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Effects of Concentrate Supplementation on Reproductive Performances and Semen Quality of Indigenous Rams in Bangladesh

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ABSTRACT

The study was set for one year to measure the effects of concentrate supplementation on reproductive performances and semen quality in indigenous rams. The study was conducted at the Department of Surgery and Obstetrics, Faculty of Veterinary Science, Bangladesh Agricultural University, Mymensingh, Bangladesh during the period from May 2011 to April 2012. Forteen ram lambs (4～5 months) were randomly divided into two equal groups (n=7); supplemented vs control. The animals of control group were maintained on natural grazing. Along with natural grazing the supplemented group was on supplemented feeding. The concentrate supplementation (Wheat bran, Crushed maize, Soy bean meal, Fish meal, DCP powder, Vitamin mineral premix, Salt) was provided @ 300 g/head /day to the supplemented group. Body weight, scrotal circumference, BCS and libido index were measured weekly. Age, body weight and scrotal circumference at puberty were recorded. Semen was collected once in a weak using artificial vagina and chilled at 5℃ for 48h for evaluation. Concentrate supplementation did not influence (p>0.05) body condition score, age, weight, scrotal circumference at puberty and libido index. Final body weight (kg), growth rate (g/d), scrotal circumference (cm) and scrotal growth rate (mm/15d) were significantly (p<0.05) higher in supplemented group of rams compared to control. Volume, concentration, motility and membrane potentiality of spermatozoa were varied significantly (p<0.05) in supplemented and control groups. However, density, mass motility, viability and sperm with normal acrosome, midpiece and tail were not differed insignificantly (p>0.05) in different observation times. It was concluded that concentrate supplementation with free grazing improved weight and scrotal circumference gain and semen production with increased quality in indigenous ram.

(Key words: indigenous ram, concentrate reproductive characters, semen quality)

INTRODUCTION

The small non-descript indigenous sheep in Bangladesh probably originated from south-eastern sub-tropical region's mutton sheep. They are sparsely distributed throughout Bangladesh with a higher concentration in the coastal region of Noakhali and Cox's Bazaar, and in many chars (Turner, 1982). There are 2.8 million sheep in Bangladesh (Apu *et al*., 2012). In our country sheep is generally managed under rural condition without any supplementation. There is no scientific breeding programme: as a result the number of sheep is increasing without any significant improvement in growth rate. This management system causes poor reproductive performance, which may results in economic loss.

Many factors influence reproductive performance of livestock, of which genetic merit, the environment (Kafi *et al*., 2004), management and particularly the nutritional status of the animal are important (Al-Ghalban *et al*., 2004). The genetic potential and productivity of goats and sheep are deteriorating due to indiscriminate breeding. This may be minimized by providing sound breeding knowledge (FAO, 1991). Selection of young rams for fertility can be accomplished through selecting some important reproductive traits such as age at puberty, body condition score, body growth rate, scrotal circumference,

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scrotal growth rate, semen quality (Land and Carr, 1975). Young rams of prolific breeds differ in their potential reproductive performance (Louda *et al*., 1981). Dietary energy profoundly affects spermatogenesis. Several factors can affect sperm motility, such as stress, diet, body weight and physical activity. Increasing dietary intake of certain vitamins can improve the motility of sperm. The effect of nutrition, particularly underfeeding and flush feeding on female fertility has been extensively studied (Lozano *et al*., 2003). The importance of concentrate supplementation on growth and productivity of goats and sheep is reflected. Grazing alone may not be sufficient for optimizing live weight gain, wool production (Kochapakdee *et al*., 1994), quality of semen and fertility. If grazing can be supplemented with concentrates then the level of production may increased at minimum cost. Nutritional effects on male fertility have not received the same attention in Bangladesh. Therefore, a comprehensive study was designed to observe the effects of concentrate supplementation along with free grazing on reproductive performances and quality of semen.

