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A COMPARATIVE STUDY OF SPERMATOZOAL ABNORMALITIES AND SOME BIOCHEMICAL CHARACTERISTICS OF OVINE AND CAPRINE SEMEN IN THE HUMID TROPICS

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Target Audience: Animal scientists, sheep and goat breeders / farmers and veterinarians.

ABSTRACT

A classification of morphologically abnormal spermatozoa in the ejaculates and an evaluation of some biochemical characteristics of the semen of West African Dwarf (WAD) bucks and Yankassa rams were made from semen samples harvested twice weekly by electro-ejaculation. While only similarities were observed between buck and ram semen in all forms of abnormal sperm morphology as well as in the concentrations of total protein, cholesterol and phospholipids in both spermatozoa and seminal plasma, buck spermatozoal total protein was highly related to both cholesterol and phospholipids. Ram spermatozoal total protein was likewise related to phospholipids even as cholesterol and phospholipids were also related. These results imply similarities between these species in their fertility and suggest similarities in the responses of their spermatozoa to chilling and freezing during storage for artificial insemination (AI).

Key words: Spermatozoal abnormalities; semen biochemical characteristics; bucks; rams; humid tropics.

DESCRIPTION OF PROBLEM

The ejaculate and seminal plasma characteristics of rams (1, 2, 3) and bucks (4, 5, 6, 7) in the humid tropics have been reported. The scope of the biochemical characteristics covered was however limited to enzyme activity and cations in seminal plasma only.

Lipids especially cholesterol and phospholipids, are involved in cellular actions and functions (8). Thus Darin Bennett and White (9) reported that the relative resistance of rabbit and human ejaculates to cold shock is due to their cholesterol content and lesser degree of immaturation of the phospholipids of these species in contrast to those of ram and bull. Seminal plasma proteins have also been implicated to play roles in seminal coagulation (10). Furthermore, seminal plasma

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proteins are also associated with the buffering capacity and hence the transport of viable spermatozoa in the female reproductive tract; and reproductive disorders have been reported to affect the protein status of whole semen (11). It has also been reported that the concentration of two surface polypeptides could be of diagnostic value of the curled defect in the bovine, and a decrease in cholesterol content of spermatozoa has been reported to occur during maturation in the epididymis (12,13, 14).

Information on spermatozoal abnormalities in bucks and rams are also prerequisite to programmes aimed at improving their productivity. The objectives of the present study were thus to provide information on sperm abnormalities and the concentrations of total protein, cholesterol and phospholipids in the spermatozoa and seminal plasma of bucks and rams in their native humid tropical environment. Such information is expected to be useful not only in the selection of sires for goat and sheep improvement programmes but also to assist in the formulation of extenders for AI programmes for the small ruminants in the humid tropics.

MATERIALS AND METHODS

Animals and Management

Four adult West African Dwarf (WAD) bucks, 24-36 months in age and 15-22 kg in weight and two Yankasa rams, 32 36 months in age and 29.50-33.00 kg in weight were used for this study. All the animals had been used previously for breeding with satisfactory results. The two species were housed separately in standard pens and fed maize- based diets supplemented with forage *ad libitum*, while cool clean drinking water was available always.

Semen collection

Semen was collected twice weekly (Tuesdays and Saturdays) between 0800 and 0900 h for 2 months. One ejaculate was collected from each animal on collection days by electro-ejaculation (15). Freshly harvested semen samples were centrifuged at 1,200g at room temperature for 5 minutes and the plasma separated while the pellets were resuspended in 1 ml deionised water and stored at 20°C until analysed for biochemical characteristics. The total protein, cholesterol and phospholipid levels in both spermatozoa and seminal plasma were evaluated by methods outlined and described in The Boehringer Mannheim (Germany) Diagnostica (16) and used by Egbunike and Jeyakumar (17).

Statistical analysis

Data were subjected to the students 't' test and linear correlation (18).

RESULTS AND DISCUSSION

The incidences of spermatozoal abnormalities in buck and ram semen are presented in Table 1. Although bucks exhibited a higher proportion of spermatozoa with simple bent tails (8.18±2.22%) than rams (4.03±1.57%). The differences were not significant. All other forms of morphologically abnormal spermatozoa were likewise similar between buck and ram ejaculates. The two species may thus be similar in terms of fertility as both fertility and abortion are related to abnormal sperm morphology (19, 20, 21).

Although there is a relationship between male infertility and the proportion of abnormally shaped cells in the ejaculate, the overall percentage must exceed a certain level before fertility is questioned. Williams and Savage (19) and Foote

Table 1. Classification of morphologically abnormal spermatozoa in the ejaculates of WAD bucks and Yankasa rams (means±s.e.m.)

