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Research Article

Semen Characteristics and Scrotal Size of Pubertal West African Dwarf Rams Fed Diets Containing *Tetrapleura Tetraptera* Fruit Meal

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Abstract

The study investigated and explored the potential effect of Tetrapleura tetraptera fruit meal (TTFM) on the spermatozoa attributes and scrotal sizes of West African dwarf ram in a 20-week trial. Thirty-five (35) West African dwarf rams with an average weight of 12.80±0.20 were randomly allotted to five dietary treatments in a completely randomized design. The diets included 0% TTFM, 0.5%TTFM, 1.0%TTFM, 1.5%TTFM and 2.0%TTFM designated as treatments 1, 2, 3, 4 and 5 respectively. Each treatment had seven replicates, while semen was collected from five replicates in each treatment using electro-ejaculator at the pre-experimental and post experimental periods assessed for semen colour, semen pH, semen temperature, sperm motility, sperm concentration, live and dead sperm cells. The result showed that the scrotal circumference ranged from 15.20 to 23.00cm both at the beginning and the end of the experiment which did not differ significantly ($p > 0.05$). The scrotal length increased significantly ($p < 0.05$) across the treatment from 13.00 to 15.80cm. The sperm motility ranged from 54.00 to 60.80% though not significantly differed ($p > 0.05$). The sperm volume increased significantly ($p < 0.05$) from 0.32 to 0.53ml in rams fed diet containing 2.0% TTFM. Except for sperm volume, inclusion of TTFM up to 2% in the diet of breeding rams did not have direct or adverse effect on the sperm reproductive attributes.

Keywords: Sperm Volume; Scrotal Length; Rams; Motility

Introduction

Conventionally, semen is evaluated on the basis of motility, morphology and viability [1]. Semen quality parameters are considered as vital indices of semen quality and significantly correlated with fertility [2]. Spermatozoa attributes are the most valuable indicators of male reproductive health [3] and the physical characteristics of the seminal fluid can affect its fertility [4]. Some factors that affect the quality of sperm cells also have impacts on the efficacy of seminal fluid. Semen analysis measures three major factors of sperm quality: sperm count, morphology and motility [5]. The use of rams with greater testicular development and consequently with high fecundation capacity is important to ensure good reproductive efficiency of the flock [6,7] Observed that the yearly seasonal changes have significant effect on the scrotal circumference, sperm motility, concentration and quality of sperm defects. Therefore, this study was designed to explore the reproductive potential of precursors in the *T. tetraptera* fruit meal in the diet of West African dwarf rams.

Materials and Methods

The study was conducted at the small ruminant unit of the Federal College of Animal Health and Production Technology, Moor Plantation, Ibadan. The unit is located in the southwestern part of Nigeria. The area lies within the rain forest ecological zone and fall within longitude and latitude 7^0-27^0N and 3^0-25^0E respectively and altitude of 220-300m above sea level with the average rainfall of about 1250mm. The temperature and relative humidity ranges from 30-35^{0}C and 76-84% respectively. Thirty-five (35) West African dwarf rams randomly allotted to five dietary treatments in a completely randomized design with 5 replicates chosen from each treatment between 6 and 8months of age and weighing between 12.80 and 13.00kg were used for the experiment. The fresh *T. tetraptera* fruits\were purchased from a reputable market in Ibadan, Oyo State Nigeria. This was identified and authenticated at the Herbarium unit of the Forest Research Institute of Nigeria (FRIN) Ibadan, Oyo state, Nigeria. The authenticated fruits were rinsed in sterile water and air-dried for two (2) consecutive weeks at room temperature and later milled into powdery form before compounding with other feedstuffs as fruit meal at 0%, 0.5%, 1.0%, 1.5% and 2.0% inclusion levels for treatments 1, 2, 3, 4 and 5 respectively. Each animal was served with *Panicum maximum* grass *ad-libitum* and concentrate diets at 3% body weight twice daily.

Testicular size was estimated by measuring the scrotal circumference with a flexible measuring tape at the point of maximum circumference of the paired testes [8]. Both testes were gently pushed into the posterior region of the scrotal sac and the skin of the scrotum stretched taut to get more accurate measurements of the scrotal circumference. Scrotal circumference was measured by grasping the scrotum but not the neck of the scrotum to avoid distracting the testes [9] then using two fingers to push the testicles ventrally to eliminate any wrinkles and for both testes to be held at the same level. A measuring tape was passed around the scrotum and tightened at the greatest width of the two testicles and measured in centimeters [10,11] when the ram was relaxed. This was easily done with the ram standing. Scrotal length was measured by placing the measuring tape at the proximal end and at the distal end of the scrotum. Testis length was measured from the top of the testis to the bottom of the epididymis with a pair of vernier calliper. Semen will be collected at the beginning of the experiment and at the end of the feeding trial from each ram using electro-ejaculation (EE) method. The electro-ejaculator with a rectal probe of about 22cm long, 2.5cm in diameter has two electrodes. The rectal probe was lubricated and gently inserted into rectum and oriented so that the electrodes are positioned ventrally. The electro-ejaculator