MATERIALS AND METHODS

1. Experimental Animals and Management

Forteen ram lambs 4～5 months old, selected on the basis of indigenous or local characters were purchased from the local market and kept under semi-intensive condition at the Department of Surgery and Obstetrics, Faculty of Veterinary Science, Bangladesh Agricultural University, Mymensingh, Bangladesh. After acclimatization, de-worming and vaccination, rams were randomly divided into two equal groups. Rams maintained on natural grazing were the control. In the supplemented group, concentrates were supplied along with grazing. The concentrate consisted of wheat bran (50%), crushed maize (25%), soy bean meal (20%), fish meal (1%), dicalcium phosphate (DCP) powder (2%), vitamin mineral premix (0.5%) and salt (1.5%) 300 g/ head/ day. Both groups were supplied *ad libitum* drinking water.

2. Experimental Design

Body weight (kg) and scrotal circumference (cm) were measured weekly and growth rate (g/d) and scrotal growth rate (mm/15d) were calculated. Body condition score (BCS) was measured by palpating lumber region as like other small ruminants and recorded in a score (1～5 with 0.5 increment) (Thompson and Meyer, 1994). Scrotal circumference (cm) was measured by passing a flexible tape around the scrotum (both testes at the same level) at the point of maximum circumference. Age (months) and weight (kg) at puberty was calculated. Puberty was determined as the age when the ejaculate contained > 50 × 10^6 spermatozoa, sufficient to accomplish fertilization (Foster, 1994). Libido index was graded from 0 to 3, 0 no desire to move towards a teaser ewe. 1 very reluctant to reach the teaser. 2 willingly moved towards the teaser. 3 moved to wards the ewe in an uncontrolled manner.

3. Semen Collection and Evaluation

Semen was collected by artificial vagina once a week. All glassware for collection and handling were cleaned and sterilized using high-pressure steam, dried and warmed at 35℃. After ejaculation, the tube was immediately placed in a bath at 37℃. The volume of semen was measured directly from the graduated collecting tube. Colour was estimated by visual inspection and density was scored by making the tubes slant with score range 0～5. Microscopic examination was performed under phase contrast microscope (Gallenhamp, No. 82TT8, Cat No. M/6-200-H HZ 60, England). Mass motility was estimated by assessment of wave motion of fresh undiluted semen under microscope 10 × with 0～5 score. To evaluate sperm motility, 5 µl of diluted semen was placed on a warmed (37℃) slide, covered by a cover slip and examined (400×). The concentration of spermatozoa was counted by placing a drop of diluted (1:400) semen on haemocytometer.

1) Morphological Evaluation

Eosin-nigrosin stain was used to determine the viability of spermatozoa. Small drop of semen and one drop of eosin-nigrosin stain were placed on a clean slide and mixed with a clean stick, a thin smear was made, dried in air and examined under microscope (400×). At least 200 spermatozoa were examined from each smear to calculate the percentages of live spermatozoa. Hypo-osmotic swelling test (HOST) was used to measure the proportion of spermatozoa that swelled, giving an estimate of the proportion with intact membranes. Abnormalities of the acrosome, midpiece and tail of spermatozoa were evaluated using Spermac stain® (Minitube, Box 152, Wellington, 7654, South Africa) (400～1,000×).

4. Statistical Analysis

Data generated and statistical analysis were carried out to evaluate the differences in results between control and supple-

Table 1. Reproductive parameters of indigenous rams

Parameters	Control group	Supplemented group	*P*-value
Initial body weight (kg)	8.7 ± 1.8	8.1 ± 1.1	NS
Final body weight (kg)	15.6 ± 1.8	18.0 ± 1.9	S
Body growth rate (g)/d	19.9 ± 3.5	27.3 ± 3.5	S
Initial body condition score (1～5)	2.8 ± 0.2	2.8 ± 0.2	NS
Final body condition score (1～5)	3.1 ± 0.5	3.5 ± 0.3	NS
Initial scrotal circumference (cm)	14.9 ± 3.5	14.8 ± 3.1	NS
Final scrotal circumference (cm)	20.2 ± 1.5	22.6 ± 0.8	S
Scrotal growth rate (mm/15d)	1.9 ± 1.0	3.2 ± 1.3	S
Age at puberty (months)	7.0 ± 0.4	6.6 ± 0.4	NS
Body weight at puberty (kg)	10.0 ± 1.6	9.9 ± 1.3	NS
Scrotal circumference (cm) at puberty	17.6 ± 3.5	19.5 ± 1.1	NS
Libido index (0～3)	2.6 ± 0.5	2.7 ± 0.5	NS

Values are presented as mean ± S.D. S indicate significant difference at (p<0.05) and NS indicate non significant difference between supplemented and control groups.

mented groups using Independent samples *t*-test by using SPSS 11.5 computer program package (SPSS, USA). Significance was accepted at p<0.05.