Types of Abnormalities	Buck	Ram	Level of significance
Detached normal heads(%)	1.10±0.03	1.70±0.40	ns
Simple bent tails (%)	8.20±2.20	4.00±1.60	ns
Coiled tails (%)	0.80±0.10	0.60±0.10	ns
Proximal cytoplasmic droplet(%)	1.00±0.20	0.80±0.20	ns
Distal cytoplasmic droplets(%)	0.70±0.10	0.50±0.10	ns
Pear shaped heads (%)	0.50±0.00	0.00±0.00	ns

ns: Not significant (P > 0.05)
s.e.m.: Standard error of mean

(20) put this at 20% in bull semen. The bucks in the present study with a total of 10.38% abnormal cells and the rams with 5.17% can therefore be rated as fertile. Also the proportions of spermatozoa with abnormal forms in the ejaculates of both species were in agreement with the reports of earlier workers elsewhere (22, 23).

With regards to semen biochemical characteristics (Table 2), only similarities again were observed between buck and ram ejaculates in both spermatozoa and seminal plasma concentrations of total protein, cholesterol and phospholipids. As shown in (Table 3), buck spermatozoal total protein was highly significantly positively related to both cholesterol ($r = 0.63$, $P< 0.01$) and phospholipids ($r = 0.84$, $P< 0.001$) while spermatozoal cholesterol was likewise significantly positively ($r = 0.58$, $P< 0.05$) related to spermatozoal phospholipids. Ram spermatozoal total protein was also significantly positively related to cholesterol ($r = 0.44$, $P< 0.05$) and phopholipids ($r = 0.48$, $P< 0.05$) while spermatozoal cholesterol and phospholipids were also significantly positively related ($r = 0.56$, $P< 0.05$).

Table 2: Some biochemical characteristics of buck and ram semen in their native environment (means ± s.e.m.)

Parameter	Buck	Ram	Level of significance
1. Spermatozoa			
(a) Total Protein ($g/10^9$cells)	0.09±0.02	0.03±0.004	ns
(b) Cholesterol ($mg/10^9$cells)	5.12±1.03	6.72±0.20	ns
(c) Phospholipids ($g/10^9$cells)	0.89±0.17	0.59±0.23	ns
2. Seminal Plasma			
(a) Total Protein (g/%)	0.64±0.10	0.92±0.15	ns
(b) Cholesterol (mg/%)	142.94±27.89	130.44±21.46	ns
(c) Phospholipids (µg/%)	28.56±2.30	39.20±5.72	ns

ns: Not significant (P > 0.05)
s.e.m: Standard error of mean

That spermatozoa from both species were considerably richer in protein, phospholipids and cholesterol than their respective seminal plasma is consistent with the reports of earlier workers (24, 25).

The concentration of total protein observed in the semen of the Yankassa ram is remarkably lower than that reported by Murdock and White (24) for temperate breeds of rams. It thus appears that there are breed differences in the total protein concentration of spermatozoa of sheep. Even though there are no published reports on the protein content of goat semen with which the present report could be compared, the value obtained in the present study is highly comparable (and similar) to that of temperate breeds of rams (24) after taking the sperm concentration into consideration, thus showing some degree of similarity between the species.

There are still only a few reports on the cholesterol and phospholipid concentrations in the ejaculates of rams and bucks within available literature. Our results on the cholesterol and phospholipid concentrations of the ejaculates of both rams and bucks were however remarkably lower than values obtained by Darin-Bennett and White (9) who reported 266 mg/10^9 cells and 300 mg/10^9 cells for cholesterol of ram and bull spermatozoa respectively. The results were similarly lower than that of Pursel and Graham (25) for the bull. These differences may be due to species, genotype and probably analytical procedures. The differences observed in the present study and published reports in sheep may imply that the spermatozoa of tropical breeds of rams and bucks may require a different buffer in any semen extension programme from that used elsewhere.

Table 3. Relationships between some biochemical characteristics of buck and ram spermatozoa

A* Buck spermatozoa:			
	3	2	1
1. Total Protein	0.84***	0.63**	–
2. Cholesterol	0.58*	–	
3. Phospholipids	-		
B* Ram Spermatozoa:			
	3	2	1
1. Total Protein	0.48*	0.44*	–
2. Cholesterol	0.56*	–	
3. Phospholipids	–		

* = ($P < 0.05$)
** = ($P < 0.01$)
*** = ($P < 0.001$)

The significantly positive relationships between the biochemical characteristics of both buck and ram spermatozoa provide a basis for the understanding and prediction of nutrient availability to cells based on a knowledge of the concentration of one or more metabolites in spermatozoa. A knowledge of the protein content of spermatozoa of the species may thus elucidate the more the involvement of lipids in cellular structure and functions as earlier reported (8).

CONCLUSION AND APPLICATIONS

This preliminary comparison of spermatozoal abnormalities and some biochemical characteristics of ovine and caprine semen in their native environment has shown only similarities between the species. These results thus suggest that both species might require the same media for semen extension. The results also imply similarities between these species in their fertility and the responses of their spermatozoa to chilling and freezing during storage for AI.

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