Inclusion levels of TTFM (%)					
	0	**0.5**	**1.0**	**1.5**	**2.0**
Ingredients					
Corn bran	30.00	30.00	30.00	30.00	30.00
Palm kernel cake	25.00	25.00	25.00	25.00	25.00
Rice bran	20.00	20.00	20.00	20.00	20.00
Wheat offal	15.00	15.00	15.00	15.00	15.00
Groundnut cake	5.00	5.00	5.00	5.00	5.00
TTFM	-	+	++	+++	++++
Dicalcium phosphate	3.00	3.00	3.00	3.00	3.00
*Premix	1.00	1.00	1.00	1.00	1.00
Salt	1.00	1.00	1.00	1.00	1.00
Total	100.00	100.00	100.00	100.00	100.00

Table 1: Gross compositions of concentrate diets containing varying levels of *Tetrapleura tetraptera* fruit meal for WAD rams.

TTFM: *Tetrapleura tetraptera* fruit meal.

+ (0.5kg TTFM), ++ (1.00kg TTFM), +++ (1.50kg TTFM), ++++ (2.00kg).

*contains Vitamin A (I.U.) 10,000.000; Vitamin D_2 (I.U.) 2,000,000; Vitamin E (I.U) 20,000; Vitamin K (mg) 2,250; Riboflavin (mg) 5000; Pyridoxine (mg) 275; Biotin (mg) 50; Pantothenic acid (mg) 7500; Vitamin B_1 (mg) 175; Vitamin B_{12} (mg) 15.0; Niacin (mg) 27,500; Folic acid (mg) 7500. Choline Chloride (mg) 400; Antioxidant (mg) 125; Fe (g) 20.0; Zn (g) 50.0; Mn (g) 80.0; Cu (g) 5.0g; I (g) 12.0; Co (mg) 200; Se (mg) 200.

was then used in automatic setting, applied for few seconds with 2-seconds rest intervals between stimuli, increasing the voltage stimuli by one volt at a time. The penis prolapsed beyond the prepuce, and semen collected into a graduated collection. The probe was then inserted up to about 12 inches and held in a position of rectal floor. Alternative current increasing in voltage gradually from 0-5 volts and returning again to zero within 5 to 10s passed. The subsequent stimulation made progressively higher so that at about fifth stimulus a maximum of 10-15 volts is reached. Erection and ejaculation was obtained. The source of electric current was AC/220-250volts/single phase/50 cycles. After collection by electro-ejaculator, the volume of each ejaculate was measured in a graduated tube. The proportion of spermatozoa with an intact apical ridge evaluated. After fixation in a buffered 2% glutaraldehyde solution and was examined under differential interference contrast microscopy at magnification of 400. The total number of

Parameters	Inclusion levels of TTFM (%)				
	0	0.5	1.0	1.5	2.0
Dry matter	81.50	81.40	81.10	80.90	81.55
Crude protein	15.20	15.28	15.34	15.38	15.43
Ether extract	8.40	8.70	8.95	8.96	9.02
Ash	11.00	10.95	10.75	11.02	10.93
Crude fibre	15.89	15.91	16.05	16.10	16.23
Nitrogen free extract	49.51	49.16	48.71	48.54	48.39
Neutral detergent fibre	48.64	52.62	54.69	58.19	60.38
Acid detergent fibre	34.64	36.84	38.93	43.64	47.19
Acid detergent lignin	9.87	11.64	14.62	16.32	17.11
Hemicelluloses	14.00	15.78	15.76	14.55	13.19
Cellulose	24.77	25.20	24.31	27.32	30.08
Tannin	0.32	0.38	0.45	0.56	0.74
Saponin	0.71	0.73	0.78	0.84	0.95
Flavonoid	2.32	2.44	2.67	2.82	3.54
Alkaloid	1.87	1.86	1.90	2.01	2.23
Hydrogen cyanide	0.12	0.15	0.22	0.25	0.26
Sterol	0.76	0.96	1.11	1.36	1.45
Macrominerals (g/kg)					
Calcium	0.84	0.92	1.24	1.68	2.31
Phosphorus	1.12	1.32	1.65	1.97	2.22
Magnesium	2.47	2.54	2.95	3.54	4.01
Potassium	0.74	0.56	0.98	0.79	0.98
Sodium	0.24	0.28	0.28	0.31	0.34
Microminerals(mg/kg)					
Manganese	234.12	242.23	251.23	264.33	267.67
Iron	184.60	177.80	173.30	195.45	205.54
Copper	11.34	8.79	10.33	11.65	10.98
Zinc	55.32	44.76	45.65	51.21	48.87

Table 2: Chemical compositions of experimental diet containing varying levels of *Tetrapleura tetraptera* fruit meal.