RESULTS

1. Effects of Concentrate Supplementation on Reproductive Performance of Indigenous Rams

At the start of experiment, there was no significant difference in body weight, scrotal circumference and body condition score in rams of control and supplemented groups. However, at the end of experiment, the final body weight (kg) (18.0 ± 1.9, 15.6 ± 1.8) and body growth rate (g/d) (27.3 ± 3.5, 19.9 ± 3.5) increased significantly (p<0.05) in supplemented group compared to control group. In case of scrotal circumference a significant difference (p<0.05) was found in final scrotal circumference (22.6 ± 0.8 vs 20.2 ± 1.5 cm) and scrotal growth rate (mm/15d) (3.2 ± 1.3, 1.9 ± 1.0) between supplemented and control groups. There were no significant (p>0.05) difference in age, body weight, scrotal circumference at puberty, BCS, and libido index between two groups (Table 1).

2. Effects of Concentrate Supplementation on Semen Quality

The colour of fresh semen was white creamy in all rams immediately after collection (Fig. 1). The volume and concentration of semen was significantly higher (p<0.05) (1.4 ± 0.4 ml, 4.8 ± 1.7 × 10^9/ml) in supplemented group compared to (1.2 ± 0.4 ml, 4.3 ± 1.7 × 10^9/ml) than that of control. There was no significant difference in density and mass motility between groups.

The Fig. 2～5 represents the parameters of ram semen. The percentage of motile spermatozoa was 90.4 ± 4.6, 81.9 ± 4.6,

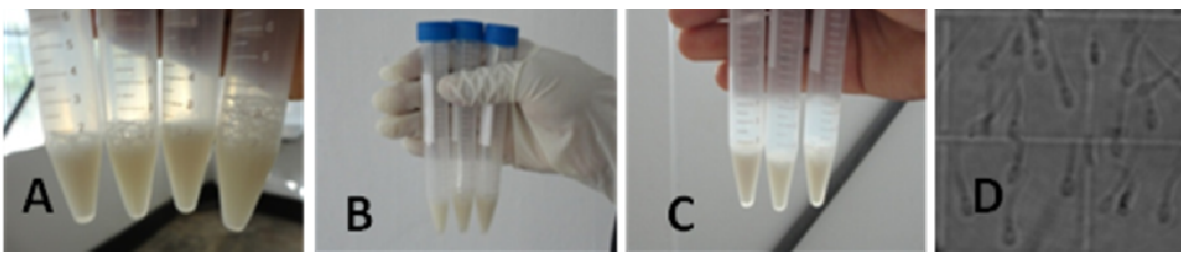

Fig. 1. A. Volume, B. Colour, C. Density, D. Spreading of sperm on haemocytometer.

72.6 ± 4.5, 61.6 ± 5.6 and 89.0 ± 4.4, 80.2 ± 4.1, 69.7 ± 4.8, 58.7 ± 5.3 in supplemented and control group, respectively in different observation time (0h, 24h, 36h and 48h). Similarly the percentage of membrane potentiality of spermatozoa was 91.3 ± 4.4, 80.6 ± 4.4, 71.4 ± 4.0, 59.6 ± 4.9 in supplemented group, and 90.0 ± 4.2, 79.0 ± 4.0, 69.3 ± 4.0 and 58.1 ± 4.1 in control group. The percentage of sperm motility (Fig. 2) and membrane potentiality (Fig. 4) of spermatozoa in different observation times; 0h, 24h, 36h and 48h was significantly higher in supplemented group than control (p<0.05). There was no significant difference in percentage of viable (Fig. 3) and normal spermatozoa (Fig. 5) between groups.

