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# Relationship Between Testicular Measurements, Body Weight and Semen Quality in Young Dairy Bulls

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**Andersson, M. and M. Alanko: Relationship between testicular measurements, body weight and semen quality in young dairy bulls. Acta vet. scand. 1992, 33, 15-20.** – Dairy bulls, 322 Ayrshires (Ay) and 85 Friesians (Fr), were studied at the age of 11 months. Of the bulls, 286 Ay-bulls and 80 Fr-bulls produced semen of acceptable quality for use in A.I. Scrotal circumference, tonometer measure, scrotal fold thickness, 1-year body weight and testicular palpation were used to predict unsuitable bulls for A.I. Non-return rate was used as a measure of fertility.

Scrotal fold thickness and 1-year weight had no significant correlation with fertility or semen quality. Scrotal circumference had a significant positive correlation with fertility. Tonometer ratio had a significant negative correlation with fertility. Testicular palpation was the best basis for predicting bulls with poor semen quality in this study. Twelve bulls were recorded as having testicles of different sizes, 1 testicle being more than 20 % bigger than the other. Only 2 of these 12 bulls produced semen of acceptable quality. One of these 2 bulls was, after slaughter, diagnosed as having a hereditary testicle disease. Friesians were shown to have significantly higher fertility than Ayrshires.

## Introduction

In many studies testicular measurements have been evaluated and related to some seminal parameters, usually sperm number, sperm concentration and sperm motility *(Aehnelt et al.* 1964, *Gipson et al.* 1985, *Hahn et al.* 1969a and b, *Rossouw* 1975, *Ruttle et al.* 1982). Many studies show that young bulls with small scrotal circumference have significantly lower fertility than bulls with large scrotal circumference. Bulls with small testicles were shown to have semen with a higher percentage of sperm defects *(Aehnelt et al.* 1964). A soft consistency of the testis is often related to poor semen quality and low fertility *(Aehnelt et al.* 1964, *Haq* 1949, *Roberts* 1956). However, studies to determine the association between testicular measurements and semen quality in dairy bulls have often been based on a small number of observations or on bulls of different age.

In Finland, young bulls are taken from the rearing station to 6 different A.I. stations when they are 1 year old. No semen is collected at the rearing station. Therefore, methods for excluding bulls with unsatisfactory semen quality and low fertility at the age of 11-12 months would be of economic importance. In this study we followed dairy bulls born in 1983 and 1984. The aim was to evaluate the capability of different testicular measurements to select bulls unsuitable for A.I. at the age of about 11 months.

## Material and methods

The material consisted of 322 Ayrshire bulls and 85 Friesian bulls. All the animals were raised at the same rearing station. The bulls were fed good quality hay, silage and concentrate to facilitate measurement of growth characteristics. About 20% of the bulls with inferior growth or unsatisfactory conformation were slaughtered. The remaining bulls were studied at the age of 11 months ± 1 week. The following testicular traits were measured: scrotal circumference, consistency of both testicles using a tonometer (Hajoka, Hannover), scrotal fold thickness using the same cutimeter, and palpation of the testicles to determine any variation in the size of the testicles. The bulls were not sedated but were restrained in a stock to minimize forward, backward and lateral movement during measurement. Testicles were recorded as being of unequal size on the basis of a palpatorial examination (estimated weight difference >20%). All testicular measurements were made by the same investigator. In assessing testicular consistency, only the results of the left testicle were used. This was based on the findings of an earlier study, in which the correlations between tonometer measurements by 2 technicians were greater for the left testicle *(Hahn et al.* 1969a). The bulls were examined once every 2 weeks for 2 years. The influence of the month on scrotal circumference was studied by grouping the bulls according to the month in which measurements were made.

Semen quality was evaluated at 6 bull stations by technicians with several years of experience in daily semen evaluation. Initial progressive motility and semen density were the most important criteria used. Bulls with most ejaculates with less than 60% of progressively motile spermatozoa or less than 0.5 x $10^9$ spermatozoa/ml were discharged because of poor semen quality. The bulls accepted were used in A.I. and the non-return rate within 60 days of the 500 first inseminations (later referred to as NR%) was calculated and used as a fertility parameter. The results for Ayrshires and Friesians were compared. The relationship between testicular measurements and semen quality and NR% was studied in the Ayrshires. For further comparisons the Ayrshires were subdivided into 5 categories according to semen quality, libido, testicular symmetry and fertility. The differences between the categories were compared. Similar classification was not possible for the Friesians due to the small number of animals.

The categories used here were as follows:

A. Bulls accepted for use in A.I. (286 Ayrshires).
B. Bulls with poor semen quality and not accepted for use in A.I. (30 Ayrshires).
C. Bulls with little or no libido and no semen obtained (6 Ayrshires) .
D. Bulls with testicles of different size (12 E. Ayrshires).
E. Bulls accepted for use in A.I. but with low fertility (5 Ayrshires, NR% <55).