spermatozoa per concentration and volume of the ejaculate were determined. Percentage of abnormal spermatozoa (considering all normal forms in sperm head, intermediate piece and tail) estimated. The sperm colour was determined using a standard colour charts. The volume of the ejaculate was measured with a graduated cylinder. The sample volume can also be determined directly in the collection tube by weighing; assuming 1ml equals 1g. Thereby loss of volume associated with transfer from the collection tube to either another tube or a pipette can be avoided [12]. Sperm motility was assessed by the method described by [13] and evaluated microscopically within 2 to 4 min of their isolation from the caudal epididymis and later expressed as percentages. A fixed volume of semen (not more than 10ml) was delivered onto a clean warm glass slide with a few drops of 2.9% sodium citrate and covered with a 22 x 22mm cover slip. The preparation then examined at a magnification of x400 under a light microscope. The percentage liveability was assessed by a drop of semen was mixed with 1% eosin and 5% nigrosine in 3% sodium citrate dehydrates solution for the live/dead ratio as described by [14]. The morphology was also determined by placing on a clean, warm slide. The smear air-dried and observed using the light microscope starting with low power to high magnification. The presence of abnormal cells out of at least 400 sperm cells from several fields on the slide was counted and their total percentage estimated [14].

Statistical analysis

Data were subjected to analysis of variance (ANOVA) in a completely randomized design and significant differences between treatment means were separated using Duncan Multiple range test of the same package [15].

Results and Discussion

Semen morphological parameters of West African dwarf rams fed diets containing varying levels of African porridge fruit meal

Table 3 shows the semen morphological parameters of West African Dwarf rams fed diets containing *T. tetraptera.* There was significant difference ($p < 0.05$) in the semen pH observed at the onset of the experiment. The highest value was obtained with the animals offered 0.5% TTFM. No significant difference ($p > 0.05$) observed in the semen concentration both at the beginning and the end of the experiment which ranged from 1.68-1.92(x 10^6/ml) and 1.74-2.07(x 10^6/ml) respectively. Similarly, significant differences were obtained at the end of experiment on the semen temperature and concentration. The highest semen temperature (30.86°C) at treatment 3 containing 1.0 TTFM while the least value (30.41°C) was recorded at treatment five with 2.0% inclusion level of TTFM. The sperm motility though not significant ($p > 0.05$) values ranged from 54.00-62.40% at the end of the experiment. There was marked significant difference in the sperm volume obtained

Parameters	Inclusion levels of TTFM (%)							
	0	0.5	1.0	1.5	2.0	SEM	P-value	Range
Semen pH								5.80-6.85[1]
Initial	5.78[b]	6.07[a]	5.92[ab]	5.91[ab]	6.02[ab]	0.04	0.02	
Final	5.94	6.05	5.95	5.94	6.02	0.03	0.81	
Variation	0.16	0.02	0.03	0.03	0.00	0.34	0.34	
Temperature (0°C)								29.20-32.30[2]
Initial	30.69	30.74	30.44	30.61	30.56	0.09	0.39	
Final	30.54	30.33	30.86	30.44	30.41	0.03	0.08	
Variation	0.15	0.43	-0.42	0.17	0.15	0.12	0.41	
Concentration (x10^9/mL)								1.36-1.60[3]
Initial	1.86	1.92	1.68	1.87	1.76	0.87	0.19	
Final	1.89	2.01	1.74	1.99	2.07	0.93	0.21	
Variation	0.03	0.09	0.06	0.12	0.31	0.10	0.32	
Motility (%)								66.25-85.00[2]
Initial	56.00	49.00	54.00	55.00	54.00	1.86	0.82	
Final	56.20	54.00	59.40	60.80	57.40	1.72	0.53	
Variation	0.20	5.00	5.40	5.80	3.40	0.09	0.11	
Livesperm (%)								63.40-87.00[4]
Initial	52.00	48.00	50.80	52.40	56.40	1.72	0.68	
Final	58.00	55.80	59.20	58.60	64.80	1.43	0.38	
Variation	6.00	6.20	8.40	5.80	8.40	0.56	0.22	
Deadsperm (%)								13.00-36.60[4]
Initial	48.00	52.00	49.20	47.60	43.60	1.71	0.71	
Final	42.00	44.20	40.80	41.40	35.20	0.31	0.42	
Variation	-6.00	-8.20	-8.40	-6.20	-8.40	0.57	0.31	
Volume (mL)								0.17-0.53[4]
Initial	0.25[b]	0.36[a]	0.31[ab]	0.29[ab]	0.32[ab]	0.38	0.02	
Final	0.38[b]	0.43[ab]	0.43[ab]	0.48[ab]	0.53[a]	0.02	0.01	
Variation	0.13	0.07	0.12	0.19	0.21	0.15	0.21	
Total sperm (×10^9/mL)								0.65-0.95[1]
Initial	0.47	0.69	0.52	0.54	0.56	0.09	0.71	
Final	0.72	0.87	0.75	0.96	1.10	0.13	0.11	
Variation	0.25	0.18	0.23	0.42	0.54	0.35	0.23	
Colour	Creamy	Creamy	Creamy	Creamy	Creamy			Creamy[1]

Table 3: Semen morphological parameters of West African Dwarf rams fed with diet containing *Tetrapleura tetraptera* fruit meal.

[a,b,c] Means with different superscripts along the same row are significantly different ($p > 0.05$).

TTFM: *Tetrapleura tetraptera* fruit meal. SEM: Standard Error of Means.