DISCUSSION

1. Concentrate Supplementation and Reproductive Parameters

1) Body Weight

This is the first study concerning the reproductive performance of native rams in Bangladesh. The rams supplemented with concentrate gained weight faster (p<0.05) than controls, and body weight was higher (p<0.05) at the end of experiment in this group (Table 1). Salim *et al*. (2002) reported that supplemented group of sheep gained significantly higher body weight than that of control. Our finding also corresponds with

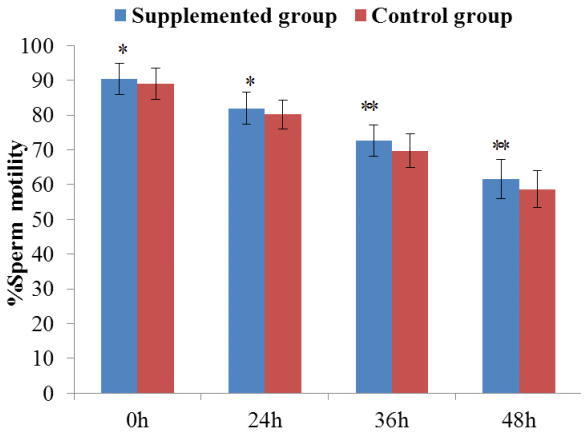

Fig. 2. Motility (%) of spermatozoa (mean ± SD) observed at different preservation times in supplemented and control groups of indigenous ram semen. Significantly (p<0.05) higher percentages of motile spermatozoa were in supplemented group compared with control group in 0h, 24h, 36h and 48h of observation. * Indicate significant difference between two groups (p<0.05) and ** indicate significant difference between two groups (p<0.01).

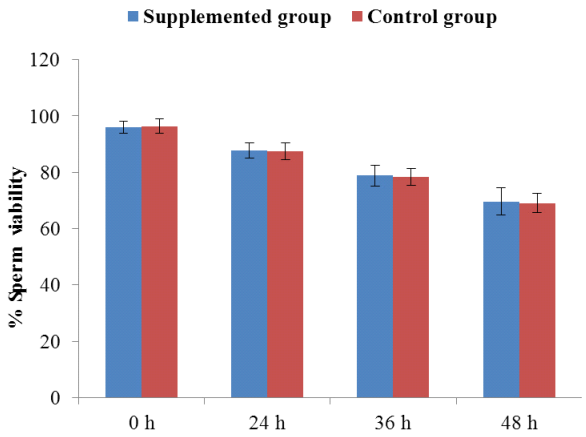

Fig. 3. Viability (%) of spermatozoa (mean ± SD) observed between supplemented and control groups at different preservation times in indigenous ram semen. Non significant (p>0.05) percentages of viable spermatozoa were in supplemented and control group in all observation (0h, 24h, 36h and 48h).

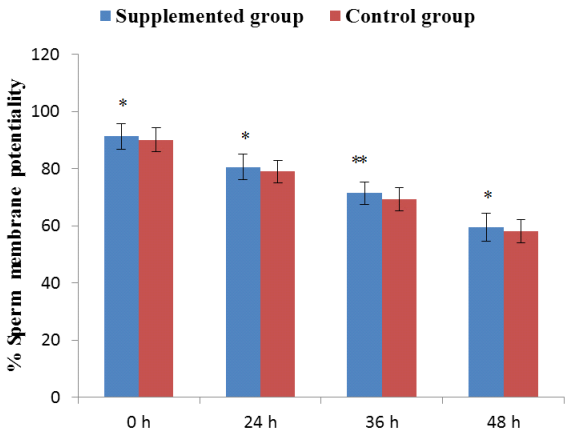

Fig. 4. Membrane potentiality (%) of spermatozoa (mean ± SD) observed between supplemented and control groups at different preservation times in indigenous ram semen. Significantly higher number of (p<0.05) percentages of membrane potential spermatozoa were in supplemented group compared with control group in 0h, 24h, 36h and 48h of observation. * Indicate significant difference between two groups (p<0.05) and ** indicate significant difference between two groups (p<0.01).

Tufarelli *et al*. (2011) who revealed that higher concentrate supplementation resulted in improved weight gain in Sardinian rams. Study on the effect of supplementation with multi-nutrient urea molasses blocks on body weight and body condition in Lohi ewes revealed a significant difference (p<0.01) compared with control (grazing) (Rafique *et al*., 2007). Alam *et al*. (2006) reported that cows supplemented with urea molasses had signi-

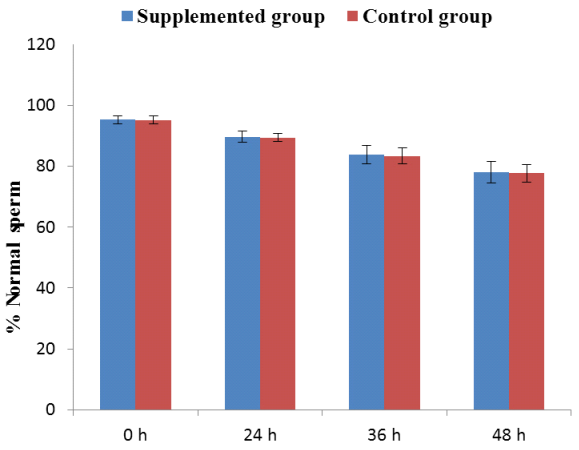

Fig. 5. Normal (%) of spermatozoa (mean ± SD) observed between supplemented and control groups at different preservation times (0h, 24h, 36h and 48h) in indigenous ram semen. Non significant (p>0.05) percentages of normal spermatozoa were in supplemented and control group in all observation (oh, 24h, 36h and 48h).

ficantly (p<0.01) higher body weight than controls. High protein diet influenced live weight gain significantly in sheep (p<0.05) (Kabir *et al*., 2004). Mukasa-Mugerwa and Ezaz (1992) stated that the level of nutrition had effect (p<0.05) on body growth rate (48.5 ± 1.6 g/d) from weaning to puberty in Menz ram lambs.

2) Scrotal Circumference

At the end of study the scrotal circumference was significantly different (p<0.05) between groups. The mean growth rate of scrotal circumference was faster (p< 0.05) in supplemented rams. Ram lambs fed on whole plant silage showed the highest (p< 0.001) scrotal circumference and scrotal growth rate compared to those fed maize stover and silage (Endale *et al*., 2009). Rams fed a diet with 12.1% CP had significantly higher scrotal circumference than those on 17.1% CP and control (Jibril *et al*., 2011). On the other hand, Tufarelli *et al*. (2011) observed no change in scrotal circumference with different level of concentrate feeding.

3) Age, Weight and Scrotal Circumference at Puberty

Supplemented ram lambs attained puberty non-significantly earlier and the body weight at puberty was non-significantly higher than control ram lambs. Similarly, there was no significant difference was observed in scrotal circumference between groups (Table 1) at puberty in the present study. However, post-weaning nutrition had a strong influence on ram lamb weight gain, which in turn was related to testicular growth and scrotal circumference in Menz ram lambs at puberty (Mukasa-Mugerwa and Ezaz, 1992). One of the previous study showed that the average age at first heat of Bangladeshi native ewe was 8, 7.5 and 9.3 months in Jumunapari, Barind and Coastal region, respectively (Hassan and Talukder, 2011), slightly higher than the present findings (Table 1) in males. The age at sexual maturity was 11.8 ± 0.6 months in male goats (Hassan *et al*., 2010). However, in semi-intensive conditions, age and weight at puberty were 7.8 months and 10 kg in Black Bengal goats in Bangladesh (Halim *et al*., 2011). Zeshmarani *et al*. (2013) found the earliest puberty was 6.3 month in Black Bengal goats. Most cattle and buffalo heifers in Bangladesh are reared on green fodder and poor quality roughage, resulting in slow growth (Jabbar *et al*., 2006) and delayed puberty (Bhatti *et al*., 2007).

4) Body Condition Score

We observed higher (p>0.05) BCS in supplemented rams compared to control. In most cases, healthy sheep and goats should have a BCS of 2.0 to 3.5 and breeding ram should have BCS 3～4 (Kochapakdee *et al*., 1994). The present results were within this range (Table 1). In ewes with BCS 3 reproductive performance was better, oestrous cycle was normal and heavier lambs were born, while in ewes with BCS 2～2.5, oestrous cycle was shorter and more irregular (Aliyari *et al*., 2012). Supplementation with multi-nutrient urea molasses blocks (MNUMB) significantly improved body weight and BCS in Lohi ewes compared with those grazing post-harvest crop residues and road side (Rafique *et al*., 2007). The fertility in ewes in BCS 3 was better than in other ewes (Aliyari *et al*., 2012). Improved diet assures good BCS, increases cholesterol availability to maintain ovarian follicle function and favours earlier resumption of ovarian activity (Oliveira Filho *et al*., 2010) and consequently enhances pregnancy rates.

