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EFFECTS OF RESIDUAL CYANIDE ON TESTICULAR AND SPERM CHARACTERISTICS OF RABBIT BUCKS FED DIETS CONTAINING PROCESSED CASSAVA PEEL/BLOOD MEAL MIXTURES

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ABSTRACT

Forty (40) Cross – bred, (New Zealand white X Chinchilla) male weaner rabbits of between 6 and 8 weeks of age were used to investigate the effect of pre-treatment methods as well as the inclusion levels of cassava peel/blood meal mixture (3:2) on development of reproductive organs and semen characteristics. Three types of cassava peels treatment were compared. Ten experimental diets were formulated with diet 1 serving as the control without cassava peel/blood meal mixture. Diets 2, 3, and 4 had 10, 20 and 30% inclusion of ash treated cassava peels/blood meal mixture. Diets 5, 6 and 7 had 10, 20 and 30% parboiled cassava peel/blood meal mixture while diets 8, 9 and 10 had 10, 20 and 30% simply sun dried cassava peels/blood meal mixture. The rabbits were divided after weight balancing into 10 treatments groups of four rabbits each and assigned randomly to the ten diets with each rabbit serving as a replicate in a randomized complete block design experiment. Rabbits received feed and water *ad libitum* during the 12 weeks of the experiment. The testis width, volume and weight were significantly (P<0.05) influenced by the dietary treatments. The paired testes weight (1.53 g and 1.51 g) for the control and PAB-BM diets respectively were similar and significantly (P<0.05) higher than 1.39 and 1.37g for ATD-BM and SUD-BM respectively. The paired testes volume and paired testes weight were significantly (P<0.05) affected by the levels of inclusion. The sperm motility, sperm concentration, progressivity and percent deformity were significantly (P<0.05) influenced by the dietary treatments. Rabbits fed with the control diet had the highest (P<0.05) sperm motility (76.25%) compared to ATD-BM (64.00%), PAB-BM (60.69%) and SUD-BM (55.40). Rabbits fed the control diet had the highest sperm concentration of $46.50x10^6/mm^3$, which was significantly (P< 0.05) higher than 26.76, 27.80 and 18.59 x $10^6/mm^3$ obtained in those fed with ATD-BM, PAB-BM and SUD/BM, respectively. The percentage deformity differed significantly (P<0.05) across the treatment groups. Rabbits fed the control diet had the lowest (P<0.05) deformed sperm cells (6.5%) compared with ATD-BM, PAB-BM and SUD-BM which had 9.31, 8.19 and 8.50%, respectively. Sperm motility in rabbits fed the control diet (76.25%) was similar to 67.04% obtained in rabbits fed 10% processed CPM/BM but higher (P<0.05) than those fed 20% and 30% inclusion levels of CPM/BM mixtures. Sperm concentration decreased linearly with increasing levels of CPM/BM mixture from 0 to 30%. Percent sperm deformity was highest at 30% inclusion level and lowest at 0% level. Sperm progressivity decreased (P<0.05) with increasing levels of inclusion.It was concluded that residual cyanide had negative effects on reproductive potential of rabbit bucks

Keywords: cassava peels, testicular measurements, sperm characteristics, rabbits, blood meal

INTRODUCTION

The ultimate aim of breeding management in livestock is the production of more virile off springs. This is of great economic importance as it determines the profitability or otherwise of livestock enterprise. Emphasis on the reproductive status of the animal forms the basis for stock population increase, which ultimately translates into increased animal protein availability. The achievement of this can only come through adequate growth of the body as well as optimum development of reproductive apparatus. Therefore, the factors that affect reproductive potentials are of economic concern in livestock breeding. Genetics, nutrition and environmental factors greatly influence growth, development and efficient functioning of the reproductive organs (Swierstra, 1968). Although, manipulations of genetic and environmental factors are sometimes difficult, nutrition can easily be manipulated. Consequent upon this, McDonald *et al.* (1981) reported that sexual maturity could be delayed by poor nutrient regime during growth. According to Gbore *et al.* (2007), nutrition among other factors plays a very important role in the regulation of the reproductive efficiency of animals.

It is imperative to understand and improve the reproductive performance of rabbits in order to form a basis for rapid artificial insemination programme and increase productivity (Zahraddeen *et al.,* 2007). Male animals have great potential in determining the continuity of any livestock business and they contribute 50% the genetic make-up of nay flock or herd.

Reproductive performance of the male is an essential economic trait in the management of breeder stock and the evaluation of the ejaculate is an important aspect of the determination of the reproductive status of male animals (Nwoko and Ibe, 2005). A number of factors such as ambient temperature, photoperiod and season do affect the development of reproductive structures of males.

The effect of diets containing toxic substances has been well documented. Egbunike and Oluyemi, (1979) observed lower seminal fluid caused by reduction in nutritive substances needed for normal sperm motility and also reported that nutritional toxicity affected spermatogenesis, which subsequently reduced sperm concentration.

