Chapter

Breeding Soundness Evaluation in Ram and Bucks under Community-Based Breeding Program (CBBP) Sites of the Amhara Region, Ethiopia

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Abstract

The objective of this study was to evaluate the breeding soundness (BSE) of rams and bucks used in community-based breeding programs (CBBPs). The evaluation was done in April 2022. The data were analyzed using the general linear model (GLM) procedures of the SPSS (version 22). Based on the criteria set for physical soundness, 88.89% and 87.32% of rams and bucks were satisfactory. The overall semen volume per ejaculation in small ruminants under study was 0.67 ± 0.04 ml with a minimum of 0.1 ml in buck and 1.2 ml both in rams and bucks. The average gross semen motility score was 3.55 ± 0.09 (>70% of sperm cells are active). A significant ($P < 0.05$) difference was observed between ram and buck semen concentrations, which was 4.06 ± 0.42 (10^9) and 3.89 ± 0.23 (10^9), respectively. Based on the selected examination parameters, 84.23% of the mating males of small ruminants were satisfactory for breeding, from which rams and bucks contribute to 86.48% and 82.18%, respectively. Rams and bucks above 22 cm of scrotal circumference at two and lower age, alert and active with no feet, eye, and conformation abnormalities can be selected for mating. In CBBP sites, it is better to furnish semen evaluation equipment and technical capacity to implement artificial insemination.

Keywords: breeding soundness, bucks, rams, satisfactory, semen characteristics

1. Introduction

Reproductive capacity of the herd/flock is influenced by numerous factors such as reproductive health, fertility, prolificacy, the ability to mount, and the nutritional level of individuals [1]. A successful breeding period relies on mating an appropriate number of sound males to reproductively active females and monitoring to identify any problems [2]. In fact, 50% of the reproductive potential and genetic change of a flock is

provided by the mating male animal [3, 4], care and strategic management of them is required. To help identify males that are capable or not capable of settling females, producers can perform breeding soundness examinations (BSE). Breeding soundness examination is an overall assessment of a male's potential ability to service and impregnate a given number of females during a given period of time [3]. The evaluation consists of a physical examination, body condition score, scrotal circumference, inspection of the reproductive organs, semen evaluation [5, 6], libido assessment [3], and screening for sexually transmitted disease [4]. Measurement of scrotal circumference reflects the weight of the gonad and therefore the ability of sperm production [7], and it has a great value as an indicator of the onset of puberty, total semen production, semen quality, pathological conditions of testes, and the potential subfertility or infertility [8].

Breeding soundness examination should be performed at least two months before breeding season [9] to allow animals to recover from pathologies or poor physical conditions [3], and it also should be a routine activity in breeding programs [2, 4]. Periodical BSE identifies the main causes of ram/buck failures, making it an important tool to increase the reproductive efficiency of the herd [10]. Rams/bucks are subsequently classified as sound/satisfactory, temporarily unsound/questionable, or unsound [2]. The satisfactory rams will achieve good reproductive performance if joined to ewes at a ratio of 1:50 for 60 days [5, 11].

The selection and distribution of rams/bucks for mating in the existing CBBP sites of Ethiopia were based on physical evaluation, pedigree information, and breeding values for selected target traits. And they are handled at farmers' hands with varying management levels. Both of these methods do not guarantee the fertility of these animals. Currently, the number of CBBP sites has increased, and scaling-out plans of the CBBP were also implemented. In the document [12], rams to be distributed for the scaling out sites were sourced from existing CBBPs, and as these animals are genetic materials, their failure to mate after distribution costs the program. Therefore prior to distribution, BSE should be done as a routing activity. This paper, therefore, was initiated to address the following objectives:

- To determine the effect of breed, body condition, and scrotal circumference on different semen parameters of mating animals in CBBP sites of small ruminants;
- To evaluate the breeding soundness of rams and bucks used in the existing CBBPs;
- To set standards for the use and distribution of satisfactory rams and bucks.

2. Material and methods

2.1 Working sites and breeds

The activity was conducted at established community-based breeding program sites of the Washera breed at the Sekela district, Simien sheep at the Dabat district, and Central highland goat at the Gondar Zuria district (**Figure 1**).

Sekela district: It is located 160 km away to the South East from Bahir Dar, the capital of the Amhara National Regional State, and 74 km away North East from Finote Selam, the capital town of West Gojjam Zone. The estimated total area coverage of the district is 6534.5 hectares, from which 70%, 18%, and 12% were highland (Dega), midland (Woynadega), and lowland (Qola) agroecologies. It is located at an

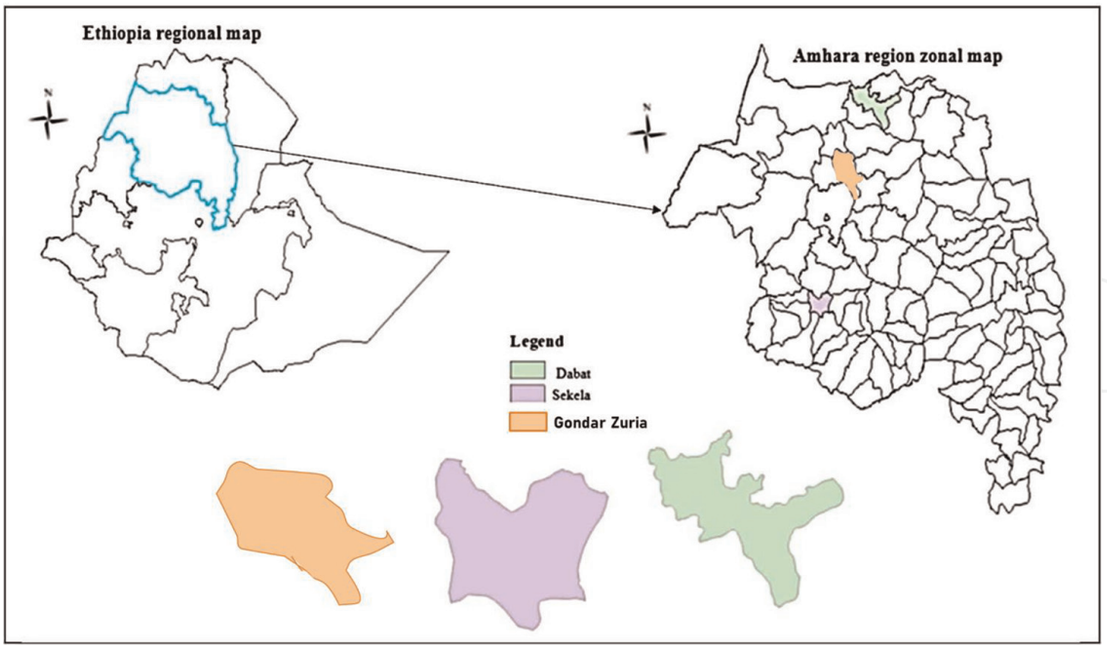

Figure 1.
Map of the study districts.

elevation of 3062 meters above sea level and 10°55′0″ N latitude and 37°31′60″ E longitude. The average annual rainfall of the area ranges from 1600 mm to 1800 mm with an average temperature of 18°C [13].

Dabat district: It is located at 12°59′3″ N and 37°45′54″ E in Amhara National Regional State, North Gondar Zone. It receives an average annual rainfall of about 1100 mm with the main rainy season extending from June to October. The average annual maximum and minimum temperatures are 19.9°C and 8.58°C, respectively [14].

Gondar Zuria district: It is located in the Central Gondar Zone of the Amhara Regional State, northwest Ethiopia. The District is among the 11 districts of the Central Gondar zone and has 41 rural and three urban Kebeles. The total area of the district is around 48,204 km^2. The district receives monthly average maximum and minimum temperatures of 29.96°C and 15.72°C, respectively. The altitude ranges from 1500 to 3200 m above sea level. Agroecologically, the district falls into two zones: Weyna Dega (72%) and Dega (28%). Mixed farming is predominant in the district (i.e., crop production and livestock rearing (90%)) [15].

2.2 Source and type of data

Semen evaluation was done in April 2022. A total of 63 and 92 body measurements from ram and bucks, respectively, were collected. The rams were Washera and Simien sheep breeds, while the bucks are Central Highland goats. Semen parameter evaluation was done from 16 rams and 15 bucks, which are under mating at CBBP sites.

