Theriogenology Insight: 6(2): 83-96, August 2016
DOI: 10.5958/2277-3371.2016.00012.7

Factors affecting sperm abnormalities and breeding soundness classification of bulls kept on commercial farms in Zambia

Sitali[1*], M.C, Mwanza[2], A.M, Mwaanga[1], E.S, Sianangama[3], P.C, Parsons[3], I.R. and Parsons[3], N.J.

[1]Department of Biomedical Sciences and [2]Department of Clinical Studies, Faculty of Veterinary Medicine, [3]Department of Animal Sciences, school of Agricultural Sciences, The University of Zambia, P.O. Box, 32379, Lusaka, Zambia. [3]Matobo Veterinary Centre, P.O. Box, 670387, Mazabuka, Zambia*

***Corresponding author:** *sitalimuloongo@yahoo.com*

Abstract

A total of 441 eosin-nigrosin bull breeding soundness examination (BBSE) data was obtained from Matobo Veterinary centre and analysed. 82 bulls were classified as unsound for breeding representing 18.6% of the entire bull population studied. The breeds studied were the *Bonsmara*, *Sussex*, *Brahman*, *Boran*, *Afrikander* × *Tuli* and the *Tuli*. Breed and scrotal circumference (SC) were the significant predictors of BBSE classification. The *Bonsmara* and the *Sussex* breeds were not significantly different in predicting sperm abnormalities ($p>0.05$). The *Brahman* breed had odds of 0.358 less likely to be classified as sound, *Boran* breed had odds of 0.206 less likely to be classified as sound and the *Afrikander* × *Tuli* breed had odds of 0.097 less likely to be classified as sound while the *Tuli* breed had odds of 0.214 less likely to be classified as sound. Therefore, the *Afrikander* × *Tuli* breed had the highest probability of being classified as unsound for breeding. Bulls with a SC of <36 cm had odds of 0.235 less likely to be classified as sound while those of 39 to <42cm had odds of 0.384 less likely to be classified as sound compared to bulls with SC of ≥42cm. Body condition score (BCS) had an effect on mass motility ($p<0.05$). Bulls in month category (cat) 1 (September, October and November) had odds of 2.29 more likely to have fair mass motility relative to very good mass motility compared to bulls examined in June-July (cat 2) and month category 1 bulls had odds of 2.46 more likely to have good mass motility relative to very good mass motility compared to month category 2 bulls. Bulls in SC category 1 (≤39 centimetres (cm)) had odds of 1.81 more likely to have fair mass motility relative to very good mass motility compared to bulls in category 2 (>39cm) and bulls in BCS category 1 (2.5 and 3.0) had odds of 2.71 more likely to have fair mass motility relative to very good mass motility compared to bulls in category 3 (4.0). Bulls with a BCS of 4.0 had the highest mass motility of 3.72±0.41 and the lowest was recorded in Bulls of BCS 2.5, 2.39±0.24 ($p<0.05$). The month of November had the lowest mass motility of 2.26±0.15 ($p<0.05$) and bulls of age <36 months had the lowest mass motility of 3.08±0.14 while the highest was recorded in bulls of age 48 to <60 months 3.73±0.08 ($p<0.05$). Bulls with a SC of ≥42 cm had the highest mass motility of 3.85±0.06 and the lowest was seen in bulls of SC <36 cm, 2.83±0.14 ($p<0.05$). The *Sussex* breed had the highest mass motility of 3.97±0.09 and the lowest was seen in the *Afrikander* × *Tuli* breed 1.69±0.39 ($p<0.05$). The month of November had the highest percent total abnormalities of 20.73±2.56% and July with the lowest of 8.98±0.66% ($p<0.05$), The *Afrikander* × *Tuli* breed had the highest total abnormalities of 25.50±6.62% while the *Bonsmara* breed had the lowest of 7.24±0.43% ($p<0.05$). Bull of age <36 months had the highest total abnormalities of 17.19±2.02% and the lowest in bulls of age range 48 to <60 8.23±0.72% ($p<0.05$). Bulls with SC <36cm had the highest total abnormalities of 19.00±1.82% while those of ≥42 cm had the lowest 7.63±0.72% ($p<0.05$). The highest total abnormalities was recorded in those bulls with a BCS of 4.0 as 24.67±11.47% and the lowest in bulls of BCS 3.5, 9.15±0.54% ($p<0.05$). In conclusion, Breed and SC had an effect on sperm abnormalities, BBSE classification and mass motility. Body condition score, age and month had an effect on mass motility and total sperm abnormalities. This therefore signifies why morphological sperm determinations are important in predicting bull fertility.

