


# Andrological characteristics of young beef bulls of different breeds in Hungary

O. VARGA-BALOGH\* , E. BALOGH, L. KERN, G. HOLLÓ,  
H. NAGYNÉ KISZLINGER, B. PÓTH-SZEBENYI and  
SZ. T. NAGY

Institute of Animal Sciences, Hungarian University of Agriculture and Life Sciences, Hungary

Received: 9 October 2025 • Revised manuscript received: 12 January 2026 • Accepted: 12 January 2026  
Published online: 31 March 2026

Acta Veterinaria  
Hungarica

74 (2026) 2, 134–138

DOI:  
10.1556/004.2026.01256  
© 2026 The Author(s)

## RESEARCH ARTICLE



### ABSTRACT

This study examines the andrological characteristics of young beef bulls from various breeds in Hungary. Data were collected from 1,714 bulls between April 2018 and December 2024, with 1,198 bulls included in the analysis after exclusions. The research focused on breeds such as Angus, Blonde d'Aquitaine, Charolais and Limousine, assessing fertility through bull breeding soundness evaluations (BBSE). Physical exams, including scrotal circumference and semen quality analysis, were performed to determine breeding potential. Based on the results, andrological characteristics of young beef bulls are given. Mean scrotal circumference for bulls aged 10–14 months was  $35.98 \pm 2.73$  cm. Total motility of sperm cells was above 30%, while progressive motility was above 50%. The mean of spermatozoa with normal morphology was more than 80%. The study highlights the importance of selecting fertile bulls to improve herd fertility and compares key andrological traits across different breeds.

### KEYWORDS

beef bull, andrology, scrotal circumference, sperm motility, sperm morphology

## INTRODUCTION

Beef breeding and production do not have a long history in Hungary, since the division of milk and meat production dates back to 1972. Before that, the main cattle breed was the dual-purpose Hungarian Simmental ([Cabinet Council Decision 1025/1972, 1972](#)). Initially, Hungarian Simmental was crossed with English and French beef breeds imported to Hungary (Charolais, Hereford, Angus, Limousin, etc.). Since then, the pure-breeding of these breeds has been increasing (KSH Database). In the last decade, Hungarian beef breeders have focused on improving fertility. The first and most important step to increase fertility in beef herds is using bulls with good fertility.

Reliable methods to assess reproductive potential, such as the bull breeding soundness evaluation (BBSE), is essential in ranch management ([Menegassi et al., 2015](#)). Performing a BBSE before the breeding season decreases the risk of having subfertile or infertile bulls in the herd. Yearling bull producers should remember that the purpose of BBSE testing is to increase the percentage of cows in a pasture that become pregnant during a breeding season. A field study showed at least a 5% higher pregnancy rate in cow herds exposed to bulls that passed fertility tests compared to herds exposed to unselected bulls. The study also found that simply adding more unselected bulls does not compensate for this difference ([Schrag and Larson, 2016](#)). Clinical andrological examination of a sire not only checks the normality of testicular and epididymal function and the male's genital tract but also evaluates its potential breeding capacity. Semen analysis is a vital part of this screening, helping identify clear cases of infertility or potential sub-fertility ([Rodríguez-Martínez, 2007](#)). Among the traits assessed during a physical exam, scrotal circumference and semen quality parameters such as motility and morphology are the most correlated with fertility ([Parkinson, 2004](#)).

\*Corresponding author.  
E-mail: [varga-balogh.orsolya.gabriella@uni-mate.hu](mailto:varga-balogh.orsolya.gabriella@uni-mate.hu)

Breed differences exist in average scrotal circumference and these averages change over time. Currently, no breed-specific standards are recommended for use in the United States (or even in Europe) when conducting a BBSE (Schrag and Larson, 2016).

In our study, the main andrological characteristics of young bulls from different breeds were determined and compared.

## MATERIAL AND METHODS

### Animals

Examinations were conducted between April 2018 and December 2024 in Hungarian beef herds. During this period, 1,714 BBSEs were performed. Due to missing data, physical abnormalities, diseases, etc., 516 bulls were excluded from the study. Bulls aged 10–14 months were included, representing Angus ( $n = 70$ ), Blonde d'Aquitaine ( $n = 73$ ), Charolais ( $n = 86$ ) and Limousine ( $n = 377$ ).

### Examinations

The routine BBSE was performed on each animal. Every bull was examined while in stocks. First, a physical examination was conducted, including assessment of the legs, skin, overall condition and external sexual organs. Afterwards, photographs were taken of the head and the scrotum (testes) of individual bulls for identification purposes. Measurements of the scrotal circumference and the length of both the left and right testes were also recorded by the same operator using the same method (using a measure band).

