Use of ultrasonography as an auxiliary predictive method in the reproductive evaluation of bulls

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ABSTRACT

Brazil is the leader in beef exports, being one of the largest producers in the world, in addition to occupying the third position of the world's largest milk producer. To obtain such status, it is necessary to make a large investment in the area of animal production, especially with regard to genetics, nutrition and health. The genetic improvement of breeding stock is one of the most important and necessary factors, because it directly contributes to the efficiency of production and reproduction of animals. Currently, the selection of animals aiming at sexual precocity is considered one of the strategies with a direct impact on the profitability of cattle farming. Methodologies for the analysis of reproductive characteristics have always been renewed, and among them, ultrasonography was considered a safe, non-invasive technique that allows monitoring the morphology and functionality through the echogenicity presented, without causing any risk to the integrity of the bull's reproductive system. This technique can be used as an indicator of sexual precocity, since pubertal animals appear to have a more hyperechoic testicular parenchyma when compared to prepubertal animals of the same age, and this fact can be explained by the changes that occur in the testicular parenchyma due to the onset of puberty and spermatogenesis. The use of ultrasonography is of paramount importance as a complementary diagnostic method in the andrological examination, as it facilitates the choice with greater precision and precocity of bulls that are already suitable for reproduction.

Keywords: Ultrasonography, Bulls, Genetic Improvement.

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INTRODUCTION

Brazil is the leader in beef exports, being one of the largest producers in the world (ABIEC, 2023). According to the Brazilian Institute of Geography and Statistics (IBGE), in 2022 the country had about 234 million head of cattle. And according to the most recent data, 8.93 million head of cattle were slaughtered in the third quarter of 2023 alone, representing a record since 1997, when the historical series of the survey began. The country not only occupies a prominent position in beef cattle, the dairy sector is of full importance since the country occupies the position of the third largest producer in the world and constantly shows growth in milk production (Silva *et al.*, 2023). According to the IBGE, 6.23 million liters of raw milk were produced in the third quarter of 2023.

The genetic improvement of breeding stock has been playing a role of extreme importance and necessity, contributing to improve and increase productivity and, consequently, profitability in cattle breeding. The evaluation of reproductive fitness and fertility has been of great value for the process of genetic improvement, and currently several producers seek more and more sexual precocity from their bulls (Silva *et al.*, 2020) because, in addition to the bull producing viable semen earlier, its service time will also increase, producing more offspring. Animal reproduction biotechniques are of great value for genetic improvement and reproductive efficiency through the selection of superior animals in the herd (Sousa *et al.*, 2020).

The use of males that have proven fertility and are genetically superior is one of the most important tools for those who want to increase the productivity rates of the herd. The number of females covered is directly related to the fertility of the herd (Neto, 2011). It should be noted that with the use of semen for artificial insemination, a bull can have a much higher number of 60 offspring/year while the cow produces only one calf per year (Sousa *et al.*, 2020)tag. According to the Brazilian Association of Zebu Breeders (ABCZ) in 2011, there were few improved herds directed to the breeding of breeders, however, it is estimated that this shortage of breeding bulls will be met only in the medium to long term. However, it is necessary that knowledge about the genetic improvement of bulls be disseminated in order to become a primary subject in reproductive and productive management.

Puberty is characterized as the phase in which all the reproductive organs of the animal undergo a structural transformation due to the beginning of the function of sperm production, not only this, but the circulation of male hormones and gonadal concentrations are compatible with adult animals. And among the reproductive indices, one of the most important is age at puberty. Several factors influence this, such as environmental, management and nutrition, however, age at parturition, maternal ability and breed of the father are closely related, both in males and females, to the age of onset of puberty (Neto, 2011).

The appropriate selection of the sire is important for the transmission of the desired characteristics, however, effective transmission depends on several factors that include libido, copulation capacity, and semen quality (Nunes, 2018; Ribeiro, 2018). The choice of the precocious mother and father in mating is of paramount importance to give rise to precocious offspring. The age at puberty of zebu is very advanced, around 25 to 28 months of age, much higher when compared to taurines, which are around 12 to 14 months (Neto, 2011).