Keywords: Breed, month, body condition score, scrotal circumference, age

---

Semen quality and its relationship to fertility are the major concerns in animal production (Mahmound *et al.,* 2013). Artificial insemination (AI) can be applied as a tool to improve genetics and to preserve original breeds and thus knowledge of semen characteristics is essential for both successful AI and natural mating programs (Kridli *et al.,* 2007).

Over many decades laboratory analyses have been used to evaluate semen quality, these laboratory evaluations of semen samples remain an important procedure for the AI industry and cattle breeders to eliminate low fertility bulls or semen from being used in artificial insemination programmes. Until recently, the most important measure which has been used to determine quality of bull sperm is the microscope (Sellem *et al.,* 2015). Integrity and stability of the plasma membrane is paramount and methods vary, from wet smears, the use of impermeable dye eosin (eosin-nigrosin test), and exposure to a hypo-osmotic saline solution (Hos- test) to use of single or multiple fluorophores (Alm-packalén, 2009). Evaluation of sperm motility characteristics has traditionally been the most frequently used semen quality test in the AI industry this is because motility is an essential property of fertile spermatozoa and enables it traverse the female reproductive tract, reach the site of fertilization and penetrate the zona-pellucida of the oocyte (Sapanidou *et al.,* 2014).

Alm-packalén, (2009), reported that morphological abnormalities of sperm can have a detrimental impact upon fertilization and embryonic development. He further stated that bulls and boars used for commercial AI and natural mating are selected to a certain degree on the basis of a low incidence of morphologically abnormal spermatozoa. Spermatozoa with abnormal morphology are the most important factor that has direct bearing on fertility of animals for successful AI programmes and natural mating (Ambali *et al.,* 2013) and experiments have revealed that the proportion of morphologically abnormal spermatozoa in the semen correlates negatively with fertility results (Fordyce *et al.,* 2006). Abnormalities of the spermatozoa occur due to disorder of the seminiferous tubules, during ejaculation or in manipulation of the ejaculate including excessive agitation, over-heating to rapid cooling, mixture of water, urine or antiseptic in the semen (Chenoweth, 2005).

Vincent *et al.* (2012), also stated that morphology, or the shape of the sperm cells, is important semen characteristic. According to Parker *et al.* (2004), morphology (normal vs. abnormal cells) evaluations are vital for the scoring system developed by the Society of Theriogenology. This scoring system has become the standard by almost all veterinarians. According to Parker *et al.* (2004), abnormal cells should usually be less than 25 percent of the total sperm cells to receive the full points in this category. Fordyce *et al.* (2006) reported that, to successfully complete a breeding soundness evaluation, a bull must have at least 70% or more normal sperm morphology, and a minimum scrotal circumference based on age and breed.

Vilakazi, (2003), reported that faulty spermatogenesis result into different structural abnormalities of spermatozoa. He further stated that semen quality is also affected by factors which cause under development of the testis and that such factors related to testicular degeneration such as hereditary and pathological factors should be carefully considered. These may adversely affect semen quality through testicular development.

Methodology

Eosin nigrosin BBSE data from January 2014 to September 2015 were obtained from Matobo Veterinary centre. The breeds comprised of 20 *Tuli*, 97 *Brahman*, 218 *Bonsmara*, 43 *Boran*, 11 *Afrikander*×*Tuli* and 52 *Sussex*. Data on age, breed, SC, BCS, months, estimated total sperm abnormalities, mass motility and percent live sperm were entered into the Excel spread sheet and exported to SPSS version 20.0 for analysis. Age and SC were each divided into four categories of <36 months (mo), 36 to <48 mo, 48 to <60 mo, ≥60 mo and <36 centimetres (cm), 36 to <39 cm, 39 to <42 cm and ≥42 cm respectively. Bulls found to have any disease or any disorder prior breeding soundness examinations were not included in the study. Classification as sound or unsound for each bull was done based on reports by Fordyce *et al.* (2006) were bulls with less than 70% normal sperm morphology were classified as unsound for breeding.