[1]Oguike., *et al.* (2013); [2]Ososanya., *et al.* (2014); [3]Adeniji., *et al*. (2016); [4]Oyeyemi., *et al* (2014).

which ranged from 0.38-0.53ml. The highest value was obtained at the treatment containing 2.0% TTFM. Though not significant (P > 0.05), the livesperm values obtained ranged from 58.40-64.80% at the end of the experiment. The semen colour observed ranged from milky to creamy, only animals offered with 0% TTFM inclusion level semen appeared milky while others are creamy in colour.

It was also reported that in the bovine species, *Bos indicus* was reported in Africa to have had higher sperm production sperm concentration and sperm viability than *Bos taurus* [16]. [17] Observed a greater sperm production and quality in *Bos taurus* than *Bos indicus* bulls. The higher sperm quality reported for *Bos indicus* by [18] could have been due to better adaptation to tropical environment. [19] also observed greater sperm production in an adapted *B. Taurus* breed than in non-adapted breed in the tropics. Semen quality decreased faster and to a greater extent in *B. taurus* bulls than in *B. indicus* bulls and cross-bred bulls exposed to high ambient temperatures.

Semen quality and quantity assessment is very important and useful especially for diagnosing fertility problems. In this study, the semen pH varied from 5.71 to 6.18 which was significantly influenced by the inclusion level of *T. tetraptera* fruit meal. Treatment 5 with 2% inclusion level of *T. tetraptera* fruit meal had the highest pH which showed that they were significantly different (p > 0.05) across the treatment but were still within the range reported by [20]. Semen pH is an indicator of semen Acidity or Alkalinity. It has been reported that normal semen pH in breeds of rams vary between 6.5 and 7.5. The delay in analysis could lead to more acidity of the due to degradation of fructose by the sperm cells. Treatment 1 which were fed at an inclusion level of 0% and treatment 3 fed at an inclusion level of 1.0% of the test ingredient (*T. tetraptera*) displayed some low level of sexual capabilities by having sexual interest not more than once, one mount with no attempt and more than two mount with no service, this was in accordance with the libido scoring system as described by [21]. Spermatozoa are divided into three main segments which are the head, mid-piece and the tail, the head consist of little other than condensed nucleus and overlying acrosome containing acrosin and hyaluronidase [22]. The mean values for percentage total sperm abnormalities obtained in the rams of the control group are similar to normal values reported for Yankasa rams by [23] and [24] and [25] for West African Dwarf rams. Gossypol has been reported to cause morphological changes in the germ cells due to gossypol-induced inhibition of the synthesis of sperm-cell histones and other nuclear proteins that stabilize the structure of DNA [26]. The finding of our study supports this assertion. There was an increase in percentage total abnormal sperm from week 8 to the end of the experiment in the control group. This agrees with the findings of [27] who reported that the interval between damage to the testis and the appearance of abnormal spermatozoa in the ejaculate is generally between 30 and 60 days, depending upon the site of damage. The mean values observed for total sperm abnormalities for the experimental rams were higher than that recommended by [28] as satisfactory for classification of reproductive potential in rams (≤ 10%). The study showed that the mean percentage gross motility of the semen for Yankasa rams obtained in the pre-experimental period was within the normal range reported by [22], and those reported for West African Dwarf bucks by [25]. These values are higher than those reported for Yankasa rams by [24]. The mean semen concentration obtained for the control rams is within the normal range reported for Yankasa rams by [24]. These values also concur with those reported by [31] for West African Dwarf bucks. On the contrary, these values are lower than those reported by [23] in Yankasa rams and [22]; [30] in temperate breeds. The colour of semen of experimental rams obtained in this study was almost similar throughout the experiment. This is in accordance to the reports of [32] and [31], they observed a creamy colour semen characteristic of WAD buck. In general, total abnormalities per group or as per total sperm cells in all the groups were within normal range and show that increasing plane of *T. tetraptera* fruit meal did not have any adverse effect on the sperm count. This was contrary to the work of [24] who found out that feeding high protein diet (17.94% CP) had a negative effect on semen concentration and resulted in lower motility confirming that feeding high level of CP in diet is associated with decline in fertility. Sperm output, sperm morphology, semen volume and sperm viability were not influenced by level and source of protein.

Scrotal size of West African dwarf rams fed diet containing *t. tetraptera* fruit meal

Table 4 shows the scrotal size of West African Dwarf rams fed diet containing *T. tetraptera* fruit meal. There were significant differences (p < 0.05) in initial scrotal circumference which ranges from 13.50 to 19.34 cm and final scrotal circumference which also ranges from 15.20 to 22.60cm respectively. There were significant

Parameters	Inclusion levels of TTFM (%)						
	0	0.5	1.0	1.5	2.0	SEM	P-value
Scrotal circumference (cm)							
Initial	19.34^{a}	13.50^{b}	19.00^{a}	14.90^{ab}	17.80^{ab}	0.79	0.05
Final	22.60^{a}	15.20^{b}	21.20^{a}	17.60^{ab}	22.70^{a}	0.86	0.03
Differences	3.26^{a}	1.70^{ab}	2.20^{b}	2.70^{b}	4.90^{a}	0.49	0.07
Scrotal length (cm)							
Initial	14.60^{a}	10.30^{b}	13.10^{ab}	10.80^{b}	15.00^{a}	0.48	0.00
Final	16.70^{ab}	11.70^{c}	15.20^{ab}	12.30^{bc}	16.30^{a}	0.55	0.01
Differences	2.10	1.40	1.80	1.90	2.50	0.25	0.64

Table 4: Scrotal Size of West African Dwarf rams fed diet containing *Tetrapleura tetraptera* fruit meal.

