

CORRELATION BETWEEN TESTICULAR MORPHOMETRIC MEASURES, SEMINAL QUALITY, LIBIDO, MORPHOLOGICAL CHARACTERISTICS AND TEMPERAMENT OF BREED BULLS “GIR LEITEIRO”

Débora Cristina de Oliveira Martins

Bolsista FAPEMIG – Polo do Leite

Uberaba – Minas Gerais

<http://lattes.cnpq.br/7892437156203047>

Camila de Moraes Raymundo

Faculdades Associadas de Uberaba – FAZU

Grupo Genus/ABS. Uberaba – Minas Gerais

<http://lattes.cnpq.br/1910474344532513>

Fabiana Araujo Rios

Faculdades Associadas de Uberaba – FAZU

Uberaba – Minas Gerais

<http://lattes.cnpq.br/4210866567072293>

Iasmin Midian Ferreira da Costa

Faculdades Associadas de Uberaba – FAZU

Uberaba – Minas Gerais

<http://lattes.cnpq.br/1877197523545734>

André Rabelo Fernandes

Faculdades Associadas de Uberaba – FAZU

Associação Brasileira dos Criadores de “Gir Leiteiro” - ABCGIL. Uberaba – Minas Gerais

<http://lattes.cnpq.br/8494688705380231>

All content in this magazine is licensed under a Creative Commons Attribution License. Attribution-Non-Commercial-Non-Derivatives 4.0 International (CC BY-NC-ND 4.0).



Marcelo da Cunha Xavier

Bio-Biotecnologia em Reprodução Animal
Brasília – Distrito Federal
<http://lattes.cnpq.br/8739105502350545>

Thiago Felipe Braga

Faculdades Associadas de Uberaba – FAZU
Geneal Diagnósticos
Uberaba – Minas Gerais
<http://lattes.cnpq.br/1958352993375388>

Arthur Alves Silva

Faculdades Associadas de Uberaba – FAZU
Uberaba – Minas Gerais
<http://lattes.cnpq.br/9272614867685515>

Fábio Luís Henrique

Faculdades Associadas de Uberaba – FAZU
Uberaba – Minas Gerais
<http://lattes.cnpq.br/2615631361209872>

Abstract: The objective of this study was to evaluate the correlation between testicular morphometric measurements, age, seminal quality, libido, morphological characteristics and temperament of bulls of the breed “Gir Leiteiro”. Data from the 12th edition of pre-selection for the Progeny Test (2021) were analyzed, using 798 information from 42 animals aged between 23 and 35 months. The phenotypic correlations between age, length, width and testicular volume (left and right), scrotal circumference, aspect, seminal volume, motility, vortex, vigor, total, major and minor defects, functional type, libido and temperament were performed by the test. of Pearson’s correlation, at 5% of significance, through the software R Studio version. Positive correlations of high and moderate magnitude (0.40 to 0.93) were observed between the testicular morphometric characteristics studied, and moderate magnitude (0.37) between scrotal circumference and age. Left and right testicular length showed a moderate and negative correlation with major defects (-0.32 and -0.33, respectively). The functional type showed a positive and moderate correlation with right testicular length (0.33), width (0.48) and left testicular volume (0.25) and scrotal circumference (0.48). Libido and total defects were negatively correlated with moderate magnitude (-0.31). Temperament was positively correlated with moderate magnitude with motility (0.44) and vigor (0.46). Therefore, in the animals of the present study, testicular morphometric measurements are shown to be good parameters used in the selection of bulls with better seminal quality and functional type. The physical characteristics of semen were also correlated with libido and temperament, demonstrating the relationship between animal behavior and the seminal characteristics studied in this work.

Keywords: Andrological. Behavior. Improvement. Selection.

INTRODUCTION

In dairy cattle breeding programs, the most important traits to be considered are those related to dairy production. In addition to this, it is essential to evaluate the behavior of reproductive traits, conformation and temperament, for a more assertive selection (WENCESLAU et al., 2000).

To choose animals that have greater reproductive capacity will result in an increase in the ratio of cows per bull, reducing production costs (FONSECA et al., 2020). One of the tools used for this is the andrological examination, which measures the fertility and reproductive potential of a bull (MARIANO et al.; 2015).

