ADA), but non-significant between scrotal circumference and average daily gain (ADG), because ADA included preweaning gain. It is evident that the preweaning stage is a critical period for testicular development. Bulls with inferior testicular development at a young age showed an increase in scrotal circumference with both age and body mass, but those bulls with superior development at a relatively young age maintained that advantage throughout life (Venter, Van Zyl and Tami, 1984). Thus the probability of finding bulls with smaller than average testes among bulls selected for weaning weight would be smaller than in bulls selected on growth rate in a feedlot test.

**LEVEL OF NUTRITION**

Young bulls are performance tested under various nutritional regimes, periods and ages. Sexual development as measured by total length of penis, testicular mass, testicular circumference and mass of the vesicula seminales was not significantly affected by divergent nutritional regimes. (Venter, 1970). Bulls initially on a low level of nutrition tended to show some consistent reduction in sexual development in this investigation.

The question arises whether a certain minimum testicular circumference is sufficient for evaluation purposes, or whether the relationship between testes circumference and semen quality is quadratic after a certain minimum circumference is
reached. In a group of bulls where the scrotal circumference varied above 30 cm no correlation between scrotal circumference and semen quality could be detected, indicating that variation in testicular size may be unimportant above 30 cm (Tami, 1982).

CONCLUSION

Because of the importance of natural service in the beef cattle industry and the fact that growth rate and scrotal circumference are both considered in the selection of young bulls, the need for quick, reliable methods to evaluate functional efficient bulls in terms of breeding soundness and growth potential is pointed out. Consistency of testes, a minimum scrotal circumference at a specific age for individual breeds and previous level of nutrition can be taken into account. Scrotal circumference is easily measured, highly heritable and favourably related to semen quality. Preweaning gain was the most important factor in the association between body mass and scrotal circumference. Scrotal circumference apparently has little influence on libido.

REFERENCES:


