Semen Quality of Brakmas Bulls Under Short Term Feeding Regimes

Tan, Y.J.[1]*, Zaidi, S.[2], Mohd. Firdaus, O.[1], Roslan, O.[3], and Shanmugavelu, S[1].
[1]Strategic Livestock Research Centre, MARDI, P. O. Box 12301, 50774 Kuala Lumpur, Malaysia. [2]Muadzam Shah MARDI Research Station, MARDI, P. O. Box 62, 26700 Muadzam Shah, Pahang, Malaysia, [3]MARDI Research Station, MARDI, P. O. Box 525, 86009 Kluang, Johor, Malaysia
*Corresponding author: yjtan@mardi.gov.my

Abstract

Nutritional status of a bull is an important consideration in ensuring its semen is of high quality. A study was carried out to evaluate the effect of feeding regime on semen quality of Brakmas bulls. Nine mature bulls of 3-5 y of age were selected and assigned to three feeding regimes: complete ration (CR) as pellets at 3% of body weight (BW) in individual pens, CR at 1% of BW plus fodder offered *ad-libitum* in individual pens and grazing on *Brachiaria decumbens* grass supplemented with CR at 1% BW fed twice a wk and all bulls were monitored for three mo. The bulls were weighed and their semen collected using artificial vagina fortnightly. No significant difference was detected in the semen quality of the bulls given the different feeding regimes. Similar results in semen quality were observed before and after 61 d of spermatogenesis. The mean BW of bulls grazing *B. decumbens* grass and supplemented with complete ration significantly decreased ($p<0.05$) compared to bulls kept in individual pens and fed with CR at 1 or 3% BW. The study suggests that bulls which are raised on *B. decumbens* grass and supplemented with a complete ration at 1% of BW is sufficient to maintain good semen quality while at the same time it contributes to a reduction in maintenance cost with reduced feed cost.

Keywords: semen quality, feeding, bulls

Introduction

The mechanisms controlling reproduction and energy balance are intrinsically related and have evolved to confer reproductive advantages as well as guarantee the survival of species (Barth et al., 2008). Under practical feeding conditions, long term intake imbalance would have effects on spermatogenesis (Thwaites, 1995). Nutritional status is of primary importance in determining semen quantity and quality (Robinson et al., 2006; Martin et al., 2010), besides climate, stress, pollution, management, genetics and behavioural factors (Petherick, 2005; Mukhopadhyay et al., 2011).

Therefore, dietary manipulations and feeding strategies are among the key tools for influencing ruminant production. Although bull reproductive system and process of spermatogenesis are well understood, the studies of feeding strategies for successful spermatogenesis are not deeply studied as yet. A bull reproductive system comprises of hypothalamus, anterior pituitary gland and testes, which form the hypothalamic-pituitary-gonadal system in producing sperm and hormones. The restriction of nutrient intake is proven to cause delays in sexual maturity and causes rapid regressive changes in male accessory organs (Cheah and Yang, 2011). Hence, successful reproductive performance of bulls requires balanced feed intake. Besides, feed contributes a significant

proportion to the cost of production in any livestock breeding enterprises. One of the most important parameters to measure the level of fertility in bulls is semen quality. Hence, this study was conducted to evaluate the effect of feeding regimes on the semen quality of Brakmas (*Bos indicus*) bulls.

Materials and Methods

Location of study

The study was conducted at Muadzam Shah MARDI Research Station, Muadzam Shah, Pahang Darul Makmur, Malaysia. The geographical coordinates are between 03° 03' latitude north, 103° 05' longitude east and at 3.3m above mean sea level.

Treatments and bull management

Nine Brakmas bulls aged 3-5 years old were randomly and equally divided into three treatment groups differing in feeding regimes. Brakmas is a beef cattle composite breed developed from the crossing of Brahman and local Kedah-Kelantan breeds of cattle. At the beginning of the study, the reproductive system of each bull was inspected visually and only mature bulls with normal reproductive system were selected. The treatments were: bulls in group A were confined in individual pens and fed with a complete ration (CR) at 3% of body weight, bulls in group B were fed CR at 1% of body weight plus cut fodder of *Brachiaria decumbens* offered *ad-libitum* and bulls in group C were grazed on *Brachiaria decumbens* pasture in paddocks at a stocking rate of one animal unit per ha and supplemented with CR at 1% of body weight twice a week. Water was freely made available to the bulls during the entire study. The bulls were adapted to their specific treatment for a period of one week prior to the study which lasted for three months.

