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Evaluation of semen parameters of Brahman graded bull compared to Holstein graded and Local bulls using Computer Assisted Sperm Analyzer

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Abstract

An experiment was conducted to characterize, compare, estimate of heritability, and genetic and phenotypic correlations of semen parameters of three genetic groups of bulls. The study was carried out at the Central Cattle Breeding and Dairy Farm, Saver, Dhaka from April to November, 2015. A total of 16 bulls from three genetic groups namely Brahman graded (8), Friesian graded (5) and Local (3) bulls were selected. Motility % and sperm concentration ($\times 10^6$/ml) were observed using Computer Assisted Sperm Analyzer (CASA). Data were analyzed using SAS Computer Package Program, version 9.1.3. Analysis of data showed that, individual genotypes had significant ($p<0.05$) effect on semen parameters. The maximum sperm concentration ($\times 10^6$/ml) was found as 1516.59±33.07 for Local group (LG), intermediate as 1380.38±19.06 for Brahman groups (BG) and lowest as 1105.03±22.54 in Friesian group (FG), respectively. The season had also significant ($p<0.05$) effect on semen parameters. The estimated heritability for the semen production traits were medium to high as 0.39 to 0.51, 0.36 to 0.48 and 0.35 to 0.44 for BG, FG and LG, respectively. The strongest positive genetic and phenotypic correlations were noticed between the related semen parameters for all the genetic groups. Through ranking of different traits used in this study for each genotypes it is signified that Brahman genotypes stood 1st position in terms of selection index value which has newly been introduced for beef production in Bangladesh.

Introduction

The livestock population in Bangladesh has been estimated to be about 28.49 million cattle, 0.72 million buffalos, 19.29 million goats, 0.89 million sheep, 189.26 million chickens, 67.53 million ducks and 1.45 million turkeys (BBS, 2019). Although the cattle population in Bangladesh is considerably high but the productivity is not satisfactory in terms of meat and milk production. The annual meat production in Bangladesh is estimated to be 7.52 million metric ton (DLS, 2019), where the beef contributes 48%, 12% from sheep and goat of the total value and poultry meat alone contributes 40% of the total meat production in Bangladesh (DLS, 2019). Now we are surplus in meat production as developing country because the availability of meat per capita is 45.26 kg per annum against the requirement of 43.25 kg (DLS, 2019). Between 1997/99 and 2030, annual meat consumption in developing countries is projected to increase from 25.5 to 37 kg per person, compared with an increase from 88 to 100 kg in developed countries (Ritchie, 2020). So we need to increase meat production more and more by utilizing the available genetic resources. The cattle resources of Bangladesh are mainly being reared for milk and to some extent for meat. As there is no recognized beef breed in Bangladesh and the farmers are frequently being involved in fattening of either local or upgraded dairy graded bull calves for increasing the beef production in Bangladesh. Very recently grading-up of native cattle with Brahman breed for beef production has been advocated in the breeding policy in the country (BES, 2007). In the present socio-economic condition, Brahman graded bull may be more adaptable to our agro-climatic condition for beef cattle improvement. Considering weather, agro-climatic condition, heat tolerance, disease and insect resistance, longevity, grazing ability, calving ease, mothering ability and management, Brahman breed is being considered for meat production in tropical and sub-tropical regions.

But the success of grading-up program mainly depends on semen quality, skill of artificial insemination (AI) technician and awareness on heat detection. When highly fertile bulls are used, better conception rates possible to achieved, which reduces costs of reproduction. It was also observed a high variability in fertility among bulls using different sperm concentrations per dose at AI. It requires evaluation of semen parameters very cautiously. To predict the

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fertilizing capacity of spermatozoa, many methods of semen evaluation have been suggested. To avoid human bias computer based semen evaluation techniques have been developed. Many experiments have already been done for the evaluation of semen parameters manually in Bangladesh but computer based semen evaluation techniques only one researcher (Islam *et al*., 2017) been used in our country. Thus for this research, the semen of Brahman graded bulls along with other two genotypes of bulls were evaluated using computer based semen analyzer for the second time in Bangladesh giving emphasis particularly to the quality of semen of Brahman graded bull and to disseminate Brahman graded semen through AI program for genetic improvement of beef cattle. So production criteria will be improved and thus will be strengthening income generation activity of the farmers.

Materials and Methods

Research site, selection of breeding bulls and semen collection

The present study was conducted the Central Cattle Breeding and Dairy Farm (CCBDF) at Saver, Dhaka from April to November, 2015. A total of eight Brahman graded bulls of G_1 generation (Brahman x Local=50:50) were selected from “Beef cattle development project”. The other experimental bulls were five Friesian graded (Friesian × Local =50:50) and three Local bulls selected from CCBDF.

The age of the bulls were determined by the date of birth from the record book maintained by AI Center. The bulls were between 3.11 to 5.5 years in age for Brahman, 4.5 to 6.5 years for Friesian and 4 to 7 years for Local. The body weight and scrotal circumference of bull were 570 to 710 kg and 31.5 to 40.1 cm for Brahman, 550 to 750 kg and 34 to 37.5 cm for Friesian, and 400 to 450 kg and 33.5 to 38 cm for Local, respectively. The semen was collected once a week with two ejaculations during each collection session by means of AV (artificial vaginal method). Before collection all the parts of Artificial Vagina were cleaned, sterilized, assembled properly and the internal temperature was maintained at 42 to 45^0 C. After collection, semen was placed immediately into water bath at 37^0 C until going for further handling. A total of 266, 170 and 99 ejaculates were collected from three genetic groups viz. Brahman graded, Friesian graded and Local bulls, respectively.

Physical evaluation

The ejaculate volume was recorded by reading the graduated mark of the collection vial in milliliter. The color of semen was recorded as milky and creamy white depending on the thickness and pigments of the semen and was assigned a numerical value 1 for milky white and 2 for creamy white for statistical analysis. The consistency of semen was observed by inclining and moving the semen in collection vial with care. It was recorded and scored in 4 scales viz. 1= thin milky, 2= thick milky, 3= thin creamy and 4= thick creamy.

Microscopic evaluation (mass activity, sperm concentration and motility)

The mass activity of fresh semen was evaluated using phase contrast microscope (Nikon Eclipse YHDO9628) with 10X zoom and a heated stretching table. One drop of fresh semen was placed on pre-heated table at 37^0 C and covered with a cover slip. The mass activity was scored from 1-4 scales as follows:

1 = weak motion without forming any wave;
2 = small, slow moving wave;
3 = vigorous movement with moderate rapid waves and eddies and
4 = dense, very rapidly moving waves and eddies.

CASA calibration setup

Temperature of analysis 37^0 C; Frame rate (Frames/sec) 30; Duration of data capture 15; Minimum motile speed (microns/sec) 28; Maximum burst speed (microns/sec) 600; Distance scale factor (microns/sec) 7.50; Minimum cell size (pixels) – 6; Maximum cell size (pixels) 6; Sperm count per field analysis - >1000; Minimum number of fields per sample 3. The concentration of spermatozoa and motility was done using the Computer Assisted Sperm Analysis (CASA), latest version 6.0.1 (Andro Vision AXIO, Minitub, Germany). One small drop of sodium citrate diluted semen was placed on a clean prewarmed (37^0C) slide and examined under Computer Assisted Microscope with cover slip at 10X zoom. Analysis was performed at least three new fields of each of slide.

Season

To evaluate the seasonal variation on semen quality the experimental period was divided into three seasons:
(a) Summer season (March to June); (b) Rainy season (July to October), and (c) Winter season (November to February).

Statistical analysis

The design of experiment was factorial. The significance of fixed effects (non-genetic factors) was tested by least-squares analyses of variance using the Generalized Linear Model (GLM) procedure of the Statistical Analysis System (SAS institute Inc., 2009; version 9.1.3) to find out the genotypes of bulls and seasonal effects on semen parameters according to the following linear model:

$$Y_{ijk}= \mu + S_i +M_j + e_{ijk}$$

Where, Y_{ijk} = the dependent variable
μ = the overall mean
Si = the fixed effect of i^{th} genotype
Mj = the fixed effect of j^{th} season
e_{ijk} = the residual error

Duncan multiple range test (DMRT) was performed to separate mean values in case of significant effects. Pearson correlation coefficients for phenotypic values were calculated by means of the procedure CORR (SAS, 2009).

Heritability and genetic correlations were estimated by VCE (version 4.2.5) (Groeneveld, E. 1998) on the basis of intra-class correlation. The model fitted for both uni-trait and two-trait analyses were as followed:

Y= Xb + Za + e
Where:
Y= vector of observations;
B= vector of fixed effects;
a= vector of random animal effects (direct genetic);
X= incidence matrix for fixed effects;
Z= incidence matrix for random effects and
e= vector of random residual effects.

It was assumed that all effects in the models are independent and normally distributed.

Ranking of genotype of bulls

Breeding bulls were ranked by calculating selection index. The following formula was used for calculating selection index:

$I=a_1b_1h_1^2+ a_2b_2h_2^2+ a_3b_3h_3^2$

Where, a_1=phenotypic value of ejaculate volume;
b_1=economic weight value of ejaculate volume;
h_1^2=heritability of ejaculate volume;
a_2=phenotypic value of mass activity;
b_2=economic weight value of mass activity;
h_2^2=heritability of mass activity;
a_3=phenotypic value of sperm concentration;
b_3=economic weight value of sperm concentration and
h_3^2=heritability of sperm concentration.

Results and Discussion

Influence of genotype of bulls on semen parameters

Table 1 shows that significantly (p<0.05) higher ejaculate volume of semen was obtained in Friesian groups (FG) followed by Brahman groups (BG) and Local groups (LG) in the order of 7.86±0.19, 7.24±0.15 and 6.68±0.19 ml/ ejaculate, respectively. This observation strongly supports with the findings of Rahman *et al.* (2014) and Akhter *et al.* (2013) who found the mean value as 7.19±0.19 ml for Holstein-Friesian × Zebu bulls and 6.92±0.2 ml for 1/4 Local x 3/4 Friesian, respectively. According to Islam *et al.* (2019) and Islam *et al.* (2017), ejaculate semen volume obtained from Brahman graded and Holstein Friesian graded bulls were 4.93±0.10 and 5.63±0.16 ml, and from Brahman graded bulls it was 6.24±0.15 ml, respectively which was lower than the present study which might be due to different management practices. In respect of color the current study showed the mean value as 1.96±0.01, 1.88±0.02 and 1.65±0.03 for LG, BG and FG, respectively and color was found almost creamy white. This observation strongly agrees with the studies of Akhter *et al.* (2013) who reported the color as creamy for genetic groups L×F×F, S×F and L×F×F, respectively. The result of the present study for semen consistency was thick milky and mean value reported as 2.56±0.07, 2.19±0.04 and 1.72±0.04 for LG BG and FG, respectively which is in agreement with the result of Tania (2012) who obtained 2.00±0.63 in Brahman graded bulls. On the other hand, Akhter *et al.* (2013) reported the overall consistency of semen was thick milky.

The highest and lowest consistency of thin creamy and thick milky was observed among the genetic groups (L×F×F; L×F×F; S×F×F and S×F), respectively which is not similar to the present result. The premier (3.19±0.02) and lowest (2.81±0.02) value of mass activity was found in LG and FG, respectively. The mass activity of semen for Local groups was significantly (p<0.01) higher than that of FG but no significant difference was observed with BG (3.08±0.02). This observation strongly supports with the result of Rahman *et al.* (2014) who found mean value as 3.94±0.25 for Holstein-Friesian x Zebu. However, the present observation differs from that of Farooq *et al.* (2013) who reported the overall mean mass activity of semen was 1.94±0.14; having the range as 0.50-3.75. The concentration of sperm in current study was $1516.59±33.07×10^6$/ml, $1380.38±19.06×10^6$/ml and $1105.03±22.54×10^6$/ml for LG, BG and FG, respectively. This result agrees with the previous findings of Tania (2012) and Islam *et al.* (2019) who studied semen characteristics of Brahman graded (50% BR × 50% L) breeding bulls and obtained average sperm concentration of 1258.89±183.59 to $1321.11±120.47×10^6$/ml and $1147.00±28.75×10^6$/ml, respectively.