^{a,b} Means with different superscripts along the same row are significantly different ($p > 0.05$).

TTFM: *Tetrapleura tetraptera* fruit meal.

differences ($p < 0.05$) in the initial scrotal length and final scrotal length. Rams fed 0.00% *T. tetraptera* fruit meal recorded the highest value (15.00cm) of initial scrotal length and treatment with 0.5% inclusion level gave the lowest value (10.30 cm) of initial scrotal length. The rams fed diet containing 2.00% *T. tetraptera* fruit meal recorded the highest value (15.00cm) of final scrotal length and animals fed diet containing 1.5% *T. tetraptera* fruit meal recorded the lowest value (11.70cm) of final scrotal length.

Scrotal circumference is an important indicator when observing animals for breeding soundness [6]. It is favourably correlated to testes mass, sperm production, semen quality, and age at puberty and body weight in young bulls [33]. Sperm production is correlated to testicular measurement (Rege., *et al*. 2000). Scrotal circumference varies with season and body weight, but is at its maximum peak during the fall breeding season [34]. Final scrotal diameter obtained in this experiment ranged from 18.00 to 23.00cm. This finding was in line with earlier report by [35] on West African Dwarf rams fed diets containing varying levels of *Garcinia kola* with scrotal diameter of 18.16 to 21.00. It is also in agreement with the report by [36] on indigenous Damascus bucks with scrotal circumference of 16cm to 21cm. Though the authors concluded that testis sizes are related to the body size. The scrotal characteristics in terms of scrotal diameter increased with increasing protein level in this study. However, this study was inconsistent with the findings of [37] and [38] who found that testicular growth can be affected when animals were fed above their maintenance requirement. Animals with small testicles have reduced sperm production and poor semen quality, the animals in this study had decreased proportion of functional somniferous tubules, reduced sperm output and elevated percentage of morphologically abnormal sperm [39]. Moreover, nutritional factors, more than any others, readily lend themselves to manipulations to ensure positive outcomes [40]. As indicated by scrotal diameter from this study, testicular size was not affected by the different level of inclusion of the diet. This result supported the hypothesis obtained by [6] that there was no significant difference ($P > 0.05$) of improved pasture or high dietary protein on testicular dimensions. [41] reported that scrotal circumference (SC) was not an accurate predictor of sperm morphology or motility when a scrotal circumference of 32 cm was used to predict the recommended minimal standards for semen quality. In addition, there was no significant linear relationship between scrotal circumference and either the degree of germinal epithelial loss or the percentage of Grade 4+ seminiferous tubules in the bulls completing the performance test. [42] reported a favorable genetic relationship of scrotal circumference with measures of semen quality and quantity. In general, as scrotal circumference increases in yearling bulls, mass motility, percentage normal sperm, semen volume, sperm concentration and total sperm output increased while the percentage of sperm abnormalities decreased. [43] posited that the shorter the scrotal length (SL), the better the thermal condition. In fact, a larger distance between the testicles and the abdominal cavity provides for maximizing heat loss in the area, which is an indication of greater thermoregulatory ability. Electroejaculation is one of the most important and routine procedures

for semen collection in veterinary medicine [44]. The semen volume (0.22- 0.37ml) obtained in this study by electro-ejaculation with T_5 of 2% TTFM inclusion level had the highest value which was significantly differed across the treatments. Semen volume is a major factor in semen evaluation and reproductive performance in the males [45]. The difference observed in the quantity of semen collected could be due to degree of stimulation received by the rams on each collection time [46]. The volume obtained is similar to that of earlier reports on the West African Dwarf bucks by [20] by insulating scrotal environment of West African Dwarf bucks with volume (0.2- 0.35ml). The result of this study shows trend in semen volume, therefore semen volume was significant ($P > 0.05$) in treatment group. This result is in line with the report of [45] that there was a tendency for semen volume to increase ($P = 0.073$) in treatment group, in comparison with the control group. Similarly, this difference was statistically significant between groups throughout the experiment. Although, semen volume and sperm motility values obtained in this study were respectively lower than the corresponding values reported by [47] while investigating the correlation between semen characteristics, testosterone and scrotal circumference on MIS lambs. The differences in seminal characteristics could be adduced to breed and species of animals used in these studies. A number of studies have demonstrated that the spermatogenesis in rams is sensitive to increases in protein intake. This effect has been related to an increase in testicular size because it is due to an increase in the volume of somniferous epithelium and in the diameter of semniferous tubules; however this result is similar to the report of [37]. The colour of semen of experimental rams obtained in this study was almost similar throughout the experiment. This is in accordance to the reports of [5] and [31], they observed a creamy colour semen characteristic of WAD buck. In general, total abnormalities per group or as per total sperm cells in all the groups were within normal range and show that increasing plane of *T. tetraptera* fruit meal did not have any adverse effect on the sperm count. This was contrary to the work of [24] who found out that feeding high protein diet (17.94% CP) had a negative effect on semen concentration and resulted in lower motility confirming that feeding high level of CP in diet is associated with decline in fertility. Sperm output, sperm morphology, semen volume and sperm viability were not influenced by level and source of protein. The sperm concentration obtained in this study (4.81- 5.40 x 10^3) was significantly higher than the earlier report by [35] who recorded ranged 1.99-0.29 x 10^3 by feeding West African Dwarf rams with diets containing *G. kola*. The difference might be due to higher steroidal effects contained in the *T. tetraptera.*

