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LIBIDO TEST SCORES, BODY CONFORMATION AND TESTICULAR TRAITS IN BOER AND KIKO GOAT BUCKS

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ABSTRACT

Independent of whether natural mating or artificial insemination is used for breeding, libido (sex drive) is evidently crucial to reproductive competence in all male meat animal species. Breeding goat bucks vary in their levels of libido; therefore, there is a need for the development of a predictive standardized test for estimating sex drive. The objective of this study was to evaluate libido (sex drive) and examine its relationship to body conformation (body condition scores-BCS, chest girth-CG, height at withers-HTW, body length-BL, body weight-BTW) and testicular traits (scrotal circumference-SC and testicular consistency-TC) in two breeds of goat bucks. Eight sexually mature Boer and Kiko bucks (four from each breed) were trained to mount and service a teaser buck. Results show that reaction time in seconds did not differ significantly (P>0.05) between breeds (65.1 ± 11.1 vs. 49.2 ± 7.1 seconds for Boer and Kiko bucks, respectively. Mounting enthusiasm (total mounts), although not significantly (P>0.05) different between the two breeds, appeared to be more evident in Kiko bucks. Mean values for body conformation and testicular traits were 4.25 ± 0.47 vs. 3.43 ± 0.21 (BCS), 51.2 ± 7.1 vs. 45.1 ± 3.6 kg (BTW), 64.1 ± 3.0 vs.65.1 ± 2.2 cm (HTW), 62. 8 ± 5.7 vs. 60.9 ± 3.2 cm (BL), 27.3 ± 3.3 vs.22.8 ± 1.03 (SC) and 4.25 ± 0.25 vs. 3.75 ± 0.23 (TC) for Boer or Kiko bucks, respectively. A highly significant correlation coefficients were established between scrotal circumference and reaction time (r = 0.555, $P < 0.01$). However, reaction time was not significantly (P>0.05) correlated to any body conformation traits (RT vs. BWT, r = 0.048; RT vs. BCS). This study has demonstrated for the first time a relationship between scrotal circumference (testicular size) and libido in male meat animal specie.

Keywords: goat bucks, libido, body conformation, testicular traits, Boer, Kiko.

INTRODUCTION

The Kiko Goat originated from New Zealand by crossing feral goats with dairy goats in the 1980s. Kiko is actually the Maori word for flesh or meat [1]. This breed has been selected solely for survivability and growth rate under commercially farmed conditions [2]. The exact origin of Boer goats is not clear. The name is derived from the Dutch word “Boer” meaning farmer [3]. Boer goats have gained worldwide recognition for excellent body conformation, fast growth rate and good carcass quality [4]. In the southern United States, the major meat goat production system is extensive husbandry, the dominant breeding system is uncontrolled natural mating, both of which can conspire against efficient reproduction and result in low fertility when sub-fertile males are allowed to breed. In such systems, both fertile and infertile male and female goats are kept together in the same grazing/browsing field. This negatively influences flock fertility, be it in a single or multi-herd system. Anecdotal evidence suggest that in places where limited controlled natural mating is practiced, selection of the bucks is usually phenotypically based, while little attention is paid to basic reproductive traits or semen quality examinations. There is no tradition of using assisted reproductive techniques (artificial insemination or embryo transfer) in extensive meat goat production systems [5].

Male fertility is an important factor in caprine reproduction since numerous does are generally bred to a single buck. Hence, evaluation of male fertility prior to breeding is of paramount importance to achieve breeding success. The potential fertility of breeding males can be evaluated in the field by assessment of mating ability, physical examination and a genital tract examination of both the external and internal genitalia (including a scrotal circumference measurement), and semen quality evaluation [6]. These methods are useful for screening out sub-fertile males, although neither allows precise determination of the pregnancy rates that males actually achieve [7]. To avoid the selection of males unwilling or unable to serve females, observations of coitus, libido testing and semen quality evaluation are the main methods of assessing mating ability in the field [8].

