Effect of Feed Rations and Bull Breeds on Semen Parameters of Bulls at Kenya Animal Genetic Resources Center Nairobi Kenya

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Abstract- ***Adequate nutrition is crucial for maintaining good reproductive health in bulls. Nutritional deficiencies can negatively impact semen quality, depending on the breed of the bull. It is from this perspective that the study sought to investigate the influence of nutrition quantity (DM7.5 (R1)- Control nutrients- DM4.4 (R2) =lower nutrition, R= high nutrients, DM9.5 (R4)=highest nutrient) of bulls on different bull breed semen parameters, that is, the quantity (number of reproductive jumps, number of doses and volume) and quality(concentration, density, motility) at Kenya Animal Genetic Resources Center, Kenya. The study was an experimental in design in the Latin square framework involving 32 bulls. The volume, dosage, sperm concentration, density, and sperm motility (rate, percentage, warm, and post-thaw motility) of the semen were all measured twice a week. The difference between treatment means (± SD) was calculated based on the ANOVA framework. The SPSS aided and significant level set at 0.05. The results showed that feed quantity, had a significant influence on semen characteristics. The number of doses were significantly higher in Jersey bulls (529.58±268.72) than in Ayrshire (404.44 ± 188.58) and Sahiwal (430.64±278.72). The volume of semen across different feed rations was not different (P>.05). The number of doses were significantly lower in bulls fed on reduced DM4.4 (R2) feed (391.53b±230.16) compared to doses from bulls fed on the usual quantity DM7.5 (R1) feed (514.34a ± 360.99). The concentration and density of semen were found significantly higher in bulls on DM5.0 (R3) and DM9.5 (R4) feeds than the reduced nutrient feed DM4.4 (R2). No difference in both concentration and density was observed between higher nutrient feeds (DM5.0 (R3) and DM9.5 (R4)) and the usual feed DM7.5 (R1). Motility (warm), Motility (diluted), Motility (post-thaw) did not differ across types of feeds. Jersey bulls proved superior in most qualitative characteristics than other breeds. It produced significantly higher concentrated semen and higher number of doses than Frisian and Sahiwal bulls.***

Indexed Terms- Bull Breeds, Semen Parameters

I. INTRODUCTION

Bull fruitfulness is inclined by a number of features, plus genetics, environment, season, and nutrition, according to Singh et al.'s (2018) research, "Nutrition and bull fertility: A review in India." Among these, diet significantly affects a bull's ability to reproduce. A balanced diet takes a considerable influence on testicular steriodogenesis and gonadotropin-discharging hormone in male calves during the pre- and post-weaning stages, which eventually affect bull fertility. In order to determine the extent of different dietary requirements in bulls at different ages and their impact on youth, sensual adulthood, and fruitfulness, it is required.

Widiyono et al. (2017) in his study states that nutritional status has an impact on the reproductive organs of goats. In Kacang goats, he also found that full feeding followed by controlled nutrition followed by full feeding had no ejaculation volume effect. They further report that sperm parameters were kept within the normal physiological range for Kacang goats. Unlike this study, which was based on goats in Pakistan with the goal of triangulating it with comparable studies, this study will attempt to bring out

the effect of varying feeding levels in bulls in Kenya. Studies by Soliman et al. (2014) on indicate that feeding nutrition especially during pubertal development should be investigated globally, particularly among those undergoing rapid nutritional transformation. This they argue is to ensure that the timing and progression of pubertal development should be checked to avoid overweight acquisition which has an impact on early neonatal, and childhood nutrition. The suggested study to establish the nutritional effect on bull semen production quality and quantity fits into the gap identified by (Soliman et al., 2014) from their study as reported in their study.

Walker et al. (2013) in their study on states Bull Nutrition- Achieving Yearling Breeding, yearlings (making quality semen) and are physically able to seek out bulls and heifers on pasture, diet plays a crucial impact. Nutritional management is critical in ensuring that they are able to meet expectations. Many producers disregard the nutritional needs of their bulls until issues emerge.

Walker et al. (2009) opines proper nutrition and management of semen producing bulls is key in enhancing the bull's reproductive development and performance. The study recommends that in as much as reproductive traits can be genetically, there ought to be proper assessment and selection of bulls coupled with selective nutritional programmes in order to achieve the much-desired genetically success. The suggested study is different from Walker et al. (2009) studies given than the study will only endeavor to establish the result of nutrition on bull semen quantity and quality without looking into their genetical backgrounds.