The calculated nutrient intake and total feed cost of the three groups are shown in Table 2. Feed used in this study was proximate analysed. As anticipated, group A had the highest crude protein (CP) and metabolizable energy (ME), followed by groups B and C. Similarly, group C had the highest percentage of neutral detergent fiber (NDF) intake, and group B had the highest acid detergent fiber (ADF). The cost of feeding regime in group C was the cheapest among all treatments, as it was mainly forage based.

Examinations and measurements of semen quality

The bulls were weighted using a weighing scale. Semen was collected every two weeks from all bulls throughout the study. Semen from maximum of two ejaculations per bull were collected using an artificial vagina and the semen were kept at 37 °C in a water bath after collection. Semen evaluation was done on fresh samples within one hour of ejaculation. The data of temperature, humidity, libido of ejaculation time, semen volume and colour, general motility, individual sperm motility, mortality, abnormal morphology and concentration parameters were collected (Table 1). Environmental temperature and relative humidity were obtained from thermometer and hygrometer readings, respectively.

Table 1: Techniques used for measuring semen evaluation parameters

Parameter	Technique
Libido of ejaculation time	Time taken (second) starts from bull exposed to female to ejaculation.
Semen volume	Total ml per ejaculation.
colour	Colour determined upon collection, usually whitish, creamy and yellowish for semen of *Bos indicus* (Brakmas) bulls.
General motility	Collective movement of sperm observed under phase contrast microscope (10X) examination of undiluted semen, score 1-5; 0= no swirl (nil or sporadic oscillation of individual sperm), 1= no swirl (generalised oscillation of individual sperm only), 2= very slow distinct swirl, 3= slow distinct swirl, 4- moderately fast distinct swirl, and 5= fast distinct swirl (appearance of good quality bull semen).
Individual sperm motility	The percentage of motile (moving) sperm seen under phase contrast microscope (10X) examination after 10X dilution with normal saline (0.9% NaCl)
Mortality	A drop of semen sample is mixed with three drops of the eosin-negrosin stains on a pre-warmed slides using applicator stick and a thin smear is made using another slide. After air drying, the smear is observed under phase contrast microscope (40X) to get the percentage of stained or partial stained heads of spermatozoa.
Abnormal morphology	The smear of eosin-negrosin stained sperm were observed under under phase contrast microscope (40X) to get the percentage of abnormal sperm size, shape or appearance.
Concentration	Sperm concentration (per ml) determined using hemacytometer chamber.

Statistical analysis

Data on body weight and semen quality of the bulls were analyzed and compared among the three feeding regimes with the initial body weight included as a covariate in the regression model for semen quality parameters in SAS 9.3 (SAS Institute Inc. 2011). A probability of $p<0.05$ was considered as significant for the statistical test.

Results and Discussion

In general, all bulls had normal semen characteristics (Table 3). However, group B bulls had significantly lower ejaculation time and significantly higher semen volume ($p<0.05$) compared to other

groups. This may be due to better adaptation to the environment conditions as was also reported by Brito et al. (2002). Although semen traits are not related to libido of ejaculation time as they are influenced by endocrine regulation of the bull (Henney et al., 1990), we observed that the libido of ejaculation time of bulls in group B was higher than the bulls in groups A and C.

There were no significant differences in the other parameters such as semen colour, general motility, motility percentage, mortality, abnormal morphology, concentration and total sperm per ejaculation. These results indicated that the feeding regime of group B was sufficient to produce quality spermatozoa. Bulls in group B supplied with only CR at 1% of body weight and fodder *ad-libitum* are more cost effective compared to bulls in group A fed with a feeding regime of CR at 3% body weight.

There were no differences in the growth rate of bulls in groups A and B throughout the study (Figure 1). The body weight of bulls in group C decreased during the first month of the study. The decrease may be due to more frequent walking in the paddock for grazing or insufficient nutrient intake (Table 2). The body weight of the bulls recovered and increased consistently in the following months. Nevertheless, the decrease in the body weight of bulls in group C did not influence the quality of semen produced. Figure 1 shows comparison between the average body weights of Brakmas bulls among the three treatment groups.