Libido refers to sexual motivation, revealed through behaviors such as mate seeking, detection, courtship, and mating (also referred to as servicing or serving), and “fertility” means the ability to produce progeny [8]. Libido is typically measured using the reaction time, defined as the elapsed time between exposure to stimuli and first service [10, 11]. As libido is evidently crucial for fertility, there appears to be a need for the development of a predictive, standardized libido test. This may, however, be unachievable due to the apparent conflicting effects of some of the test factors on libido, such as the use of multiple females and genetic/breed differences [8]. Whilst some of these methods allow reasonable accuracy in determining the fertility potential of an individual male, they do not take into account other management constraints to male fertility. Although these are reasonably well understood for beef or dairy cattle herds, the management factors that affect the performance of natural service sires in meat goat herds have not been properly investigated. Breeding soundness examination (BSE) is thus valuable, and probably represents the most practical tool with which to select the potentially best

breeding male animal in a flock, as demonstrated in beef bulls [see review by 9]. Libido testing is an integral part of the breeding soundness evaluation (BSE). However, such examinations are still uncommon for small ruminants in general and goat bucks in particular.

Numerous studies have shown that testicular growth and development is closely related to body size [12, 13]. Other reports have investigated various phenotypic measurements [14, 15, 16 17, 18], and their suitability for use as selection criteria in meat goat genetic improvement programs. For Boer and Kiko bucks, information is almost non-existent with regard to the relationships between body conformation, testicular traits and reproductive performance under semi-temperate conditions. Given the increasing socio-economic importance of goats and the increased requirements for proper goat husbandry, which demands the best breeding bucks for profitable production, a functional BSE system, which incorporates libido test scores, body conformation or testicular traits evaluation, is needed. In essence, the breeding potential of any buck can be considered to depend upon both its ability to mate and its ability to produce progeny. Field assessments can be made of a buck's ability to mate, physical capability to mount, intromission achievement and ejaculation. Assessments can also be made of the quality of semen that the buck produces, which is, in turn, related to physical characteristics of its genitalia. Yet whilst it is relatively easy to assess such traits in the field, their value as predictors of bucks' fertility unfortunately remains the subject of considerable debate.

The objective of this study was to evaluate libido (sex drive) and examine its relationship to body conformation traits (body condition scores-BCS, chest girth-CG, height at withers - HTW, body length-BL, body weight- BTW) and testicular traits (scrotal circumference-SC and testicular consistency - TC) in Boer and Kiko bucks.

MATERIALS AND METHODS

Animal management

Eight sexually mature bucks (Boer, n = 4 and Kiko, n = 4) (BW = 44. 5± 2.2 kg; age = 9-12 months) were trained to mount and service a teaser buck. The ages of the bucks were determined from birth records. Animals were housed at the Tuskegee University Caprine Research Unit, Tuskegee, Alabama, U.S.A. They were fed a daily diet containing 45% Bermuda grass hay plus 55% concentrates with *ad libitum* access to water. Tuskegee University Animal Use and Care Committee approved the protocol for this study.

Libido testing

Libido was assessed at weekly intervals for four weeks by reaction time in seconds as described by [6]. Briefly, reaction time was recorded, measured as the amount of time between first contact with the teaser buck and the first false mount with the penis erected (expressed in seconds). Mounting enthusiasm was scored from – 2 to + 2: - 2 = buck does not mount, - 1 = buck mounts by sliding, 0 = mounting between sliding and jumping, +1 = buck mounts by jumping, +2 = buck jumps with great enthusiasm.

Body size and testicular measurements

The body weight of the animals was recorded using a scale, body condition score (BCS) was evaluated subjectively (ranging from 1= emaciated to 5= obese). Shoulder width (SW) was determined with the aid of a cloth tape, as the horizontal distance between the processes on the left shoulder and those of the right shoulder blade [19]. Chest girth (CG) was measured with the aid of a measuring tape around the chest, just behind the front legs; body length (BL) was measured from the sternum to the aitch bone and hip width (HW) was measured using a plastic measuring tape, while height at wither (HTW) was measured vertically from thoracic vertebrae to the ground using a metal ruler.

