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RESEARCH OPINIONS IN ANIMAL & VETERINARY SCIENCES

Influence of age, hair type and body condition score on sperm morphology and cation concentrations of Red Sokoto goat

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Abstract

The study was conducted to determine the influence of age, hair type and body condition score on sperm morphology and cation concentration in 31 Red Sokoto bucks. The ages of the bucks were categorized into four classes (9 -12, 13-16, 17-20 and 21-24 months). The hair types were categorized into short-smooth (SS) and long-curly (LC). The body condition was scored on a scale of 1 to 5 and then used to categorize the bucks into score 3 and 4. The parameters include sperm morphological defects like detached mid-piece and tail (DMT), detached head (DH), mid-piece droplet (MPD), coiled and bent tail (CBT) and acrosomal abnormality (ACR). Semen cation concentrations were also determined. The results showed that the mean DMT, MPD, DH, CBT, ACR, sodium (Na), potassium (K), calcium (Ca) and phosphate ion (PO_4) were 0.52, 0.64, 0.52, 1.03, 0.61, 94.90, 67.79, 2.62, and 5.42, respectively. Age and hair type had significant effect on sperm morphology except the MPD and ACR. Body condition score had significant ($P<0.01$) effect on DH, DMT, MPD and CBT in younger-matured bucks of between 13 and 20 months of age than older bucks. The DH and ACR were significantly higher in the younger (9–12 months of age) and older bucks (21–24 months of age). The long curly haired bucks had the highest DMT and CBT abnormalities (0.8×10^6/ml), while the short-smooth haired bucks had the highest DH abnormalities (1.1×10^6/ml). Bucks with lower body condition showed higher DH (130%) than those with higher body condition (90%). Age had significant ($P<0.01$) effect on semen cation concentration while hair type and body condition score had significant ($P<0.01$) effect on Na ion only. Except Na, the semen cations concentrations were relatively higher in the older bucks of 21–24 months than the younger bucks of 9–16 months of age. However, bucks at 17–20 months of age recorded the highest value of K and PO_4 respectively. Bucks with higher body condition score were superior in seminal Na than bucks with lower body condition score. The result of this experiment, therefore, showed that older bucks with short-smooth hairs and higher body condition score exhibited less sperm abnormalities and concentration of Na than older, long curly haired and lower body conditioned bucks. This suggest that, age 21-24 months, short-smooth hair type and higher body condition would be a useful index in selecting bucks for semen quality. Therefore, age, hair type and body condition could be important factors in selecting breeding bucks for optimum performance in Red Sokoto goat.

Keywords: Age; hairtype; sperm morphology; body condition socre; cation concentrations

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Introduction

Artificial insemination (AI) is the most valuable breeding management tool available to animal breeders to improve the genetic potential of their herds. The collection of relatively large numbers of ejaculates containing the highest number of morphologically normal sperm is among the important factors determining the success of AI. Sperm morphology is used as one of the most important criteria in the

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evaluation of semen quality (Colenbrander et al., 1993; Bearden and Fuquay, 1997). Morrow (1980) defined the relationship between sperm morphology and the reproduction potential, and indicated that when more than 30% of the ejaculated spermatozoa have structural defects, reduced fertility may occur in domesticated animals. Spermatozoa with abnormal morphology are not uncommon even in semen from good, proven fertile bucks. However, the proportion of abnormal spermatozoa must remain within a normal limit (Hafez, 1993).

In artificial insemination, the genetic impact of a superior buck is determined by the number of does inseminated and this is limited by the number of sperm and quality of semen. However, before considering the sequences of events at insemination, an understanding of good quality semen is desirable. The quality of semen in relation to fertility is determined by the volume of ejaculate, sperm concentration and motility, percent of live sperm and the sperm morphology. The knowledge of the relationships of male reproductive traits among themselves and with other variables such as age, body weight, body condition score and testis size might be important indicators to the real producing ability of a male for sperm output and quality.

The morphological characteristics of spermatozoa are influenced by several factors including the genetic make-up and physiological stage of the animal, nutrition, season, climatic factors and disease (Dowsett and Knott, 1996; Dana et al., 2000). Poor sperm morphology is an indicator of decreased fertility in many species including goats (Chandler et al., 1988).

An accurate morphological examination of spermatozoa enables the elimination of males with potentially low fertility prior to the preservation of their semen (Rodriguez-Martinez and Barth, 2007). Hence genetic improvement of farm animals would rely on the intensive use of a few superior males either for natural mating or in artificial insemination programs.