In small ruminants, particularly male sheep and goats, a change in feed intake has little effect on gonadal endocrine function but induces profound changes on sperm production. These outcomes are due to the changes in size of the seminiferous tubules and spermatogenic efficiency (Martin et al., 2010). In cattle, nutrition affects testicular development and the spermatozoa production of young bulls, however after the period of rapid growth, there appears to be little or no response to nutrition (Martin et al., 2010). However, Brown (1994) stated that severe feed restriction may result in permanent damage to gonadal and neural tissues, while restricted feed intake in adult animals can reduce androgen secretion and semen quality temporarily which can be resolved by adequately feeding previously underfed adult animals.

Therefore, an analysis was conducted to evaluate the quality of sperm before and after spermatogenesis in the different feeding regime groups. In bovine, spermatogenesis takes 61 d to produce mature spermatozoa (Johnson et al., 2000). This means the feed taken now will affect the spermatozoa that are produced after 61 d. To evaluate this, the sperm quality between week 1-6 and week 8-10 were compared (Table 4). There was no significant difference in almost all of the parameters measured between the two feeding periods. The general motility of group A bulls' semen was significantly higher at week 8 of feeding. Similarly, the total sperm count was also higher for group B at week 8 of feeding. These results reemphasize that the feeding regime of group B is sufficient for bulls to produce good spermatozoa quality.

Table 2: Calculated nutrient intake and the total feed cost of the three treatment groups

Nutrient intake / Cost parameters	Group A[1]	Group B[1]	Group C[1]
CP (kg/day)	2.58	1.43	0.93
ADF (kg/day)	6.60	7.92	7.60
NDF (kg/day)	6.96	11.56	11.97
ME (MJ/day)	118.55	103.44	89.00
Average feed intake/day (kg)	15.66	15.56	14.10
Average body weight (kg)	522.01 ± 26.77	519.78 ± 45.09	470.44 ± 44.11
Total cost of feed per bull (RM)*	657.72	218.00	145.70

[1]Group A: Complete ration (CR) as pellet given at 3% of body weight; Group B: CR at 1% of body weight plus fodder *ad-libitum*; Group C: grazed in paddocks supplemented with CR at 1% body weight. twice a week

*Cost of feed calculated at RM0.60/kg for complete ration and RM0.10/kg of dry matter of grass.

Table 3: Semen characteristics (mean ± S.D.) of Brakmas bulls under three feeding regimes

Trait	Group [1]	Group B[1]	Group C[1]
Libido (Ejaculation time, sec)	552.90 ± 241.38[a]	138.13 ± 32.51[b]	428.75 ± 305.84[a]
Semen volume (ml/ejaculation)	4.21 ± 1.11[b]	7.45 ± 1.97[a]	4.66 ± 3.21[b]
Colour	Creamy	Creamy	Creamy
General motility	3.1 ± 1.20	2.62 ± 0.52	2.42 ± 1.00
Motility (%)	70.90 ± 8.33	67.75 ± 6.71	71.39 ± 38.55
Mortality (%)	21.03 ± 4.72	27.00 ± 0.28	19.25 ± 29.47
Abnormal morphology (%)	12.21 ± 5.53	14.45 ± 5.02	15.39 ± 2.50
Concentration ($x10^8$/ml)	9.33 ± 1.71	4.64 ± 0.90	9.62 ± 4.47
Total sperm ($x10^8$/ejaculation)	42.36 ± 20.88	33.58 ± 17.05	31.87 ± 28.34

[1]Group A: Complete ration (CR) as pellet given at 3% of body weight; Group B: CR at 1% of body weight plus fodder *ad-libitum*; Group C: grazed in paddocks supplemented with CR twice a week at 1% body weight.

[a,b] Means in the same row with different superscript differ significantly at $p<0.05$

Table 4: Semen quality (mean ± S. D.) of Brakmas bulls between two feeding periods (1 -6 weeks and 8-10 weeks) in three feeding regimes