2.3 Data collection procedures

2.3.1 Physical soundness examination

The physical soundness examination includes symmetricity of testicles (1 = symmetric and 2 = nonsymmetric), shape of testicles (1 = normal and 2 = abnormal) as

Figure 2.
Ways of measuring SC (A) and different scrotal abnormalities (B) [3].

indicated (**Figure 2B**), firmness of the scrotum (1 = firm rubber ball and 2 = extremely hard and very soft), body condition score (thin (1–2 score), moderate (2–3), and fattened (above 3)), rear leg conformation (1 = desirable and 2 = camped behind, bowleggedness (base narrow) and toed-out stance (base wide)), general health condition of eye, feet, head and neck, nasal cavity and alertness (1 = healthy and alert and 2 = nonhealthy and inactive). These parameters were collected with a degree of acceptance. Each level of the evaluation was done based on the reference standards used for BSE [3, 16], and the interpretation was done [11].

2.3.2 Scrotal and other linear body measurements

The scrotal circumference was measured at the widest part of the scrotum and recorded in centimeters (**Figure 2A**). Body measurements of heart girth (cm), weight (kg), height at prepuce (cm), rump height (cm), body length (cm), height at weather (cm), and face length (cm) were collected from rams at the CBBP sites. Estimated body weight was calculated with the following formula [17]:

$$\mathrm{BW} = \frac{HG\ (inch)^2 * BL\ (inch)}{300} \tag{1}$$

where BW is estimated body weight in pound, HG is heart girth by inch, and BL is body length by inch.

2.4 Semen analysis

Semen collection: Semen was collected by an artificial vagina (AV) with temperature of 42–43°C. Prior to collection, the prepuce of the ram was cleaned to prevent contamination of the semen. The collection was performed in the morning and shade areas to avoid tiredness of rams and sperm death due to direct sunlight. The libido of the ram was recorded during semen collection and scored from 5 (excellent) to 1 (very poor) [11, 18].

Semen evaluation: The color of semen was scored subjectively and classified as: milky, watery, thin creamy, creamy, and thick creamy [18]. Semen volume was recorded using a graduated collecting glass (0.1 mL accuracy). While being processed, ejaculates were placed in a thermos flask containing water at 35–37°C. Sperm mass motility was estimated subjectively by using a phase contrast microscope. For that semen was taken with a pipette, dropped on the slide and covered with a cover slip and observed with 10× magnification on the objective lens. The mass motility was graded from 0 to 5 scores based on the passion of the wave motion [18].

Measurement of the sperm concentration was done by using a portable spectrophotometer pre-calibrated for ram semen (Ovine-caprine Accuread photometer; IMV®, France). Sperm cell concentration was estimated using a micropipette to take normal saline (0.9%) and put 4 ml of normal saline and 10 microliters of fresh semen on the UV Macro cell (UV Macro Cell 2.5 ml– 4.5 ml, Great Britain) and mix gently and measure the concentration using Accu Read IMV Technologies SA, 232 Spectrophotometer.

For spermatozoa live/dead ratio (semen morphology), semen was stained with eosin-nigrosin stain followed by microscopic examination (40×). Spermatozoa with red head were counted as dead cells and the colorless ones as live spermatozoa [11]. The proportion of morphologically abnormal spermatozoa was determined by examining 200 spermatozoa in an eosin-nigrosin smear under the same magnification. The spermatozoa were evaluated for vitality (percentage of live spermatozoa) and abnormal percentage (head, midpiece, and tail abnormal). The semen quality analysis was done in collaboration with Debre Berhan Agricultural Research Center (DBARC).

2.5 Statistical analysis

Breed, body condition score, scrotal circumference, libido, and age were used as a factor to evaluate the semen characteristics. The data were analyzed using the general linear model (GLM) procedures of the SPSS (version 22). Post-hoc least significant difference (LSD) tests were used to assess differences between means. The results are presented as mean (±SE), and the level for statistical significance was set to $P < 0.05$.

$$Y_{ijklmno} = \mu + M_i + L_j + C_k + S_l + A_m + B_n + e_{ijklmno}. \quad (2)$$

where

Y_{ijklm} = semen characteristics (volume, motility, color, concentration, vitality, and abnormality),

μ = overall mean,

M_i = effect of ith mating male animals (ram and buck),

L_j = effect of jth libido score (3, 4, and 5),

S_k = effect of k^{th} body condition score (medium (2–3 BCS) and good (>3BCS)),

C_l = effect of lth scrotal circumference (acceptable (≤20 cm), satisfactory (21–23 cm), and excellent (>23 cm)),

A_m = effect of mth age (0PPI, 1PPI, 2PPI, and 3PPI),

B_n = effect of nth birth type (single and multiple), and

e_{ijklm} = residual effect.