Correlation between scrotal size and semen characteristics of West African Dwarf rams fed diets containing varying levels of African porridge fruit meal

Table 5 and 6 show the correlation between scrotal size and semen characteristics of West African Dwarf rams fed diets containing varying levels of *T. tetraptera* fruit meal at the onset of the experiment and at the end of the study respectively. Negative correlations were observed for correlation between initial scrotal circumference and semen temperature (-0.11), pH (-0.09), motility (-0.37), volume (-0.36), concentration (-0.21) and live ability (-0.038) respectively at the onset of the experiment. Positive but weak correlations were observed scrotal size and dead sperm (0.05). Negative correlation was also observed between scrotal length and other semen characteristic except semen pH (0.019) and live sperm (0.214). At the end of the feeding trial, negative correlation was also observed between scrotal circumference and semen morphological parameter except semen concentration (0.03) and live sperm (0.07) which had positive correlation. Weak and positive correlations were observed between scrotal length and sperm concentration (0.19) and live sperm (0.14). There were very strong and positive correlations between scrotal length and scrotal circumference both at the beginning of the experiment (0.16) and at the end of the experiment (0.61)

Semen quality and quantity assessment is very important and useful especially for diagnosing fertility problems. A case was reported by [48] that sperm concentration was significantly influenced by the inclusion levels of *Moringa olifera* in the diets of Rabbit bucks. There was no significant difference ($P > 0.05$) in the percentage liveabilty of the semen in this study. Values obtained however ranged from 56.67 to 70.00% which showed that inclusion of *T.tetraptera* up to2.0% did not adversely affect the live ability of the semen.

	ISC	STP	SpH	SMOT	SVOL	SCON	LIVES	DEADS	ISL
ISC		-0.11	-0.09	-0.37	-0.36	-0.21	-0.04	0.04	0.61
STP	-0.22		0.12	0.27	-0.35	0.07	0.13	-0.11	-0.22
SpH	-0.09	0.11		-0.21	0.31	0.62	-0.08	0.08	0.02
SMOT	-0.36	0.27	-0.21		-0.02	-0.17	0.55	-0.55	-0.15
SVOL	-0.36	-0.16	0.02	-0.02		0.10	-0.11	0.12	-0.21
SCON	-0.21	0.07	0.62	-0.18	0.10		-0.03	0.02	-0.09
LIVES	-0.04	0.12	-0.08	0.55	-0.11	-0.18		-0.99	0.22
DEADS	0.04	-0.11	0.08	-0.55	0.12	0.02	-0.99		-0.21
ISL	0.61	-0.22	0.02	-0.14	-0.30	-0.09	0.21	-0.22	

Table 5: The correlation between scrotal size and semen morphological parameters at the onset of the experiment.

ISC: Initial Scrotal Circumference; STP: Semen Temperature; SpH: Semen pH; SMOT: Semen Motility; SVOL: Semen Volume; SCON: Semen Concentration; LIVES: Livesperm; DEADS: Deadsperm; ISL: Initial Scrotal Length

	FINSC	STEMP	SpH	SMOT	SVOL	SCON	LIVES	DEADS	FISL
FINSC		-0.12	-0.47	-0.14	-0.02	0.03	0.07	-0.19	0.75
STEMP	-0.11		-0.05	0.27	-0.03	0.07	-0.07	0.09	-0.08
SpH	-0.47	-0.05		0.11	-0.27	0.25	0.18	-0.19	-0.28
SMOT	-0.14	0.27	0.11		0.16	0.03	0.55	-0.52	-0.13
SVOL	-0.02	-0.03	-0.23	0.16		0.11	0.96	0.01	0.08
SCON	0.03	0.07	0.25	0.31	0.11		0.13	-0.12	0.19
LIVES	0.20	-0.08	0.18	0.55	-0.02	0.13		-0.99	0.14
DEADS	-0.19	0.09	-0.19	-0.52	0.01	-0.13	-0.99		-0.13
FINSL	0.75	-0.08	-0.29	-0.13	0.08	0.19	0.14	-0.13	

Table 6: The correlation between scrotal size and semen morphological parameters at the end of the experiment.

