Physical Traits Versus the Buck's Reproductive Abilities

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ABSTRACT : Highly significant correlation ($p < 0.001$) was found between body weight and chest circumference of the local Katjang and cross-bred (local Katjang ♀ x German Fawn ♂) bucks under study. Increase in body length, chest circumference, depth of chest and height at withers ($p < 0.001$) reflected significantly the increase in body weight of the bucks. At the same age the cross-breds were bigger than the indigenous breed. No significant correlation was detected between body weight and scrotal circumference, or the latter with sperm counts in both buck types under study. However, the fluid portion of the semen increased in acidity and volume, the latter being significant ($p < 0.01$) in the local Katjangs, with increase in scrotal circumference. Although the effects of body condition on buck libido of both groups were not significant, the reaction time taken to mount the teaser females were significantly diminished ($p < 0.001$) with better body condition, at least in the local Katjangs. The reaction time had an inverse, though not necessarily significant, relationship with semen characteristics such as volume, pH (in local Katjangs, $p < 0.05$), concentration, colour (in cross-breds, $p < 0.05$), agglutination and mass movements in both phenotypes.
(**Key words** : Body Traits, Libido, Semen Characteristics)

INTRODUCTION

Measurable criteria for breeding soundness evaluation (BSE) has been well documented for the bull (Chenoweth et al., 1984) and included scrotal circumference measurement, sperm morphology and motility. Attempts have been made to set up a similar BSE standard for the breeding rams and bucks and included a general examination for health, evaluation of its reproductive performance and semen characteristics, and examination of its reproductive organs (Ott and Memon, 1980). However, a uniform BSE for rams and bucks have not been conclusively established.

In addition to the above traits, body size and buck libido could also be important in determining fertility because when all other factors were favourable, rams with high sex drive have been reported to mate with more ewes than those of low sex drive (Hulet et al., 1964). It was, therefore, timely that the role of body condition score and libido status of bucks in relation to reproductive performance be investigated in the male goats.

The present study was undertaken to determine whether there are any significant differences between the local Katjang breed and its cross-bred (local Katjang ♀ × German Fawn ♂) in relation to various physical traits and libido, and whether there are any significant positive or negative correlations between them and various semen characteristics and sperm production.

MATERIALS AND METHODS

Animals used

A total of 10 cross-bred and 10 local Katjang were used in this study. The ages of all 10 cross-bred (local Katjang ♀ × German Fawn ♂) bucks and 4 of the local Katjangs were known as they originated from the nucleus herd of the University of Malaya Research farm while six of the other local Katjang bucks were purchased from local farmers. Efforts were made to select animals of uniform body size that best typify the phenotypes concerned. At the commencement of this study, the age of the youngest cross-bred buck was 184 days, 7 were between 295-351 days and 2 were 541 and 692 days old, respectively. The ages of the local Katjangs ranged from 219-328 days for 5 bucks and from 559-633 days for the other 5.

Feeding management: The animals were fed with fresh Napier grass once in the morning and again in the afternoon at the rate of 5 kg/animal/day. The feed was further supplemented with pellets in the morning at the rate of 0.5 - 10 kg/animal/day. The pellets comprised of

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molasses - 5%, yeast - 7%, brewer's waste - 35%, palm oil sludge - 35% and poultry waste - 18%. A salt lick was provided for each individual animal and fresh water given *ad libitum*. All the animals were kept in individual pens under one shed so as to eliminate any variations attributed to environmental and management changes (Mukherjee, 1992).

Measurement of physical parameters

All physical parameters were measured in the mornings, prior to any feed intake. Measurements were made once a month, with the average of 3 readings taken for each trait for analyses, for a total duration of two years.

Physical parameters measured: Body weight (BW); height at withers (HW); chest circumference (CC); depth of chest (DC); body length (BL); length of pelvic bone (LPB); length of hind bone (LHB); and scrotal circumference (SCC).

Body condition score (BCS): Body condition scores were given at the time the above measurements were made. The body condition score of the animals were assessed subjectively and ranged from a score of 1 to 5, based on the categories that were adapted from an earlier study (Thangavelu, 1982).

Libido status

The libido status of both phenotypes during semen collection were also measured as reaction time and libido test score.