3. Result and discussions

3.1 Physical soundness of rams and bucks at CBBP sites

Based on the criteria set for physical soundness, 88.10% (88.89% of rams and 87.32% of bucks) were satisfactory (**Figure 3**). The observed result in the current study is a good indicator of satisfactory ram, which is capable to mount and mate female animals, and an indication of the care during ram and buck selection as a replacement at the same CBBP and for distribution to other sites. The observed lower percentage in firmness of the scrotum is an indicator of the absence of reproductive organ palpation during selection and this should get attention during selection. Good

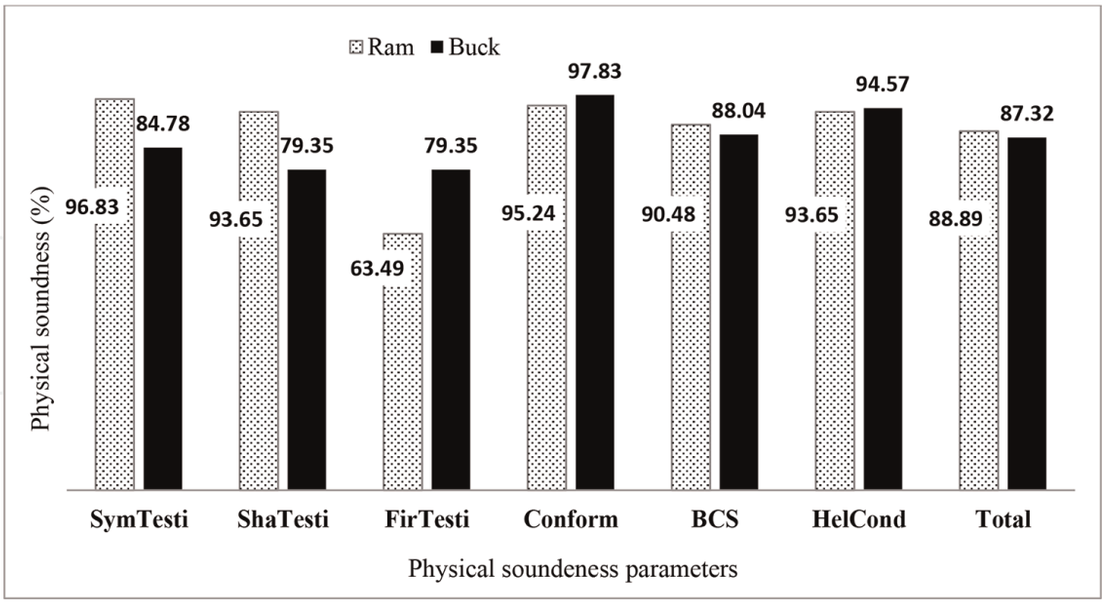

Figure 3.
Physical soundness examination result for ram and buck at CBBP sites. SymTesti = symmetricity of testicles; ShaTesti = shape of testicles; FirTesti = firmness of the testicles; Conform = rear leg conformation; BCS = body condition score (above 2); HelCond = health condition.

physical soundness is an indicator of the ram to deliver semen to ewes and management level of the producers [19]. Physical problems such as lameness, blindness, and penile or perpetual problems may not interfere with semen production or quality, but rams will not be able to find estrous ewes and/or mate them, resulting in poor reproductive performance [11]. During the physical examination, the body condition of the ram during the breeding season is an indicator of its breeding efficiency [10].

3.2 Effect of fixed factors on semen quality parameters

3.2.1 Semen volume

The mean (±SE) semen volume per ejaculation in small ruminants under study was 0.67 ± 0.04 ml with a minimum of 0.1 ml in buck and 1.2 ml in both rams and bucks. The volume of semen could be higher if there would be training of the artificial vagina before a day or two. The body condition score and libido had shown a significant ($P < 0.01$) effect on semen volume. The best animals in libido had higher volume per ejaculation (**Table 1**). A significant difference between semen volume and age was also reported [1, 20] for different sheep breeds of Spain. The average volume of semen per ejaculate (ml) was comparable with Menz sheep ram (0.7 ml) [18], Abergelle buck (0.64 ± 0.03 ml) [21], 0.5 ± 0.3 ml reported by Siddiqua et al. [22]; higher than 0.27 ± 0.12 ml [23] ranging from 0.43 ± 0.03 to 0.45 ± 0.22 in black Bengal bucks [24]; and lower than 1.0 ± 0.2 ml in Norduz goats [25]. The difference in semen volume within the same species was due to breed differences.