Scrotal circumference measurement

The SC measurement was obtained by using a measuring tape from the rear side of each bull. Testicles were gently forced to the bottom of the scrotum while making sure that they do not spread apart. The SC was measured by placing the measuring tape around the widest point of the scrotum and the records were made in centimeters (Alexander, 2008).

Body condition score scoring system

The BCS was scored using a 5 point scale scoring system after restraining the bulls in a crush pen. A score of 1 denoted a very thin bull, while 5 denoted an extremely fat bull and 3 as an average BCS.

A BCS of 1 (poor) denoted that the entire animal was extremely thin, all the skeletal structures were visible with no fat in the tail docks and brisket and no muscle tissue or external fat present. The individual vertebrae on the spine were evident such that fingers could be placed between the vertebrae and their horizontal processes were sharp.

A BCS of 2 (moderate) denoted that the entire animal was thin with the upper skeleton prominent with some muscle tissue present. There was also some muscle tissue over the tail dock, hip bones and flank. The individual vertebrae could be felt in the backbone but were not sharp and fingers couldn't be placed in between the vertebrae. Tail head had a shallow cavity.

A BCS of 3 (good) was defined slightly visible ribs, visible hooks and spine which were not prominent, the muscle tissue was nearing its maximum and the bull had fat behind the shoulder and brisket. The backbone was defined but easy to feel the tops of the vertebrae. Short ribs were completely covered with fat and individual ribs could only be felt with firm pressure. Tail head had fat cover over the whole area with smooth skin but pelvis could be felt.

Bulls of BCS 4 (fat) had their skeletal structure was difficult to identify because of fat deposits behind the shoulder, tail head and brisket. The backbone had a flat appearance over the top line and individual vertebrae could not be felt.

Bulls of BCS 5 (grossly fat) were obese and they had a blocky look with a dominating flat appearance, the brisket was heavy with fat, the hips and tail heads of the bulls were buried in fat and had a flat back (Penny, 2016).

Statistical Analyses

Descriptive statistics was performed for the entire bull population studied. Fishers' exact test was used to assess association between the categorised variables and BBSE classification. Mean percentages (±SEM) were calculated for estimated total abnormalities, live sperm and mass motility and these means were summarized separating the bulls into categories according to age, BCS, SC and breed and an analysis of variance (ANOVA) was performed between categories, using the Bonferroni test for comparisons of means (SPSS 20.0). Effects of variables studied on BBSE classification was analysed using logistic regression. The overall effect of variables studied on mass motility score was analysed using multinomial logistic regression and the statistical significance was set to $p<0.05$. For multinomial regression, categories (cat) of age, SC and month were merged into two categories each. Category 1 for age had bulls ≤ 48months and category 2 included bulls above 48 months and for SC, category 1 included bulls with SC≤ 39cm and Category 2 bulls >39cm. BCS of 2.5 and 3.0 were merged (cat 1), BCS of 3.5 (cat 2) and BCS of 4.0 (cat 3). The months of June and July were merged (cat 1) and August, September and November were merged (cat 2). Breed was not included in the multinomial model as the breed types could not be merged.

Results

Table 1 shows means (±SEM) according to month and breed *versus* percent live, percent abnormal and mass motility. The month of November had the lowest mass motility 2.26±0.15 and July with the highest 3.73±0.06. The highest total abnormalities were recorded in November and the least in July as 20.73±2.56% and 8.98±0.66% respectively. No significant differences were found on the percent live sperm for month, age, SC and BCS ($p>0.05$). However, the *Afrikander* × *Tuli* breed had the lowest percent live sperm while the *Sussex* breed had the highest ($p<0.05$). The *Afrikander* × *Tuli* breed had the highest total abnormalities and the lowest mass motility of 25.50±6.62% and 1.69±0.39 respectively ($p<0.05$).

Table 2 shows means (±SEM) according to age, SC and BCS *versus* percent live, percent abnormal and mass motility. No significant differences were observed due to age on percent live sperm. It was found that the youngest age category of <36 months had the highest total sperm abnormalities and the least mass motility of 17.19±2.02% and 3.08±0.14 respectively while the lowest total sperm abnormalities was found in the age category 48 to <60 months of 8.23±0.72%

which were seen to increase in bulls above 60 months of age (p<0.05). Mass motility was significantly high in bulls of age range 48 to <60 months and reduced in bulls above 60 months of age (p<0.05).

