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Effect of *Pleurotus tuber regium* treated cassava peel based diets on haematological and serum biochemical parameters of WAD bucks.

***Barde, R.E[1]., Ayoade, J.A[2]., Attah, S[2]and I.S.Musa[1]**

[1]*Animal Science Department, College of Agriculture, Lafia.*
[2]*Animal Production Department, University of Agriculture, Makurdi.*
**rowebarde.rb@gmail.com*

Abstract

Twenty intact West African Dwarf (WAD) bucks age between 7-9 months weighing average of 6.17±0.96kg were randomly allocated to five treatment diets containing untreated cassava peels (UCPS) and Pleurotus tuber regium treated CPS (PT-CPS) in a completely randomized design experiment lasting 84 days. Daily feed intake, weekly weight gain, the haemotological and serum biochemical parameters were evaluated at the end of 84 days feeding trial. Growth performance of WAD bucks fed treatment diets showed significant (P<0.05) final weight of 13.25kg by bucks fed 100% PT-CPS diet, and the lowest 8.00kg for 100%UCPS. Bucks on 100% PT-CPS diet also recorded the highest (P<0.05) total mean weight gain of 7.08kg while bucks on control 100%UCPS diet had 1.73kg as total mean weight gain. The serum biochemical studies showed significant (P<0.05) difference among the five treatments. Packed cell volume ranged between 36.0-37.7%, haemoglobin concentration 10.60-12.17g/dl, erythrocyte was between 4.86-5.55X10$^{12/l}$ and leucocytes count ranged between 6.35-10.48X10$^{9/l}$. There was no significant (P>0.05) difference among the values recorded for Mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and the mean corpuscular haemoglobin concentration (MCHC). All the haemotological values were within the range recommended for healthy WAD goats as well as all values of serum biochemistry obtained. This is an indication of good protein metabolism and that white rot biodegraded cassava peel in the rations showed no susceptibility to anaemia related disease condition as they pose no health challenges.

***Keywords**: Pleurotus tuber regium, cassava peels, bucks, haematological and biochemical parameters*

Introduction

Nigeria is the world leading producer of cassava (*Manihot esculenta*) with projected annual production of 60 million tonnes (FAO, 2009). It is produced predominantly (99%) by small farmers with 1-5 ha of land intercropped with yams, maize, or legumes in the rainforest and savannah agro -ecologies of Southern, Central, and lately Northern Nigeria.

Cassava processing into gari, fufu, or cassava flour for human consumption is the dominant activity in the cassava value chain engaging small scale processors across the country. In processing cassava, the tubers are peeled to rid them of the outer coverings. Cassava peels make up 10% of the total wet weight and could be 20 -35% of the wet weight if the tubers are manually peeled (Oboh, 2006; Obadina *et al*., 2006).

In recent years, white rot fungi have been extensively used (Ohkuma *et al*., 2001; Shah and Nerud, 2002 ; Mshandete and Mgonja, 2009) in bioremediation (degradation of wide range of environmental pollutants) to degrade pesticides, herbicides, coal tars, heavy fuels, chlorinated aromatic compounds, dyes, synthetic high polymers etc. These ligninolytic enzymes are responsible for initiating the depolymerization of lignin due to their strong oxidative activity and low substrate specificity. Furthermore, the potential role of basidiomycetous fungi is not only in conversion of lignocellulosic biomass into more soluble feeds for animals, human food (mushrooms), bioremediation but remarkably also in the production of mycopharmaceuticals (Mshandete and Mgonja, 2009).

Therefore biodegradation of agricultural waste provides a cheap and safe process in which the wastes like cassava peels are decomposed by mono or mixed cultures of microorganisms under controlled environmental conditions to improve the quality of the wastes. Thus, the use of microbial enzymes to cleave the complex carbohydrates bonds resulting from the process of biodegradation can be used to improve the nutritional value of non conventional feed ingredients which are readily available leading to increased inclusion of such into livestock feeding. This process will invariably reduce the cost of ruminant production if it is safe. Examining blood of animals for theirconstitutes is used to monitor and evaluate disease prognosis (Yusuf *et al*., 2012).
This study was designed to determine the haematological and serum biochemical parameters of West African Dwarf (WAD) goats fed diets containing *Pleurotus tuber regium* (white rot fungi) treated cassava peels.