The andrological examination aims to evaluate the reproductive potential of the animal, seeking not only to visualize the fecund capacity but also its ability to mount, being considered a fast and economical method for evaluating the reproductive potential of the bull (Nunes, 2018; Ribeiro, 2018; Neto, 2023).

According to Lima (2009), the measurement of the scrotal circumference should be a basic point for the selection of sires since it allows the selection of earlier animals and indicates the potential for sperm production, since young bulls with a larger girth tend to be younger than the age to enter puberty. This statement corroborates with Palmer (2016), where he reports that it is an easy trait to measure, associated with the animal's fertility and highly heritable. It is positively correlated with seminal production and age, which have a greater effect on the development of the scrotal circumference in young bulls, due to the rapid testicular growth up to two years of age, which varies from 2 to 3 centimeters (Lopes *et al.*, 2016; Nunes 2018; Kerts *et al.*, 2017).

The role that the male plays in production is decisive since a single bull is responsible for mating a large number of females, therefore, it is of great value to carry out the reproductive evaluation through the andrological examination, in order to prevent those considered questionable or unfit from representing production losses. Attention to the result and interpretation of the andrological examination is essential, since it is not because an animal was considered "fit for reproduction" that in the future its performance cannot be affected by some trauma or disease, as well as a "Questionable for reproduction" will not become fit in the future (Ribeiro, 2018).

Genetic diversity in sires allows for a significant selection differential and high genetic potential. For the selection of the sires of a herd of high zootechnical value, the parameters of the scrotal circumference, clinical evaluation of the male genital system, together with the values of the seminal evaluation, have been fundamental in the choice of quality bulls. Selection based on scrotal circumference is related to reproductive and ponderal traits in males due to their high heritability. In genetic improvement programs, it is essential to carry out a correct and thorough andrological evaluation of these animals (Mendonça *et al.*, 2019).

Ultrasonography (USG) is a non-invasive technique that allows real-time image visualization, making it possible to monitor the functionality and morphology of the organ and has been widely used as a tool that assists in reproductive management (Balaro, 2019). Using this technique does not

entail any risk to the reproductive integrity of the bull, and it is still possible to correlate echogenicity with sperm production in the testicular parenchyma (Sousa *et al*., 2020). In addition to also allowing an accurate and early diagnosis of pathologies that have not yet been detected on clinical examination or are hidden, reducing or even avoiding damage to the animal's reproductive tract (Pastore *et al.*, 2015; Martinez, 2019).

Cardilli *et al.* (2014) conducted a research on Nellore bulls and stated that ultrasonography is a method that can be used as an indicator of sexual precocity, as pubertal animals have a more hyperechoic testicular parenchyma when compared to prepubertal animals at the same age, and this fact is explained by the onset of puberty and spermatogenesis, which causes changes in the testicular parenchyma. This statement corroborates Aravindakshan *et al.* (2000), who also complement by reporting that this detection technique can also indicate bulls with higher reproductive potential in a herd.

Studies carried out on Nellore bulls report that the echogenicity of the testicular parenchyma and mediastinum, as well as their thickness, increase with the advancement of the animal's life (Cardilli *et al*., 2014). Pastore *et al.* (2015) also allege an increase in the echogenicity of the bladder glands and the correlation between the echogenicity of the testicular parenchyma with the testicular volume and the scrotal circumference, i.e., echogenicity is expected to increase when these variables increase.

The use of this technique is an effective method in the selection of broodstock, since it is possible to predict the sperm production of the animal by measuring the intensity of testicular pixels (TPI). Some studies report that IPT can be used to assess age at puberty, because it increases between 6 and 13 months of age, this fact may be related to the proliferation of cells in the testicular parenchyma that later originate spermatozoa (Martinez, 2018 Mendonça *et al.*, 2019).

Several articles report that the use of ultrasonography as a complementary diagnostic method in the andrological examination is of great importance, since it allows the evaluation of the size, shape, and echogenicity of the internal structures of the male reproductive tract, facilitating the appropriate choice of the most qualified sires for production (Martinez, 2018).

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