Table 1: Means (±SEM) according to Month and Breed *versus* % Live, Abnormal and mass motility

Variable		%Live	% Abnormal	Mass motility
Month	Jul	85.52±0.86[a]	8.98±0.66[a]	3.73±0.06[a]
	Aug	84.44±2.11[a]	9.02±1.11[a]	3.63±0.09[a]
	Nov	84.82±1.51[a]	20.73±2.56[b]	2.26±0.15[b]
	Jan	87.08±1.56[a]	10.83±2.57[ab]	3.71±0.28[a]
	Sep	84.49±2.13[a]	12.28±2.57[ab]	3.46±0.16[a]
	Jun	81.64±2.23[a]	16.24±2.47[b]	3.52±0.18[a]
Breed	Bonsmara	85.45±0.90[a]	7.24±0.43[a]	3.77±0.04[a]
	Sussex	88.17±0.85[ac]	10.25±1.71[a]	3.97±0.09[a]
	Brahman	82.62±1.39[a]	17.62±1.80[b]	2.97±0.13[b]
	Boran	85.47±1.90[a]	13.67±2.37[ab]	3.44±0.18[a]
	Afrikander × Tuli	71.25±10.08[ab]	25.50±6.62[b]	1.69±0.39[b]
	Tuli	85.25±2.90[a]	21.55±3.81[b]	2.50±0.29[b]

[a-c] Means within the same column and category with a distinct letter are statistically significant (P<0. 05)

Total sperm abnormalities were highest in the bulls with the lowest SC of <36cm and lowest in bulls with SC of ≥42 cm of 19.00±1.82% and 7.63±0.72% respectively (p<0.05).

The bulls of age <36 months had the lowest mass motility and was highest in bulls with of age 48 to <60 months (p<0.05). The highest mass motility was observed in bulls with SC ≥42cm and lowest in bulls with SC<36 cm of 3.85±0.06 and 2.83±0.14 respectively. Bulls with a BCS of 3.5 had the least total abnormalities while those of BCS 4.0 had the highest (p<0.05). Bulls of BCS 2.5 had the lowest mass motility (p<0.05).

Table 2: Means (±SEM) according to Age, SC and BCS on % Live, Abnormal and mass motility

Variable		% Live	% Abnormal	Mass motility
Age (months)	<36	83.33±1.63[a]	17.19±2.02[a]	3.08±0.14[a]
	36 to <48	84.60±1.10[a]	13.20±1.35[ab]	3.42±0.09[ab]
	48 to <60	86.56±1.01[a]	8.23±0.72[b]	3.73±0.08[b]
	≥60	84.76±1.34[a]	8.83±0.78[b]	3.63±0.08[b]
SC (centimetres)	<36	82.12±1.53[a]	19.00±1.82[a]	2.83±0.14[a]
	36<39	84.79±1.35[a]	12.51±1.40[b]	3.43±0.11[b]
	39<42	84.71±1.38[a]	9.18±0.97[bc]	3.64±0.08[bc]
	≥42	86.83±0.93[a]	7.63±0.72[bc]	3.85±0.06[bc]
BCS	2.5	79.52±3.51[a]	19.03±3.42[a]	2.39±0.24[a]
	3.0	83.55±1.47[a]	18.56±1.96[a]	3.00±0.18[b]
	3.5	85.77±0.67[a]	9.15±0.54[b]	3.67±0.04[bc]
	4.0	79.33±8.07[a]	24.67±11.47[a]	3.72±0.40[bc]

[a-c] Means within the same column and category with a distinct letter are statistically significant (P<0. 05).

The effects of Breed and SC on BBSE classification are shown in table 3. Breed and SC were significant predictors of BBSE classification.

Table 3: Odds ratio of Breed and SC on BBSE classification

Variable	intercept	P value	Odds ratio	95% Confidence interval for odds ratio	
SC Ref(≥42cm)		0.009		Lower	Upper
<36cm	-1.450	0.002	**0.235**	0.095	0.577
36 to <39cm	-.696	0.117	0.498	0.209	1.192
39 to <42cm	-.958	0.028	**0.384**	0.164	0.900
Ref (*Bonsmara*)		0.001			
Sussex	-.462	0.339	0.630	0.244	1.625
Brahman	-1.026	0.010	**0.358**	0.163	0.786
Boran	-1.582	0.000	**0.214**	0.072	0.636
Afrikander × Tuli	-2.336	0.004	**0.097**	0.019	0.482
Tuli	-1.541	0.005	**0.206**	0.088	0.481