Testicular biometry is one of the most used parameters when selecting bulls, as it is easy to measure and correlates with other reproductive characteristics, such as sperm production, and productive characteristics such as body weight (SILVA et al., 2002). Furthermore, testicular volume may be related to thermoregulation and seminal quality (BAILEY et al., 1996).

Another important selection criterion is the functional type, which allows the identification of animals with better conformation, through visual evaluation. This is a low-cost, viable and efficient tool (KOURY FILHO, 2001).

Temperament is a term used to define the animal's reaction to an action. Due to the importance in productive efficiency, this term has been more recognized (SCÁRDUA; BASTOS; MIRANDA, 2009). Some studies show that animals that are less reactive have better reproductive efficiency (CARVALHAL, 2017). Therefore, the study of temperament becomes an important tool to select animals for the production system (CEMBRANELLI et al., 2018).

The investigation of the relationship of visual and morphological traits with

reproductive and behavioral traits can facilitate the selection of breeding animals.

Therefore, the objective of this study was to evaluate the correlation between testicular morphometric measurements, seminal quality, libido, morphological characteristics and temperament of bulls of the "Gir Leiteiro" breed participating in the pre-selection of bulls for the 2021 progeny test.

MATERIAL AND METHODS

The evaluations were carried out at the farm-school of Faculdades Associadas de Uberaba, located in the city of Uberaba-MG. The city is located in the Minas Gerais triangle, in the State of Minas Gerais, with an altitude of 743 meters, south latitude 19°45'27" and west longitude 47°55'36". According to the National Institute of Meteorology (2021), the average temperature is 22°C and the average rainfall of the place is 1571 mm.

We used 798 information from 42 bulls of the "Gir Leiteiro" breed from the 12th edition of pre-selection for the Progeny Test, carried out by the Brazilian Association of Breeders of "Gir Leiteiro" (ABCGIL) and Empresa Brasileira de Pesquisa Agriculture (EMBRAPA). The animals were aged between 23 and 35 months, with an average of 30 months.

The test started in November 2020 and ended in April 2021. The animals were subjected to 15 days of adaptation to the environment and to the batch, remained 5 months with the same treatment, kept in an intensive and rotated system, in paddocks with *Panicum* sp., with mineral supplementation and water ad libitum. Feed management was planned so that the animals consumed 4% dry matter/100kg live weight. Controlled concentrated supplementation was provided.

Data were collected on age, left testicular length (CTE), right testicular length (CTD),

left testicular width (LTE), right testicular width (LTD), left testicular volume (VTE), right testicular volume (VTD), circumference scrotum (SC), aspect (ASP), seminal volume (VOL), motility (MOT), turbulence (TURB), vigor (VIG), total defects (DT), major defects (DMAI), minor defects (DMEN), type functional (TYPE), libido (LIB) and temperament (TEMP).

The collection of semen for the andrological examination and the measurement of testicular morphometric characteristics were performed by an outsourced company registered with the Brazilian Association of Artificial Insemination (ASBIA). The procedures were performed according to the manual for Andrological Examination and Animal Semen Evaluation of the Brazilian College of Animal Reproduction (2013). During the test, two to four collections were made per animal, being carried out in the months of December, February, March and April. In the present work, the last collection of each animal was used. The animals that showed semen freezeability in the second andrological period were no longer evaluated for seminal characters.

For the measurement of EC (cm) an appropriate measuring tape was used, following the methodology described by

Josahkian; Ax; Koury Filho (2003). To measure the length (cm) and width (cm), a caliper was used to measure each testicle (Figure 1).

To calculate testicular volume (left and right, cm³), the formula described by Unaniam et al. (2000), as shown below:

$$\text{Vol} = 2 \left\{ \left(\frac{r}{2} \right)^2 \times \pi \times h \right\};$$

Where r = width/2; h = length (considering only the testes) and $\pi=3.14$. Result in cubic centimeters (cm³).

Seminal quality was analyzed according to the methodology described in CBRA (2013). VOL was obtained in mL. ASP was classified as aqueous (1), milky (2) and creamy (3). The MOT was evaluated between 0 and 100%. TURB and VIG were scored from 0 to 5. The percentages of DMEN and DMAI were also evaluated, the sum of which constituted the DT.

For the functional type characteristics, masculinity, termite, width and inclination of the croup, neck, sacrum, dorso-lumbar region and harmony of the whole set were evaluated. The grade was obtained through the average of the classification carried out by three evaluators, who are part of the college of judges of the zebu breeds, being from 1 to 6 points - where 1 is the worst and 6 the best grade.