Materials and Method

Experimental Site

The study was conducted at the Farm Unit of the College of Agriculture, Lafia, Nigeria located Latitude N08^0 29'8.66''; Longitude E08^0 29' 49.10''and Altitude 164.5m in the guinea savannah vegetation, with its sandy loam soil texture (Akwa *et al*., 2007).

Treatment of Cassava Peel

Fresh cassava peel was obtained from the Family Support Programme's Gari Processing Industry, Shabu – Lafia and sun dried for six days as describe by Uza *et al*. (2005). Treatment of cassava peels (with *Pleurotus tuber- regium*) was by inoculation of composted cassava peels with slides of the tuber on a concrete floor at room temperature covered with polythene sheet and allowed to ferment for 21 days.

Experimental Diets

Five diets containing untreated and biodegraded cassava peels were compounded and fed the experimental animals as follows:

T1 – 100% untreated cassava peels (UCPS)
T2 – 100% *Pleurotus tuber regium* treated Cassava Peels (PT-CPS)
T3 – 75% UCPS + 25% PT-CPS
T4 – 50% UCPS + 50% PT-CPS
T5 – 25% UCPS + 75% PT-CPS

Table 1: Composition of Treatment Diets

Ingredients (%)	**T1**	**T2**	**T3**	**T4**	**T5**
UCPS	45	-	33.75	22.50	11.25
PT-CPS	-	45	11.25	22.50	33.75
BDG	30	30	30	30	30
SBM	10	10	10	10	10
PKC	12	12	12	12	12
Bone meal	2	2	2	2	2
Premix*	0.5	0.5	0.5	0.5	0.5
Salt	0.5	0.5	0.5	0.5	0.5
Total (%)	100	100	100	100	100

**Pfizer Premix : Vit A 10,000,000 IU; Vit D3 2,000,000 IU; Vit E 8,000 IU; Vit K 2,000mg;Vit B1 2,000 mg; Vit B2 5,500mg; Vit B6 1,200 mg; Vit B12 12 mg; Biotin 30 mg; Folic Acid 600 mg; Niacin 10,000 mg; Pantothenic Acid 7,000mg; Choline chloride 500,000 mg; Vit C 10,000mg; Iron 60,000 mg; Mn 80,000 mg; Cu 8,00mg; Zn 50,000 mg; Iodine 2,000 mg; Cobalt 450 mg; Selenium 100 mg; Mg 100,000 mg; Anti Oxidant 6,000 mg.*

Other feed ingredients were purchased from open market, livestock feed retailers and veterinary service providers within Lafia.

Animal Management

Twenty West African Dwarf (WAD) intact bucks of age between 7-9 months and having an average weight of 6.17±0.96kg from the small ruminant section of the farm were allocated to five treatments (T1, T2, T3, T4 and T5) diets in a completely randomized design format (Steel and Torrie, 1980). The bucks were housed in individual pens measuring 1.5m^2 each with feed and watering troughs. The animals, four per treatment were allowed access to water, mineral salt lick and fed *ad libitum*. The animals were weighed at the beginning of the trial and weekly thereafter for twelve weeks to assess weight changes. Feed intake was determined by subtracting feed remnant from quantity offered daily at 0800 hours. Fourteen days was allowed for the animals to get accustomed the diets before data collection (daily feed intake and weekly weight gain) commenced. Daily feed intake and weekly weight gain were recorded.

Haematological and Serum Biochemical Parameters of the WAD bucks

Blood samples were collected from the jugular vein of the 20 WAD goats at the 84th day of the feeding trial. Three millimetre (3ml) of blood collected from each of these goats were stored in plastic sample bottles containing EDTA (ethylene diamine tetra acetic acid) for haematological studies, while another 7ml were deposited into anticoagulant free plastic tube and allowed to clot at room temperature within 3 hours of collection. The serum samples were stored at a temperature of -20ºC prior to biochemical studies.