Scrotal measurements

Scrotum shape (normal ovoid or long ovoid), scrotum anatomy (undivided or split) and degree of testicular symmetry (symmetrical or not) were visually assessed. The Scrotal Circumference (cm) is the most accurate indicator of testicle size; measurements were taken at the largest diameter of the scrotum with a flexible tape placed around the scrotum after both testicles have been positioned beside each other in the scrotum. The scrotal content was palpated and scored for freely moving testicles, testicular tone and consistency (1 = very soft, 2= soft, 3 = normal, 4 = hard or 5 = very hard).

Statistical analysis

Descriptive statistics (Statistix7, 2000, Analytical Software, Tallahassee, FL) was performed on the data to determine normality. Pearson correlation coefficients were calculated to determine the phenotypic correlation between libido, selected body measurements and testicular parameters. Separate models (linear and multiple) were developed to determine the combination of testicular traits (scrotal circumference and weight) or body dimensions (chest girth, body condition score and height at withers) that explains variation in the dependent variable (BW).

However, only results, utilizing the following regression model are reported:

$$Y = a + b (x)$$

Where Y = body weight, X = chest girth, body condition score, body length, scrotal circumference, scrotal weight or height at withers. A = intercept and B = regression coefficients of Y on X.

RESULTS AND DISCUSSIONS

A descriptive statistics of Libido test scores, body conformation, weight and testicular morphormetric traits in Boer and Kiko bucks is presented in Table-1. Overall libido test scores (reaction time) did not differ significantly ($P>0.05$) between breeds (65.1 ± 11.1 vs. 49.2 ± 7.1 seconds) for Boer and Kiko bucks respectively.

Mean values for body conformation and testicular traits were 4.25 ± 0.47 vs. 3.43 ± 0.21 (BCS), 51.2 ± 7.1 vs. 45.1 ± 3.6 kg (BTW), 64.1 ± 3.0 vs.65.1 ± 2.2 cm (HTW), 62. 8 ± 5.7 vs. 60.9 ± 3.2 cm (BL), 27.3 ± 3.3 vs.22.8 ± 1.03 (SC), and 4.25 ± 0.25 vs. 3.75 ± 0.23 (TC) for Boer or Kiko bucks respectively. For both breeds, highly significant (P<0 01) correlation coefficients were established between BTW and CG (r = 0.982 - Boer) and (r = 0.986 - Kiko), BTW and SC (r = 0.897 - Boer), and (r = 0.793-Kiko, Table-2), indicating strong relationships between these variables. Libido test scores were not related to either body conformation or testicular traits (P>0.05) (Table-2).

Table-3 shows the regression equation including the coefficient of determination (R^2) for both Boer and Kiko bucks. The R^2 indicated that both CG and HTW succeeded in describing more variations in body weight than any other body conformation traits in both breeds. CG and HTW accounts for 94% and 86% of the variation in body weight in Boer bucks respectively. For Kiko bucks, they account for 95% and 97% of the variation respectively. As an individual measurement, CG was the best predictor of body weight in Boer bucks, while the situation is revised in Kiko buck with HTW being the best predictor of bodyweight. Also, for Boer bucks, BTW accounted for 70% of the variation in scrotal circumference (SC) and only 44% in Kiko bucks (Table-3).

Overall, the reaction time differed neither significantly between individual Boer and Kiko bucks, nor between both breeds during the weekly tests, although a tendency was noticed within the Boer bucks toward a slower reaction with increasing test duration in weeks. Mounting enthusiasm (total mounts), although not significantly (P>0.05) different between the two breeds, appeared to be more evident in Kiko bucks, thus illustrating an obvious increase in mounting enthusiasm as the test period increases (weeks 1- 4). This confirms the fact that libido test scores of Kiko bucks were not lower than those of Boer bucks, and that the extreme muscularity of the Boer bucks did not make them more willing and able to mate naturally than Kiko bucks.