According to Ahmed *et al.* (2014) and Islam *et al.* (2019) the average sperm concentration per ml ejaculate of Friesian and Holstein Friesian graded bulls semen were ($1043.5±93.2×10^6$/ml) and (1087.00±54.41 10^6/ml), respectively which are almost similar to the present study. These differences existed in semen parameters might be due to the variation in age, breed, collection frequency, feeding regime, climatic condition scrotal circumference, endocrine balance, soundness of the sex organs, individual potentiality of bull and overall management systems. Table 2 represents the semen motility of three genetic groups of bulls. The highest progressive motility (65.80±1.51%) was found in BG, which is significantly (p<0.01) higher (6.4 and 6.73%) than FG and LG, respectively. However, the present observation differs from that of Vincent *et al.* (2012) who reported higher (70%) progressive motility of bovine semen. According to Contri *et al.* (2010) who obtained the mean value progressive motility were 45.0±5.0% which is slightly lower than present study. The mean values of non-motility were 7.82±1.00, 32.28±0.80 and 28.18±1.44% for BG, FG and LG, respectively. According to Vincent *et al.* (2012) who obtained the mean value of bovine non-motility was 24%, which is higher than the Brahman groups but close to the Local and Friesian groups, respectively. The ejaculate volume, color, concentration and motility is a breed specific parameter of semen. That's why it was vary genotype to genotype.

Table 1. Least-square means with ±SE of semen characteristics and comparison among three genetic groups of bulls

Parameter	Genotype			Level of Significance
	BG (50%)	FG (50%)	LG	
Number of observation	266	170	99	
Volume (ml)	$7.24^{a}\pm0.15$	$7.86^{a}\pm0.19$	$6.68^{b}\pm0.19$	*
Color	$1.88^{a}\pm0.02$	$1.65^{b}\pm0.03$	$1.96^{a}\pm0.01$	**
Consistency	$2.19^{b}\pm0.04$	$1.72^{c}\pm0.04$	$2.56^{a}\pm0.07$	**
Mass Activity	$3.08^{a}\pm0.02$	$2.81^{b}\pm0.02$	$3.19^{a}\pm0.02$	**
Concentration (10^{6}/ml)	$1380.38^{b}\pm19.06$	$1105.03^{c}\pm22.54$	$1516.59^{a}\pm33.07$	**

BG= Brahman Group, FG=Friesian Group, LG=Local Group; [a, b, c] Mean values with different superscripts within same row differed significantly from each other; *Significant at 5% level ($p<0.05$); **Significant at 1% level ($p<0.01$).

Table 2. Least-square means with ±SE of semen motility of three genetic groups of bulls

Parameter (%)	Genotype			Level of Significance
	BG (50%)	FG (50%)	LG	
Number of observation	41	36	46	
Total motility	$73.85^{a}\pm1.46$	$67.72^{b}\pm0.80$	$71.82^{a}\pm1.44$	*
Progressive motility	$65.80^{a}\pm1.51$	$59.40^{b}\pm0.89$	$59.07^{b}\pm1.13$	**
Circular motility	1.92±0.48	1.65±0.29	1.85±0.20	NS
Fast motility	46.91±2.09	50.06±0.77	50.14±1.25	NS
Slow motility	$17.19^{a}\pm2.06$	$7.68^{b}\pm0.48$	$7.08^{b}\pm0.30$	**
Local motility	$7.82^{b}\pm1.00$	$8.33^{b}\pm0.62$	$12.73^{a}\pm1.41$	*
Immotility	$26.16^{b}\pm1.46$	$32.28^{a}\pm0.80$	$28.18^{b}\pm1.44$	*

BG= Brahman Group, FG=Friesian Group, LG=Local Group; means with different supercrips within the same row with at least one common letter do not have significant difference. *Significant at 5% level ($p<0.05$); **Significant at 1% level ($p<0.01$), NS= Non-significant.