All statistical analyses were carried out using the Statgraphics Statistical Software package (Anon. 1985). Analyses of variance, calculation of correlation coefficients and Student's t-test were used to calculate statistical differences.

## Results

*Comparison between Ayrshire and Friesian bulls*

Of the 322 Ayrshires investigated, 286 (89%) produced semen acceptable for use in A.I., compared with 80 out of 85 (94%) for the Friesians. The results for the 2 breeds are

Table 1. A comparison between Ayrshire and Friesian bulls accepted for A. I. with regard to non return rate, 1- year weight and testicular measurements.

| | Breed | |
|---|---|---|
| | Ayrshire N= 286 x±Sd | Friesian N=80 x±Sd |
| NR % | 64,1±3,7*** | 68,2±3,2*** |
| One-year weight (kg) | 454±26*** | 474±24*** |
| Scorotal circumference (cm) | 32,2±1,8 ns | 32,6±1,6 ns |
| Testicular tone | 14,5±0,9*** | 14,1±1,0*** |
| Scrotal fold thickness (mm) | 5,7±1,0** | 5,3±0,8** |

Level of significance *p<0.05 **p<0,01 ***p<0.001
NR % = non return rate.

compared in Table 1. The average NR% was 4.1% higher in the Friesians (p<0.001). The 1-year weight of the Friesians was 20 kg higher than that of the Ayrshires (p<0.001). The average scrotal circumference was larger in the Friesians, but the difference was not significant (32.6 cm vs 32.2 cm). The average tonometer values were lower in the Friesians than in the Ayrshires (14.1 vs 14.5, p<0.001). The average scrotal fold thickness was 5.3 mm for the Friesians and 5.7 for the Ayrshires (p<0.01).

*Results and comparison for different categories of Ayrshire bulls*

A. Bulls accepted for use in A.I. (286 Ayrshires). Bodyweight was found to have no influence on fertility. The relationship between scrotal circumference (SC) and fertility is presented in Table 2. There was a positive correlation between SC and fertility (correlation coefficient R = 0.134, p<0.05).

The month during which measurements were made had no influence on scrotal circumference. The relationship between tonometer ratio and fertility is presented in Table 3. A significant negative correlation was found between testicular tone and fertility (correlation coefficient = -0.176, p<0.01). There was

Table 2. Scrotal circumference and fertility (NR %) in 286 Ayrshire bulls (Mean±SD)

| Sc (cm) | NR % Mean±SD | Number of bulls |
|---|---|---|
| <29 | 61.7±3.8 | 6 |
| 29-30 | 63.9±4.3 | 38 |
| 31-33 | 64.0±4.0 | 176 |
| >33 | 64.7±2.2 | 66 |
| | | 286 |

Table 3. Tonometer ratio and fertility (NR %) in 273 Ayrshire bulls.

| Tonometer ratio | NR % Mean±SD | Number of bulls |
|---|---|---|
| (Soft) 12 | 64.9±4.3 | 4 |
| 13 | 65.3±2.2 | 26 |
| 14 | 64.5±3.1 | 89 |
| 15 | 63.9±3.6 | 126 |
| 16 | 62.3±6.6 | 27 |
| 17 | | 0 |
| (Firm) 18 | 64.1 | 1 |

Table 4. Comparison between 6 categories of Ayrshire bulls. One-year weight, scrotal circumference, testicular tone and scrotal fold thickness.

| Bull category | N (bulls) | One-year weight (kg) Mean±SD | Scrotal circumference (cm) Mean±SD | Tonometer ratio Mean ±SD | Scrotal fold thickness (mm) Mean±SD |
|---|---|---|---|---|---|
| A. Bulls accepted for use in A. I. | 286 | 454±26 | 32.2±1.8[a] | 14.5±0.9 | 5.7±1.0 |
| B. Bulls with poor semen quality | 30 | 459±23 | 32.5±2.2 | 14.4±0.7 | 5.4±1.0 |
| C. Bulls with poor libido | 6 | 439±24 | 32.3±1.6 | 14.7±0,5 | 5.0±1.0 |
| D. Bulls with testes of different sizes | 12 | 457±28 | 34.1±2.8[b] | 14.5±0.7 | 5.6±1.0 |
| E. Bulls with low fertility | 5 | 439±26 | 31.0±2 | 15.0±0.7 | 6.2±1.1 |

a-b: Level of significance $p<0.001$.

no correlation between thickness of the scrotal fold and fertility.

B. Bulls with poor semen quality and not accepted for use in A.I. (30 Ayrshires). No statistical differences were found between group A and B in any of the parameters measured (Table 4).

C. Bulls with poor libido (6 Ayrshires). There were no statistical differences between group A and group C in any of the parameters measured (Table 4).