The structure of the testes and epididymis was examined using ultrasound with a 6 MHz linear transducer (Draminski IScan, Draminski Poland). Additionally, a rectal ultrasound was performed on the seminal vesicles. Images of these structures were captured.

To collect ejaculates, rectal massage was performed. All sperm samples were collected into a double-walled glass cup (maintained at 38 °C) and examined on site for motility. In some cases, ejaculation was too dense; in these instances, 100 µL of Triladyl (Triladyl<sup>®</sup> CSS One-step, Ref.: 13500/1200, Minitube, Germany (pre-heated to 38 °C) was added to the sample. A Mobile CASA system with pre-set bovine settings (OnGo, Microfluidlabs Ltd., Hungary) was used to gather data on progressive and total motility, as well as the rate of non-motile spermatozoa (min. of 300 sperm cells

have been measured). All data were saved onto a USB drive. From the ejaculate, 100 µL was measured into an Eppendorf tube filled with a mixture of 4% buffered formaldehyde and gelatin. These samples were transferred to the laboratory for DIC (differential interference contrast, 400× magnification) examination to assess sperm morphology. The percentage of normal cells, as well as sperm with proximal or distal droplets, tail abnormalities, or detached heads, was documented (based on Barth and Oko, 1989). All data were stored in an Excel file.

### Statistical analysis

The scrotal circumferences, the length of the left and right testis of the bulls, and the sperm motility were compared between breeds, using a Generalised Linear Model (GLM). The comparison of the recorded proportions of normal and abnormal spermatozoa (proximal and distal droplets, simple coiled tails, tightly coiled tails or twisted tails and detached head) per individual was examined using the GLIMMIX procedure to assess differences between breeds, for each trait. Statistical analysis was performed using SAS Studio. The results of all tests were evaluated at a 5% significance level.

## RESULTS

Mean scrotal circumference (SC) in 10–14 month-old bulls was  $35.98 \pm 2.73$  cm. The mean length of the left testes was  $19.05 \pm 2.13$  cm, and the right testes measured  $19.02 \pm 2$  cm. Scrotal measurements by breed are shown in Table 1.

There were significant differences in SC between Angus, Blonde d'Aquitaine and Limousin bulls. SC did not differ between Angus and Charolais bulls, nor between Blonde d'Aquitaine and Limousin bulls. The length of both the left and right testes was significantly smaller in Limousin bulls than in other breeds.

Mean and SD of sperm motility are shown in Table 2.

Progressive motility was significantly higher in Angus bulls than in Blonde d'Aquitaine and Limousin bulls, but no significant difference was found with Charolais bulls. No significant differences were found in the rate of total motility and non-motile sperm cells.

Results of sperm morphology examinations are shown in Table 3.

There were no significant differences in the rate of normal spermatozoa, proximal droplets, tightly coiled or bent tails, or in detached heads. The rate of sperm cells with

Table 1. Mean and standard deviation of scrotal circumference, length of left and right testis (cm), in different breeds of young bulls (different letters indicate significant differences at  $P < 0.05$ )

Scrotal measurements	Angus ( $n = 70$ )	Blonde d'Aquitaine ( $n = 73$ )	Charolais ( $n = 86$ )	Limousin ( $n = 377$ )
SC (cm)	$36.95 \pm 2.23^a$	$35.44 \pm 2.89^b$	$36.75 \pm 2.96^a$	$35.69 \pm 2.64^b$
Length of left testis (cm)	$19.68 \pm 1.96^a$	$20.09 \pm 2.13^a$	$20.59 \pm 2.33^a$	$18.34 \pm 1.77^b$
Length of right testis (cm)	$20.19 \pm 1.9^a$	$19.66 \pm 1.63^a$	$20.34 \pm 2.13^a$	$18.31 \pm 1.74^b$

Table 2. Sperm motility of young bulls from different breeds (means and standard deviations; different letters indicate significant differences at  $P < 0.05$ )