Figure 1. Measurements of scrotal circumference, testicular length and width.

Source: Falcão *et al.* (2010).

For the libido test, the bulls were placed individually, for 20 minutes, in a 400m² corral in the presence of 12 females, in different stages of induced estrus. Thus, the sexual performance of males was evaluated, as shown in Table 1.

Notes	Attitude
0	Taurus showed no sexual interest.
1	Sexual interest shown only once (eg, sniffing the perineal region).
2	Positive interest in the female on more than one occasion.
3	Activates female pursuit with persistent sexual interest.
4	One mount or attempted mount, but no service.
5	More than one mount or attempt to mount, but no service.
6	Mounds and service (ejaculation).

Table 1. Classification score for sexual performance of "Gir" bulls in pre-selection test.

Fernandes et al.(2021).

To assess temperament, the vanishing point was used as a scoring parameter (adapted from MOURÃO et al., 1999). The rating scale used is from 1 to 6 points, with 1 being extremely reactive animals and 6 being extremely tame animals.

With the phenotypes collected, the Pearson correlation test was performed, at 5% of significance, using the R Studio version software.

RESULTS AND DISCUSSION

The mean EC was 32.40 ± 2.44 , being considered excellent values according to Fonseca et al. (2020). The averages found for VOL (4.74 ± 2.31), MOT (70.12 ± 7.69), VIG (3.52 ± 0.51), DT (17.13 ± 8.94), DMEN (5.20 ± 4.99) are within the ideal, but the TURB average (2.55 ± 1.04) was lower and the DMAI

(11.93 ± 7.55) was above that proposed by CBRA (2013). For LIB (3.17), TYPE (3.79) and TEMP (4.40) the values found are above average, according to the evaluation criteria of the Pre-Selection Tests of Bulls of the "Gir Leiteiro" breed. (ABCGIL/EMBRAPA).

Table 2 shows the phenotypic correlations between age, CTE, CTD, LTE, LTD, VTE, VTD, CE, ASP, VOL, MOT, TURB, VIG, DT, DMAI, DMEN, TYPE, LIB and TEMP.

It was observed that age presented a moderate positive correlation with CTD (0.42), with CTE (0.38), LTD (0.32), LTE (0.41), VTD (0.41), VTE (0.46) and with EC (0.37), testicular characteristics increase with the age of the animal. Dias et al. (2008) found a high magnitude positive correlation between age and EC in Nellore bulls. According to Bergamann et al. (1996), the testes show rapid growth in the initial phase, a growth spurt in the puberty phase and later, a slower and continuous growth.

EC showed a high positive correlation with CTD (0.53), LTE (0.88), LTD (0.74), VTE (0.81) and VTD (0.77), as well as CTE with CTD (0.93), LTD with LTE (0.74), VTD with VTE (0.80) and LTE with CTD (0.55). It also showed moderate positive correlation with CTE (0.42), as well as LTD with CTD (0.40) and LTE with CTE (0.49). The EC can be a reference to predict the size of the testes of bulls of the Dairy Gir breed. Menegassi et al. (2011) states that EC has a high correlation with testicular volume, tending to a higher seminal production, which is an important characteristic for the selection of young bulls. However, in the present study we did not find a correlation between seminal volume and EC or testicular volume. The seminal volume can be influenced by several factors such as the age of the animal, the method of seminal collection, the number of times semen is collected, breed, environmental temperature (PELLEGRIM et al., 2009).