II. LITERATURE REVIEW

According to a 2015 study by Alemayehu and Tena on the impact of age on the quality of the semen and the upbringing reliability of young bulls in pre-service, different breeds responded differently in terms of the quantity and quality of semen generated. For instance, Holstein Friesian bulls generated the maximum volume while Borana bulls produced modest capacity but highly focused semen with the uppermost form motility of sperm (p0.001). The study came to the conclusion that an important factor in determining the amount of semen generated is the breed of the animal. Whereas the study by Alemayehu and Tena (2015) was centered on the type of breed on quantity of semen produced, the present education aimed at establishing the result of a feeding program on the different breeds on the quantity of semen produced.

The excellence of the semen generated was dependent on the breed of the bull that produced it, according to a study by Alemayehu and Tena (2015) on the impact of age and breed on semen excellence and breeding accuracy assessment of pre-service new bulls. Pre-freeze sperm motility was shown to be lower in crosses (p 0.05) than in other breeds, according to the study. In pre-service young bulls, the mean (SD) scrotal circumference was 34.51.7cm, with a substantially greater fraction of dead sperm (34.219.5%).

Different breeds had different semen quality characteristics. Bulls from the Limousin breed had the greatest (p0.05) EV. Additionally, as compared to Bali bulls, Simmental and Limousin bulls showed higher SC, TSN, and FSD values (p 0.05). However, compared to other breeds, Bali bulls' ISM and PTSM were higher (p 0.05).

Different bull breeds have different semen quality, according to earlier research. Anchieta et al. (2005) found that the sperm concentration in bovine semen from European breeds was higher than that of Zebu breeds. Bos taurus bulls, on the other hand, have worse sperm motility than Bos indicus bulls, according to Koivisto et al. (2009). Simmental bulls, one of the breeds with European ancestry, generated more frozen sperm than Ongole crossbred bulls, according to a different study by Isnaini et al. (2019).

The studies on breed and semen parameters have shown that type of breed determine the seminal characteristics. It is therefore important to find out the variations in seminal characteristics among different breeds under different feed rations of bulls used for AI in Kenya

III. MATERIALS AND METHODS

Bryman and Bell (2015) define a research design as a strategy for data collection and analysis to generate answers to a specific research problem. An

experimental research design is a framework of protocols and procedures established to perform scientifically based experimental research. Experiments are used to investigate causal links by manipulating some independent factors and measuring their effect on one or more dependent variables. An experimental design is a set of procedures used to test a hypothesis methodically. The experimental procedure was used; that's, define the IVs, specify the hypothesis, design the experimental treatment, assign elements to groups and measure the outcome variable (semen parameters) This study used experimental design in the context of Glaeco Latin Square Design (GLSD) In assigning the treatment the Latin square design. Latin square is a generalizations of a randomized block design with two different blocking system. It is used because of the efficiency of blocking in two different directions, allowed duplication of treatments with simultaneous blocking of more than one factors as well. However, Latin designs suffer from low degree of freedom, df. The replication aided to increase the degrees of freedom which Latin squares suffers from.

There was a total of 122 at KAGRC bull station and out of which 32 bulls met the eligibility of the Latin Square Design hence, selected for the study. The bulls were categorized into four in terms of age, BCS in the range 1 to 5, and four types of breeds, the feed quantity was also divided into 4 categories in terms of dry matter. That's is DM7.5 Kgs DM4.4 Kgs, DM5.0 Kgs and DM9.5 Kgs. DM7.5 Kgs (R1) was the control experiment which represents the usual feed currently used at KAGRC. The feed contained 7.5 dry matter; DM7.5 Kgs DM4.4 Kgs (R2). Reduced dry matter, reduced supplement and concentrates levels prepared by mixing a total of 4.4kg of Dry matter; DM4.4 Kgs. DM5.0 Kgs (R3)- Moderate dry matter supplements and concentrate levels containing 5.0kg Dry matter; DM 5.0 Kgs and DM9.5 Kgs (R4) is the ration that with highest Dry Matter containing a total of 9.5kg Dry matter. The study used electronic ejaculator, artificial vagina, teaser bulls, deep freezer, liquid nitrogen, and semen diluent in semen collection and storage before analysis.