However, sperm density, viability and activity as well as other sexual characteristics of the different breeds may limit the extent to which bucks can be used for breeding. Considerable attention has been paid to the effect of age on sperm morphology of rams (Akpa et al., 2012). However, information is lacking in indigenous bucks in Nigeria. Information on the extent of variation of seminal characteristics between bucks of different breeds is an essential pre-requisite for effective preservation of their germ plasm to be used in artificial insemination program. It is known that the seminal plasma contains substances that support the sperm cells. Sodium (Na) and Potassium (K) cations in the seminal plasma establish the osmotic balance, while the essential trace elements are the components of many important enzymes (Zamiri and Khodaei, 2005). Also calcium (Ca) is needed for stimulation of steriodogenesis in leydig cells of the testis (Henricks, 1991). A large number of reports on the biochemical composition of cattle semen have been published (Rattan, 1990), but there is scarcity of parallel information about the semen of the Red Sokoto bucks maintained in the northern part of Nigeria. This study therefore, was aimed at determining the effect of age, hair type and body condition score on sperm morphology and cation concentrations in Red Sokoto bucks.

Materials and methods

Study location

The study was conducted at the Experimental and Research Farm of the Department of Animal Science, Faculty of Agriculture, Ahmadu Bello University, Zaria, Nigeria. The area is situated between latitude 11^0 and 12^0N and altitude of 640m above sea level (Encarta Encyclopedia, 2009 PC version). The area falls within the Northern-Guinea Savannah Zone, having an average annual rainfall of 1100mm, which starts from late April or early May to mid-October. The peak rainy season is between June and September, followed by the harmattan period of cool and dry weather which last from October to January. This is then followed by hot-dry weather from February to April. The mean maximum temperature varies from 26 to 35^0C depending on the season, while the mean relative humidity during Harmattan period and wet season are 21 and 27% respectively. Detailed description of Zaria was given elsewhere by Akpa et al. (2002).

Experimental animals and their management

A total of thirty-one Red Sokoto bucks were used for the study. The animals were under the management practice of the Department of Animal Science, Ahmedu Bello University, Zaria. The bucks were reared under semi-intensive system. The animals were released daily for grazing at 8.00 am and another shift by 2.00 pm. Supplemental feed (concentrates) were provided. Animals received routine inspection and dipping (ectoparasite), as well as anti-helminthic drenching (deworming) and vaccination againt endemic diseases. Drinking water was provided *ad libitum*. The experiment commenced when the bucks were 9–12 months of age in July 2011 and ending when they were 21–24 months, in June, 2012. Sampling of bucks commenced when they were 9-12 months of age and terminated a year after when they were 21-24 months of age.

Data collection

Traits measurement semen collection and evaluation

Semen samples were collected from each animal at the onset and thereafter on weekly basis for 52 weeks

using an electro-ejaculator and were labelled accordingly. This was done in the morning throughout the duration of the experiment. Smear of each semen sample were prepared, air dried, labelled and kept for the determination of sperm morphology using oil immersion. A total of 1488 records were generated for each of the observed characteristics.

Sperm morphology

Live and abnormal spermatozoa percentages were counted using hand counter. Fifty spermatozoa were examined for each sample. The total number of abnormal cells were counted and recorded. Types of abnormality observed were: detached mid-piece and tail, detached head, mid-piece droplet, coiled and bent tail, and acrosomal abnormality (acrosome membrane detached, acrosome outlines and acrosome cap defect). Acrosomal abnormalities were determined by using smears made from the raw semen and stained by Giemsa stain.

Semen mineral concentration

Mineral analysis was performed with a Coleman 21 Flame Photometer at the Pathological Department of Ahmadu Bello University Teaching Hospital, Shika, Zaria. The Flame photometer was calibrated with five standard stock solutions for concentration of minerals. The semen samples were centrifuged for separation of seminal plasma. Seminal plasma was then processed and different elements (Na, K, Ca, $P0_4$) were estimated.

Determination of factors

Age determination

The age of the animals were determined using the dentition estimation method by counting the number of permanent incisors that had erupted on the lower jaw of the mouth as described by Matika et al. (1992) and Sastry and Thomas (1980). This method puts the bucks at 9–12 months of age at the onset of the study. Measurements were made on these bucks at this age group and subsequently, until after 12 months. Thereafter, the ages of the bucks were categorized into 9–12, 13–16, 17–20 and 21–24 months.

Hair type

The hair type of the animal was determined through a touch and a feel of the hair. Short-Smooth (SS) and Long-Curly (LC) which was based on length and texture of the hair were used to categorize the animal into two groups.