5) Libido Index

Rams may exhibit a wide range of libido levels. Rams were classified as high libido if they achieved an average of 5～6 ejaculations within 30 min, whereas low libido rams performed fewer than four (Price, 1987). Day length has an effect on reproduction in male and female. The highest libido, fertility, and semen volume with good quality were observed in late

Table 2. Effects of nutrition on quality of indigenous ram semen

Parameters	Control group	Supplemented group	*p*-value
Colour	Creamy white	Creamy white	-
Volume (ml)	1.2 ± 0.4	1.5 ± 0.4	S
Density (0～5)	2.8 ± 0.4	2.8 ± 0.4	NS
Concentration ($\times 10^9$)	4.8 ± 1.8	5.4 ± 1.9	S
Mass activity	4.0 ± 0.7	4.2 ± 0.6	NS

Values are presented as mean ± S.D. S indicate significant difference at (p<0.05) and NS indicate non significant.

summer and autumn, when the females will allow breeding (Senger, 2003). The supplemented diet has no effect (p>0.05) on libido in this study. However, diet has effect on libido. Carbohydrate or protein deficiency may impair libido in males (Alejandro *et al*., 2002; Mitchell *et al*., 2003). Warnick *et al*. (1961) stated that libido and semen quality appeared normal in rams fed on purified diets containing urea. We did not find any difference in libido index between two groups. However, it seems to be that supplemented diet had tendency to increased sex drive.

2. Concentrate Supplementation and Semen Quality

It is well documented that adequate nutrition is crucial for successful mating in sheep (Fernandez *et al*., 2004). Several studies have documented the relationship between energy intake and reproductive performance in adult rams (Murray *et al*., 1990) and protein deficiency can reduce semen quality and sexual activity (Brown, 1994).

1) Volume

Semen volume was significantly greater (P<0.001) in supplemented group than the control. Our results agree with the findings of El-Azab *et al*. (1998) reported that rams fed on ammoniated rice straw had higher ejaculate volume (p<0.05) than those fed untreated rice straw. Gundogun (2009) reported the overall mean volume of semen from Pirlak rams was 1.5 ± 0.1 ml which was near about our result in supplemented group. There is no study concerning the relationship between concentrate supplementation and semen volume of native rams in Bangladesh. However, some researchers produced report in the