Reaction time (RT): was defined as the time interval (secs) taken by the buck from the moment it was brought close to a receptive female to the time it successfully mounted and ejaculated into the artificial vagina (AV). Reaction time was measured with a hand-held stopwatch.

Libido test score (LT): was based on various scores given for the buck's response on being in close proximity to a female on heat. Scores ranging from 1 to 6 were given by the authors through observations of the buck's responses and the categories were modified from those previously used by others (Chenoweth et al., 1979) as follows:

1 - buck shows no interest at all and turns away from the teaser.

2 - buck sniffs the female quietly, with slight nudgings of the perineal area with the head.

3 - buck moderately aggressive, sniffs and licks the perineal area, paws the ground with Its forelimbs, emits sound and bares its teeth, followed by several aborted attempts to mount before being successful after which it shows no further interest.

4 - same as 3, however, after successful ejaculation, the buck still demonstrates interest by sniffing, nudging and emitting sounds.

5 - same as 3, however, buck is more aggressive and mounts the female almost immediately after it was brought to the teaser after which it shows no further interest.

6 - same as 5, however, but after ejaculating the buck repeats the behaviour of 3.

Semen collection

Semen was collected from each buck using the AV twice a week and any changes in characteristics throughout the duration of the study period were recorded and analysed.

Semen characteristics determined: Semen volume (VOL); pH; colour (COL); concentration (CONC - $\times 10^9$/ml); consistency (CONSIS); agglutination (AGGL); progressive forward motility (% PFM); mass movement (MM) and percentage live (% live).

Semen volume was read off immediately from the graduated collection tube used, its pH was determined by using pH paper, its concentration was determined by the method used previously (Noran and Ramli, 1987), the percentage live was determined using semen smears stained with eosin-nigrosin, and the percentage of progressive forward motility was determined qualitatively through the light microscope and given scores ranging from 0% (no movement at all) to 99% (all sperms swimming vigorously and moving in waves and whirls). Scores for other semen characteristics were given as follows:

Colour-(1-translucent; 2-white; 3-whitish-yellow; 4-yellow).

Consistency-(1-watery; 2-milky; 3-creamy).

Agglutination-(1-absent; 2-slight; 3-moderate; 4-heavy).

Mass Movement (0-no sperms; 1-all sperms are dead; 2-slight movement of sperm heads, none swimming; 3-individual sperms swimming at slow speed; 4-active mass movement of sperms at moderate speed; 5-swift, massive movements of sperms in waves and whirls).

Statistical tests

Unpaired t-test was used for all possible comparisons, multiple regression and linear correlation were estimated between traits and Duncan's multi-variate test was carried out where applicable.

RESULTS

Relationship of age with body weight and other physical parameters.

The overall values of all physical parameters (table 1) at the end of this study were significantly different ($p < 0.05$) between the two buck types. The average size of cross-bred bucks (CB) of about the same age as the local Katjangs (LK) were bigger and they have better body condition score (BCS). Body weight (BW) was positively correlated ($p < 0.001$) with age in both buck types (table 3A & 3B). Other than with BW, age showed slight correlations ($p < 0.05$) only with depth of chest (DC) and body condition score (BCS) for the cross-bred, in contrast to that of the local Katjang.

Table 1. Differences in age and various body traits between two buck types

Traits	Local Katjang ($\bar{x} \pm$ S.E.)	Cross-bred ($\bar{x} \pm$ S.E.)	t-value
1. Age (days)	766.66 ± 30.35	723.91 ± 28.36	−1.03*
2. Body Wt (kg)	29.34 ± 0.52	39.26 ± 0.54	13.19*
3. Scrotal Cir. (cm)	19.81 ± 0.41	21.88 ± 0.47	3.33*
4. Ht. Withers (cm)	54.15 ± 1.12	60.07 ± 1.24	3.55*
5. Chest Depth (cm)	24.11 ± 0.57	27.07 ± 0.61	3.54*
6. Chest Cir. (cm)	68.60 ± 1.50	74.20 ± 1.60	2.55*
7. Body Lth (cm)	55.15 ± 1.21	61.13 ± 1.27	3.41*
8. Pelvic B. Lth. (cm)	16.04 ± 0.37	17.38 ± 0.39	2.50*
9. Hind B. Lth. (cm)	15.96 ± 0.33	17.70 ± 0.36	3.59*
10. Body Cond. Score	2.82 ± 0.06	3.14 ± 0.07	3.46*

*$p < 0.05$.