Body condition score

The body condition scores (1-5) were employed to score the bucks. The buck's backbone, loin and rump areas were palpated and examined and then scored. These areas do not have muscle tissue covering them, hence, combination of skin and fat deposit account for any cover that were felt around these areas. Amount of fat deposit was determined by the use of finger tip pressure which was exerted on the backbone, pin bone and hip bone, respectively.

Score 1 (Very thin)

Individual short ribs have a thin covering of flesh. Bones of the chine, loin and rump region are prominent. Hook and pin bones protrude sharply, with a very thin covering of flesh and deep depressions between bones. Bony structure protrude sharply and ligament prominent.

Score 2 (Thin)

Individual short ribs can be felt but are not prominent. Each rib is sharp to touch but have a thicker covering of flesh. Short ribs do not have as distinct an over-hanging shelf effect. Individual bone is the chine, loin and rump regions are not visually distinct but easily distinguishable by touch. Hook and pin bones are prominent but the depression between them is less severe. Area below tail head and between pin bones is somewhat depressed but the bony structure has some covering of flesh.

Score 3 (Moderate)

Short ribs can be felt by applying slight pressure. Altogether, short ribs appear smooth and the over-hanging effect is not so noticeable. The backbone appears as a rounded ridge, firm pressure is necessary to feel individual bones. Hook and pin bones are rounded and smooth. Area between pin bone and around tail head appears smooth without sign of fat deposit

Score 4 (Fat)

Individual short rib is distinguishable only by firm palpation. Short ribs appear flat or rounded, with no overhanging shelf effect. Ridge formed by backbone in chine region is rounded and smooth. Loin and rump region appear flat. Hooks are rounded and the space between them is flat. Area of tail head and pin bones is rounded with evidence of fat deposit.

Score 5 (Obese)

Bony structures of backbone, short ribs and hook and pin bones are not apparent; subcutaneous fat deposit very evident. Tail head appears to be buried in fat tissue.

Statistical analysis

Descriptive statistics were determined for each trait. The effect of age, hair type and body condition score on sperm morphology and cation concentrations

were determined using General linear Model Procedure of SAS (2002). Significant differences in means were separated using Duncan's Multiple Range Test. The model used is as follows:

$Y_{ijk} = \mu + A_i + H_j + C_k + E_{ijk}$

Where: Y_{ijk} = estimates of the given measurable characteristics

μ = over all mean

A_i = effect of ith age (i: 9-12, 13-16, 17-20 and 21-34)

H_j = effect of jth hair type (j: SS and LC)

C_k = effect of kth body condition score (k = 3, 4)

E_{ijk} = random error.

Results

The sperm morphology and cation concentrations in Red Sokoto bucks are presented in Table 1. These characteristics varied widely with the CV ranging from 68.43 to 110.41%. The most variable characteristics were detached midpiece and tail and detached head. The mean semen cation concentrations were 94.90, 67.79, 2.62 and 5.42 (millimol/litre) for Na, K, Ca and PO_4 respectively. The variability was low for Ca (4.90%), moderate for Na ion (19.00%) and high for K (43.74%) and PO_4 (40.04%).

The effect of age, hair type and body condition score on sperm morphology is shown in Table 2. Age and hair type had significant effect on sperm morphology except the effect of hair type on MPD and ACR (P>0.05). The BCS only had significant (P<0.01) effect on DH. There was higher number of DMT, MPD and CBT in the younger bucks of between 13 and 20 months of age than those of later ages while DH and ACR occured in both younger (9–12) and older bucks (21–24 months of age), respectively. With respect to hair type, the long-curly haired bucks had the highest DMT and CBT abnormalities (0.8 x 10^6/ml), while the short-smooth haired bucks had the highest DH (1.1 x 10^6/ml) abnormalities. For body condition score, bucks with lower score showed higher DH (130%) than bucks with higher score (90%).