	CTE	CTD	LTE	LTD	VTE	VTD	CE	ASP	VOL	MOT	TURB	VIG	DT	DMAI	DMEN	TYPE	LIB	TEMP
AGE	0,38*	0,42*	0,41*	0,32*	0,46*	0,41*	0,37*	0,00	-0,09	-0,23	-0,13	-0,20	0,02	-0,14	0,23	0,26	0,02	-0,22
CTE	1,00	0,93*	0,49*	0,23	0,72*	0,51*	0,42*	0,00	0,00	-0,12	-0,20	-0,10	-0,20	-0,32*	0,12	0,25	-0,02	-0,18
CTD	-	1,02	0,55*	0,40*	0,74*	0,66*	0,53*	-0,14	0,03	-0,09	-0,32*	-0,07	-0,20	-0,33*	0,13	0,33*	-0,12	-0,13
LTE	-	-	1,00	0,74*	0,94*	0,79*	0,88*	-0,14	0,18	0,14	-0,05	0,23	-0,11	-0,25	0,19	0,48*	0,06	0,04
LTD	-	-	-	1,00	0,65*	0,94*	0,74*	-0,11	0,23	0,20	-0,06	0,17	0,00	-0,20	0,29	0,14	-0,13	0,10
VTE	-	-	-	-	1,00	0,80*	0,81*	-0,13	0,14	0,10	-0,10	0,16	0,14	-0,30	0,21	0,45*	0,05	-0,03
VTD	-	-	-	-	-	1,00	0,77*	-0,14	0,20	0,15	-0,15	0,15	0,05	-0,26	0,31*	0,20	-0,14	0,02
CE	-	-	-	-	-	-	1,00	-0,10	0,25	0,09	0,00	0,19	-0,19	-0,22	-0,01	0,48*	-0,09	-0,01
ASP	-	-	-	-	-	-	-	1,00	-0,21	-0,06	0,44*	-0,05	-0,16	-0,17	-0,03	-0,17	-0,03	-0,21
VOL	-	-	-	-	-	-	-	-	1,00	0,02	-0,25	-0,10	0,34*	0,21	0,29	-0,09	-0,09	-0,03
MOT	-	-	-	-	-	-	-	-	-	1,00	0,33*	0,52*	-0,03	-0,11	0,11	0,20	0,09	0,44*
TURB	-	-	-	-	-	-	-	-	-	-	1,00	0,14*	-0,34*	-0,25	-0,24	-0,08	0,02	-0,05
VIG	-	-	-	-	-	-	-	-	-	-	-	1,00	-0,07	-0,01	-0,12	0,19	-0,02	0,46*
DT	-	-	-	-	-	-	-	-	-	-	-	-	1,00	0,83*	0,54*	-0,09	-0,20	0,26
DMAI	-	-	-	-	-	-	-	-	-	-	-	-	-	1,00	-0,03	0,03	-0,31*	0,33*
DMEN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,00	-0,21	0,11	-0,02
TIPO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,00	0,03	0,22
LIB	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,00	0,02

CTE: left testicular length; CTD: right testicular length; LTE: left testicular width; LTD: right testicular width; VTE: left testicular volume; VTD: right testicular volume; EC: scrotal circumference; ASP: aspect; VOL: volume; MOT: motility; TURB: whirlpool; VIG: vigor; DT: total defects; DMAI: major defects; DMEN: minor defects; TYPE: functional type; LIB: libido; TEMP: temperament; *p<0.05

Table 2. – Phenotypic correlation coefficients, by Pearson’s test, between AGE, CTE, CTD, LTE, LTD, VTE, VTD, CE, ASP, VOL, MOT, TURB, VIG, DT, DMAI, DMEN, TYPE, LIB and TEMP, for bulls: “Gir Leiteiro”.

The values of correlations between VTD and LTD (0.94) and VTE and LTE (0.94) were similar to those indicated by Dias et al. (2008), being 0.96 for both correlations in Nellore, attesting to the great influence of testicular width on testicular volume.

The DMAI showed a moderate negative correlation with the CTE (-0.32) and with the CTD (-0.33), suggesting that bulls with greater testis length may have a lower number of DMAI. According to Bailey et al. (1996), in zebu breeds it is common to find animals with longer testes, increasing the contact area and better distribution of blood vessels, improving thermoregulation, resulting in better seminal quality characteristics.

The DMEN showed a moderate positive correlation with the VTD (0.31). Pastore et al. (2008) found no correlation between testicular volume and defects. However, in the present study, the animals had a lower mean DMEN (5.20%, that is, ideal), than the presupposition by CBRA (2013). Thus, the greater testicular volume related to the increase in these defects, in this population, does not negatively impact the fertility of bulls.

The DTs expressed a moderate positive correlation with VOL (0.34) and a moderate negative correlation with TURB (-0.34). Thus, according to Pellegrim et al (2009), when spermatogenesis is affected, there are significant changes in cell morphology, compromising sperm viability.

A strong positive correlation of DTs with DMAI (0.83) and DMEN (0.54) was observed, as well as Folhadela et al. (2006) who found a correlation of 0.94, this is explained by the fact that the total defects are the sum of major and minor defects.