The semen was collected according to the time schedule drawn in table 1 and subsequently taken to the laboratory for analysis. This took a period of 180 days from the inaugural day of feeding. Semen was collected from each bull once per week with 2 to 3 ejaculates collected. Which was done very early in the morning to avoid heat stress on the bull as it affects performance. The following procedures were adhered to. First the bulls were washed to remove the dirt and pre-putial hairs clipped to avoid contamination of the collected semen; the bull was then left to dry. The bulls from the Frisian, Jersey and Ayrshire were then brought out and taken to the collection yard where the teaser bull was restrained. The bull is allowed several false mounts depending on age (affect libido) so as to allow good teasing and this improves semen collection.

The bull is finally allowed to make a true mount and the steward doing the collection approaches the bull and directs the penis towards the artificial vagina. The bull made a thrust into the artificial vagina and the ejaculate was collected on a graduated tube attached to the artificial vagina. The amount of semen collected was recorded alongside the bull's name. The 8 Sahiwal bulls were subjected to the electronic ejaculator because they are known to be poor in responding to the teaser hence, they electronic ejaculator was used to prompt then to ejaculate (KAGRC, 2021). Frozen semen was packaged in French straws which were arranged in racks and then placed in freezer and frozen with liquid nitrogen vapour until they attained a temperature of -196°C.The multiple mean comparison in the context of ANOVA was used to evaluate the pair significant difference existed. The Bonferroni adjustment method was in to determine the mean differences between different levels of a factor.

ANOVA model with replication $y_{hijk} = \mu + \sigma_h + \rho_i + \beta_j + \tau_k + e_{hikk}$

Where; $\begin{cases} h = 1,..p \\ i = 1,...p \text{ and } k = d_h(i,j) - \text{greek letters} \\ j = 1,...p \end{cases}$

IV. FINDINGS OF THE STUDY

Bull Breeds and Semen Parameters

The study presents number of productive jumps, volume of semen, and number of doses across bull's breeds. The chi square test results showed that number

of reproductive jumps depended on the type of breed; Pearson's χ^2=16.427 df; =6 p =.012*

Table 4.4: Chi square results to test the association between number of productive jumps across different breeds

		Breed			
		Friesian	Ayrshire	Jersey	Sahiwal
Number of productive jumps	One	4	6	2	11
	Two	26	33	10	27
	Three	49	78	43	37
	Total	70	117	55	75

Pearson's χ^2=16.427 df; =6 p =.012*

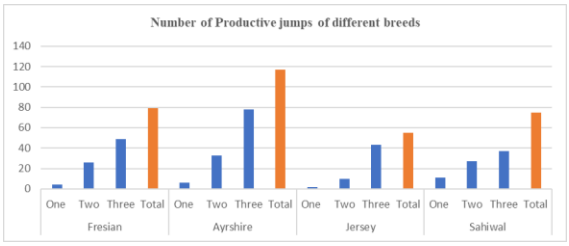

Figure 4.7: Productive jumps per breed

Figure 4.7, The Ayrshire bulls showed superior in production of number of productive jumps but the jersey bulls showing inferior. Each breed produced more three jumps than two or one jump which is a positive sign for desirable AI success. Table5 Mean(±SD) comparison of quantitative parameters of different breeds of bulls.

Mean Comparison of semen parameters across different feed rations

The study ran inferential statistics to establish the effect of feeding ratios on semen parameters among the bull breeds under study. The findings were recorded and presented as shown in tables 4.14.

Table 4.5: Mean(±SD) of semen parameters across bulls of different breeds

Parameters	Friesian	Ayrshire	Jersey	Sahiwal	sig
Doses day	404.44_{a}±188.58	462.84_{ab}±307.54	529.58_{b}±268.72	430.64_{a}±278.72	*
Volume (ml)	5.53_{a} ±1.60	6.29_{b} ±2.45	$6.17_{a, b}$ ±2.45	$5.92_{a, b}$ ±2.41	*
Quality data					
concentration million	804,625.77$_{a}$	±814,317.39$_{a}$	±1,029,969.23$_{b}$	±825,397.44$_{a}$	±*
cumm	400,000.54	427,973.63	493,229.13	465,122.83	
Density	875.221,35$_{a,b}$± 462,178.00	789.264,93$_{a}$± 415,754.07	1.022.223,88$_{b}$± 488,878.89	1.027.222,22a, b± 1,954,536.59	*
Motility Rate	1.70_{a} ±.61	1.66_{a} ±.58	1.75_{a} ±.57	1.76_{a} ±.54	
Motility (warm)	80.80_{a} ±4.58	$81.20_{a, b}$ ±4.42	82.19_{b} ±4.03	$81.38_{a, b}$ ±4.49	
Volume of Extender	43.26_{a} ±38.86	$46.70_{a, b}$ ±35.57	55.03_{b} ±28.39	43.98_{a} ±28.80	*
Number of doses	203.05_{a} ±122.26	223.59_{a} ±146.93	265.27_{b} ±127.94	216.18_{a} ±129.66	**
Motility (diluted)	79.75_{a} ±4.37	81.04_{a} ±4.60	80.23_{a} ±7.12	81.12_{a} ±4.38	
Postthaw Motility	52.39_{a} ±5.01	52.73_{a} ±5.12	52.73_{a} ±4.58	52.18_{a} ±4.37	
conc x 10^6	$.80_{a}$ ±.40	$.81_{a}$ ±.43	1.03_{b} ±.49	$.83_{a}$ ±.47	*