According to Nkanga and Egbunike (1990), the testes mass is significantly correlated with the daily sperm production and has been reported to be a good indicator of the present and future sperm production as well as the breeding quality of the male (Gupta, 2003; Togun, 2009; Togun *et al.,* 2006a and 2006b). Variation in male breeding quality could be due to management, environment, nutrition, genetic make-up or the combined effect of these factors (Durape, 2007). One of the factors that can affect the survivability of spermatozoa is the amount of seminal fluid and excessive seminal fluid can adversely affect the survivability of spermatozoa (Lake and Steweant (1978), Sternova *et al*., 1984 and Singh *et al.,* 1987).

While many of the alternative feed ingredients have resulted in lower feed cost and have enhanced the attainment of required optimum body confirmation and slaughter weight within a short period of time, it is imperative to investigate the direct and indirect effects of such ingredients on the spermatogenic potentials of breeding males, which are fed diets containing such ingredients.

Most of the ingredients for ration formulation contain some obnoxious materials that do obstruct the normal reproductive functioning of livestock. For instance, toxins with estrogenic effects have been reported to impede breeding (Petzinger and Weindenbach, 2002). This study

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was designed to evaluate the long term effect of feeding differently-processed cassava peel in combination with blood meal on the performance and physical characteristics of the reproductive traits of rabbit bucks.

MATERIALS AND METHODS

Project Site

The experiment was carried out at the Rabbitry Unit of the Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso. Ogbomoso is in the derived Savannah Zone of Nigeria. The description of the study area has earlier been giving by Ojebiyi *et al* 2014

Collection and preparation of Test ingredients: The cassava peels used in this study were processed in three ways: these are ash treatment, parboiling and sun drying. The collection and processing is as described by Ojebiyi *et al.* (2008).

Formulation of Experimental diets: Cassava peel-blood meal mixtures was prepared by combining each of the ash treated, parboiled and sundried cassava peels and blood meal in ratio 3:2. Ten diets were formulated, diet one which served as the control contained no cassava peel+blood meal mixture; diets 2, 3 and 4 contained either 10, 20 or 30% ash treated cassava peel+blood meal; diets 5, 6, and 7 contained either 10, 20 or 30% parboiled cassava peel+blood meal mixture while diets 8, 9 and 10 contained either 10, 20 or 30% sun dried cassava peel+blood meal mixture. The composition of the diets is shown in Table 1.

Table 1: Percentage Composition of Experimental Diets fed the Rabbit bucks

	Percentage Composition									
Ingredients			AA			PP			SS	
	Control	10	20	30	10	20	30	10	20	30
¶Fixed ingredients	58.50	58.50	58.50	58.50	58.50	58.50	58.50	58.50	58.50	58.50
GNC	14.50	8.00	3.00	0.00	8.00	3.00	0.00	8.00	3.00	0.00
PKC	27.0	23.50	18.50	11.50	23.50	18.50	11.50	23.50	18.50	11.50
Cassava peel / Blood meal	0.00	10.00	20.00	30.00	10.00	20.00	30.00	10.00	20.00	30.00
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Determined analysis										
Crude Protein (%)	16.54	17.28	17.76	18.12	17.42	18.25	18.46	16.76	16.69	17.14
Metabolizable Energy (kcal/kg)	2454.02	2342.25	2437.46	2441.97	2342.25	2437.46	2441.17	2442.25	2437.25	2441.9
Cyanide Spectrophotometric method (mg/kg)	0.00	7.69	8.84	12.34	1.94	3.75	4.82	11.76	13.87	15.37

*¶Fixed ingredients- Maize 12.25, Corn bran 40.00, fish meal 0.50, Molasses 2.50, Bone meal 2.50, Salt 0.50, *Premix-0.25*

**Premix composition; content per 1kg diet: Vitamin A 3,200,000iu; Vitamin D_3 1,200iu; Vitamin E 3,200iu; Vitamin k_3 800mg; Vitamin B_1 400mg; Vitamin B_2 2000mg; Vitamin B_{12} 2000mg; Niacin 400mg; Selenite (Se) 40mg; manganese (Mn) 3200mg; Pantothenic acid 2000mg; Folic acid 200mg; Chlorine (Cl) 60,000mg; Iron (Fe) 8,000mg; Copper (Cu) 3,200mg; Zinc (zn) 2,000mg; Cobalt (Co) 90mg; Iodine (I)*

AA=Ash treat, PP= Parboiled=SS= Sun dried

Experimental Animals and Management: A total of 40-crossbred (New Zealand white X Chinchilla) male weaned rabbits of 5-7 weeks of age with mean weight of between 609.90 - 612.710 g were used for the study. They were divided into 10 treatment groups of 6 rabbits with each rabbit serving as a replicate in a completely randomized block design experiment in a factorial arrangement. The rabbits were housed individually in wood-wire cages. The hutches used were movable all-wire type re-enforced round with hard square galvanized wire. The hutches were flat – deck type of two cages each and each cage had a separate removable collection trays for easy collection of faeces, urine and left over feeds to avoid build-up of odour and pathogens. The dimension of each cage was 35cm X 30cm X 30cm in-to-in. The rabbits were stocked at rate one rabbit per cage.