FINSC: Final Scrotal Circumference; STEMP: Semen Temperature; SpH: Semen pH; SMOT: Semen Motility; SVOL: Semen Volume; SCON: Semen Concentration; LIVES: Livesperm; DEADS: Deadsperm; FISL: Initial Scrotal Length

Conclusion

It can be concluded from this study that addition of varying levels of *T. tetraptera* fruit meal into the diets of Pubertal West African Dwarf rams improved semen attributes in terms of sperm volume, live ability and reduced abnormalities.

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Bibliography

1. Akusu MO and Ajala OO. "Reproductive performance of West African dwarf goats in the humid environment of Ibadan". *Israel Veterinary Medicinal Association* 55.2 (2000): 8-9.

2. Ajani OS., *et al*. "Correlation between age, weight and scrotal circumference and the epididymal parameters of red sokoto bucks". *Journal of Veterinary Medicine and Animal Health* 7.5 (2018): 159-163.

3. Devkota B., *et al*. "Relationship among age body weight scrotal circumference, and peripheral testostorone and estradiol concentration in pubertal and postpubertal Hostein bulls". *Journal Veterinary and Medical Science* 70.1 (2008): 1119-1121.

4. Adeniji SA., *et al*. "Semen characteristics of pubertal Yankassa rams fed *Zingiber officinale* supplemented diets". *Nigerian Society for Animal Production* 43.1 (2016): 247-252.

5. Oguike MA., *et al*. "Libido and semen characteristics of West African dwarf rams administered aqeous African marigold plant (*Aspilia africana*) extract". *Academic Journal of Science* 07.02 (2013): 25-34.

6. Elmaz O., *et al*. "Prediction of post pubertal reproductive potential according to prepubertal body weight, testicular size, and testosterone concentration using multiple regression analysis in Kivircik ram lambs". *Turkish Journal of Veterinary and Animal Science* 32.5 (2008): 335-343.

7. Rege OEJ., *et al*. "Reproductive characteristics of Ethiopian highland sheep. II: Genetic parameters of semen characteristics and their relationship with testicular measurements in ram lambs". *Small Ruminant Resource* 37 (2000): 173-187.

8. Notter DR., *et al*. "Accuracy of estimation of testis weight from in situ testis measures in ram lambs". *Theriogenology* 15 (1981): 227-234.

9. Memon AG., *et al*. "Association between sperm abnormalities, breed, age and scrotal circumference in beef bull". *Canadian Journal of Veterinary Research* 75.4 (2011): 241-247.

10. Adedeji OS and Gbadamosi AJ. "Relationship of scrotal circumference to age, body weight, the right and left scrotal length in the red Sokoto goats". In: Proceedings of 26th Annual Conf. NSAP 21-25 March, Ilorin, Nigeria (1999): 10-13.

11. Ahmad M., *et al*. "Relationship of Testicular size and Libido to age and season in sahiwal bulls". *Pakistan Veterinary Journal* 23 (2005): 202-206.

12. Jergensen N., *et al*. "Semen analysis performed by different laboratory teams: an inter-variation study". *International Journal of Andropology* 20 (1997): 201-208.

13. Zemjanis R. "Diagnostic and Therapeutic technique in animal reproduction. Baltimore, Williams and Wikins". Company (1977): 88-96.

14. Wells ME and Awa OA. "New technique for assessing acrosomal characteristics of spermatozoa". *Journal of Dairy. Science* 53.2 (1977): 227-232.

15. Statistical Analysis System [SAS]. (2013). SAS/STAT User guide, Version 9.4. Cary, NC: SAS Institute Inc (2013).

16. Hofflack G., *et al*. "Breeding soundness and libido examination of Belgian Blue and Holstein Friesian artificial insemination bull in Belgium and Netherlands". *Theriogenology* 66 (2006): 207-216.

17. Chenoweth PJ., *et al*. "Sexual behavior in the bull". In: G. Fordyce, Editor, Bull Fertility: Selection and Management in Australian Association of Cattle Veterinarians, Indooroopilly (2002): 4.1-4.11.

18. Britto FC., *et al*. "Comparism of methods to evaluate the planalemma of bovine sperm and their relationship with *in vitro* fertilization rate". *Therigenelogy* 60 (2003): 1539-1551.

19. Bindariet YR., *et al*. "Effects of nutrition on reproduction- A review". *Advances in Applied Science Research* 4.1 (2013): 421-429.

20. Ajala OO., *et al*. "The effects of scrotal insulation on the testicles and spermatozoa characteristics of West African Dwarf Goats". *Sokoto Journal of Veterinary Science* 3.1 (2001): 44-50.

21. Raheem AK., *et al*. "Selected fertility parameters for West African Dwarf bucks experimentally infected with Trypanosoma Congolese". *Folia Veterinarian* 53.2 (2009): 68-71.

22. Garner DL and Hafez ESE. "Spermatozoa and Seminal Plasma". In: Hafez, E.S.E. and Hafez, B. (eds) Reproduction in farm animals, 7th edition Lippincott Williams and Wilkins, Philadephia (2000): 96-107.

23. Jibril A., *et al*. "Effect of graded levels and sources of protein on scrotal circumference and semen profile of Yankasa rams". *Sokoto Journal of Veterinary Science* 9.1 (2011): 22-27.