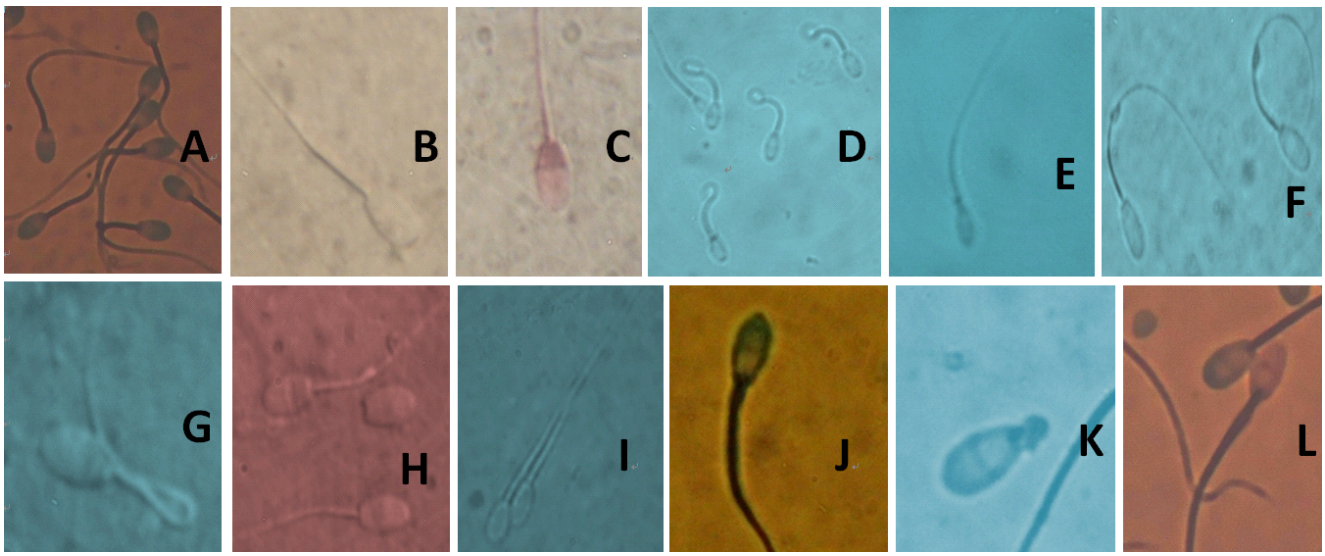

Fig. 6. A. Normal sperm, B. Viable sperm, C. Dead sperm, D. HOST-positive sperm (swollen tail), E. Proximal cytoplasomic droplet, F. Distal cytoplasomic droplet, G. Bent tail, H. Detached head, I, Joined tail, J. Abnormal midpiece, K. Stunted tail, L. Absence of acrosome.

Jamunapuri goat in Bangladesh. Hassan *et al*. (2010) showed that average volume of semen was 0.9 ± 0.2 ml in Jamunapuri goat. Semen volume is one of the important factors in semen evaluation and reproductive performance in males (Ax *et al*., 2000). There was an increase in semen volume in rams fed a concentrate mixture with ammoniated rice straw and/or alfalfa hay, compared with those fed the concentrate mixture with untreated rice straw. Such an increase might be due to ammonia raising the digestible crude protein in the ration (Khadr, 1995). Many researchers noted that spermatogenesis in rams is sensitive to increases in protein intake (Parker and Thwaites, 1972). In this study, the lower ejaculate volume of semen in the control group was probably due to the lower level of protein intake. On the other hand increased volume of semen in supplemented group confirmed that semen volume can be improved by concentrate supplementation with free grazing.

2) Concentration

Diet affect the concentration of spermatozoa /ml ($p<0.01$) in this experiment. It is positive to artificial insemination (AI) because increasing sperm concentration is generally allows insemination of a larger number of females (Ro- binson *et al*., 2006). The present results agree with Tufarelli *et al*. (2011) who found concentrate supplementation resulted in improved sperm production in Sardinian rams. Sperm production, as well as total number of spermatozoa per ml, can be affected by nature of diet (Fernandez *et al*., 2004). Gundogun (2009) recorded the concentration of spermatozoa was 424×10^7 /ml of Pirlak rams. A number of studies have demonstrated that extra protein led to an increase in testicular size due to an increase in the volume and diameter of seminiferous tubules (Abisaab *et al*., 1997; Hotzel *et al*., 1998). Rams fed ammoniated rice straw had higher sperm concentration than those maintained on untreated rice straw (El-Azab *et al*., 1998). However, bulls fed moderate energy diets had 52% greater epididymal sperm reserves (Coulter and Bailey, 1988) and 12% greater daily sperm production (Coulter *et al*., 1997) than bulls fed high-energy diets.

3) Mass Motility

The mass motility of semen from supplemented rams tended to be higher than control rams, but the difference was not significant. Similarly Cunha *et al*. (2012) found that a diet containing cottonseed did not influence the mass motility of ram semen. On the other hand the mass motility increased significantly in semen of buffalo fed ammoniated rice straw (El-Khadrawy, 1991).

4) Motility

The proportion of motile spermatozoa (Fig. 3) was significantly ($p<0.05$) increased by concentrate supplementation compared to control in all observation. Sperm motility is a fairly reliable indication of the viability of fresh and frozen semen (Grahman *et al*., 1980). The motile spermatozoa provide strong evidence for sperm maturation. Concentrate supplementation improved sperm quality. The percentage of motile spermatozoa in this experiment gradually decreased with storage time (Fig. 2). The results confirm the finding of Gundogun (2009). He recorded that mean spermatozoa motility of Pirlak rams was 82.4% and gradually decreased during storage. In Bangladesh, the percentage of motile sperm in Jamunapuri goats was 76.3 (Hassan *et al*., 2010). Rams fed on ammoniated rice straw had higher sperm motility than those fed untreated rice straw (El-Azab *et al*., 1998). Selenium supplementation (An- derson *et al*., 1996) improved motility of ram semen. However, high energy diet resulted in a smaller proportion of progressively motile spermatozoa than a moderate-energy diet (44.5 vs 53.4%) (Coulter *et al*., 1997). Tufarelli *et al*. (2011) concluded that concentrate supplementation improved sperm production and semen quality in Sardinian rams. In this study, the mean values were within a standard range in both groups. The minimal value of sperm motility for the ram is 60% as reported by Garner and Hafez (Garner and Hafez, 1982). Our results confirm that sperm motility was acceptable until 48h in both groups, though the motility of spermatozoa in the control group was lower than in the supplemented group (Fig. 2).