To the best of our knowledge, results of libido evaluations and breeding soundness in Boer or Kiko meat goat bucks have never been published. However, [20, 21] reviewed literature and data on bull sexual behavior, and demonstrated that genetics play a large role in determining libido. Studies show that in *Bos indicus* and *Bos taurus*, cross-bred bulls generally exhibited higher libido scores in pen-tests than did their parental purebreds, providing further evidence of genetic influence on libido [22, 23]. Differences in libido scores were also observed between breeding lines and sires-within-lines in young bulls of British breeds [24], and sire strongly influenced serving capacity in young Angus bulls [25]. A heritability estimate of 0.59 ± 0.16 was obtained for serving capacity in a study of 157 paternal half-sibling bull groups in Australia [26], whilst in another Australian study of 251 Santa Gertrudis, 208 Belmont Red and 189 Hereford bulls, significant heritability estimates for mounts of 0.29 ± 0.14 and 0.57 ± 0.25 were found across all breeds and for Santa Gertrudis bulls respectively, but services were not demonstrated to be heritable [27]. In summary, there is evidence of genetic effects on libido and inherent fertility differences between individual males, especially in beef and dairy bulls. A number of reports indicate that *B. indicus* bulls show lower and more variable sexual responses in tests of libido than *B. taurus* bulls [21, 22, 27]. However, there is no evidence that this apparent reduced libido of *B. indicus* bulls translates into poorer fertility compared to *B. taurus* bulls.

Whilst the use of multiple bucks in tests of libido may be desirable to increase sexual activity, it is not a guarantee that some of these bucks may not be sexually inhibited by the presence of others. Thus, their "true" libido will not be revealed. Furthermore, the dominance hierarchy relates to specific groupings of individuals, so libido tests will reveal more about the likely paddock sexual activity of the bucks if tests are conducted with the same social group as will be used in the paddock. Factors such as physical fatigue and external stimuli may play major roles in determining levels of sexually interest in many livestock species. [28] reported increase mounting activity in individually penned bulls, but attributed this increased activity to the excitement of the bulls coming out of their pens rather than to increase libido. Clearly, there are many question concerning performance testing and selection of meat goat sires, but it would appear that a combination of libido test scores and routine semen quality evaluation might prove to be best way to accelerate selection of superior breeding bucks. Libido tests can certainly indicate whether or not a buck is able to mate, but they may not reliably predict the fertility of individual bucks or herds. There is a need for the development and use of a standardized test for assessing libido to allow valid comparisons between bucks.

As shown in Table-2, highly significant (P < 0 .01) correlation coefficients of r = 0.98) were established between body weight and chest girth; body weight and body condition score (r = 0.601); body condition score and height at withers (r = 0.557), respectively, indicating strong relationships or degree of association between these variables. [40] reported similar correlation coefficients of r = 0.59 and 0.60 respectively between weight and body condition scores. Also, [41] reported correlation coefficients of r = 0.839 between body weight and chest girth; body weight and body condition score (r = 0.653); body condition score and height at withers (r = 0.582), respectively in pubertal Boer bucks. The correlation coefficients between testicular measurements and body weight were high, positive, and highly significant (SC vs. BWT, r = 0.793, P < 0.01). Also, highly significant correlation coefficients were established between scrotal circumference and reaction time (r = 0.555, P < 0.01). However, non-significant (P > 0.05) low r values were obtained for reaction time vs. BWT, r = 0.048; HTW, r = 0.0210; BCS, r = 0.065, respectively.