The effect of age, hair type and body condition score on semen cation concentration is presented in Table 3. Age had significant (P<0.01) effect on semen cation concentrations while hair type and body condition score only had significant effect (P<0.01) on Na. The semen cation concentrations

Table 1: Summary statistics for sperm morphology and cation concentrations in Red Sokoto bucks (N = 1488)

Characteristics	Mean ± Se	CV (%)	Min	Max
Sperm Morphology (%)				
Detached Midpiece and Tail (DMT)	0.52 ± 0.10	110.41	0.00	2.00
Midpiece Droplet (MPD)	0.61 ± 0.11	100.38	0.00	2.00
Detached Head (DH)	0.52 ± 0.10	110.41	0.00	2.00
Coiled and Bent Tail (CBT)	1.03 ± 0.13	68.43	0.00	3.00
Acrosome (ACR)	0.61 ± 0.12	108.86	0.00	2.00
Semen Cation concentrations (millimol/litre)				
Sodium (Na)	94.90 ± 3.24	19.00	56.00	136.00
Potassium (K)	67.79 ± 5.33	43.74	24.70	129.80
Calcium (Ca)	2.62 ± 0.02	4.90	2.05	2.77
Phosphorus ($P0_4$)	5.42 ± 0.39	40.04	3.14	10.50

Table 2: Effect of age, hair type and body condition score on sperm morphology in Red Sokoto bucks

Factor	N	Detached Midpiece and Tail (x10^6/ml)	Midpiece Droplet (x10^6/ml)	Detached Head (x10^6/ml)	Coiled and Bent tail (x10^6/ml)	Acrosome (x10^6/ml)
Age (months)	1488	**	**	**	**	**
9 – 12	372	0.2^b	0.5^b	1.2^a	0.2^b	0.7^a
13 – 16	372	0.7^a	0.7^a	0.9^b	0.7^a	0.5^b
17 – 20	372	0.7^a	1.0^a	1.0^b	0.7^a	0.3^b
21 – 24	372	0.2^b	0.4^b	1.4^a	0.2^b	1.0^a
SEM		0.10	0.11	0.13	0.10	0.12
Hair type	1488	**		*	**	
Short-smooth	1008	0.4^b	0.5	1.1^a	0.4^b	0.6
Long-curly	480	0.8^a	0.6	0.8^b	0.8^a	0.7
SEM		0.1	0.11	0.13	0.10	0.12
Body Condition Score	1488			**		
BCS (3)	576	0.60	0.6	1.3^a	0.6	0.5
BCS (4)	912	0.5	0.6	0.9^b	0.5	0.7
SEM		0.10	0.11	0.13	0.10	0.12

**= P<0.01; *= P<0.05; a,b means within the same column and factor with different superscripts differ significantly (P<0.05).

Table 3: Effect of age, hair type and body condition score on semen cation concentrations in Red Sokoto bucks

Factor	N	Na (mM/l)	K (mM/l)	Ca (mM/l)	PO_4 (mM/l)
Age (months)	1488	**	**	**	**
9 – 12	372	94.8[a]	42.6[c]	2.6[b]	5.3[b]
13 – 16	372	99.3[a]	72.2[b]	2.6[b]	4.8[b]
17 – 20	372	70.7[b]	83.6[a]	2.6[b]	6.9[a]
21 – 24	372	94.6[a]	73.6[ab]	2.7[a]	6.8[a]
SEM		3.03	5.05	0.02	0.02
Hair Type	1488	**			
Short-smooth	1008	93.6[b]	65.9	2.6	5.5
Long-curly	480	100.2[a]	75.5	2.6	4.9
SEM		3.26	5.37	0.02	0.39
Body Condition Score	1488	**			
BCS (3)	576	90.8[b]	72.8	2.6	5.3
BCS (4)	912	97.5[a]	64.7	2.6	5.5
SEM		3.24	5.37	0.02	0.40

**= P<0.01; a,b,c means within the same column and factor with different superscripts differ significantly (P<0.05)

were relatively higher in the older bucks of (21–24 months) than the younger ones (9–16 months) except for Na which was also high in younger bucks of 9–16 months of age.

However, bucks at 17–20 months of age recorded the highest value for K and PO_4 respectively. Observations on the hair type of the bucks showed that the long-curly haired bucks were superior in seminal Na than the short-smooth haired bucks. With respect to BCS, bucks with higher body condition score were superior in seminal Na than bucks with lower body condition score.

Discussion

The mean values obtained in the present study for sperm morphology are supported by the report of Elwishy and Elsawaf (1971) and Mekasha et al. (2007). Recently, Bitto and Egbunike (2012) reported mean values of 3.01±0.29 and 1.78±0.26 for detached head, in pubertal and adult WAD, respectively. These are relatively higher than the result of the present study. Akpa et al. (2012) reported mean 0.7±0.07 for DH in Yankasa ram, which is slightly higher than the value obtained in the present study. The differences may be due to variations in breed, age, secretary activities of the sex glands. Moreover, collection frequency, pre-collection sexual stimulation, feeding regime, semen collection methods and feeding regime could equally influence the sperm abnormality. However, it is worthy to note that the total abnormal sperm morphology in the Red Sokoto bucks obtained in this study is 3.3% which is within the acceptable range of not more than 20% of the semen acceptable for use in artificial insemination (Hafez, 1993).

The significant influence of age on sperm morphology indicates that age is an important determinant of sperm morphology. Although the sperm abnormalities were present in all the age categories, it was, however, more prevalent in the younger than the older bucks except for DH and ACR which also occured in the older bucks. The presence of sperm abnormalities in all the age categories may probably indicate that sperm abnormalities of any kind could be present in semen irrespective of age category. Occurrence of more normal semen morphology in mature bucks compared to younger and older bucks as observed in this study may probably be due to variation in scrotal circumference, age, body size, secretary activities of their sex glands (Brito et al., 2002) and the heat regulation mechanisms (McDowell, 1972), which increase with age.

Age of the animal is an important physiological factor that modifies the sperm morphological characteristics of domestic animals. This has been demonstrated by earlier studies, which found abnormal sperm head shape to be more prevalent at younger age, to gradually decrease after sexual maturity, and to become greater again at older age, provided that the animal is healthy (Amann et al., 2000). This trend was observed in the present study as detached head and acrosome was first seen to be prevalent in the younger bucks and then decreased at maturity and become greater again at old age. The same trend was also observed by Mekasha et al. (2007) on indigenous Ethiopian bucks, Abd-Allah et al. (2007) in native Egyptian bucks and Vilakazi and Webb (2004) in South African Friesland bull.

Prior to maturity, the reproductive system in bucks, particularly testicle size and thermo-regulatory mechanism are still developing. As a consequence, a higher proportion of sperm defects may appear in the ejaculate of bucks prior to maturity (Bearden and Fuquay, 1997) than in older bucks. As bucks advance in age, testicular tissues may be broken down faster than being replaced (King, 1993). This may result in

testicular degeneration and abnormal scrotal thermograms, and hence poor sperm morphology in older bucks.

According to Barth and Oko (1989) sperm tail pathologies (bent or coiled) may result from failures in thermoregulation, testicular degeneration, hypo-osmotic conditions or failures in epididymal transit. Just like what was observed by Folhadella et al. (2006) in the bovine species, the high prevalence of tail pathologies in this study, such as the detached midpiece and tail; midpiece droplet and coiled and bent tail as observed in the pubertal (youthful) age category can be associated with sexual immaturity. Under normal conditions, sperm tail defects decrease against the increasing age, which indicates sexual maturity of domestic animals (Mekasha et al., 2007). High prevalence of tail pathologies was also observed by Akpa et al. (2012) in Yankasa rams.

The variation in the sperm abnormalities with hair type could probably be due to the temperature absorbing capacity of the hair. Hansen et al. (2001) reported that a rise in body temperature affects the viability of spermatozoa. This implies that hair types indirectly affect sperm viability by influencing the body temperature. In this study, the short smooth haired bucks had fewer abnormalities than the others. This is in line with the earlier report (Tumpenny et al., 2000) that short, sleek, thin hair coat improved heat and water vapour conductance through the coat layer in stressful hot and humid environments.

Bucks with BCS 4 had lower detached head compared to BCS 3. Therefore, it seems that bucks with lower body condition score tends to have higher sperm morphological abnormalities. As has been reported earlier (Hossain et al., 1990), abnormalities of the spermatozoa could occur due to disorder of the seminiferous tubules or germinal epithelium, which is directly or indirectly related to the body conditions of the bucks. However, the present results appear to fall within the normal variation range.

Observation from this study demonstrated that cations in semen vary in concentration due to the influence of age, hair type and body condition. Among the cations, it was observed that the concentration of Na was the highest, followed by K while the Ca content was the lowest in the semen collected from bucks. Similar observation/trend has been reported by many authors (Kanwal et al., 2000; Akpa et al., 2012).

Average Ca obtained in the present study is comparable or similar to the values obtained by Akpa et al. (2012) in Yankasa ram by Asadpour (2012) in Merino x Moghani, Ghezel x Merino and Ghezel x Baluchi cross bred rams respectively, but lower in bull (Kanwal et al., 2000). Abdel-Rahman et al. (2000) also reported higher value in Barbari, Merino and Naemi rams.