MOT showed a strong positive correlation with VIG (0.52), possibly because they are characteristics related to sperm metabolism, so when there is modification, they behave

similarly. (PELLEGRIM et al., 2009). Folhadela et al. (2006) also found a correlation between seminal quality characteristics, such as concentration, vortex, vigor and motility.

TURB showed moderate positive correlation with ASP (0.44) and with MOT (0.33). Pellegrim et al. (2009) show that semen with a creamier appearance has a higher concentration of sperm, increasing the amount of mobile cells and, if there is an increase in turmoil, there will also be motility. In the population studied, there was also a moderate negative correlation between TURB and CTD (-0.32), noting that animals with lower CTD expressed higher TURB. However, the average value found for the TURB (2.55) in this population is below the predicted ideal by CBRA (2013).

TYPE showed moderate positive correlation with CTD, LTE, VTE and CE (0.33 – 0.48). Since among the characteristics evaluated in TYPE is masculinity and neck, it is suggested that some testicular biometrics may influence it. The testes are responsible for the production of testosterone, a hormone secreted by Leyding cells, responsible for the development of the male's secondary characteristics. Testicles with larger measurements will have a greater amount of Leyding cells and greater testosterone secretion (BOLLWEIN; JANETT; KASKE, 2017).

LIB expressed a moderate negative correlation with DMAI (-0.31). Salvador et al. (2003), studying the nelore breed, found no correlation between libido and seminal quality characteristics. These differences may be related to the evaluation methodology, and because they use adult animals with sexual experience. Therefore, libido can be considered for the use of bulls in natural mounting, but it is essential that an andrological evaluation is carried out for selection.

TEMP was positively correlated with moderate magnitude with MOT (0.44), with VIG (0.46) indicating that TEMP-based selection will indirectly influence seminal quality traits. In more reactive animals, there is an increase in plasma cortisol levels, affecting reproductive efficiency (CHACUR, 2010). TEMP also showed a correlation with DMAI, more tame animals have a higher percentage of DMAI, however, despite the average of these defects being above the allowed by CBRA (2013), the DT is within what is considered ideal.

CONCLUSION

In animals: “Gir Leiteiro”, in the present study, the testicular morphometric measurements are shown to be good parameters used in the selection of bulls with better seminal quality and functional type. In the presented work, the seminal quality characteristics presented correlations with each other. The physical characteristics of the semen also correlated with libido and temperament, demonstrating the relationship between the behavior of the animal and the seminal characteristics studied.

REFERENCES

- BAILEY, T. L. *et al.* Testicular shape and its relationship to sperm production in mature Holstein bulls. **Theriogenology**, v. 46, n. 5, p. 881-887, 1996.
- BERGMANN, J.A.G. *et al.* Estimativas de parâmetros genéticos do perímetro escrotal e do peso corporal em animais da raça Nelore. **Arquivo Brasileiro de Medicina Veterinária e Zootecnia**, v. 48, n. 1, p. 69-78; 1996.
- BOLLWEIN, H.; JANETT, F.; KASKE, M. Effects of nutrition on sexual development of bulls. **Animal. Reproduction**. v. 14, n. 3, p. 607-613, 2017.
- CARVALHAL, M. V. de L. **Temperamento de bovinos da raça girolando: técnicas de avaliação e suas relações com desempenho produtivo e reprodutivo**. Orientador: Mateus José Rodrigues Paranhos da Costa. 2017. 95 p. Dissertação (Doutorado em Zootecnia) - Faculdade de Ciências Agrárias e Veterinárias, UNESP. Jaboticabal, 2017.
- CEMBRANELLI, M. A. R. *et al.* **Programa de melhoramento genético da raça girolando 6ª prova de pré-seleção de touros**. Embrapa Gado de Leite, Juiz de Fora, p.15-18, 2018.
- CHACUR, M. G. M. *et al.* Influence of one nutraceutic on semen, testosterone, cortisol, eritrogram and body weight in young bulls *Bos taurus indicus*. **Semina: Ciências Agrárias**, Londrina, v. 31, n. 2, p. 439-450, 2010.
- COLÉGIO BRASILEIRO DE REPRODUÇÃO ANIMAL- CBRA. **Manual para exame andrológico e avaliação de sêmen animal**. 3.ed. Belo Horizonte, MG, 2013. 104 p.
- DIAS, C. J. *et al.* Correlações genéticas e fenotípicas entre características reprodutivas e produtivas de touro da raça Nelore. **Pesquisa Agropecuária Brasileira**, v.43, n.1, p.53-59, 2008.
- FERNANDES, A. R. *al.* **PROGRAMA NACIONAL DE MELHORAMENTO DO “GIR LEITEIRO”**. Juiz de Fora: Embrapa Gado de Leite, 2021.
- FOLHADELLA, I. M. *et al.* Características andrológicas de touros da raça Gir. **Arquivo Brasileiro de Medicina Veterinária e Zootecnia**, v.58, n.5, p.809-815, 2006.
- FONSECA, V. O. *et al.* Potencial reprodutivo de touros Nelore avaliados por parâmetros andrológicos e comportamento sexual. Classificação por pontos: nova proposição. **Arquivos Brasileiros de Medicina Veterinária e Zootecnia**. v.72, n.4, p.1102-1212, 2020.
- INMET, Instituto Nacional de Meteorologia. **BDMEP - Banco de Dados Meteorológicos para ensino e Pesquisa**. Disponível em: <http://www.inmet.gov.br/portal/index.php?r=bdmep/bdmep>. Acesso em 27 out. 2021.