Age, month and BCS were not significant predictors of BBSE classification (p>0.05). The *Brahman* breed had odds of 0.358 less likely to be classified as sound; the *Boran* breed had odds of 0.206 less likely to be classified as sound and the *Afrikander* × *Tuli* breed had odds of 0.097 less likely to be classified as sound while the *Tuli* breed had odds of 0.214 less likely to be classified as sound for breeding. Therefore, the *Afrikander* × *Tuli* breed had the highest probability of being classified as unsound for breeding. Bulls with SC<36 cm had odds of 0.235 less likely to be classified as sound while those of 39 to <42cm had odds of 0.384 less likely to be classified as sound compared to bulls with SC ≥42cm.

Table 4: Odds ratios of age, month, SC and BCS on mass motility score

Mass motility cat	Variable		Intercept	P value	Odds ratio	95% CI for odds ratio	
						Lower bound	Upper bound
Fair	Month	Cat 1	0.83	**0.008**	2.29	1.24	4.22
		Cat 2	0^b				
	BCS	Cat 1	0.99	**0.017**	2.71	1.19	6.13
		Cat 2	0.61	0.069	1.84	0.95	3.54
		Cat 3	0^b				
	SC (cm)	Cat 1 (≤39)	0.60	**0.04**	1.81	1.01	3.24
		Cat 2 (>39)	0^b				
	Age (months)	Cat 1 (≤48)	0.02	0.943	1.02	0.59	1.76
		Cat 2 (>48)	0^b				
Good	Month	Cat 1	0.90	**0.007**	2.46	1.28	4.75
		Cat 2	0^b				
	BCS	Cat 1	0.11	0.815	1.11	0.46	2.69
		Cat 2	0.28	0.401	1.33	0.69	2.58
		Cat 3	0^b				
	SC	Cat 1	0.08	0.804	1.08	0.57	2.05
		Cat 2	0^b				
	Age	Cat 1	0.14	0.652	1.15	0.64	2.06
		Cat 2	0^b				

0^b =Reference variable, cat = category, the reference mass motility score category was very good CI = confidence interval

As shown in table 4 below, only BCS, SC and Month were significant in the model ($p<0.05$). Bulls examined in September, October and November (cat 1) were more likely to have fair mass motility relative to very good mass motility compared to bulls examined in June and July (Cat 2). Bulls examined in the month category 1 were more likely to have good mass motility relative to very good mass motility compared to bulls examined in month category 2.

Bulls in SC category 1 (≤39cm) were more likely to have fair mass motility relative to very good mass motility compared to bulls in SC cat 2 (>39cm). Bulls in BCS category 1 (2.5 and 3.0) were more likely to have fair mass motility relative to very good mass motility compared to bulls in category 3 (4.0). No significant difference was found on fair mass motility relative to very good mass motility due to BCS cat 2 (3.5) and BCS cat 3 ($p>0.05$). No significant differences were found on good mass motility relative to very good mass motility due to age, SC and BCS ($p>0.05$).

Discussion

The results indicate that only breed and SC had a significant effect on BBSE classification. The *Bos indicus* bulls have been previously reported by Brito *et al.* (2002); Chacon *et al.* (1999); Fields *et al.* (1979) to adapt well in tropical and semi-tropical regions and that the *Bos taurus* and the *Bos taurus* x *indicus* bulls do not adapt well in tropical/semi-tropical regions due to high temperatures in tropical regions and due to their lower heat tolerant capacities. The findings of this study indicate that the breeds *Tuli* (*Bos taurus*) and their Crosses the *Afrikander* × *Tuli* breed (*Bos indicus x taurus*) had significantly higher probabilities of failing the BBSE examination compared to the *Brahman* and the *Boran* (*Bos indicus*). *Bos indicus* bulls have a smooth coat with a higher proportion of hair follicles and their scrotum is hairless.