Cross-bred bucks attained their maximum body weight earlier (1 3/4 to 2 years) than the local bucks (2 1/2 to 2 3/4 years). The first viable semen was collected from the youngest local Katjang buck at 183 days old (about 6 months) and at 127 days (about 4 months) from the cross-bred. The maximum scrotal circumference (SCC) was achieved at about the same age (about 1,000 days) for both buck types (table 2A) but correlation analysis between SCC and increase in age showed no significant relationship in both buck groups (table 3A and 3B).

Table 2A. Changes in height at withers (HW), chest circumference (CC) and body length (BL) with age in local katjang (LK) and cross-bred (Local Katjang ♀ × German Fawn ♂) (CB) bucks

Age (Days)	HW (cm)		CC (cm)		BL (cm)		SCC (cm)	
	LK	CB	LK	CB	LK	CB	LK	CB
100-199	–	2.7^{a}	–	3.4^{a}	–	2.9^{a}	–	1.1^{a}
200-299	3.4^{a}	2.3^{ab}	4.0^{a}	2.8^{b}	3.1^{a}	2.5^{a}	1.4^{a}	0.9^{a}
300-399	3.0^{b}	2.1^{b}	3.6^{b}	2.5^{c}	2.9^{a}	2.0^{b}	1.2^{b}	0.8^{b}
400-499	2.5^{c}	2.0^{b}	3.0^{c}	2.4^{c}	2.7^{a}	2.0^{b}	1.0^{c}	0.7^{c}
500-599	2.3^{c}	1.9^{b}	2.8^{c}	2.3^{c}	2.4^{a}	2.0^{b}	0.9^{c}	0.7^{c}
600-699	2.3^{c}	1.7^{c}	2.8^{c}	2.1^{d}	2.3^{a}	1.8^{c}	0.8^{d}	0.6^{d}
700-799	2.0^{c}	1.6^{cd}	2.6^{d}	2.0^{d}	2.1^{b}	1.6^{d}	0.7^{e}	0.6^{e}
800-899	1.9^{d}	1.6^{d}	2.4^{de}	2.0^{d}	1.9^{bc}	1.6^{d}	0.7^{e}	0.6^{e}
900-999	1.8^{d}	1.5^{d}	2.3^{e}	1.9^{d}	1.8^{c}	1.5^{d}	0.6^{f}	0.5^{f}
1,000-1,099	–	–	–	–	–	–	–	–
1,100-1,199	1.7^{e}	1.5^{d}	2.3^{e}	1.9^{d}	1.7^{c}	1.5^{d}	0.6^{f}	0.5^{f}
1,200-1,299	1.9^{e}	1.6^{d}	2.5^{e}	1.9^{d}	1.9^{c}	1.5^{d}	0.6^{f}	0.5^{f}
1,300-1,399	1.8^{e}	1.3^{d}	2.7^{e}	1.8^{d}	2.2^{c}	1.4^{d}	0.6^{f}	0.5^{f}

* Records were not obtained at this age.
Varying superscripts within a column represent significant differences ($p < 0.01$) in that column.

Table 2B. Relative contributions of various physical parameters to body weight

Buck type	Local Katjang		Cross-bred	
Parameter	R-squared	*t*-value	R-squared	*t*-value
Body Length	0.562	29.50***	0.487	25.00***
Chest Circum	0.847	37.36***	0.715	20.57***
Depth of Chest	0.507	18.89***	0.524	11.97***
Ht. At Withers	0.763	54.26***	0.601	37.56***