Motility	Angus ( $n = 70$ )	Blonde d'Aquitaine ( $n = 73$ )	Charolais ( $n = 86$ )	Limousin ( $n = 377$ )	Total ( $n = 606$ )
Progressive motility (%)	48.07 ± 24.54 <sup>a</sup>	33.1 ± 24.94 <sup>b</sup>	36.56 ± 25.98 <sup>ab</sup>	37.84 ± 26.72 <sup>b</sup>	38.44 ± 26.53
Total motility (%)	70.04 ± 22.52 <sup>a</sup>	57.15 ± 26.99 <sup>a</sup>	60.13 ± 26.57 <sup>a</sup>	60.87 ± 27.46 <sup>a</sup>	61.28 ± 27.01
Non-motile (%)	30.39 ± 22.99 <sup>a</sup>	42.85 ± 27 <sup>a</sup>	39.87 ± 26.57 <sup>a</sup>	38.86 ± 27.35 <sup>a</sup>	38.58 ± 26.91

Table 3. Sperm morphology results of young bulls from different breeds (means and standard deviation; different letters indicate significant differences;  $P < 0.05$ )

Sperm morphology	Angus ( $n = 70$ )	Blonde d'Aquitaine ( $n = 73$ )	Charolais ( $n = 86$ )	Limousin ( $n = 377$ )	Total ( $n = 606$ )
Normal (%)	84.43 ± 6.04 <sup>a</sup>	85.12 ± 9.44 <sup>a</sup>	87.49 ± 13.87 <sup>a</sup>	86.07 ± 13.30 <sup>a</sup>	86.41 ± 12.94
Proximal droplet (%)	6.61 ± 4.84 <sup>a</sup>	4.22 ± 3.40 <sup>a</sup>	4.22 ± 6.15 <sup>a</sup>	5.38 ± 10.36 <sup>a</sup>	4.88 ± 8.26
Distal droplet (%)	4.33 ± 1.21 <sup>ab</sup>	4.54 ± 2.60 <sup>a</sup>	3.06 ± 2.45 <sup>b</sup>	3.54 ± 3.37 <sup>b</sup>	3.52 ± 3.03
Simple coiled tails (%)	4.19 ± 1.33 <sup>ab</sup>	4.65 ± 3.10 <sup>a</sup>	4.64 ± 2.98 <sup>ab</sup>	4.36 ± 3.12 <sup>b</sup>	4.47 ± 2.98
Tightly coiled tails (%)	5.14 ± 1.62 <sup>a</sup>	6.66 ± 4.80 <sup>a</sup>	7.37 ± 7.20 <sup>a</sup>	6.33 ± 5.60 <sup>a</sup>	6.63 ± 5.99
Bent tails (%)	4.35 ± 2.45 <sup>a</sup>	3.91 ± 1.80 <sup>a</sup>	4.34 ± 2.89 <sup>a</sup>	4.03 ± 2.98 <sup>a</sup>	4.15 ± 2.84
Detached head (%)	3.02 ± 1.99 <sup>a</sup>	4.12 ± 3.89 <sup>a</sup>	5.25 ± 6.57 <sup>a</sup>	3.80 ± 3.67 <sup>a</sup>	4.35 ± 5.02

distal droplets and simple coiled tails was significantly higher in Blonde d'Aquitaine bulls than in Limousin bulls.

## DISCUSSION

Fertility defines the performance of a beef herd. The most important factor affecting fertility in a beef herd is the reproductive performance of the breeding bull. It is well-documented that bull selection influences herd performance; therefore, using reliable methods such as the bull breeding soundness evaluation (BBSE) to evaluate reproductive potential is essential in ranch management. The BBSE is considered a quick, reliable and cost-effective method. A properly performed and interpreted evaluation offers a valuable management tool to reduce the risk of sub-fertile bulls in the herd (Menegassi et al., 2015). For example, a Texas study concluded that bulls who “pass” a BBSE and/or related semen quality tests have a 6% or greater fertility advantage over unevaluated bulls (Chenoweth and McPherson, 2016). Irons et al. (2007) stated that bulls classified as satisfactory for breeding soundness achieved a 9% higher pregnancy rate. Another field study demonstrated a >5% greater pregnancy percentage in cow herds exposed to bulls passing fertility tests versus herds exposed to untested bulls (Schrag and Larson, 2016).

In our study, the mean scrotal circumference in 10–14-month-old beef bulls was 35.98 ± 2.73 cm. Persson (2007) stated that measurement of the scrotal circumference (SC) is an accurate predictor of both testicular weight and sperm output and for yearling bulls, SC should be at least 30 cm (Persson, 2007). Alexander (2008) and Higdon et al. (2000) also reached the same conclusions for bulls younger than 15 months. There is much data on the minimum SC for beef bulls aged 12–15 months, but only a few studies

show differences between breeds. Menegassi et al. (2012) stated that rejection criteria for SC were lower than 30 cm in young bulls of synthetic, continental and British breeds. Many authors set the threshold for SC at 30 cm for bulls of any *Bos taurus* breed between 12 and 15 months of age (Hopkins and Spitzer, 1997; Higdon et al., 2000; Garcia-Paloma, 2015; Alexander, 2008). García Guerra et al. (2013) summarized mean SC corrected to 365 Days of Age; results were 34.55 ± 2.82 cm in Charolais bulls and 31.52 ± 2.22 cm in Limousin bulls.