Influence of season on semen parameters

Graphical presentation of average ejaculates volume at different season were shown in Fig. 1. The significantly ($p<0.01$) 2.01 ml higher ejaculate volume was initiated in FG than LG, respectively at summer season. At the same time, the significantly ($p<0.01$) highest ejaculate volume was found in FG (7.62±0.28) and lowest in LG (6.17±0.17) at rainy season, respectively. But in winter season, the significantly ($p<0.05$) premier ejaculate volume was found in BG (8.17±039) and lowest in LG (6.71±0.37), in that order. FG genotype is a temperate breed. So, performance could be better in winter and BG is tropical so it is good in summer we expect. But present result is totally opposite it may due to genetic potentiality of used genotype and correlate with Tania (2012) who observed that maximum volume was found in summer season and minimum volume was in rainy season when considering only two seasons. According to Fiaz *et al.* (2010) the semen volume was significantly ($p<0.05$) high during August, September, October, November and December and low ($p<0.05$) in the remaining part of the year. However, the results contradict somewhat with the results by Shaha *et al.* (2008) who found the value ranging from 4.1 to 7.6 ml for Sahiwal × Zebu, Sindhi × Zebu, Jersey × Zebu and Holstein-Friesian × 25% Zebu at three seasons. They also concluded that all these attributes varied significantly ($p<0.05$) between breeds and seasons.

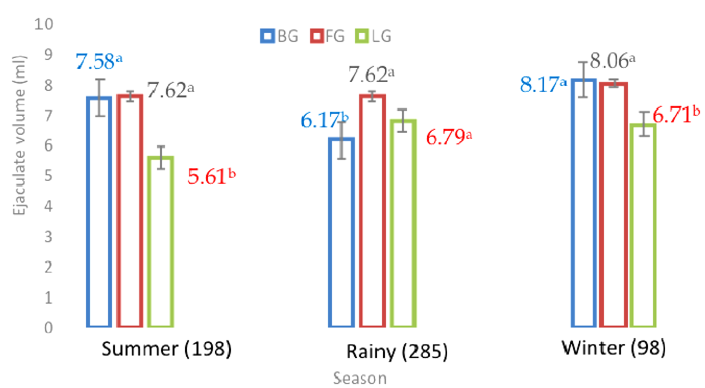

Fig. 1. Graphical presentation of average ejaculate volume at season

Estimated variance components and heritability for semen parameters of three genetic groups

From Table 3, the estimated heritability (0.39, 0.36 and 0.35 for BG, FG and LG) for ejaculate volume in current study well agrees with Ducrocq and Humblot (1995) and Druet *et al.* (2008) who obtained values from 0.22 to 0.65 for bovine semen volume and 0.24 to 0.44 for Brahman bulls. According to Gredler *et al.* (2007) who estimate low heritability for semen volume as 0.18±0.02 and 0.19 for Austrian dual-purpose Simmental (Fleckvieh) AI bulls and Simmental bulls, respectively which are lower than this study. The high heritability estimates for this trait indicate that environment has minor influence on these traits. Heritability (0.49, 0.50 and 0.50 for BG, FG and LG) estimates for semen color was not supported by the estimate reported by Kealey *et al.* (2006) of 0.15 in Line 1 Hereford bulls. The estimated heritability of semen color was considered high in this study and implies that additive gene have a greater effect on the color of the semen for all the groups. Estimated heritability (0.49, 0.38 and 0.49 for BG, FG and LG) for semen consistency was also high for all groups. Estimated heritability (0.51, 0.48 and 0.44 for BG, FG and LG) for sperm concentration in this experiment was also high which is closely related to other published work ranged from 0.36 to 0.52 Diarra *et al.* (1997) respectively. According to Gredler *et al.* (2007) who estimate the lower heritability for semen concentration as 0.13±0.06 for Angus bull and 0.14±0.040 for Austrian dual-purpose Simmental (Fleckvieh) AI bulls, respectively. This medium to high heritability due to medium to high proportional influence of environmental and additive gene effects which indicate that there is chance to improve these traits through selection or any genetic manipulation. For low heritable traits, genetic improvement is impossible or very slow rate per generation and family selection is applicable. But in case of medium to high heritability, permanent improvement of genotypes for certain traits is possible or rate is very fast and individual or mass selection is applicable.