The drinking and feeding troughs were earthen pot re-enforced with cement to prevent tipping off. A total of 100 g feed divided into two portions of 50 g was served in the morning (8:00 hr) and 50 g in the evening (16:00 hr) were supplied to each rabbit per day. At the commencement of the experiment the rabbits were weight-balanced such that the differences in weight between treatments were less than ±3.00 g.The rabbits were allowed unrestricted access to clean, cool, drinkable water throughout the period of the experiment. They were weighed on weekly basis throughout the period of the experiment. The experiment was terminated at twelve weeks post commencement of the experiment.

Chemical Analysis

Samples of experimental diets were analysed for proximate composition using the procedure of AOAC (2005). The hydrogen cyanide levels which give a measure of the acidity of the peels were determined using the procedure described by Bradbury *et al.* (1999) and Egan *et al.* (1998).

Data Collection

Reproductive organ measurements: at the 12^{th} week of the experiment, the rabbits were weighed and then sacrificed by stunning at the back of the neck region for cervical dislocation before slaughtering. Using a midline abdominal incision, the abdominal cavity was opened to access the reproductive organs. The scrotal sacs were removed immediately and the testes were trimmed free of the epididymis and other adjoining tissues before necessary measurements were taken on a sensitive scale:

Testis weight: Testis was weighed individually using an electronic sensitive analytical balance (Gallenkomp FA 2104A).

Testis volume: The testis volume was taken, using archimede's principle of water displacement. The scrotal length and width**:** The scrotal length and width were measured as the length and width of the testes while in the scrotum, as they form the boundaries on which the veneer callipers were fixed and recorded in centimetres**.**

Determination of physical characteristics of semen:

The caudal epididymides were dissected out from the testis length. Several lacerations were made on the epididymis using sterile scalpel in separate specimen bottles containing normal physiological saline solution at 27^0C. The liberated spermatozoa could then swim out within 3-5 minutes. Caudal epididymal sperm motility and concentration were estimated using the methods of Brooks and Welbster (1975).

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***Sperm Motility*:** Epididymal sperm motility was assessed by examining undiluted fluid from the caudal epididymis. A drop of undiluted epididymal fluid was placed on a clean glass slide and examined under the light microscope at a magnification of x400. The mass activity was scored by estimating microscopically the intensity of wave motion. The percentage epididymal sperm motility was determined to the nearest 5% for each epididymis.

Sperm cell concentration: The right epididymis was minced with anatomic scissors in 5 ml of normal saline, placed in a rocker for 10 min and allowed to incubate at room temperature for 2 min. After incubation, the supernatant was diluted at 1:100 with a solution containing 5 g sodium bicarbonate and 1 ml formalin (35%). The new improved Neuber's counting chamber (haemocytometer) was used in counting the total number of spermatozoa. About 10 ml of the diluted sperm suspension was transferred to each counting chamber of the haemocytometer and was allowed to stand for 5 min, and thereafter observed under a binocular light microscope.

Estimation of abnormal cells: The proportions of abnormal spermatozoa were examined by random observation of at least 200 spermatozoa on the slide prepared for the estimation of live and dead spermatozoa. The proportion of bent tail and detached head (abnormal sperm cells) were determined, respectively.

Statistical Analysis

Data collected were analyzed using analysis of variance (ANOVA) of the general linear model according to SAS (2000). Significantly different means were separated using Duncan's Multiple Range test of the same statistical model at 5% level of significance.

RESULTS AND DISCUSSIONS

Testicular Morphometry

The body weight and testicular morphometry of the rabbits fed diets containing cassava peel/blood meal mixture are presented in Table 2. The terminal body weights of 1164.83, 1149.51, 1164.90 g and 1131.48 g for the control, ATD-BM, PAB-BM and SUD-BM respectively were not significantly ($P>0.05$) affected by the dietary treatments. The daily feed intake 48.78, 50.17, 49.23 and 48.69 g for the control, ATD-BM, PAB-BM and SUB-BM, respectively, were not significantly ($P>0.05$) affected by the treatment methods. The total cyanide intake showed a significant ($P<0.05$) effect of treatment methods on this parameter. While the control diet had zero cyanide intakes, the rabbits fed with the SUB-BM diet recorded the highest value of 62.05 mg/kg followed by the rabbits fed the ATD-BM diet which had 47.80 mg/kg. Rabbits fed PAB-BM had 16.89 mg/kg cyanide intake.