3.2.2 Gross semen motility score

The average gross semen motility score was 3.55 ± 0.09, which is above 70% of sperm cells are active (**Table 1**). All the factors considered in the current study had no significant ($P > 0.05$) difference in semen motility. Nonsignificant difference of breed

Parameters	N	Volume/ejaculation (ml)	Motility (1–5)	Color	Concentration (10^9)	Vitality (%)	Abnormal (%)
Overall	31	0.67 ± 0.04	3.55 ± 0.09	2.68 ± 0.27	3.98 ± 0.24	90.71 ± 0.36	9.00 ± 0.24
Animal					*		
Ram	16	0.71 ± 0.05	3.50 ± 0.13	2.94 ± 0.37	4.06 ± 0.42	90.53 ± 0.54	8.81 ± 0.33
Buck	15	0.63 ± 0.07	3.60 ± 0.13	2.40 ± 0.40	3.89 ± 0.23	90.90 ± 0.49	9.20 ± 0.34
BCS		*		*			
Medium	17	0.62 ± 0.05	3.53 ± 0.12	2.35 ± 0.38	3.80 ± 0.40	91.03 ± 0.44	9.03 ± 0.33
Good	14	0.74 ± 0.06	3.57 ± 0.14	3.07 ± 0.37	4.19 ± 0.23	90.32 ± 0.59	8.96 ± 0.35
SC							
Acceptable	8	0.74 ± 0.07	3.50 ± 0.19	2.25 ± 0.62	4.12 ± 0.51	90.19 ± 0.72	9.50 ± 0.48
Satisfactory	8	0.71 ± 0.08	3.63 ± 0.18	2.63 ± 0.53	3.87 ± 0.60	90.88 ± 0.69	9.00 ± 0.35
Excellent	15	0.61 ± 0.06	3.53 ± 0.13	2.93 ± 0.37	3.96 ± 0.30	90.90 ± 0.55	8.73 ± 0.37
Libido score		*		**	***	*	
3		0.59 ± 0.11b	3.43 ± 0.20	1.43 ± 0.43b	3.58 ± 0.27b	89.79 ± 0.71	8.93 ± 0.49
4		0.62 ± 0.04b	3.64 ± 0.15	2.73 ± 0.45ab	3.26 ± 0.44c	91.64 ± 0.69	9.09 ± 0.26
5		0.76 ± 0.07a	3.54 ± 0.14	3.31 ± 0.38a	4.80 ± 0.30a	90.42 ± 0.45	8.96 ± 0.47
Age						*	**
0PPI	6	0.68 ± 0.07	3.67 ± 0.21	2.50 ± 0.67	3.67 ± 0.37	91.25 ± 0.77a	8.75 ± 0.62b
1PPI	13	0.58 ± 0.06	3.62 ± 0.14	2.31 ± 0.44	3.79 ± 0.47	90.62 ± 0.58ab	9.46 ± 0.27a
2PPI	8	0.74 ± 0.08	3.38 ± 0.18	3.13 ± 0.48	4.18 ± 0.40	91.44 ± 0.61a	8.13 ± 0.54c
3PPI	4	0.80 ± 0.15	3.50 ± 0.29	3.25 ± 0.75	4.63 ± 0.55	88.75 ± 0.85b	9.63 ± 0.31a
Birth type							*
Single		0.66 ± 0.05	3.58 ± 0.12	2.74 ± 0.36	4.11 ± 0.27	90.34 ± 0.46	8.74 ± 0.28
Multiple		0.69 ± 0.07	3.50 ± 0.15	2.58 ± 0.43	3.76 ± 0.45	91.29 ± 0.57	9.42 ± 0.39

BCS = body condition score; SC = scrotal circumference; 0PPI = shoat with milk teeth (>about 9 months); 1PPI = shoat with 1 pair of permanent incisor (PPI) and the like.
Means with the same letter are not significantly different.
$^{*}P < 0.05$. $^{**}P < 0.01$. $^{***}P < 0.001$..

Table 1.
Mean (±SE) of values of semen quality parameters across different fixed factors.

and BCS on semen motility was reported [1]. The mass motility score was comparable with the Menz sheep ram (3.17) [18].