24. Oyeyemi MO., *et al*. "The semen characteristics of West African dwarf bucks infected with Listeria monocytogenes". *Bulletin Animal Health and Production African* 56 (2008): 307-313.

25. Braun WF., *et al*. "Ram scrotal circumference measurements". *Theriogenology* 13.3 (1980): 221-229.

26. Jones R. "Sperm Survival Versus degradation in the mammalian epididymis: A hypothesis". *Biology of Reproduction*71 (2004): 1405-1411.

27. Kimberling CV and Parsons GA. "Breeding soundness evaluation and surgical sterilization of the ram. In: Youngquist, RS and Threlfal, WR (eds) Current Therapy In Large Animal Theriogenology, 2nd Edition, Saunders Elsevier St. Louis, Missouri 63146 (2007): 620-626.

28. Ososanya TO., *et al*. "Semen characteristics of pubertal West African Dwarf rams fed pineapple waste silage as replacement for dried cassava fed". *African Journal of Agricultural Research* 9.1 (2013): 501-506.

29. Pineda M. The biology of sex. In: Pineda, M. and Dooley, M.P. (eds). "McDonald's Veterinary endocrinology and reproduction, 5th edition". Iowa State Press (2003): 201-223.

30. Oyeyemi MO., *et al*. "Spermiogram and changes in body parameters of West African Dwarf bucks fed Dussa- Poultry waste combination. *Global Veterinaria* 6.2 (2011): 136-139.

31. Bitto II., *et al*. "Comparative studies of the physical and micrometric characteristics of ovine and caprine semen in the humid tropics". Proceedings of the 11th Congress on Animal Reproduction and A.I., Dublin, Ireland 3.230 (1988): 3.

32. Puglisi R., *et al*. "Genome wide analysis of bull sperm quality and fertility traits". *Reproductive Domestic Animal* 51.5 (2006): 840-843.

33. Kafi M., *et al*. "Seasonal variation in semen characteristics, scrotal circumference and libido of Persian Karakul rams". *Small Ruminant Research* 53 (2004): 133-139.

34. Jinadu KB., *et al*. "Semen characteristics and scrotal size of pubertal West African dwarf rams fed diets containing *Garcinia kola* (Bitter kola) seed meal". *Nigerian Journal of Animal Production* 45.3 (2018): 107-114.

35. Al-Ghalban AM., *et al*. "Factors affecting semen characteristics and scrotal circumference in Damascus bucks". *Small Ruminant Research* 53 (2004): 141149.

36. Hotzel MJ., *et al*. "Determinants of the annual pattern of reproduction in mature male Merino and Suffolk sheep: responses to a nutritional stimulus in the breeding and non-breeding seasons". *Journal of Reproductive, Fertility and Development* 15 (2003): 1-9.

37. Fernandez M., *et al*. "Effect of undegradable protein supply on testicular size, spermiogram parameters and sexual behavior of mature Assaf rams". *Theriogenology* 62 (2004): 299-310.

38. Kridli TR., *et al*. "Age at puberty and some biological parameters of Awassi and its first crosses with Charollais and Romanov rams". *Italian Journal Animal Science* 5 (2006): 193-202.

39. Adeniji SA., *et al*. "Semen characteristics of pubertal Yankassa rams fed *Zingiber officinale* supplemented diets". *Nigerian Society for Animal Production* 43.1 (2016): 247-252.

40. Smith OB and Akinbamijo OO. "Micronutrients and reproduction in farm animals". *Animal Reproductive Science* 60-61 (2000): 549-560.

41. Thompson JA., *et al*. "Scrotal circumference does not accurately predict degree of germinal epithelial loss or semen quality in yearling Hereford and Summental bulls". *Theriogeology* 38.6 (1992): 1023-1032.

42. Preston TB., *et al*. "Testes size, testosterone production and reproductive behaviour in a natural mammalian mating system". *Journal of Animal Ecology* 81 (2012): 296-305.

43. Teodoro SM., *et al*. "Infleunce of availability of shade on testicular characteristics of Santa Ines rams". *Acta Scientiarium* 35.4 (2013): 441-446.

44. Whitlock BK., *et al*. "Electroejaculation increased vocalization and plasma concentrations of cortisol and progesterone, but not substance in beef bulls". *Theriogenology* 78 (2012): 737-746.

45. Ax RL., *et al*. "Artifcial insemination. In: Reproduction in Farm Animals". 7th edition, Lea and Febiger, *Philadelphia* (2000): 387-388.

46. Naoman UT and Taha MB. "Effect of Hemi castration on castration on testicular growth and seminal characteristics of Iraqi male goats". *Iraqi Journal of Veterinary Sciences* 24.2 (2010): 71-74.

47. Maksimović N., *et al*. "Investigation of serum testosterone level, scrotal circumference, body mass, semen characteristics, and their correlations in developing MIS lambs". *Turkish Journal Veterinary Animal Science* 40 (2016): 53-59.

48. Adeyemi AA., *et al*. "Testosterone, libido assessment and semen characteristics of Rabbits fed supplemented Moringa oleifera leaf meal". *African Journal of Biotechnology* 11.43 (2014): 10146-10148.