D. Bulls with testicles of different size (12 Ayrshires). The 1-year weight was equal to that of the accepted bulls. Scrotal circumference was significantly larger than that of group A (see Table 4). Tonometer values and scrotal fold thickness did not differ between group A and group D (Table 4). Bulls with asymmetric testicles often had 1 testicle of normal size and 1 bigger than normal. Only 2 out of 13 bulls in this group produced semen of acceptable quality. When examined after slaughter, many of these bulls proved to have accumulation of rete testis fluid due to impaired drainage of testicular fluid to the epididymis. One bull had segmental aplasia of the epididymis. Malformation of the epididymis was found in 1 bull and traumatic injury of 1 testicle in one bull.

E. Bulls with low fertility (5 Ayrshires). No statistical significant differences were seen in any of the parameters between group A and group E (Table 4).

## Discussion

Friesian bulls were shown to have a higher NR% than Ayrshire bulls. This means that either Friesian bulls are more fertile than the Ayrshire bulls or the Friesian cows are more fertile than Ayrshire cows. A combination of these factors might also be possible. Friesian bulls had a higher 1-year weight, but their average testicular tonometer measure was lower than that of the Ayrshire bulls. The

much higher number of Ayrshires might have affected the validity of the comparison.

It is of economic importance to screen out bulls with semen of low quality at an early stage. According to *Downey et al.* (1984), the scrotal circumference is smaller in summer than in winter (northern hemisphere), being negatively correlated with day length to a significant degree. In this study no correlation was found between measurement month and scrotal circumference. One explanation for the disagreement may be that the bulls in our study were kept indoors all year round.

The scrotal circumference was positively correlated with fertility, which is in accordance with the results achieved by *Aehnelt et al.* (1964), *Coulter & Foote* (1979), *Jakubiec* (1983) and *Ruttle et al.* (1982). Scrotal circumference should be measured to identify bulls with testicular hypoplasia. In this study, no bulls with testicular hypoplasia were found. In another study, testicular hypoplasia has been observed more frequently *(Eriksson* 1952).

The tonometer results published by *Hahn et al.* (1969a), could not be repeated in our study. In *Hahn's* study, measures were taken at an older age (17-150 months). In the material presented here, a significant negative correlation between testicular tone and fertility was found in Ayrshire bulls. However, in our study the tonometer value was measured about 1 month before the onset of semen collection. In another previous study, no significant correlation was found between tonometer measurements and conception rates, sperm production or sperm motility *(Rossouw* 1975). In view of these conflicting findings we conclude that a tonometer should not be used to select young dairy bulls of the Ayrshire breed for A.I.. The only examination in the present study correlating with semen quality was palpation of the testicles. Only 2 out of 13 bulls with testicles of different sizes produced semen of acceptable quality. Many of these 13 bulls were shown after slaughter to have accumulation of rete testis fluid, which is considered to be a hereditary disease among Ayrshires *(Andersson & Alanko* 1991). Measurement of scrotal circumference is a useful way to identify bulls with testicular hypoplasia at the age of 11 months (SC <26 cm in dairy bulls). Evaluation of testicular size by palpation seemed to be the most accurate testicular measure. Bulls with 1 testicle obviously bigger than the other at the age of 11 months are not likely to produce semen of acceptable quality. They may have a testicular disease of hereditary, traumatic or infectious origin.

In conclusion, we suggest that testicular palpation (including epididymides) and measurement of scrotal circumference are 2 useful methods for identifying dairy bulls that are unsuitable for artificial insemination.

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**Sammanfattning**

*Sambandet mellan testikelmått, levanade vikt och spermakvalitet hos ungtjurar av mjölkras.*

Vid en ålder av 11 månader undersöktes 322 Ayrshire tjurar och 85 tjurar av Frisisk ras. Av dessa tjurar producerade 286 Ay-tjurar och 80 Fr-tjurar sperma av för semin godkänd kvalitet. Skrotumsäckens omkrets, tonometervärdet, scrotumsäckens tjocklek, kroppsvikten vid 1 års ålder samt palpation av testiklarna testades som parametrar att välja ut tjurar olämpliga för semin. Icke omlöparprocenten användes som fertilitetsmått.

Varken skrotumhudens tjocklek eller tjurens vikt vid 1 års ålder var signifikant korrelerade till fertiliteten. Skrotumsäckens omkrets var signifikant positivt korrelerad till fertiliteten. Tonometervärdet hade en signifikant negativ korrelation till fertiliteten. Palpation av testiklarna var den bästa metoden för att identifiera tjurar med dålig spermakvalitet i denna studie. Tolv tjurar konstaterades ha testiklar av olika storlek, där den större testikeln var mer än 20% större än den mindre. Av dessa 12 tjurar producerade endast 2 sperma av godkänd kvalitet. En av dessa 2 tjurar konstaterades efter slakt att ha en ärftlig testikelsjukdom. Den frisiska rasen visade sig ha en signifikant högre fertilitet än Ayrshire rasen.

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