3.2.3 Semen concentration

The average semen concentration (10^9) reported in the current study was 3.98 ± 0.24. A significant difference was observed between ram and buck semen concentrations (**Table 1**), which was 4.06 ± 0.42 (10^9) and 3.89 ± 0.23 (10^9), respectively. Besides, the respective minimum and maximum concentrations were observed in rams 7.7 (10^6) of Simien sheep and 6.98 (10^9) of Washera sheep. Libido score had also a significant ($P < 0.001$) effect on sperm concentration (**Table 1**); the higher the libido score the higher the concentration. The observed concentration has given a good insight to conduct artificial insemination in the genetic improvement programs. As indicated by Larsen [26], 300 million spermatozoa were used for a single insemination in small ruminants; based on this, with the average 3.98 ± 0.24 (10^9) number of spermatozoa recorded in the current study, 13 ewes can be inseminated. The average semen concentration (10^9) recorded in the current study was higher than Menz (2.44), Awassi cross Menz (3.34) [18], and Abergelle bucks (3.14 ± 0.11) [21]. Significantly lower sperm cell count (0.98×10^9) in the testicles of West African dwarf bucks was reported [27]. The concentration of the current study was considered as normal based on the study of Faigl et al. [28], which reported a concentration range from 3.5 to 6.0 billion as normal. A similar report on a nonsignificant difference of breed and BCS on sperm concentration was reported [1].

3.2.4 Semen morphology

The morphology analysis was done for vitality and abnormality percentage (**Table 1**). The average vitality and abnormality percentage of the current study was 90.71 ± 0.36 and 9.00 ± 0.24, respectively. The head, midpiece, and tail abnormalities for ram were 0.12, 0.51, and 8.41%, and for bucks were 1.0, 1.0, and 8.0%, respectively; the proportion is presented in **Figure 4**. Age had shown a significant effect on semen vitality ($P < 0.05$) and abnormality ($P < 0.01$), and libido score and birth type had a significant ($P < 0.05$) effect on semen vitality and abnormality, respectively. The current result was higher than the reports of Faigl et al. [28] and Goshme et al. [18] who reported an average vitality range of 70–80 and 84.04% for different breeds, respectively. Varying level of head, midpiece, and tail abnormality in sperm cell was reported (**Figure 5**) [29]. Based on the study by Petrovic et al. [30], sperm

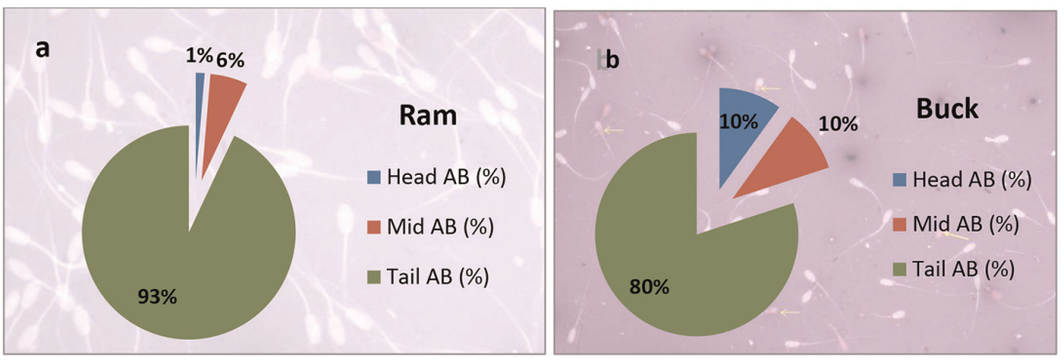

Figure 4.
Proportions of sperm morphological abnormality (%) of ram (a) and buck (b).

abnormality is varied depending on the seasons of the year on which higher abnormality was recorded during hot seasons. **Figures 6** and 7 present sperm abnormalities at different parts.

3.2.5 Semen color

The average value for semen color was 2.68 ± 0.27, which is characterized as a thin creamy from the five color ranges (**Figure 5**). The color observed in the current study was in line with the finding of Pankaj et al. [31] who reported a color range of 1.9 ± 1.0

Figure 5.
Reading: semen volume (left) and concentration (right).