Table 2: Reproductive organ characteristics of rabbit bucks as influenced by treatment methods of cassava peel/ blood meal mixture

Parameters	Treatments				
	Control	ATD-BM	PAB-BM	SUD-BM	SEM
Body weight (g)	1164.83	1149.51	1164.9	1131.48	160.58
Daily feed intake (g)	48.78	50.17	49.23	48.69	1.37
Total cyanide intake (mg/kg)	0.00	47.80	16.89	62.05	4.05
Paired tests length (cm)	3.85	3.77	4.12	3.75	0.83
Paired testis width (cm)	0.88^{b}	0.84^{b}	1.24^{a}	0.95^{ab}	0.53
Paired testis volume (cm^3)	0.78^{ab}	0.61^{b}	1.13^{a}	0.84^{ab}	0.45
Paired testis weight (g)	1.53^{a}	1.39^{b}	1.51^{a}	1.37^{b}	0.35

[ab]Means along the same rows with different superscripts are significantly different (P<0.05).
ATD-BM = ash-treated cassava peel-blood meal, PAB-BM = Parboiled cassava peel-blood meal, SUD-BM=sun-dried cassava peel-blood meal SEM = Standard Error of Mean

The paired testes length 3.85, 3.77, 4.12, 3.75 g for the control ATD-BM, PAB-BM and SUD-BM were not significantly (P>0.05) affected by the treatment methods. However, the testis width, testis volume as well as the testis weight values obtained were significantly (*P*<0.05) influenced by the dietary treatments.

The paired testes width obtained in rabbits fed PAB-BM (1.24 cm) and SUD-BM (0.95 cm) were similar but higher (*P*<0.05) than 0.88 cm and 0.84 cm for ATD-BM respectively, which were also similar. The paired testes volume for the control (0.78 cm^3) and SUD-BM (0.84 cm^3) were not significantly (*P*>0.05) different from those fed ATD-BM diets (0.61 cm^3).

The paired testes weight (1.53 g and 1.51 g) for the control and PAB-BM diets respectively weresimilar and were significantly (*P*<0.05) higher than 1.39g and 1.37 g for PAB-BM and SUB-BM, respectively. The paired testes volume for the control (0.78 cm^3) and SUD-BM (0.84 cm^3) were not significantly (*P*>0.05) different from those fed ATD-BM diets (0.61 cm^3). The paired testes weight (1.53 g and 1.51 g) for the control and PAB-BM diets respectively were similar and were significantly (*P*<0.05) higher than 1.39 g and 1.37 g for PAB-BM and SUB-BM, respectively.

The body weight and testis morphometry of rabbit bucks as influenced by the inclusion levels of cassava-peel blood meal mixture is presented in Table 3. The terminal body weight, unlike the effect of the pre-treatment methods, was influenced (*P*< 0.05) by the inclusion levels. Rabbits fed the control (0%), 10%, and 20% inclusion had 1164.83, 1197.56, 1178.06 respectively and were significantly (*P*<0.05) higher than 1054.05 g obtained for the 30% inclusion. Although the daily feed intake (48.78, 50.82, 49.91, 47.94 g for 0, 10, 20 and 30%, respectively) were not significantly (*P*>0.05) affected by the inclusion levels. The total cyanide intake varied significantly (P<0.05) with 30% inclusion level having the highest intake of 37.49 mg/kg followed by 20% (30.63) and 10% (26.93).

The paired testes length (3.85, 3.89, 3.70, 4.08 cm) mean testes width (0.93, 1.10, 1.15, 0.87 cm), for 0, 10, 20 and 30% respectively were not significantly (*P*>0.05) affected by the inclusion levels. However the paired testes volume (0.98, 0.93, 0.98, 0.73 cm^3) and paired testis weight (1.53, 1.48, 1.44, 1.45 g) were significantly (P<0.05) affected by the inclusion levels.

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Table 3: Reproductive organ characteristics of rabbits buck as influenced by levels of inclusion of cassava peel/ blood meal mixtures

Parameters	Inclusion Levels (%)				SEM
	0	10	20	30	
Terminal weight (g)	1164.83[a]	1197.58[a]	1178.06[a]	1054.05[b]	160.58
Daily feed intake (g)	48.78	50.82	49.91	47.94	1.37
Total cyanide intake (mg/kg)	0.00 [d]	26.93 [c]	30.63 [b]	37.49 [a]	4.05
Paired testis length (cm)	3.85	3.89	3.7	4.08	0.83
Paired testis width (cm)	0.87	1.1	0.93	1.15	0.53
Paired testis volume (cm3)	0.98[a]	0.93[a]	0.98[a]	0.73[b]	0.45
Paired testis weight (g)	1.53[a]	1.45[ab]	1.44 [ab]	1.48[ab]	0.35

[ab]Means along the same rows with different superscripts are significantly different (P<0.05).
ATD-BM = ash-treated cassava peel-blood meal, PAB-BM = Parboiled cassava peel-blood meal, SUD-BM=sun-dried cassava peel-blood meal SEM = Standard Error of Mean

Sperm Characteristics

The effects of treatment methods of cassava peel/blood meal mixture on the sperm characteristics of rabbit bucks are presented in Table 4. The sperm motility, sperm concentration, progressivity and per cent deformity were significantly ($P < 0.05$) influenced by the dietary treatments. Rabbits fed with the control diet had the highest ($P < 0.05$) sperm motility (76.25%), compared to ATD + BM (64.00%), PAB-BM (60.69%) and SUD-BM (55.40%). The result of the current study showed that rabbits fed the control diet had the highest sperm concentration of $46.50x10^6/mm^3$, which was significantly ($P<0.05$) higher than 24.76, 27.80 and 18.59 x $10^6/cm^3$for ATD-BM and SUD-BM respectively.