Higher Ca content in semen has been reported to have a depressing effect on sperm metabolism (Mann and Mann, 1981) and exaggerated the detrimental effects of K (Abdel-Rahman, 2000). Calcium also triggers the acrosome reaction in mammalian spermatozoa and is also involved with sperm motility (Kaya et al., 2002). Meseguer et al. (2004) reported that Ca concentration in seminal plasma was good predictor of post-thaw semen quality. It is to be noted that Ca level of 2.62 mmol/L observed in the seminal fluid in this study is of advantage because it is within the recommended level of 5-15 mg/dL (1.25-3.75mmol/L) for a quality semen expected to give optimal performance in the bucks.

Na is an extracellular element while K is intracellular in nature, and there has been an opinion that normal ionic equilibrium and osmotic pressure are maintained by these ions (Hawk et al., 1964). The average K and Na content of 67.79$\pm$5.33 and 94.90±3.24 (milimol/L) in the present study was comparable to the findings of Akpa et al. (2012) who reported 68.3±2.84 and 92.6±2.05 (mmol/L) for Na and K respectively in Yankasa ram. They are, however, lower to the values obtained by Singh et al. (1969) and Abdel-Rahman et al. (2000) in Merino ram. On the other hand, Asadpour (2012) reported a lower value of 42.00±2.25 and 12.70±0.25 (mg/dL) for Ghezel x Merino ram; and 37.66±6.56 and 11.10±1.92 (mg/dL) for Merino x Mogbani cross bred ram, respectively. The differences may be due to breed, age, nutrition and environmental conditions.

High levels of Na and K had been reported to be associated with low percentages of motile sperm and such semen was considered to be of lower quality (Asadpour, 2012). The Na ion is an important element for spermatozoa function (Mosaferi et al., 2005) and K is a natural metabolic inhibitor and higher K concentration in seminal plasma decreases sperm metabolism thereby, decreasing sperm motility (Massányi et al., 2003). Zamiri and Khodaei (2005) showed that low levels of Na and K ions were associated with high percentage of motile sperm, which suggest that the cations Na and K are involved in establishment of osmotic balance, and play an important role in the activation of sperm cell. The lower values for Na and K as obtained in the present study might be responsible for appreciable sperm motility percentage (76-80.3%) obtained in this study which suggests that semen from the bucks may be of high quality.

It is to be noted that the level of Na and K concentrations in this study are within the recommended range of 60-183 and 76-255 (mmol/L) for Na and K respectively which is expected to give optimal reproductive performance of the buck. The concentration of inorganic PO_4 in the current study was

similar to the previous reports of Roy et al. (1960) and Singh et al. (1969); whereas, an even higher concentration in the study of Dhami and Sahni (1993) has been reported.

Conclusions

- The study revealed that semen cation concentration in Red Sokoto bucks was in the order of Na> K> Ca.
- The high preponderance of sperm abnormalities in the young-mature bucks (9–20 months) than the older bucks (21-24 months); and in the long curly haiRed bucks than the short smooth ones suggest that bucks of 21-24 months with short smooth hair should be used for breeding purpose to achieve optimum performance.
- The average seminal Na, K, Ca and PO_4 concentrations of 94.90, 67.79, 2.62 and 5.42 mmol/L in Red Sokoto bucks produced appreciable sperm motility percentage of 76–80.3% with low spermatozoa morphological abnormality of 3.3%.

The study therefore suggests that age of 21-24 months, short-smooth hair type and body condition score (4) are useful index in selecting Red Sokoto bucks for good semen quality.

Rreferences

Abd-Allah, S.M., A.S. Mostafaa, and El-Nemr, I.Z. 2007. Reproductive Characteristics of Native Bucks at different ages. *Egyptian Journal of Veterinary Science*, 41: 1-8.

Abdel-Rahman, H.A., El-Belely, M.S., Al-Qarawi, A.A. and El-Mougy, S.A. 2000. The relationship between semen quality and mineral composition of semen in various ram breeds. *Small Ruminant Research*, 38: 45-49.

Akpa, G.N., Duru, S. and Amos, T.T. 1998. Influence of strain and sex on estimation of within-age group body weight of Nigerian Maradi goats from their linear body measurements. *Tropical Agriculture, (Trinidad)*. 75: 462-467.

Akpa, G.N., Ifut, O.J. and Mohammed, F. 2002. Indigenous management of Dystocia in ruminant livestock of northern guinea savannah of Nigeria. *Nigeria Journal Animal Production*, 29: 264-270.

Akpa, G.N., Suleiman, I.O., Alphonsus, C. and Adu, O.A. 2012. The variation of age, hair type and body condition score with sperm morphology and cation concentration in yankasa ram. *Elixir Applied Biology*, 47: 8629-8632.