JOSAHKIAN, L.A.; MACHADO, C.H.C.; KOURY FILHO, W., 2003. **Programa de melhoramento genético das raças zebuínas – Manual de Operação**. Uberaba, MG: ABCZ, 98 p.

KOURY FILHO, W. **Análise genética de escores de avaliações visuais e suas respectivas relações com desempenho ponderal na raça Nelore**. Orientador: José Bento Serman Ferraz. 2001. 82 p. Dissertação (Mestrado em Zootecnia) - Faculdade de Zootecnia e Engenharia de Alimentos, USP. Pirassununga, 2001

MARIANO, R. S. G. *et al.* Exame andrológico em bovinos: Revisão de literatura. **Nucleus Animalium**, v.7, n.1, 2015.

MENEGASSI, S. R. O. *et al.* Measurement of scrotal circumference in beef bulls in Rio Grande do Sul. **Arquivos Brasileiros de Medicina Veterinária e Zootecnia**, v.63, n.1, p.87-93, 2011.

MOURÃO, G.B. *et al.* Diferenças genéticas e estimação de coeficientes de herdabilidade para características morfológicas em fêmeas zebu e F1 Holandês-Zebu. **Revista Brasileira de Zootecnia**, v.28, p.44-54, 1999.

PASTORE, A. A. *et al.* Biometric, testicular, seminal characteristics and genetic parameters of pertaining bulls to the program of genetic improvement of the nellore race. **Ars veterinária**, Jaboticabal, SP, v. 24, n. 2, 134-141, 2008.

PELLEGRIM, A. O. *et al.* **Fertilidade, Funcionalidade e Genética de Touros Zebuínos**. 1 ed. Corumbá: Embrapa Pantanal; Campo Grande: Embrapa Gado de Corte (2009).

SALVADOR, D. F. *et al.* Avaliação da libido de touros Nelore adultos em curral e sua associação com características andrológicas e desempenho reprodutivo a campo. **Arquivos Brasileiros de Medicina Veterinária e Zootecnia**, v.55, n.5, 2003.

SCÁRDUA, S. S; BASTOS, R.; MIRANDA, C. R. R. Temperamento em bubalinos: testes de mensuração. **Ciência Rural**, v.39, n.2, 2009.

SILVA, A. E. D. F. *et al.* Relação da Circunferência Escrotal e Parâmetros da Qualidade do Sêmen em Touros da Raça Nelore, PO. **Revista Brasileira de Zootecnia**, v.31, n.3, p.1157-1165, 2002.

UNANIAN, M. M. *et al.* Características biométricas testiculares para avaliação de touros zebuínos da raça Nelore. **Revista Brasileira de Zootecnia**, v. 29, n. 1, 2000.

WENCESLAU, A. A. *et al.* Estimação de Parâmetros Genéticos de Medidas de Conformação, Produção de Leite e Idade ao Primeiro Parto em Vacas da Raça “Gir Leiteiro”. **Revista Brasileira de Zootecnia**, Juiz de Fora, v.1, n.29, p.153-158, 2000.