Table 4: Semen characteristics of rabbit bucks as influenced by treatment methods of cassava peel/blood meal mixtures

Parameters	Treatments				SEM
	Control	ATD-BM	PAB-BM	SUD-BM	
Terminal weight (g)	1164.83	1149.51	1164.9	1131.48	160.58
Total cyanide intake (mg/kg)	0.00 [d]	47.80 [b]	16.89 [c]	62.05 [a]	4.05
Sperm Motility (%)	76.25[a]	64.00[b]	60.69[b]	55.40[b]	12.14
Sperm concentration (x 106/cm3)	46.50[a]	24.76[b]	27.80[b]	18.59[C]	6.77
Sperm defects (%)	6.50 [b]	8.50[a]	8.19 [a]	9.31 [a]	5.21
Sperm Progressivity (%)	100.00[a]	73.44[b]	73.43[b]	68.75[b]	21.72

[abcd] Means along the same rows with different superscripts are significantly different (P<0.05)

Note: WHO (1987) (World Health Organization) grade for sperm progressivism = A = > 70% (Excellent) , B = > 60 <70% Good ,C = >50 < 60% fair , D = <50 poor. ATD-BM = ash-treated cassava peel-blood meal, PAB-BM = Parboiled cassava peel-blood meal, SUD-BM=sundried cassava peel-blood meal. SEM= Standard Error of Mean

The sperm concentrations for ATD – BM and PAB-BM were similar and were higher ($P<0.05$) than the value obtained in rabbits fed the SUD – BM based diets.

Progressivity score also showed that the rabbits on the control diet had 100% score, which differed significantly ($P<0.05$) from ATD – BM (73.44%), PAB – BM (73.43%) and SUD – BM (68.75%) that was not different from one another.

The percentage deformity differed significantly ($P<0.05$) across the treatment groups. Rabbits fed the control diet had the lowest ($P<0.05$) deformed sperms cells (6.50%) compared with while ATD-BM PAB-BM and SUD-BM had 9.31, 8.19 and 8.50%, respectively.

The effects of levels of inclusion of cassava peel-blood meal mixtures on semen characteristics of rabbit bucks are presented in Table 5. The parameters measured were significantly ($P<0.05$) influenced by the levels of inclusion. The sperm motility value was significantly ($P<0.05$) higher for the control diet (76.25%) and was similar to those fed 10% inclusion level of cassava peel/blood meal mixture (67.04%). The 20 and 30% inclusion levels also differed significantly ($P<0.05$) from each other. The result of the study suggests that the higher the levels of inclusion of cassava peel/blood meal the lower the sperm motility. However, there was no difference between the sperm concentration at 10% (24.28 $x10^6/cm^3$) and 20% (21.27$x10^6/cm^3$) inclusion levels ($P<0.05$). Values obtained for sperm concentrations in all the treatment groups were higher ($P<0.05$) than those fed 30% (12.8%) inclusion. The values were significantly (P<0.05) lower than the sperm concentration for the control. Per cent sperm defects was highest at 30% inclusion level and lowest at 0% level while sperm movement progressivity decreased ($P<0.05$) with increasing the level of inclusion.

Table 5: Semen characteristics of rabbit bucks as influenced by inclusion levels of cassava peel/blood meal mixture

Parameters	Inclusion Level (%)				SEM
	0	10	20	30	
Terminal weight (g)	1164.83 [a]	1197.58 [a]	1178.06 [a]	1054.05 [b]	160.58
Total cyanide intake (mg/kg)	0	26.93 [c]	30.63 [b]	37.49 [a]	4.05
Sperm motility (%)	76.25[a]	67.04[a]	63.31[b]	53.53[c]	12.14
Sperm concentration ($x10^6/cm^3$)	46.50[a]	24.28[b]	21.27[b]	12.81[c]	6.77
Sperm defects (%)	6.50[c]	7.00[b]	8.25[b]	10.75[a]	5.21
Sperm Progressivity (%)	100.00[a]	76.25[b]	72.92[b]	58.33[b]	21.72

[abcd] Means along the same rows with different superscripts are significantly different (P<0.05)
Note: WHO (1987) (World Health Organization) grade for sperm progressivism = A = > 70% (Excellent) , B = > 60 <70% Good ,C = >50 < 60% fair , D = <50 poor. ATD-BM = ash-treated cassava peel-blood meal, PAB-BM = Parboiled cassava peel-blood meal, SUD-BM=sundried cassava peel-blood meal. SEM= Standard Error of Mean

DISCUSSION

The lack of significant differences between the treatment groups in the terminal body weight shows that irrespective of the processing methods, the final weight was not affected. The result obtained in this study is in agreement with reports of Ajayi *et al.*, (2007) and Olabanji *et al.* (2007) who included graded levels of wild-sun flower/blood meal in rabbit diets which implies that cassava peel /blood meal used in this study compared favourably with wild sun flower forage-blood meal mixture. It is worthy of note to say that the pre-treatment methods of cassava peels especially those of ash-treated and parboiled, will only increase labour and add to the cost

of production for farmers. Washing cassava peels and sun drying directly without further processing will suffice for rabbit as long as it is properly dried (Ojebiyi *et al*., 2008).