Trait	Group A[1]		Group B[1]		Group C[1]	
	1-6 week	8-10 week	1-6 week	8-10 week	1-6 week	8-10 week
Libido (Ejaculation time, sec)	531.50±216.35	585.00±307.41	134.17±32.31	150.00±42.43	306.43±272.74	600.00±287.75
Semen volume (ml/ejaculation)	3.85±1.40	4.65±1.45	7.42±2.57	8.05±2.19	3.64±2.62	4.42±2.96
General motility	2.50±1.22 [a]	4.00±0.00 [b]	2.50±0.55	3.00±0.00	2.43±1.13	2.40±0.89
Motility (%)	73.33±15.06	73.50±4.73	65.00±13.42	75.00±7.07	69.29±19.46	73.00±21.10
Mortality (%)	16.58±11.13	22.75±9.64	25.52±18.87	22.00±9.19	20.50±12.37	19.40±6.37
Abnormal morphology (%)	12.25±4.06	11.38±8.90	14.00±10.60	6.25±3.18	21.57±29.75	17.30±6.57
Concentration ($x10^8$/ml)	9.77±5.56	10.19±2.63	3.76±1.83	7.56±2.86	10.21±6.22	6.64±3.86
Total sperm[2] ($x10^8$/ejaculation)	40.72±27.59	44.82±5.13	25.49±9.19 [a]	57.84±6.45 [b]	35.55±31.60	25.93±19.83

[1]Group A: Complete ration (CR) pellet given at 3% of body weight; Group B: CR at 1% of body weight plus fodder *ad-libitum*; Group C: grazed in paddocks supplemented with CR twice a week at 1% body weight.
[2]Total sampel: Total sperm per ejaculation, obtained bymultiply concentration by semen volumn.
[a,b] Means within the same row by groups with different superscripts differ significantly at $p<0.05$.

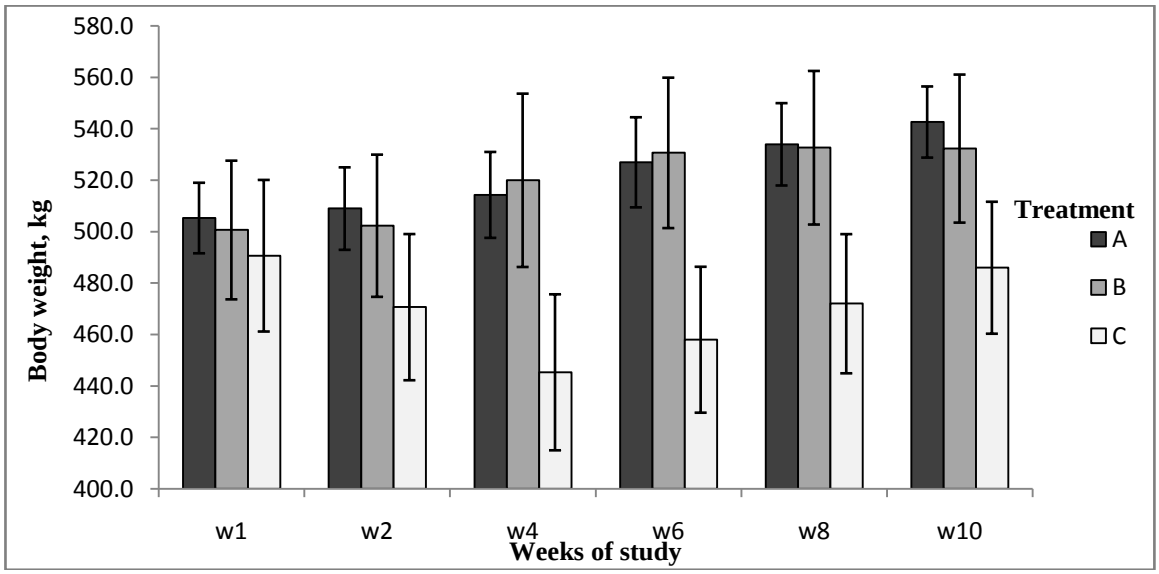

Figure 1: Average body weight (kg) (± S.D.) of Brakmas bulls under three feeding regimes (Group A: Complete ration (CR) pellet given at 3% of body weight; Group B: CR 1% of body weight plus fodder *ad-libitum*; Group C: grazed in paddocks supplemented with CR twice a week at 1% body weight).

Conclusion

There was no significant difference in semen quality of Brakmas bulls fed 100% complete ration at 3% body weight or 1% of body weight provided with *Brachiaria decumbens* fodder fed *ad-libitum* or free grazing *Brachiaria decumbens* pasture with supplementation of complete ration at 1% body weight twice a week. However, bulls on free grazing and fed minimal complete ration decreased their body weights suggesting lack of nutrients for growth despite maintaining normal semen quality. Based on this study, it can be concluded that it is not necessary to provide excessive amount of nutrients to breeding bulls. The provision of nutrients necessary to maintain required weight gain is sufficient to maintain high semen quality in Brakmas bulls while simultaneously reduces the feeding cost.

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