Based on our results, the largest SC was measured in Angus and Charolais bulls, while Blonde d'Aquitaine and Limousin bulls had significantly smaller SC in the 10–14 month age range. This aligns with the findings of Hafla et al. (2012), who measured the largest SC in Angus bulls (34.6 cm). Waldnera et al. (2010) measured an average of 36.4 ± 2.31 cm in 1-year-old Charolais bulls, which is similar to our findings (36.75 ± 2.96 cm). However, Schrag and Larson (2016) reported an average of 35.55 ± 2.82 cm, which is smaller than our measurement. Smaller SC has also been described for Angus and Limousin bulls. García Guerra et al. (2013) summarized mean SC corrected to 365 days of age; results were 34.55 ± 2.82 cm in Charolais bulls and 31.52 ± 2.22 cm in Limousin bulls, which are also smaller than our parameters. These differences could be due to the larger age range in our study. Garcia-Paloma (2015) stated that bulls belonging to breeds with larger mature size usually have larger testicles than bulls of smaller breeds, but based on our results, this does not appear to be true, since the largest SC was measured in Angus bulls, which are smaller than Limousin, Charolais or Blonde d'Aquitaine bulls. SC could be an important piece of information for breeders, as it has a relatively strong correlation to fertility (Persson, 2007; Novotná et al., 2022). Since heritability of SC is moderate to high ( $h^2 = 0.41–0.57$ ; in another study

0.27—Novotná et al., 2022), it has been suggested that rapid improvement in testicular size and its associated effects can be achieved through selection. The scrotal circumference is correlated with many productive and reproductive traits of bulls and their offspring. A relationship has been established between scrotal circumference and the quantity and quality of semen produced, as well as growth traits of the bull. It was also found that daughters of bulls with slightly above-average scrotal circumference reached sexual maturity and experienced first calving earlier than daughters of bulls with average or below-average scrotal circumference (Novotná et al., 2022).

In our study, the average total sperm motility was above 57%. According to the literature, spermatozoa motility should be at least 30% in young bulls (Higdon et al., 2000; Alexander, 2008). Progressive motility was highest in Angus bulls ( $48.07 \pm 24.54$ ), while Blonde d'Aquitaine ( $33.1 \pm 24.94$ ) and Limousin bulls ( $37.84 \pm 26.72$ ) had significantly lower progressive motility. Hafla et al. (2012) also reported higher progressive motility for Angus bulls (48.2%).

The mean rate of spermatozoa with normal morphology was 83.1% in the present study. We found no breed differences, similar to Kleshchev et al. (2018). A nearly identical rate ( $83.44 \pm 10.6$ ) was reported by Waldner et al. (2010), too. According to many reviews, one of the most accepted definitions of a normal spermiogram is that at least 70% of the spermatozoa should be normal (Higdon et al., 2000; Alexander, 2008; Hafla et al., 2012; Chenoweth and McPherson, 2016). Bulls with less than 15% proximal cytoplasmic droplets and less than 15% abnormal sperm heads were considered to have a mature semen profile (Higdon et al., 2000; Persson, 2007; Alexander, 2008). We observed a low rate of sperm morphology defects, which could indicate that these bulls were mainly examined after reaching puberty, because Garcia-Paloma (2015) described that the percentage of normal sperm during puberty is low, with proximal cytoplasmic droplet (PCD) being the primary defect. However, two months later, the droplets disappear and semen usually reaches maturity ( $\geq 60\%$  sperm motility and  $\geq 70\%$  normal sperm) (Garcia-Paloma 2015).

In conclusion, we present the mean SC, length of the left and right testes, mean sperm motility and morphological rates for 10–14 month old beef bulls from different breeds in Hungary. Additionally, we observed differences in SC, length of the left and right testes, progressive motility, and the rate of distal droplets and simple coiled sperm tails among breeds. Significant differences in SC have been observed among Angus, Blonde d'Aquitaine, and Limousin bulls, while no differences have been found between Angus and Charolais or between Blonde d'Aquitaine and Limousin bulls. Limousin bulls had significantly shorter left and right testes than the other breeds. Progressive motility was significantly higher in Angus bulls compared with Blonde d'Aquitaine and Limousin bulls, whereas total motility and the proportion of non-motile spermatozoa did not differ. Most sperm morphological traits showed no significant differences; however, Blonde d'Aquitaine bulls exhibited a

higher proportion of spermatozoa with distal droplets and simple coiled tails than Limousin bulls.