The daily feed intake obtained in this study was not affected by the pre-treatment methods and the feed intakes were lower than those reported by Olafadehan *et al.* (2008) but higher than Egbeyale *et al.* (2008) for rabbits fed cassava waste diets.Although ingestion of small quantities of HCN on regular basis may not be large enough to cause immediate toxicity, it may be sufficient to affect general health and productivity of the animal under consideration. In this study, the rabbits fed the sun dried SUD-BM consumed significantly ($P<0.05$) higher levels of HCN followed by ATD-BM but their final weight were not affected. This observation suggests that rabbit may be able to tolerate the level used in this study without any deleterious effect on growth performance. The impressive performance of the rabbits demonstrates the efficacy of the processing methods employed in this study in reducing HCN content to non-lethal level which must have invariably improved the feeding value of the cassava peel/blood meal mixtures.

The higher paired testes weight of rabbits on the control and PAB-BM diets is an indication of greater probability of the diet in supporting higher sperm production in the testis and corresponding storage (extragonadal reserves) in the epididymides. The testes mass is significantly correlated with daily sperm production (Nkanga and Egbunike, 1990). The significantly lower value of terminal body weight and paired testes volume for the rabbits on 30% inclusion levels may indicate the possibility of a threshold point in the efficacy of cassava peel-blood meal mixture generally in enhancing growth, with the probability of this effect being highest at 20% inclusion.

The paired testis weight, which is a better criterion in assessing the reproductive potential of the testis, showed that control diet and 10% inclusion level irrespective of processing methods supported the growth of the testis as shown by the testes weight. The 20% and 30% inclusion levels were not different ($P>0.05$) from each other. This may be an indication that the test ingredients and the level of anti-nutritional factor, did not significantly depress testis weight among the rabbit groups that were fed the differently processed cassava/blood meal containing diets.

Among the factors normally used in the determination of semen quality are the sperm contentration, sperm motility, pH, ratio of live to dead sperms.The significant reduction in the semen motility of rabbits fed with cassava peel-blood meal mixture when compared with the control diet is in agreement with the findings of Yousef *et al.* (1995) in studies in which toxic compounds were fed to rabbits. Earlier, Egbunike and Oluyemi (1979) had reported that seminal fluids caused reduction in nutritive substances needed for normal sperm motility and viability.

The amount of residual anti-nutritional factor (cyanide) intake greatly influenced the sperm concentration of the rabbit bucks. Nutritional toxicity affects spermatogenesis, which subsequently reduces sperm concentration (Salem *et al.*, 1988, Yousef *et al.*, 1995 and Akanji, 2002). The authors attributed this reduction in sperm concentration to the direct cyto-toxic effects of the toxic compound on spermatogenesis and indirectly via hypothalamic-pituitary-testis axis, which controls the reproductive efficiency.The result obtained in this study on the per centsperm defects confirmed the effect of the toxicity of residual anti-nutritional factors intake after a long period of feeding. This finding agreed with that of Carter and Laskey (1982) who reported decreased total epididymal live sperm cells in rats fed with a toxic substance

known as carbonite pesticide benomyI. The toxic substances might mediate through their effects on hormonal balance. The structural integrity of the sperm, most especially with respect to sperm acrosomal cap, in estimating the fertility of ejaculated semen, had received considerable attention (Allison and Hartree, 1970; Madam and Watson, 1994 and Peknicova *et al*., 1994). In the current study, residual cyanide was expected to be the only toxic substance in the cassava peel meals fed to the rabbits and this might have had some adverse effects on the testis, resulting in the abnormal sperm cells.

The implications of the results obtained are that at higher levels of inclusion of cassava peel/blood meal mixture in the diet of rabbit bucks, the residual cyanide intake progressively reduces the viability of the sperm. A marked manifestation of occurrence of morphological abnormalities also becomes obvious. Reduction in the progressive epididymal sperm motility of the rabbits fed diets containing cassava peel/blood meal mixtures, when compared with the control group is an indication of the presence of a spermatoxic agent on maturing or mature spermatozoa (Verma and Chinoy, 2000). Sperm motility depends on the coordinated propagated flagella wave under acetyI cholinesterase control. Fructose utilization and glucose oxidation are important means by which spermatozoa derive energy for their mobility (Nelson, 1972). Cyanide may induce hypoglycemic and anti-hyperglycemic activities, resulting in this abnormality. The reduction in mobility recorded in this study could therefore, be attributed to the acetylchlolinesterase inhibition and glucose lowering properties of the residual cyanide, a situation similar to the findings of Raji *et al.* (2005) with *Morindalucida* extract.