5) Viability

The percentage of viable spermatozoa did not differ significantly (Fig. 3) between groups. This result is similar to that of Fernandez *et al*. (2004). They observed no effect on the proportion of live and dead spermatozoa by improved diet. The average viability of sperm was 90% in Jamunapuri goat in Bangladesh (Hassan *et al*., 2010). The mean proportion of dead spermatozoa in Pirlak rams was 7.1% (Gundogun, 2009). Beneficial effects of supplementary trace minerals (Zn, Co and Se) (Kendall *et al*., 2000) and selenium (Anderson *et al*., 1996) on percentage of live sperm in ram lambs have been observed. However, Jibril *et al*. (2011) stated that percentage of sperm viability was not influenced by level and source of protein. In accord with present result, Abdelhamid *et al*. (2012) reported

that viability of sperm was higher in goats fed improved diet but the difference was not significant.

6) HOST Test

The supplemented diet differed significantly ($p<0.05$) the higher percentage of HOST-positive (indicating membrane potentiality) sperm cell compared to control (Fig. 4). The percentage of HOST-positive spermatozoa was higher in rams fed concentrate supplementation compared to control in each of four observations. The mean proportion of HOST-positive spermatozoa was 69% with decreased the proportion after storage in Pirlak rams (Gundogan, 2009). Juyena (2011) reported 76% HOST-positive sperm cell in Padovana rams. The HOST test was developed to evaluate the functional integrity of the sperm membrane (Jeyendran *et al*., 1984). Live spermatozoa with normal membranes show swelling of the tail due to water influx when exposed to hypo-osmotic conditions (Liu and Baker, 1992). An intact sperm cell membrane reflects semen fertility more closely than sperm motility (Perez *et al*., 1998). The HOST test may be a valuable tool for selection of breeding rams.

7) Morphology of Spermatozoa

There was no effect of concentrate supplementation on morphology of spermatozoa. However, a decreased proportion of normal spermatozoa rate was recorded with increased time of storage at 5℃ (Fig. 5) in both groups. Similar result was observed by Gundogan (2009) and Shamsuddin *et al*. (1987). Our results agree with the observation by El-Azab *et al*. (1998): rams fed on ammoniated rice straw had lower incidence of sperm abnormalities than those fed untreated rice straw. Improving feeding tends to decrease the proportion of cell abnormalities (Tufarelli *et al*., 2011). Percentage of morphologically normal spermatozoa was affected by diet (David *et al*., 2007). A higher proportion of sperm cell abnormalities might be attributed to disturbances in the function of the epididymis, probably due to subnormal levels of testosterone (Dana *et al*., 2000). Testosterone is suppressed as a result of prolonged feeding of poor quality diets (Parker and Thwaites, 1972). Season may affect the normality of sperm cells (Ritar and Salamon, 1991). However, the quality of Jamunapuri goat semen did not differ significantly between seasons (Hassan *et al*., 2010). Semen from most males contains some abnormal spermatozoa. Kasimanickam *et al*. (2007) stated that breeding potential of a ram should have more than 70% morphologically normal sperm. In the present study the proportion of abnormal spermatozoa did not exceed 30% until 48h of storage at 5℃. So it is recommended that ram semen may chill up to 48h.

CONCLUSIONS

Concentrate supplementation improve weight and scrotal circumference gain, semen volume with sperm concentration, sperm cell motility and sperm membrane potentiality. Sperm viability and normal percentages of spermatozoa were not affected by concentrate supplementation. Age and scrotal size at puberty, libido index and BCS, were improved in supplemented rams. This study could help farmers to provide appropriate diet to indigenous rams in order to improve their reproductive performance.

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