## REFERENCES

- Alexander, J. H. (2008): Bull breeding soundness evaluation: a practitioner's perspective. *Theriogenology* **70**, 469–472.
- Barth, A. D. and Oko, R. J. (1989): *Abnormal Morphology of Bovine Spermatozoa*, Iowa State University Press, Ames, Iowa, USA, pp. 89–281.
- Cabinet Council Decision 1025/1972 (VII.30): About the development programme of the cattle breeding and tasks according to it. *Tanácsok Közlönye* **36**, 660–662.
- Chenoweth, P. J. and McPherson, F. J. (2016): Bull breeding soundness, semen evaluation and cattle productivity. *Anim. Reprod. Sci.* **169**, 32–36.
- García Guerra, A., Hendrick, S. and Barth, A. D. (2013): Increase in average testis size of Canadian beef bulls. *Can. Vet. J.* **54**(5), 485–490.
- Garcia-Paloma, J. A. (2015): A bull breeding soundness evaluation system with greater emphasis on scrotal circumference. *Pesq. Vet. Bras.* **35**(9), 817–821.
- Hafla, A. N., Lancaster, P. A., Carstens, G. E., Forrest, D. W., Fox, J. T., Forbes, T. D. A., Davis, M. E., Randel, R. D. and Holloway, J. W. (2012): Relationships between feed efficiency, scrotal circumference, and semen quality traits in yearling bulls. *J. Anim. Sci.* **90**, 3937–3944.
- Higdon, H. L., Spitzer, J. C., Hopkins, F. M. and Bridges, W. C. (2000): Outcomes of breeding soundness evaluation of 2898 yearling bulls subjected to different classification systems. *Theriogenology* **53**, 1321–1332.
- Hopkins, F. M. and Spitzer, J. C. (1997): The new Society for Theriogenology breeding soundness evaluation system. *Vet. Clin. North Am Food Anim. Pract.* **13**(2), 283–293.
- Irons, P. C., Nothling, J. O. and Bertschinger, H. J. (2007): Bull breeding soundness evaluation in Southern Africa. *Theriogenology* **68**, 842–847.
- Kleshchev, M. A., Petukhov, V. L. and Osadchuk, L. V. (2018): Semen quality and diversity of morphological sperm abnormalities in bulls: breed and strain effects. *Vavilovskii Zh. Genet. Sel.* **22**(8), 931–938.
- Menegassi, S. R. O., Barcellos, J. O. J., Peripolli, V., Borges, J. B. S. and Bernardi, M. L. (2012): Causes of rejection of beef bulls in breeding soundness evaluation. *R. Bras. Zootec.* **41**, 1648–1653.
- Menegassi, S. R. O., Barcellos, J. O. J., Peripolli, V., Dias, E. A., Costa, Jr J. B. G., Vieira, M. M. and Moojen, F. G. (2015): Reproductive success or failure in four breed groups of beef bulls. *R. Bras. Zootec.* **44**(7), 240–247.
- Novotná, A., Brzáková, M., Birovaš, A. and Veselá, Z. (2022): Genetic evaluation of the scrotal circumference of beef bulls in the Czech Republic. *Czech J. Anim. Sci.* **67**(9), 349–355.
- Parkinson, T. J. (2004): Evaluation of fertility and infertility in natural service bulls. *Vet. J.* **168**, 215–229.
- Persson, Y. (2007): *Breeding soundness evaluation of young beef bulls*. Doctoral Thesis Swedish Univ. Agric. Sci. Uppsala, Acta Uni. Agri. Sue. **18**.

Rodriguez-Martinez, H. (2007): State of the art in farm animal sperm evaluation. *Reprod. Fertil. Dev.* **19**, 91-101.

Schrag, N. and Larson, R. (2016): Yearling bull breeding soundness examination, special considerations. *Vet Clin Food Anim.* **32**, 465-478.

Waldner, C. L., Kennedy, R. I. and Palmera, C. W. (2010): A description of the findings from bull breeding soundness evaluations and their association with pregnancy outcomes in a study of western Canadian beef herds. *Theriogenology* **74**, 871-883.