Data Collection

a. The haematological studies were carried out according to procedures by Jain (1986) to determine Packed cell volume (PCV), Haemoglobin concentration (Hb), Erythrocytes (RBC) , Leucocytes counts (WBC); and the mean corpuscular volume (MCV), PVCx10/RBC in femtolitre ; mean corpuscular haemoglobin (MCH), Hb x10/RBC in pictogram and mean corpuscular haemoglobin concentration (MCHC), HB x 100/PVC in gm/decilitre were determined.
b. Biochemical analyses: the method described by Ogunsami *et al*. (2002) to determine Serum Sodium (Mol/L), Potassium (Mol/L), Chloride (Mol/L), Calcium (Mol/L), Phosphorus (Mol/L), Urea (Mol/L), Cholesterol (Mol/L), Glucose (Mol/L), Urea (Mol/L), Total protein (g/L), Albumin (g/L) and Globulin (g/L) was adopted.

Statistical analysis

Experimental design employed was complete randomized design (Steel and Torrie, 1980). Data obtained were subjected to analysis of variance where significant differences occurred, the means were separated using Duncans' Multiple Range Test (SPSS, 2007).

Results and Discussion

Performance of WAD Bucks Fed Treatment Diets

Performance of WAD bucks fed the treatment diets shows (table 2) bucks on 100%PT-CPS diet (T2) with significantly ($P<0.05$) the highest final mean weight of 13.25kg while bucks on UCPS diet (T1) had the lowest final mean weight of 8.00kg. A corresponding significant ($P<0.05$) total weight gain was recorded for T2 (7.08kg) followed closely by bucks on 75% PT-CPS, T5 (6.10kg); 50%PT-CPS, T4 (5.53kg); 25%PT-CPS, T3 (3.75) while the lowest was by bucks on control diet, T1 (1.73kg). It is imperative that nutritive value of feed expresses itself not only by chemical assay but by evidence of improved gain (David, 2012).

Table 2: Performance of WAD Bucks Fed Treatment Diets

Parameter	T1	T2	T3	T4	T5	SEM
No. of bucks	4	4	4	4	4	-
Feeding period (days)	84	84	84	84	84	-
Initial mean wt (kg)	6.28	6.25	5.57	6.13	5.60	0.15
Final mean wt (kg)	8.00^{d}	13.25^{a}	10.00^{c}	11.50^{b}	11.68^{b}	0.42
Total mean wt gain (kg)	1.73^{c}	7.08^{a}	3.75^{b}	5.53^{a}	6.10^{a}	0.49

SEM - Standard error mean
a,b,c,d - Means on the same row with different superscript are significantly (P<0.05) different

Haematological Parameters of WAD Bucks

Haematological parameters of WAD bucks fed treatment diets are presented in Table 3.The blood profile of bucks fed treatment diets showed significance (P<0.05) for PCV% between 33 – 38%. Higher PCV values were observed in bucks of T5 (38.0%), T3 (37.7%) and T2 (37.0%) while the least was T4 (33.0%). All these PCV values are above normal value range of 21-35% for healthy WAD goats (Daramola *et al*., 2005). This could be an indication of increase in the number of circulating RBC. Similarly, Hb (g/dl) of all treatment bucks is within the normal range of 7 – 15g/dl for healthy WAD goats (Daramola *et al*., 2005).

Haemoglobin functions as carrier of oxygen to target organs by forming oxyhaemoglobin (Belewu and Ojo-Alokomaro, 2007) hence all diets could have supported good health of the bucks. Blood represents a means of assessing clinical and nutritional health status of animals in feeding trial and the haematological parameters most commonly used in nutritional studies include PCV, RBC, HBC, MCHC and MCV. The results of haematological variables in this study suggest that the test diets did not precipitate significant effects on the health status of the bucks as reported by Tewe (1985).

Mean Corpuscular Volume, MCV (fl) Values of bucks in this study showed significance (P<0.05) among treatments, these value were between 69.15 and 70.25fl ; but if the MCV is greater than 100femtolitres it may indicate macrocytosis (enlargement of the red blood cells) as observed by Njidda *et al*.(2013). Mean Corpuscular Haemoglobin, MCH (pg) recorded 21.75, 21.90, 21.47, 22.05, 22.10 pictogram for T1, T2, T3, T4 and T5 respectively. These values are above the values reported (Yusuf *et al*., 2012).