Furthermore, they also have better developed sweat and sebaceous glands allowing them to regulate heat properly compared to the *Bos taurus.* Fields *et al.* (1979) found that the *Brahman* bulls had better semen quality than the *Hereford* bulls, and this shows that *Bos indicus* bulls have better heat regulatory mechanisms. The crosses of the *Bos indicus* and *Bos taurus* bulls (*Afrikander* × *Tuli*) had the highest sperm abnormalities and the lowest mass motility. These findings are in line with the those by Brito *et al.* (2004) and Chacon *et al.* (1999) were despite crossing the *Bos taurus* with the *Bos indicus* bulls, their crosses were found to have significantly high levels of sperm abnormalities. In the study conducted by Brito *et al.* (2004), the *Bos indicus x taurus* bulls were more in number than the *B. indicus* and the *B.taurus* but were still found to have poor testicular vascular cone (TVC) and poor semen quality and more sperm abnormalities compared to the *Bos indicus* and therefore, in our opinion, the smaller number of the crosses in this study is not of a great concern to the interpretation of the findings.

However, the *Bonsmara* breed (*Bos taurus*) bulls had the least total sperm abnormalities signifying their potential to adapt in the tropical climate. The *Bonsmara* breed is a composite breed developed in the Transvaal province of South Africa and its genetic characteristics are as a result of the mating of the local *Afrikander* cows and the European *Shorthorn* and the *Hereford* bull breeds hence is potential to adapt to the sub tropical and tropical climates (Santana *et al.,* 2012) the objectives of the present study were to analyze the pedigree and possible inbreeding depression on traits of economic interest in the Marchigiana and Bonsmara breeds and to test the inclusion of the individual inbreeding coefficient (F(i. Significant breed differences were seen on the mean mass motility and the *Sussex* breed had the highest mass motility while the *Afrikander* × *Tuli* had the lowest. These findings are in line with those of Boujenane and Boussaq (2014) were mass motility was significantly different among the different dairy and beef bulls studied and also similar to a study conducted by Lemma and Shemsu (2015), were breed had a significant effect on mass motility with the lowest mass motility recorded in the crosses.

Age was not seen to be associated with BBSE classification in this study (no differences among age groups in the proportion of bulls that were classified as sound or unsound for breeding), this agrees with the study by Lemma and Shemsu (2015), who reported that, there were no significant differences due to age on semen parameters in the young pre-service bulls and the breeding bulls and also agree with those reported by Barth and Waldner, (2002) and Chacon *et al.* (1999), were no differences were seen in the bulls' semen quality among different age groups.

However, significant mean differences were observed with bulls less than 36 months having the highest total abnormalities with the lowest mass motility while those in the age category 48 to less than 60 months as having the least total sperm abnormalities with the highest mass motility. This is in line with the studies conducted by Lemma and Shemsu, (2015); Sarder, (2008); Chacon, (2001) and Madrid, (1988), were semen abnormalities were seen to reduce with increasing age. Although no significant mean difference was seen in the bulls of ages 48 to less than 60 months and those greater or equal to 60 months, our study revealed that the percentage of total abnormalities increased in bulls greater or equal to 60 months. Therefore, it can be suggested that it is of great benefit to use middle aged bulls than younger or older bulls in natural mating systems. Vilakazi (2003), reported that younger bulls tend to have poor sperm quality because of the under developed testicles and poor scrotal thermoregulation while in older bulls, testicular tissue tend to be broken down faster than it is replaced leading to testicular degeneration and older bulls tend to have higher levels of testicular lesions, these factors lead to poor sperm production.

Scrotal circumference was a significant predictor of BBSE classification. Sperm abnormalities were seen to reduce with increasing SC while sperm abnormalities were high in those bulls with a SC of less than 32cm. Similar findings were recorded in previous studies such as that of Garcia-Paloma, (2015); Sarder, (2008); Brito *et al.* (2004); Chacon *et al.* (1999); Madrid, (1988); Makarechian *et al.* (1985). However, the results of our study are in contrast with those of Menon *et al.* (2011), were no significant differences were seen due to SC on sperm abnormalities. Scrotal circumference significantly affected mass motility and mass motility improved with increasing SC. A study conducted by David *et al.* (2015), in sheep revealed that mass motility was associated with fertility and hence its importance in bull fertility cannot be over emphasized.

Body condition score had no relationship with BBSE classification in the study. The results are in line with those of Sarder, (2008) and Chacon *et al.* (1999) were the final outcome of BCS on the sperm abnormalities was not significant in the breeding bulls. However, the findings of our study are in contrast with those of Barth and Waldner, (2002), were BCS had a significant effect on bulls being classified as having satisfactory semen quality or not. However, bulls of BCS 3.5 had the lowest percentage of sperm abnormalities than BCS of 2.5, 3.0 and 4.0. It can thus be suggested that bulls with a good BCS have less abnormalities compared to thin and fat bulls. Body condition score was a significant predictor of mass motility were mass motility was seen to increase with an increase in the BCS of the bulls. Increasing BCS increased the probability of bulls having very good mass motility.