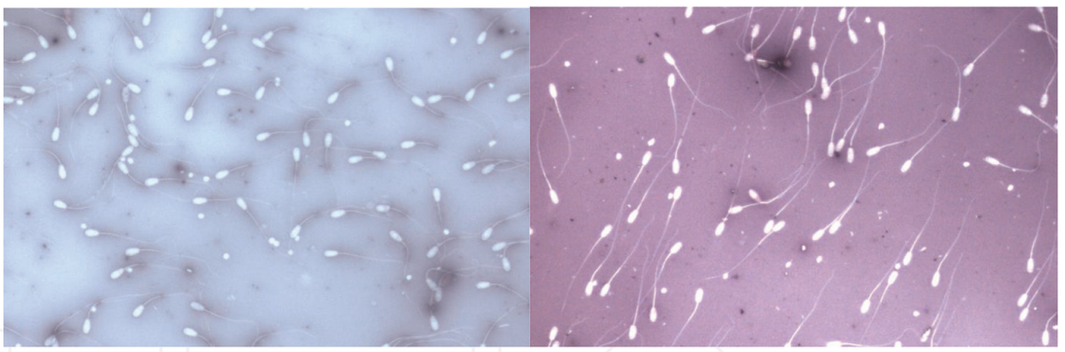

Figure 6.
Morphologically normal sperm cells (eosin-nigrosin stain).

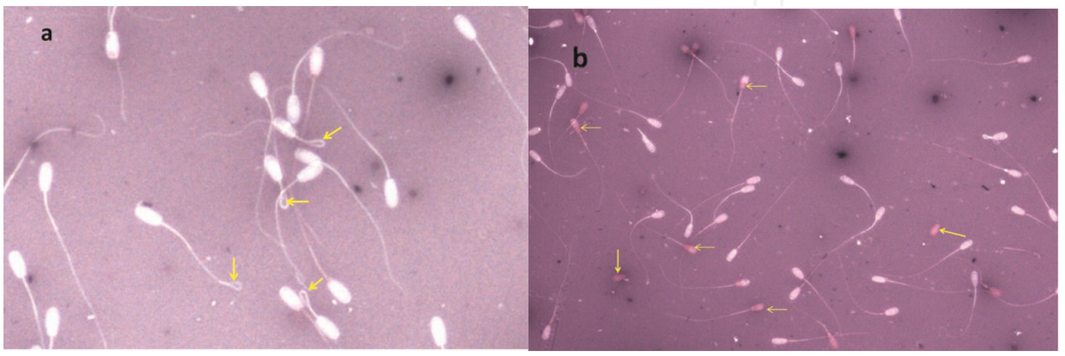

Figure 7.
Morphologically abnormality of sperm cells: (a) bended and terminally coiled tails and (b) abnormal head (eosin-nigrosin stain).

to 4.0 ± 0.0. Color is an indicator of injury or infection in the reproductive tract [31] and sperm concentration. Body condition and libido score had shown a significant ($P < 0.05$) effect on semen color (**Table 1**).

3.2.6 Correlation between semen quality parameters

A positive significant ($P < 0.05$) correlation was observed in body weight with semen volume ($P < 0.01$) and color ($P < 0.05$); libido score with semen volume, color, and concentration; and body condition with semen volume and color (**Table 2**). Besides, there is also a correlation between semen volume with color and concentration, color with motility and concentration, and motility with concentration. A similar significant difference between age and semen volume; scrotal circumference with age and BCS was reported [1].

3.2.7 Scrotal circumference and mating test (libido score)

The average scrotal circumference, body condition score, and libido score were 22.14 ± 0.23, 2.06 ± 0.04, and 4.19 ± 0.14, respectively. There was a significant ($P < 0.05$) difference in SC and BCS between mating animals. Higher scrotal circumference (22.56 ± 0.49) was observed in rams compared with bucks (21.86 ± 0.21). Similarly higher body condition score (2.18 ± 0.07) was observed in rams than in bucks (1.98 ± 0.05). In considering the scrotal circumference for classifying mating ram and buck, it is paramount important to consider age, breed, season, nutrition and other diseases, and previous reproductive history [2]. The libido score for rams and bucks was 4.31 ± 0.19 and 4.07 ± 0.21, respectively, and there is no significant difference ($P < 0.05$) between mating animals. The observed higher libido score in the study breeds was an important indicator in the efficiency of the rams and bucks to deliver semen for females [11], and poor libido was reported as a cause of infertility or reduced fertility [30].

The average scrotal circumference observed in rams was lower than 27.5 ± 1.29 cm [32] and 24.2 ± 1.8 cm [33]. For Ethiopian sheep breeds, average scrotal circumference range from 25 cm at one year to 30 cm at four years of age was reported [4]. Besides, considerably higher (22.52 ± 3.61 cm) and lower (17.25 ± 0.76 cm) scrotal circumference was reported for Algeria Indigenous Bucks [34] and West African dwarf bucks [27], respectively. Compared with these findings and the guideline [6, 11], the average scrotal circumference recorded in the study of rams and bucks can be categorized as satisfactory for breeding purposes.