*** $p < 0.001$.

Table 3A. Correlation between various body traits and age of local katjang bucks

Traits	Correlations between measurements								
	2	3	4	5	6	7	8	9	10
1. Age	.46***	.05	.13*	.15*	.18*	.15*	.17*	.11*	.06
2. BW	–	.05	.15*	.20*	.27***	.17***	.23***	.10	.03
3. SCC	–	–	.95***	.85***	.92***	.90***	.88***	.95***	.92***
4. HW	–	–	–	.91***	.98***	.94***	.91***	.98***	.91***
5. DC	–	–	–	–	.90***	.87***	.81***	.88***	.81***
6. CC	–	–	–	–	–	.94***	.91***	.96***	.89***
7. BL	–	–	–	–	–	–	.91***	.94***	.86***
8. LPB	–	–	–	–	–	–	–	.91***	.84***
9. LHB	–	–	–	–	–	–	–	–	.90***
10. BCS	–	–	–	–	–	–	–	–	–

Table 3B. Correlation between various body traits and age of cross-bred (Local Katjang ♀ × German Fawn ♂) bucks

Traits	Correlations between measurements								
	2	3	4	5	6	7	8	9	10
1. Age	.44***	.03	.05*	.13*	.10	.07	.07	.01	.12*
2. BW	–	.04	.12*	.25*	.24***	.12*	.16*	.05	.24**
3. SCC	–	–	.91***	.85***	.90***	.90***	.85***	.93***	.77***
4. HW	–	–	–	.93***	.96***	.96***	.90***	.97***	.85***
5. DC	–	–	–	–	.92***	.91***	.85***	.89***	.84***
6. CC	–	–	–	–	–	.95***	.91***	.94***	.85***
7. BL	–	–	–	–	–	–	.93***	.90***	.83***
8. LPB	–	–	–	–	–	–	–	.92***	.77***
9. LHB	–	–	–	–	–	–	–	–	.84***
10. BCS	–	–	–	–	–	–	–	–	–

* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

The data on three of the body traits, namely, chest circumference (CC), body length (BL) and height at withers (HW), that were considered to be primary contributors to body weight (table 2A), reached maximal values ($p < 0.05$) at a younger age (between 700-800 days) in the cross-bred than the local Katjang (between 900-1000 days). Furthermore, all three parameters, including chest depth (table 2B), showed significant ($p < 0.001$), positive regression with increase in body weight and could, therefore, be used as alternatives to body weight measurements to indicate buck growth.

Relationship between scrotal circumference (SCC), libido (RT, LT), body condition score (BCS) and various semen characteristics

Highly significant negative correlation ($p < 0.01$) existed between reaction time (RT) and libido score (LT) but both values showed no correlation with body

condition score (BCS) in the two buck types studied (table 4), with the exception of RT ($p < 0.001$) in the local Katjangs. In both buck groups there was inverse but insignificant correlation between LT and SCC. The correlationship between RT and SCC was positive for both buck types but was only significant in the cross-breds ($p < 0.01$).

Increase in semen volume (VOL) was positively correlated ($p < 0.01$) with SCC, in the local Katjang but not significant in the cross-bred (table 4). However, its pH showed significant ($p < 0.01$) inverse correlation with SCC in both buck types. Semen colour (COL) was inversely correlated with SCC ($p < 0.01$) only in the cross-breds. Semen agglutination (AGGL) was also inversely correlated with SCC, being highly significant ($p < 0.001$) in the local Katjang. However, semen consistency (CONSIS), concentration (CONC) and % live showed no correlations with SCC in both buck types. The mass movement of sperms (MM) was significantly correlated with SCC, both in the cross-bred ($p < 0.01$) and the local Katjang ($p < 0.05$).

Semen volume (VOL), CONC, AGGL, and MM showed no correlations with buck libido (RT or LT) in both buck groups. Its pH and colour (COL) were inversely correlated with RT, however, the relationship was not significant in both buck types. The percentage of live sperms (% LIVE) was significantly inversely correlated ($p < 0.05$) with RT only in the cross-breds. Semen consistency (CONSIS) was significantly correlated with RT only in the cross-bred bucks ($p < 0.05$). No significant correlations occurred between semen characteristics of pH, volume, CONC, COL, CONSIS, % live, AGGL and MM with LT in both buck groups.