CONCLUSION

It can be concluded that although treatment methods had no effects on terminal weights, the levels of inclusion of cassava peel+blood meal mixtures depressed weight. Treatment methods as well as inclusion levels had negative effects on testicular weights and semen characteristics.

Although cassava peels containing diets can be fed to fattening rabbits, caution should be exercised while feeding cassava peel containing diets to rabbits intended for breeding.

REFERENCES

Ajayi A.F., Fanrinu, G.O., Ojebiyi O.O. and Olayeni, T.B. (2007). Performance Evaluation of Male Weaner Rabbit fed Diets containing Graded levels of Blood-Wild sun flower leaf meal mixture. *World Journal of Agricultural Sciences, 3 (2):2 250-255.*

Akanji A.M. (2002). Enhancing the utilization of some tropical legume seeds in diets of exotic meat-type and egg type chicken.Ph.D. Thesis University of Ibadan.

Allison A.C. and Hartree E.F. (1970).Lysosomal enzymes in acorsome and their possible role in fertilization.*Journal of Reproduction and Fertility, 22: 500-515.*

AOAC,. (2005). Association of Official Analytical Chemist). Official methods of Analysis (18th edition), Washington D. C., USA.

Bradbury, M. G., Egan, S. V. and Bradbury. J. H. (1999). Determination of all forms of cyanogens in cassava roots and cassava products using picrate paper kits.*Journal of Science of Food and Agriculture* 79: 593-601.

Brooks A. K. and Welbster B. W. (1975). Handbook of laboratory diagnosis and Treatment of Infertility CRC press, Boca Raton pp 37-39.

Carter S.D. and Laskey J.W. (1982). In: Yoruset, M.I Ibrahim, H.Z., Helmi S, Seehy. M.A. and BertheussenK.eds).Toxic effects of carbofuran and glyphosate on semen characteristics in rabbits.*Journal of Environmental Science and Health.30 (4).*

Durape N. M. (2007). Phyto-chemicals improve semen quality and fertility. *World Poultry Magazine* 6 (23): 18-20.

Egan S.V. Yeoh H.H. and Brabury J.H. (1988).The caynogenic potential of cassava.*Journal of Science of Food and Agriculture*, 76: 39-48.

Egbeyale L.T., Osidipe B.O., Amole T.A., Idowu O.M.O., Sogunle O.M. and Adeleye O.O. (2008). Growth performance and Economic Benefits of Weaner Rabbits fed diets containing low levels of cassava root sievate. Proceedings of the 33rd Annual conference of the Nigerian Society for Animal Production (NSAP) college of Agricultural Science, OlabisiOnabanjo university Yewa Campus, AyetoroOgun State Nigeria March 16-20.

Egbunike G.N. and Oluyemi J.A. (1979).Comparative studies of the reproductive capacity of Nigerian and exortic poultry breeds.Nigerian.*Journal of Animal Production,* 6:47-57.

Gbore F.A, Ewuola E.O., Ogunlade J.T., Idahor K.O., Salako A.O. and Egbunike G.N. (2007). Spermatogenesis, gonadal sperm reserves and fertility of rabbits fed micro doses of fumonisin. *Nigerian Journal of Animal Production*, 32(2):316-322

Gupta A. K. and Mohanty T. K. (2003).Testicular biometry and semen quality in Karan Fries Bulls husbandry.*Journal of Dairy Science,* 56: 317 - 319.

Lake P.E. and Stewart J.M. (1978). Artificial insermination in Poultry.Biochemistry of the domestic fowl. London, Academic Press, (3): (1411-1425).

Madam k. and Watson T.P.E. (1994). Use of a simple staining technique to distinguish acrosomal changes in live sperm sub-population. *Animal Reproduction Science, 35:247-254.*

McDonald E. P., Edwards R. A., Greehalgh J. F. D. (1981). Animal Nutrition. 3rd Edition, Longman, New Yolk.

Nelson L. (1972). Quantitative evaluation of sperm motility control mechanisms. *Biology of Reproduction 6:319-324.*

Nkanga E.E and Egbunike G.N. (1990). Daily sperm production of the domestic fowl (Gallus domestians) determined by qualitative testicular histology and homogenate methods. Tropical Animal Production Investigation 1:1-8.