Table 3. Estimates of additive genetic variance (σ^2_A), environmental variance (σ^2_E), Residual variance ($\sigma^2 e$); phenotypic variance (σ^2_p) and heritability (h^2) of semen parameters

Parameter	Variance Component			σ^2_p	h^2±SE
	σ^2_A	σ^2_E	σ^2_e		
BG (50%)					
Volume	2.52	1.49	2.52	6.53	0.39±0.06
Color	0.05	0.003	0.05	0.103	0.49±0.03
Consistency	0.21	0.01	0.21	0.43	0.49±0.03
Mass activity	0.09	0.001	0.09	0.18	0.50±0.03
Concentration	45298.71	1980.37	41250.35	88520.43	0.51±0.03
FG (50%)					
Volume	3.20	2.40	3.20	8.80	0.36±0.04
Color	0.121	0.002	0.121	0.244	0.50±0.04
Consistency	0.17	0.11	0.17	0.45	0.38±0.04
Mass activity	0.08	0.03	0.07	0.08	0.44±0.04
Concentration	51419.47	5171.56	51419.47	108010.50	0.48±0.05
LG					
Volume	1.83	1.22	2.12	5.17	0.35±0.05
Color	0.02	0.00	0.02	0.04	0.50±0.04
Consistency	0.25	0.02	0.25	0.52	0.49±0.08
Mass activity	0.04	0.004	0.04	0.084	0.47±0.05
Concentration	42875.18	7650.96	42875.18	93401.32	0.44±0.05

σ^2_A= Additive genetic variance; σ^2_E = Environmental variance; σ^2_e=Residual variance; σ^2_p=Phenotypic variance; and h^2= Heritability, BG= Brahman Group, FG= Friesian Group, LG= Local Group

Genetic and phenotypic correlations among the semen parameters

Genetic correlations among the semen parameters ranged from weakly negative (-0.01) to positive (0.88) for BG, -0.02 to 0.42 for FG and -0.26 to 0.51 for LG, respectively (Table 4). In case of BG and LG, there were a few unfavorable (negative) genetic correlations among semen characteristics where semen volume was negatively correlated with sperm concentration -0.01 and -0.24. Among semen characteristics, the strongest genetic correlations were between sperm concentration with semen consistency 0.45 for BG, 0.42 for FG and 0.51 for LG, respectively. The majority of the semen characteristics had favorable genetic correlations with each other. Traits where high or low values were desirable in both traits usually had a positive relationship, such as concentration and consistency. Negative relationships were reported between traits where a high value in one trait and a low value in the other trait were desirable such as volume and concentration. All the favorable (positive) genetic correlations are promising because they indicate that selection for one trait could be able to influence of other traits simultaneously. From the result, semen volume was negatively correlated with sperm concentration which means that if the volume of semen will be increased than the sperm concentration will be decreased. The finding of the present study well agrees with Druet *et al.* (2008) estimate semen volume was negatively correlated with sperm concentration (-0.55±0.18) which is almost similar to this finding. Negative relationship between volume and concentration was confirmed by Ducrocq and Humblot (1995) who estimated a genetic correlation of -0.43. According to Gredler *et al.* (2007) who obtained positive genetic correlations between volume and mass activity was 0.21±0.17. On the other hand, Kealey *et al.* (2006) obtained negative genetic correlations between volume and mass activity as was -0.38 and -0.17±0.17, respectively which is almost similar to this result.