The results are in line with those of Chacon *et al.* (1999), were bulls with a low BCS had lower mass motility. The mass motility score results obtained in our opinion was of great relevance since the management conditions in the various farms sampled were almost similar. Sometimes the bulls from various farms are allowed to mix, graze together and supplemented together as most of the farms are near each other with similar management conditions. However, this needs to be elucidated further in future studies in order to ascertain the impacts of the minor nutritional differences on the sperm quality and sperm abnormalities of the bulls. Breeding bulls are suppose to have a good BCS, this is because BCS is indicative of the nutritional levels in the bulls that are necessary for the optimal function of the endocrine system (Barth and Waldner, 2002).

Based on morphology, month did not significantly affect the classification of bulls as either sound or unsound for breeding. Furthermore and in agreement with the present findings, Brito *et al.* (2002), did not observe any seasonal effect on sperm abnormalities of the *Bos taurus* and *Bos indicus* bulls. However, significant mean differences were found in our study with the month of November having the highest total abnormalities and the lowest mass motility than any other months. This could be due to high temperature levels that could have had an effect on spermatogenesis in the previous month of October before the semen evaluations were performed leading to high abnormal sperm due to poor testicular thermoregulation as a consequence of abnormally high temperatures, as well as reduction in nutrition due to a reduction in the quality of pasture in the hot season. The lowest total abnormalities and the highest mass motility were recorded in the month of July. Bulls evaluated in September, October and November had a higher probability of their semen having a fair mass motility relative to very good mass motility implying that mass motility decreased in the hotter months of the year. The results signify that the bulls performed better in the cold than the hotter months of the year. The results are in agreement with those of Fields *et al.* (1979) were the breeds of bulls studied showed variation in semen quality in different months of the year.

Conclusion

Bull breeding soundness classification was influenced by breed and SC. Younger and older bulls tend to have more abnormalities than the middle aged bulls. Bulls with a good BCS tend to have less sperm abnormalities and good semen quality.

References

Alexander, J.H. 2008. Bull breeding soundness evaluation : A practitioner ′ s perspective. *Theriogenology*, **70**: 469–472.

Alm-packalén, K. 2009. *Semen quality and fertility after artificial insemination in dairy cattle and pigs, Thesis*. University of Helsinki, Finland.

Ambali, A.L., Akpa, G.N. and Suleiman, I.O. 2013. Reltionships Between Sperm Morphology, Semen charactericts, Testicular Mesurements and Body conformation Traits in Red Sokoto Goat. *I.J.A.B.R*, **3**(3): 348–353.

Barth, A.D. and Waldner, C.L. 2002. Factors affecting breeding soundness classification of bulls examined at the Western College of Veterinary Medicine. *Can. Vet. J.*, **43**: 274–284.

Boujenane, I. and Boussaq, K. 2014. Breed effects on semen traits of dairy and beef artificial insemination bulls. *LRRD.*, **26**(6): 64–69.

Brito, L.F.C., Silva, A.E.D.F., Rodriquez, L.H., Vieira, F.V., Deragon, L.A.G. and Kastelic, J.P. 2002. Effects of environmental factors, age and genotype on sperm production and semen quality in Bos indicus and Bos taurus AI bulls in Brazil. *Anim. Reprod. Sci.*, **70**(3-4): 181–190.

Brito, L.F.C., Silva, A.E.D.F., Barbosa, R.T. and Kastelic, J.P. 2004. Testicular thermoregulation in Bos indicus, crossbred and Bos taurus bulls: Relationship with scrotal, testicular vascular cone and testicular morphology, and effects on semen quality and sperm production. *Theriogenology*, **61**(2-3): 511–528.

Bovine semen quality control in artificial insemination centers. *Anim Reprod*, **9**(3): 153–165.

Chacon, J. 2001. Assessment of Sperm Morphology in Zebu Bulls under field conditions in the tropics. *Reprod. Domestic. Anim.*, **36**(2): 91–99.

Chacon, J., Perez, E., Muller, E., Soderquist, L. and Rodriquez-Martinez, H. 1999. Breeding Soundness Evaluation of Extensively Managed Bulls in Costa Rica. *Theriogenology*, **52**(99): 221–231.