3.2.8 Breeding soundness examination (BSE) and interpretation

Based on the BSE, rams and bucks are classified into three, *viz*, satisfactory, questionable, and unsatisfactory [2]. The category was based on physical examination score, scrotal circumference, and semen characteristics [11]. In the current study, to evaluate the satisfactory rams, finding above average were considered as cutoff values. Based on the selected examination parameters, 84.23% of the mating males of small ruminants were satisfactory for breeding (**Table 3**), from which rams and bucks contribute to 86.48% and 82.18%, respectively. The main reasons contributing to the failure of physical examination were body condition, scrotal circumference, and semen color. Relatively higher ram BSE failure (22.15%) was reported [10]. Similarly, confirmation as a reason for ram BSE failure [1] and body condition and semen

	Age	SC	BW	LS	BCS	SV	Color	MS	Concn	Viability	AP
Age		0.188	0.538***	0.028	0.342*	0.394*	0.146	0.019	0.215	−0.243	0.075
SC			0.435**	0.198	0.271	−0.181	0.244	0.118	0.053	0.209	−0.183
BW				0.289	0.721***	0.401**	0.316*	−0.099	0.183	−0.200	0.026
LS					0.550***	0.313*	0.455**	0.076	0.418**	0.073	0.024
BCS						0.435**	0.422**	−0.069	0.253	0.026	−0.081
SV							0.333*	0.253	0.478***	−0.184	0.106
Color								0.529***	0.603***	0.007	0.002
MS									0.450**	−0.012	−0.066
Concn										−0.243	0.032
Viability											−0.194
AP											

SC = scrotal circumference; BW = body weight; LS = libido score; BCS = body condition score; SV = semen volume; MS = mass motility; Concn = concentration; AP = abnormality percentage.

Table 2.
Partial correlation between semen quality parameters.

Average values for satisfactory ram	Category		Overall
	Ram	Buck	
Physical examination (above 80% sound)	88.89	87.32	88.10
Body condition score (above 2)	90.48	88.04	89.26
SC (above 22 cm)	63.49	53.26	57.42
Semen color (thin to thick creamy)	62.5	46.67	54.84
Sperm morphology (≥70%)	100	100	100
Sperm motility (≥30% progressive motility	100	100	100
Abnormal sperm cells (˂15–20%)	100	100	100
Overall average (%)	86.48	82.18	84.23

Table 3.
Breeding soundness examination parameters for satisfactory rams.

character [10], and physical abnormalities [11] was reported. The satisfactory rams can successfully serve above 30 ewes in an unsynchronized free-grazing flock.

The aforementioned failure causes for BSE in mating animals are highly correlated with the season of the year and nutrition [18, 35–37], which indicated that these mating animals can be satisfactory if they are well managed and fed. Poor management may result in rams or bucks that are either not sound for breeding or are culled or die well before the end of their productive lives [2]. Rams and bucks evaluated under these circumferences, therefore, are categorized as questionable those need further evaluation. Besides these, the satisfactory ram should be good in general health, good conformation, normal genital tract, and no previous history of infertility [11]. **Table 3** indicates the average values set for satisfactory mating animals based on different evaluation criteria [1, 4, 6, 11].

4. Conclusion and recommendations

Implementing BSE as a routine activity under CBBP sites can improve the productivity of participant farmers under the program through the introduction of fertile ram and buck. About 15.77% of the mating animals at CBBP sites of sheep and goats failed in the general breeding soundness examination. The main reasons were physical examination, body condition, scrotal circumference, and semen color, which all can be improved through successful management. The semen characteristics and libido observed in both breeds were better, and it allows conducting artificial insemination to fasten the genetic and economical gain from the program. In areas where there is no laboratory support for semen evaluation, rams and lambs above 22 cm of scrotal circumference at two and lower age, alert and active with no feet, eye, and conformation abnormalities can be selected for mating. If there is a lab facility to evaluate the semen, the above-indicated cutoff values can be considered as a minimum standard for satisfactory ram and buck under BSE. Besides these BSE parameters, rams and bucks with better breeding values based on target traits should also be considered for selection.

- Better management throughout the year could better be implemented for mating and candidate rams and bucks.

- In CBBP sites, it is better to furnish semen evaluation equipment to better evaluate mating animals, and technical capacity on artificial insemination had better be developed to speed up the achievement and gain from the CBBP sites.

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