Table 4. Heritability (on the diagonal), genetic correlations (below the diagonal) and phenotypic correlations (above the diagonal) among the semen parameters of three genetic groups

Parameter	Volume	Consistency	Mass activity	Concentration
BG (50%)				
Volume (ml)	0.39±0.06	-0.12	-0.01	-0.20
Consistency	0.008	0.49±0.03	0.68	0.75
Mass Activity	-0.04	0.16	0.50±0.03	0.80
Concentration	-0.01	0.45	0.29	0.51±0.03
FG (50%)				
Volume (ml)	0.36±0.04	-0.15	-0.04	-0.11
Consistency	-0.02	0.38±0.04	0.71	0.92
Mass Activity	0.04	0.13	0.44±0.04	0.50
Concentration	0.07	0.42	0.22	0.48±0.05
LG				
Volume (ml)	0.35±0.05	-0.33	-0.02	-0.34
Consistency	-0.26	0.49±0.08	0.42	0.91
Mass Activity	-0.16	0.26	0.47±0.05	0.51
Concentration	-0.24	0.51	0.32	0.44±0.05

BG= Brahman Group, FG= Friesian Group, LG= Local Group

Table 5. Ranking of genotype of bulls

Genotype	Ejaculate volume (30)	Mass activity (30)	Sperm concentration (40)	Index value	Rank
BG (50%)	0.85	0.46	281.60	282.91	1
FG (50%)	0.85	0.37	212.17	213.39	3
LG	0.70	0.45	266.92	268.07	2

BG=Brahman Group; FG=Friesian Group; LG=Local Group; Figures in the parentheses indicate the weighted value of each traits; the index value was obtained by multiplying phenotypic value of traits with their weighted value and heritability.

The observed antagonistic phenotypic correlations were found between volume and sperm concentration (-0.20, -0.11 and -0.34) for BG, FG and LG, respectively. The findings of the present study is well agrees with Gredler *et al.* (2007) who obtained -0.17 correlation value between volume and sperm concentration using 301 Austrian dual-purpose Simmental (Fleckvieh) AI bulls. According to Druet *et al.* (2008) who obtained phenotypic correlations between volume and sperm concentration was -0.02±0.02 which is slightly lower than the present result. The positive and high phenotypic and genetic correlations indicated that selection for one trait would increase associate one at next generation.

Ranking of genotypes

The ranking of different genotypes of bulls were presented in Table 5 and found that the Brahman graded bull got the first position (282.91) in terms of index value (phenotypic value × economic weighted value × heritability). The lowest index value was (213.39) received by Friesian genotypes but Local genotypes stood in second position (268.07), correspondingly. This ranked score should be used for breeding bull selection for the genetic improvement of indigenous cattle.

Conclusion

The individual genotypes had significant ($p<0.05$) effect on different semen parameters. According to the phenotypic value of semen parameters, the local genetic group was found superior to other genotypes but BG stood intermediate position. In seasonal comparison, FG performed better at winter and rainy, but BG performed better in winter and summer and LG performed average all over the seasons. The estimated heritability among three genotypes was medium to high for all the genetics groups. In the present study, most of the estimated heritability from three genetic groups was fairly appreciable. However, the differences between estimates obtained from literature and present study could partly be explained by greater environmental changes in which the individuals were exposed during the study, sample size used and genetic constitution of the population from which samples were picked up. Among semen characteristics, the strongest genetic and phenotypic correlations were found between sperm concentration with semen consistency but most of the favorable genetic and phenotypic correlations was found in BG. On the basis of phenotypic, economic weight value and heritability value, Brahman graded bull got the 1st ranking out of three genotypes. So semen of Brahman graded bull could satisfactorily be used for genetic improvement of cattle in relation to meat production.

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