Chenoweth, P.J. 2002. Electroejaculators and Probes. In *Proceedings, The Applied Reproductive Strategies in Beef Cattle Workshop September 5-6. Semen Quality Assessment*. Manhattan, Kansas, pp. 247–255.

Chenoweth, P.J. 2005. Genetic sperm defects. *Theriogenology*, **64**: 457–468.

David, I., Kohnke, P., Lagriffoul, G., Praud, O., Plouarboue, F., Degond, P. and Druart, X. 2015. Mass sperm motility is associated with fertility in sheep. *Anim. Reprod. Sci*, **30**: 4–10.

Fields, M.J., Burns, W.C. and Warnick, A.C. 1979. Age, season and breed effects on testicular volume and semen traits in young beef bulls. *J. Anim. Sci.*, **48**(6): 1299–1304.

Fordyce, G., Entwistle, K., Norman, S., Perry, V., Gardiner, B. and Fordyce, P. 2006. Standardising bull breeding soundness evaluations and reporting in Australia. *Theriogenology*, **66**(5): 1140–1148.

Kridli, R.T., Tabbaa, M.J. and Barakeh, F.S. 2007. Seasonal Variation in Scrotal Circumference and Semen Characteristics of Black Bedouin and Black Bedouin-Damascus Crossbred Bucks. *Asian-Aust. J. Anim. Sci.*, **20**(3): 359–364.

Lemma, A. and Shemsu, T. 2015. Effect of Age and Breed on Semen Quality and Breeding Soundness Evaluation of Pre-Service. *Young Bulls.*, **6**(2): 35–40.

Madrid, N. 1988. Scrotal circumference seminal characteristics, testicular lesions of yearling Angus bulls. *AJVR*, **49**(4): 579–85.

Mahmound, K.G.M., EL-Sokary, A.A.E., EL-Roos, A., Abdel, G. and Nawito, M. 2013. Sperm Characteristics in Cryopreserved Buffalo Bull Semen and Field Fertility. *I.J.A.S*, **3**(4): 777–783.

Menon, A.G., Barkema, H.W., Wilde, R., Kastelic, J.P. and Thundathil, J.C. 2011. Associations between sperm abnormalities, breed, age, and scrotal circumference in beef bulls. *Can. J. Vet. Res.*, **75**: 241–247.

Parker, R., Mathis, C. and Hawkins, D. 2004. *Evaluating the Breeding Soundness of Beef Bulls, Guide B-216*, New Mexico. Available at: http://aces.nmsu.edu/pubs/_b/B216.pdf.

Penny, C. 2016. Condition Score (BCS) in Beef Herds. *NADIS*, pp. 1–4. Available at: http://www.nadis.org.uk/bulletins/condition-score-(bcs)-in-beef-herds.aspx?altTemplate=PDF.

Santana, J.L., Oliveira, P.S., Eler, J.P., Gutierrez, J.P. abd Ferraz, J.B.S. 2012. Pedigree analysis and inbreeding depression on growth traits in brazilian marchigiana and bonsmara breeds. *J. Anim. Sci.*, **90**(1), 99–108.

Sapanidou, V.G., Margaritis, I., Siahos, N., Arsenopoulos, K., Dragatidou, E., Taitzoglou, I.A., Zervos, I.A., Theodoridis, A. and Tsantariliotou, M.P. 2014. Antioxidant effect of a polyphenol-rich grape pomace extract on motility, viability and lipid peroxidation of thawed bovine spermatozoa. *J.B.R.*, **21**(19): 1–6.

Sarder, J.U. 2008. Effects of age, body weight, body condition and scrotal circumference on sperm abnormalities of bulls used for artificial insemination (AI) programme in Bangladesh. *Univ. J. Zool. Rajshahi Univ.*, **27**: 73–78.

Sellem, E., Broekhuijse, M.LW.J., Chevrier, L., Camugli, S., Schmitt, E., Schibler, L. and Koenen, E.P.C. 2015. Use of combinations of in vitro quality assessments to predict fertility of bovine semen. *Theriogenology*, **84**(9): 1447–1454.

Vilakazi, M.M. 2003. *Factors affecting the quality of semen of A. I. dairy bulls in South Africa South Africa, Thesis*. University of Pretoria, South Africa.

Vincent, P., Underwood, S.L., Dolbec, C., Bouchard, N., Kroetsch, T. and Blondin, P., 2012.