Table 4. Correlation of reaction time, libido test, and scrotal circumference to various semen characteristics and body condition scores in both buck types

Traits	React. Time (RT)		Lib. Score (LT)		SCC	
	LK	CB	LK	CB	LK	CB
1. RT	–	–	−0.10**	−0.30**	0.05	0.25**
2. LT	−0.10**	−0.30**	–	–	−0.04	−0.04
3. VOL	−0.02	−0.07	0.07	0.02	0.27**	0.01
4. pH	−0.11	−0.02	−0.04	0.04	−0.31**	−0.26**
5. CONC	−0.08	−0.01	−0.03	0.01	0.02	−0.03
6. PFM	0.13*	−0.04	0.15*	−0.04	0.07	0.22*
7. % LIVE	0.11	−0.14*	0.04	0.30	0.09	0.01
8. COL	−0.04	−0.19*	0.09	0.06	0.04	−0.27**
9. CONSIS	0.07	0.17*	−0.02	−0.05	−0.01	0.06
10. AGGL	−0.13	−0.09	−0.07	0.0	−0.34**	−0.15
11. MM	−0.01	−0.01	0.07	0.06	0.17*	0.25**
12. BCS	−0.31***	0.10	0.14	0.01	0.42***	0.29***

*$p < 0.05$.
**$p < 0.01$.
***$p < 0.001$.

DISCUSSION

This investigation revealed that there were significant correlations as well as positive regressions between increase in body weight and physical parameters such as chest circumference, depth of chest, body length and height at withers. These observations confirmed an earlier report (Gajbhiye and Johar, 1985) that various body conformation traits (e.g., chest girth or circumference, body length, etc) could be used as alternatives to body weight as indicators of growth. In contrast to an earlier finding (Mukherjee et al., 1981), this study revealed the same significant correlation between height at withers or body length and body weight, while the correlation between the latter and chest circumference was much better than with the other two traits. Overall, the cross-bred was found to be larger than the local Katjang buck at the same age and achieved maximum body size and sexual maturity, as indicated by the production of viable sperms, earlier.

Scrotal circumference (SCC) was used to indicate testis size in this study due to an earlier finding that it

was highly correlated with testis volume and gave a relatively accurate estimate of a male's ability to produce spermatozoa (Vilhar Filho, 1986). Overall, this study found no correlation between increase in body weight and testis size, in contrast to an earlier report (Bongso et al., 1984), probably because other factors (e.g., feed supply) could affect the former after sexual maturity.

There was inverse, although insignificant, correlation between sperm concentration and scrotal circumference while the reverse was true ($p < 0.01$) for semen volume and the latter. This lent support to the view that increase in scrotal circumference does not necessarily mean that there was significant increase in sperm production but rather the fluid portion of semen was affected. The fact that the sperm counts, in contrast to the seminal volume, for local Katjang (first ejaculation: $6.19 \pm 1.30 \times 10^9$/ml; 0.60 ± 0.02 ml, respectively; second ejaculation: $5.82 \pm 1.10 \times 10^9$/ml; 0.78 ± 0.02 ml, respectively) did not differ significantly from that of the cross-bred (first ejaculation: $6.33 \pm 1.40 \times 10^9$/ml; 0.90 ± 0.02 ml, respectively; second ejaculation: $5.68 \pm 1.45 \times 10^9$/ml; 1.02 ± 0.01 ml, respectively) in an earlier study (Noran and Ramli, 1987), further supports this view. The highly significant ($p < 0.01$) inverse correlation observed between scrotal circumference and semen pH in both buck types merely indicated the increase in secretions of seminal, acidic components by the accessory glands rather than increase in spermatogenesis, as suggested by Bongso et al. (1982). The inverse relationship between semen agglutination (AGGL) and scrotal circumference, being highly significant in local Katjangs ($p < 0.001$), further supports the view that increase in semen volume, in tandem with the increase in scrotal circumference, caused some seminal dilution. Thus, the mass movements of sperms were also significantly better with increase in scrotal circumference for both buck types. Hence, for bucks that have achieved maximal scrotal circumference, semen quality, as represented by sperm concentration and movements, was affected by other factors rather than testis size alone.

Results from this study showed that, generally, body condition score does not affect buck libido status, although the local Katjang did show shorter reaction time when its body condition was good. The latter does not affect semen quality in any significant manner either. These observations could have been because the bucks under study have achieved physical maturity. The reaction time seemed to have an inverse but insignificant relationship with semen pH and colour while its effect on percentage of live sperms was inversely significant only in the cross-breds.

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