Amann, R.P., Seidel, G.E. and Mortimer, R.G. 2000. Fertilizing potential in vitro of semen from young beef bulls containing a high or low percentage of sperm with a proximal droplet. *Theriogenology*, 54: 1499-1515.

Asadpour, R. 2012. Relationship between Mineral Composition of Seminal Plasma and Semen Quality in Various Ram Breeds. *Acta Scientiae Veterinariae*, 40(2): 10-27.

Barth, A.D. and Oko, R.J. 1989. Abnormal morphology of bovine spermatozoa. Iowa State University Press. Ames, Iowa, USA, Pp: 285-287.

Bearden, H. and Fuquay, J.W. 1997. Applied animal reproduction. (3th ed.). Prentic-Hall, Englewood Cliff. Pp: 145-156.

Bitto, I.I. and Egbunike, G.N. 2012. The Semen Characteristics of Pubertal West African Dwarf Bucks. *Pertanika Journal of Tropical Agricultural Science*, 35 (2): 191-197.

Brito, L.F.C., Silva, A.D.E.F., Rodrigues, L.H., Vieira, F.V., Deragon, A.G. and Kastelic, J.P. 2002. The effect of environmental factors, age, and genotype on sperm production and semen quality of B. indicus and B. taurus AI bulls in Brazil. *Theriogenology*, 70: 181-190.

Chandler, J.E., Painter, C.L., Adkison, R.W., Memon, M.A. and Hoyt, P.G. 1988. Semen quality characteristics of dairy goats. *Journal of Dairy Science*, 71: 1638-1646.

Colenbrander, B., Fustma, H. and Gooten, H.J. 1993. Optimising semen production for AI in swine. *Journal of Reproduction and Fertility*, 48: 207-215.

Cragle, R.G., Salisbury, G.W. and Anuroi, I.M. 1958. Distribution of bulk and trace minerals in bull reproductive tract fluid and semen. *Journal of Dairy Science*, 41: 1273-1277.

Dana, N., Tegegne, A. and Shenkoru, T. 2000. Feed intake, sperm output and seminal characteristics of Ethiopian highland sheep supplemented with different levels of leucaena (Leucaena leucocephala) leaf hay. *Animal Feed Science and Technology*, 86: 239-249.

Dhami, A.J. and Sahni, K.L. 1993. Comparative assessment of seminal plasma and their interrelationship in ox and buffalo bulls. *Indian Journal of Animal Reproduction*, 14: 98-108.

Dowsett, K.F. and Knott L.M. 1996. The influence of age and breed on stallion semen. *Theriogenology*, 46: 397-412.

Elwishy, A.B. and Elsawaf, S.A. 1971. Development of sexual activity in male Damascus Goats. *Indian Journal of Animal Science*, 41(5): 350-356.

Encarta Encyclopedia, 2009 PC version. Study tools, a Multimedia Encyclopedia, Dictionary and an atlas. Microsoft Student with Encarta Premium, DVD 2009.

Folhadella, I.M., Sá, W.F. and Ferreira, A.M. 2006. Andrological characteristics of Gyr bulls. *Brazilian Archives of Veterinary Medicine and Animal Science*, 58(5): 809-815.

Hafez, E.S.E. 1993. Artificial insemination, in: Hafez E. S. E (editor) Reproduction in Farm Animals. Lea and Febiger, Philadelphia, USA, pp: 424-439.

Hansen, P.J., Drost, M., Rivera, R.M., Paula-Lopes, F.F., AlKatanani, Y.M., Krininger III, C.E. and Chase Jr, C.C. 2001. Adverse impact of heat stress on embryo production: causes and strategies for mitigation. *Theriogenology*, 55: 91-103.

Hawk, P.B., Oser, B.L. and Summerson, W.H. 1964. Practical Physiological Chemistry, 13th ed. The Blakiston Co. Inc, New York.

Henricks, D.M. 1991. Biochemistry and physiology of the gonadal hormones, in: Cupps P.T. (Ed). *Reproduction in Domestic animals*. 4th edn. San Diego: Academic Press, pp: 670-674.

Hossain, M.F., Alam, M.G.S., Ahmed, J.U., Rahman, M.M. and Rahman, A. 1990. Bacteriological examination of semen as an aid to sexual health control in bulls. *Bangladesh Journal of Microbiology*, 7: 85-88.

Kanwal, M.R., Rehman, N.U., Ahmad, N., Samad, H.A., Zia-ur-rehman, Akhtar, N. and Ali S. 2000. Bulk Cations and Trace Elements in the Nili-Ravi Buffalo and Crossbred Cow Bull Semen. *International Journal of Agriculture and Biology* 2(4): 302-305.