Although there are few reports in literature regarding the measurements of meat goat scrotal circumference, scrotal circumference is highly heritable

[32, 34, 35, and 36]. It is particularly important in the evaluation of yearling bulls [29], since it is a good indicator of whether the animal is pubertal. Puberty occurs when scrotal circumference is between 28 and 30 cm; 52% of bulls are pubertal when their scrotal circumference has reached 28 cm, 97% by the time it is 30 cm [30]. The major factors affecting the age at which the testis reaches these threshold values are the genetic and nutritional effects which determine the rate of testicular growth, but age or breed per se are relatively unimportant [30]. Consequently, the American Society of Theriogenology [31] recommended that all breeding bulls should have a minimum scrotal circumference of 30 cm. However, [33] disagreed slightly from this opinion, suggesting that slightly higher figures (32-33 cm) should be used in breeds such as the Simmental, Angus and Maine-Anjou. In young bulls, scrotal circumference is correlated (r = 0.95) with paired testis weight [37], spermatozoa output (38] and fertility [39]. Meeting or exceeding minimal scrotal circumference values based upon bull/ram age is a requirement for selection as a potential breeder. There appeared to be interaction between scrotal circumference and testicular size in relation to the appearance of spermatozoa in the ejaculate. It seemed that not only is there a certain degree of scrotal circumference and testicular size required before sperm could be produced, but also a limit of chronological age below which puberty was not attained irrespective of the nutrient management regime applied. Some reports [40, 41] suggested the use of scrotal size and testicular measurements to select for improved sperm production in breeding males. Hence, advantages would accrue from selecting bucks of higher-than-average scrotal circumference, even if it were unrelated to the fertility of the buck themselves. Yet whether or not it is justifiable to set acceptable standard scrotal circumference (testis size) for meat goat bucks breeds is open to debate, and requires further investigation.

CONCLUSIONS

There exist a paucity of data on breeding soundness and libido evaluations in Boer and Kiko breeds of meat goat bucks. Therefore, this investigation compared results of libido evaluations, and its relationship to body conformation or testicular traits in pubertal bucks. This study has demonstrated for the first time a relationship between scrotal circumference (testicular size) and libido in male meat animal specie. Bucks did not vary in the expression of libido (sex drive) levels. The essential differences between bucks were the degree to which sex drive could be dissipated. Mounting enthusiasm, although not different between breeds, appeared to be more evident in Kiko bucks. This study does not imply that as a breed, Boer bucks have lower libido, but that they appear to be less sexually aggressive bucks. In swine, anecdotal evidence suggests breed differences in circulating testosterone levels in AI boars which in turn accounts differences in mating abilities. It is concluded that the frequency of services performed by these young bucks during this simple form of libido test could provide an indication of their subsequent service activities during pasture mating. In addition, phenotypic and testicular traits, together with libido test scores reported in this study will be useful tools in the early selection of sires for genetic improvement in meat goat breeding schemes.

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Table-1. Genotype variations in body conformation, body weight and testicular traits of adult meat goats (Means ± Standard Error).

Parameter	**Boer** (N = 4)		**Kiko** (N = 4)		**Boer vs. Kiko**
	Mean	**SE**	**Mean**	**SE**	**P-values***
Body Weight (kg)	51.22	7.14	45.07	3.6	0.471 NS
Body Condition Score (BSC 1-5)	4.25	0.47	3.43	0.21	0.172 NS
Body Length (BL, cm)	62.86	5.71	60.96	3.27	0.780 NS
Body Weight (BW, kg)	51.22	7.14	45.07	3.6	0.471 NS
Chest Girth (CG, cm)	85.72	3.34	83.18	1.21	0.501 NS
Height at Wither (HTW, cm)	64.13	3.00	65.08	2.28	0.809 NS
Hip Width (HW, cm)	53.34	2.93	47.62	2.81	0.209 NS
Scrotal Circumference (SC, cm)	27.30	3.34	22.86	1.03	0.250 NS
Shoulder Width (SW, cm)	53.97	2.16	50.80	1.03	0.234 NS
Testicular Consistency (TC 1-5)	4.25	0.25	3.75	0.25	0.207 NS
Libido (Reaction time - RT) (Sec)	65.12	11.16	49.25	7.17	0.544 NS

NS = Not Significant; * Significant if P< 0.05

Table-2. Correlation coefficients (r) between body conformation, body weight and testicular traits of adult meat goats[1].