Nwoko N. and Ibe S.N. (2001). Effect of tread and season on semen quality and fertility of bucks in a humid topical environment.*Nigerian Journal of Animal Production*, 32(2):327-334

Ojebiyi O.O.,Oladiti O.A**.,** Oladunjoye, I.O., Rafiu T.A. (2014). Performance, Nutrient Utilization and Carcass Characteristics of Harco Cockerels Fed Diets Containing Bio-Treated Cassava Peels Meal at Chick Phase.*Journal of Animal Production Research* 26: 113-124

Ojebiyi, O.O., Farinu, G.O., Babatunde, G.M. and Aderinola, O.A. (2008). Evaluation of the nutritive potential of cassava (*Manihotesculenta*Crantz) peels-blood meal mixture on the performance characteristics of female growing rabbits in the derived savannah zone of Nigeria.*Proceedings of the 9th World Rabbit Congress (Edited by Gerolamo Xiccato, Angela Trocino and Steven D. Lukefahr) June 10-13 2008. Verona, Italy. Pp 769-773.*

Olabanji R.O, Farinu G.O., Akinlade J.A, Ojebityi O.O. Odunsi A.A and Akingbade A.A. (2007). Studies on Haematological and serum Biochemical characteribiticsof weaner Rabbits. Fed Different levels of Wild sun-flower (*Tithoniadiversifolia*Hemsl A. Gray) Leaf-Blood meal mixture. *International Journal of Applied Agricultural and Apicultural Research, 4 (1&2):80-89*

Olafadehan O.A; Olfadehan O.O; Adewumi M.K, Omotugba S. K. and Daniel N. E. (2008). Feeding value of differently processed cassava peel meal for weared Rabbits. Proceedings of the 33rd Annual conference of the Nigerian society for Animal Production (NSAP) College of Agricultural Science, Olabisi Onabanjo University Yewa Campus, Ayetoro Ogun State Nigeria, March 16-20 Page 132-135.

Peknicova J., Moos J., Mollova M., Sisen V and Capkova J. (1994). Changes in immunochemical location of acrosomal and sperm proteins in boar sperm during capacitation and induced acrosomo reaction. *Animal Reproduction Science. 35:225-271*

Petzinger E and Weidenbach A. (2002).Mylotoxins in the food chain; the role of ochratoxins.*Livestock Production Science,* 76:245-250.

Raji Y., Akinsomisoye O.S, and Sallman T.M. (2005) Antispermatogenic activity of *Morinda Lucida* extract in male rats. *Asian Journal of Anthropology,* (4): 405-410.

Salem M.H., Zahraa Abo- Elezz, Abdul-Allah, G.A. Hassan G.A. and Shaker N. (1988). In: Toxic effects of carbofuran and glyphosate on semen characteristics in rabbits. Pp 513-534.

SAS (2000). Statistical analysis system user's guide, SAS Institute, Incorporated Cary NC 27513.

Singh K. P., Johari, D. C., Majumdar S., MohaPatra, S. C and Thiyagasundaram, T. S. (1987). Evaluation of Semen quality traits of White Leghon selected for egg production. *Indian Journal of Poultry Science*, 22:129-132.

Sternova M., Ledec M., Csuka J. and Skrobaneks P. (1984).Selection of cocks on semen production and quality.*Poultry Abstract,* 10:2307.

Swierstra E. (1968). Structural composition of short-horn bull testes and daily spermatozoa production as determined by quantitative testicular histology.*Canadian Journal of Animal Science,* 46: 107-119.

Togun V. A. (2009). Liveweight related changes in the sperm production capacity of White Fulani (Bosindicus) bulls.I: Testicular histomorphometry. *Pakistan Journal of Biological Science,*12 (17):1174-1180.

Togun V. A. Farinu G. O. and Olabanji R. O. (2006b) Feeding graded levels of Wild Sunflower (*Tithonia diversifolia* Hemsl A Gray) meal in replacement of maize at pre-pubertal age, negatively impacts on growth and morphometric characteristics of the geneitalia of Anak 2000 broiler cocks at their pubertal age. *World Applied Sciences Journal,*1 (2):115-121.

Togun V. A., Farinu G. O. and Olabanji R. O. (2006a).Effect of graded levels of Wild Sunflower (*Tithoma diversifolia* Hemls A. Gray) meal in pre- pubertal diets on the morphometric characteristic of the genitalia and some organs of Isa Brown cocks at the pubertal age.*American-Eurasian Journal of Scientific Research*, 1 (1): 61-67

Verma R.J and Chinoy N.J. (2000). Effect of Papaya seed extract on micro-environment of caudal epididymis. *Asian Journal of Anthropology, 3:143-146.*

World Health Organisation (1987). WHO Laboratory Manual for Examination of Human Semen and Semen - Cervical Interaction, 2nd ed, London; Cambridge University Press : p 1-10.

Yousef M.I., Ibrahim H.Z. Helmi S., Seehy, M.A. and Bertheussen K. (1995). Toxic effects of carbofuran and glyphosate on semen characteristics in rabbits.*Journal of Environment Science and Health, B 30: (4).*

Zahraddeen D., Butswat I.S.R. and Mbap S.T. (2007). Influence of collection period on semen characteristics of two breeds of rabbit (*Oryctalogus cunniculus*) raised in a tropical environment. Proceedings of the 32nd Annual Conference of the Nigerian society for Animal Production (NSAP) March 18-21, University of Calabar, Nigeria. Page 69-72.