Kaya, A., Aksoy, M. and Tekeli T. 2002. Influence of ejaculation frequency on sperm characteristics, ionic composition and enzymatic activity of seminal plasma in rams. *Small Ruminant Research*, 44: 153-158.

King, G.J. 1993. Reproduction in domesticated animals. Elsevier Science Publisher *B.V*. London, New York, Pp: 210-221.

Mann, T. and Mann, C.L. 1981. Male Reproductive Function and Semen. Springer-Verlag. Berlin Heilberg, New York.

Massányi, P., Trandzik, J., Nad, P., Toman, R., Skalická, M. and Koréneková, B. 2003. Seminal concentrations of trace elements in various animals and their correlations. *Asian Journal of Andrology*, 5: 101-104.

Matika, O., Sibanda, R. and Beffa, M.L. 1992. Eruption of permanent incisors in indigenous goats and sheep. In Rey, B., Lebbie, S.H.B. and Reynolds, L. (eds), 1992. Small Ruminant Research and Development in Africa. *Proceedings of the first Biennial Conference of the African Small Ruminant Research Network, ILRAD*, Nairobi, Kenya. pp: 499-504.

McDowell, R.E. 1972. Improvements of livestock production in warm climates. Cornell University. Wlt, Freeman and Company, New York. Pp: 73-81.

Mekasha, Y., Tegegne, A. and Rodriguez-Martinez, H. 2007 Sperm morphological attributes in indigenous male goats raised under extensive husbandry in Ethiopia. *Animal Reproduction*, 4 (1/2): 15-22.

Meseguer, M., Garrido, N., Martı´nez-Conejero, J.A., Simon C, Pellicer, A and Remohı´ J. 2004. Role of cholesterol, calcium, and mitochondrial activity in the susceptibility for cryodamage after a cycle of freezing and thawing fertility and sterility. 81:3-9.

Morrow, D. 1980. Current theraphy in theriogenology. W.B Saunders Co. Philadelphia. pp: 48-51.

Mosaferi, S., Niasari-Naslaji, A., Abarghani, A., Gharahdaghi, A.A. and Gerami, A. 2005. Biophysical and biochemical characteristics of Bactrian camel semen collected by artificial vagina. *Theriogenology*. 63: 92-101.

Rattan, P.J.S. 1990. Physico-chemical constituents of buffalo bull semen. *Proceedings of 2nd world Buffalo Congress, Indian Society of buffalo development and Indian Council of Agricultural Research*, pp: 26-30.

Rodriguez-Martinez, H. and Barth, A.D. 2007. In vitro evaluation of sperm quality related to in vivo function and fertility. In: Juenge JI, Murray JF, Smith MF (Ed.). *Reproduction in Domestic Animals* VI. Nottingham, UK: Nottingham University Press. pp: 39-54.

Roy, A., Pandey, M.D. and Rawat, J.S. 1960. Composition of bovine semen. *Indian Journal of Dairy Science*, 13: 112-119.

SAS. 2002. Statistical Analysis System, Computer Software, Version 9: Statistics SAS Institute Inc. Cary, NC 27513, NC27513, USA.

Sastry, S.R. and Thomas, C.K. 1980. Dentition in farm Animals. Management Vicas. Publication House, PVT Ltd. India. Pp: 39-45.

Singh, B., Mahapatra, B.B. and Sadhu, D.P. 1969. Chemical composition of cattle and buffalo spermatozoa and seminal plasma under different climatic conditions. *Journal of Reproduction and Fertility*, 20: 175-176.

Tumpenny, J.R., Wathes, C.M., Clark, J.A. and Mcarthur, A.J. 2000. Thermal balance of livestock 2. Applications of a parsimonious model. *Agriculture for Meteorology*, 101: 29-52.

Vilakazi, D.M. and Webb, E.C. 2004. Effect of age and season on sperm morphology of Friesland bulls at an Artificial Insemination Centre in South Africa. *South African Journal of Animal Science*, 34: 62-69.

Zamiri, M.J. and Khodaei, H.R. 2005. Seasonal thyroidal activity and reproductive characteristics of Iranian fat tailed rams. *Animal Reproduction Science*, 88 (3-4): 245-255.

Zemjanis, R. 1970. Collection and evaluation of semen. In: Diagnostic and therapeutic techniques in animal Reproduction. 2nd Edition, *Williams and Wilkins Co*. Baltimore, USA, Pp: 156-193.