	BWT	**BCS**	**HTW**	**CG**	**BL**	**HW**	**SW**	**SC**	**RT**
BWT	1.00	0.976*	0.954*	0.982*	0.899	0.951*	0.898	0.897	-0.592
BCS	0.601	1.00	0.995**	0.960*	0.793	0.905	0.968	0.827	-.0.493
HTW	0.998**	0.557	1.00	0.925	0.760	0.855	0.971*	0.764	-0.501
CG	0.986*	0.543	0.991**	1.00	0.838	0.988*	0.909	0.952*	-0.557
BL	0.909	0.529	0.898	0.832	1.00	0.834	0.618	0.810	-0.832
HW	0.793	0.946*	0.763	0.770	0.640	1.00	0.845	0.988	-0.401
SW	0.896	0.478	0.909	0.956	0.632	0.736	1.00	0.761	-0.271
SC	0.793	0.239	0.795	0.717	0.949*	0.368	0.500	1.00	-0.348
RT	0.048	0.065	0.021	-0.112	0.459	-0.097	-0.398	0.555	1.00

* = Significant if P< 0.05; ** = Significant if P <0.01

[1] Values above the diagonal are for Boer while those below are for Kiko goats.

Table-3. The predictive equations and coefficient of determination (R^2) for body weight (BTW) using chest girth (CG), height at withers (HTW), for scrotal circumference (SC), scrotal weight using body weight on linear regression analysis.

Parameter	Regression equation	R^2	Significance
Boer bucks			
CG	Y = -128.870 + 2.100 (CG)	0.94	*
HTW	Y = - 94.50 + 2.27 (HTW)	0.86	NS
BTW	Y = 5.828 + 0.419 (BTW)	0.707	NS
Kiko bucks			
CG	Y = -95.22 + 1.63 CG	0.953	*
HTW	Y = -57.45 + 1.57 (HTW)	0.971	**
BTW	Y = 12.56 + 0.228 (BTW)	0.444	NS

* Significant if P< 0.05; ** Significant if P <0.01; NS = Not Significant

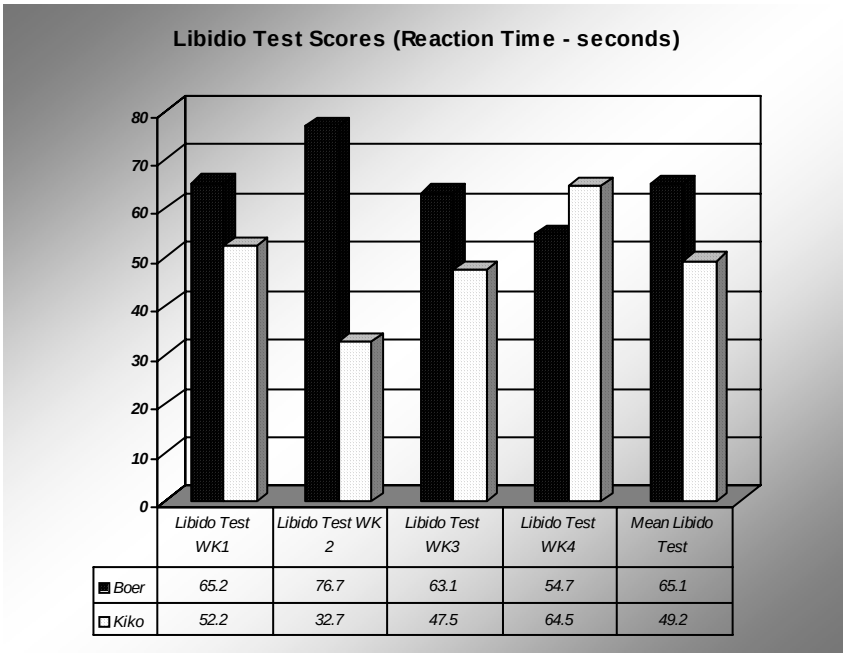

Figure-1. Breed differences in libido test scores (reaction time-seconds).