From Table 4.5 results, it was discovered that the volume of the spermatozoa produced by the sampled breeds of bulls did not differ (p>.05) across bulls of different breeds during the study period. The findings concur with findings by Shah, et al. (2019) who established that mean semen volume was significantly (P<0.05) high in Jersey bull than the Friesian or Sahiwal bulls. According to the KAGRC, the normal range of total volume of semen from a bull for viable breeding should be 7-15 ml. The mean volume obtained ranged from a minimum of 12.13±6.95ml (Sahiwal) to 13.73± 13.74 (Friesian) that is within the

standard recommended range in AI services. Moreover. further scrutiny of the semen volume data through the ration-age-breed lens

The jersey bulls produced significantly (p<.05) higher average number of doses in a day (529.58±268.72) than the Friesian (404.44a ±188.58) or the Sahiwal (430.64a ±278.72) an indication that the higher proportion of Jersey bulls among the AI cohort would likely be effective in mitigation of semen scarcity in breeding programs of cattle through AI services.

The spermatozoa from the four breeds differed on the concentration. The jersey bulls proved most superior producing the most concentrated spermatozoa (1.030 ±.493X106mm-3), then either the Friesian bulls (0.800 ± 404x106), Ayrshire bulls (.814 ± .428x106) and Sahiwal bulls (.825 ± .465). The spermatozoa from Friesians, Ayrshire, Sahiwal all were not significantly different in concentration. Some previous studies found related results. For instance, Rehman's (2016) research in Pakistan on the association between age, breed, and libido and the characteristics of cattle bulls' sperm found that Jersey bulls had significantly higher (P0.05) sperm concentrations than Friesian, Jersey, Ayrshire, Cross (Friesian x Sahiwal), and Sahiwal sperm concentrations.

The spermatozoa density was different across the breeds. The Jersey bulls once again had significant (p<.05) higher density (1,022,223.88 ± 488,878.89) of spermatozoa than that of the Friesian bulls (789,264.93 ± 415,754.07). The Frisian, the Ayrshire and Sahiwal produced semen of density that did not significantly differ (p>.05). Further inquiry into the data on number of doses across the age, breed and feed ration showed that the youngest cohort of Jersey bulls had the best semen of highest density (Fig. 4.6). This is the cohort that also produced the best semen of highest concentrated semen as seen from early results. The results indicative that the young jersey bulls on high diet have good reproductive capabilities. However, because of the missing data on number of rations for each breed, the research could not confidently conclude on the ideal ration breed and age combination that would be superior in semen density. The rate of motility, motility of fresh semen (warm), motility of diluted semen and post thaw motility did not differ across the bulls of different breeds (p<.05).

In summary, the qualitative characteristic was influenced by the type of breed. The sample of jersey breed used during the study proved superior in two out of four qualitative characteristics; of high dense and high concentrated spermatozoa. Bulls of high reproductive efficiency bear excellent semen quality. Sperm concentration and density are some indicators of semen quality of AI bulls. The breeding of high proportion of jersey bulls seems one of the critical drivers that can propel KAGRC towards development of sustainable animal production of high-quality semen for farmers in Kenya and for export.

CONCLUSION

the study concludes that there is a significant positive effect between the type of bull breed and semen parameters of bulls at Kenya Animal Genetic Resources Center Nairobi Kenya.

RECOMMENDATIONS

The study recommends that for optimal doses for Ayrshire bulls they ought to be feed on ration R1 compared across the other feeding rations R2, R3 and R4.

The study further recommends that bulls in the Friesian category produced the highest doses per day when fed on R1.

On the Jersey bulls the study recommends that for optimal semen parameters, the bulls ought to be feed on R4. The study further recommends that Sahiwal bull breeds be fed on R3 produced the highest amount of semen compared to other feeding rations.

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