Mean Corpuscular haemoglobin Concentration, MCHC (g/dl) values were however not significant (P>0.05) but all values are within the normal values (14.20- 37.50) for

healthy WAD goats (Yusuf *et al*., 2012). MCHC is very significant in the diagnosis of anaemia and an index of the capacity of bone marrow to produce red blood cells (Njidda *et al*., 20013). However, blood composition of animal may be influenced by certain factors like nutrition, management (Grunwaldt *et al*., 2005).

Table3: Haematological Parameters of Bucks

Parameter	T1	T2	T3	T4	T5	SEM
Packed cell volume (%)	36.0^{ab}	37.0^{a}	37.7^{a}	33.0^{b}	38.0^{a}	0.62
Haemoglobin concentration (g/dl)	12.17^{a}	11.67^{a}	11.70^{a}	10.60^{b}	12.10^{b}	0.17
Erythrocyte ($x10^{12/l}$)	5.20^{ab}	5.31^{ab}	5.46^{a}	4.86^{b}	5.55^{a}	0.08
Leucocytes Count ($x10^{9/l}$)	10.48^{a}	6.35^{b}	7.90^{b}	6.47^{b}	9.85^{a}	0.48
Mean Corpuscular Volume, (Pl)	69.25^{bc}	70.05^{ab}	69.15^{c}	69.80^{bc}	70.25^{a}	0.15
Mean Corpuscular Haemoglobin, (Pg)	21.75^{ab}	21.90^{a}	21.47^{b}	22.05^{a}	22.10^{a}	0.09
Mean Corpuscular haemoglobin Concentration (g/dl)	31.40	31.20	31.07	31.47	31.17	0.13

SEM - Standard error mean
a,b,c,d - Means on the same row with different superscript are significantly (P<0.05) different

Serum Biochemical Parameters of Wad Bucks

Serum sodium, potassium chloride, calcium phosphorus, cholesterol, glucose, total protein and globulin of bucks fed treatment diets presented in Table 4 showed significance (P<0.05) among treatments. All biochemical parameters in this study except urea and albumin contents are significant (P<0.05) amongst treatments and the values of Serum sodium, potassium chloride, calcium phosphorus cholesterol, glucose total protein and globulin recorded in this study fall within the healthy ranges reported for WAD goats (Daramola *et al*.,2005; Grunwaldt *et al*., 2005; Opara *et al*., 2010).

Urea in bucks serum recorded in this study is 4.60, 4.97, 5.37, 4.40 and 4.90 mmol/litre for T1, T2, T3, T4 and T5 respectively; these values though not significant (P>0.05) are within the normal serum urea (3.50 – 9.7) reported in WAD goats (Daramola *et al*., 2005). A high level of serum urea has been attributed to excessive tissues protein catabolism associated with protein deficiency (Opara *et al*., 2010). The normal urea content in all the treatment bucks could suggest amino acid ingested are used for synthesis of proteins and yielding normal urea in the serum as is shown to be an indirect indicator of feed protein composition in farm animals (Elitok, 2012).

Serum albumin was not significant (P>0.05) in this study but shows values of 26.67, 28.67, 26.67, 31.00 and 27.67 for T1, T2, T3, T4 and T5 respectively. These values are within the normal value range of 20.8 -40.3g/l (Daramola *et al*., 2005). Total serum protein may be used as an indirect measurement of dietary protein quality (Tewe, 1985). The values obtained in this study could be an indication of good protein metabolism influenced by proper nutrition (Grunwaldt *et al*., 2005).

Table 4: Serum Biochemical Parameters of WAD Bucks

Parameter	T1	T2	T3	T4	T5	SEM
Serum Sodium (mol/l)	137.63^{c}	138.07^{c}	144.77^{ab}	150.67^{a}	145.20^{ab}	1.62
Potassium Chloride (mmol/L)	4.77^{b}	4.77^{b}	5.00^{b}	4.57^{b}	5.70^{a}	0.13
Calcium phosphorus (mmol/L)	8.77^{a}	8.60^{a}	8.58^{a}	8.80^{a}	7.90^{b}	0.11
Urea (mmol/L)	4.60	4.97	5.37	4.40	4.90	0.15
Cholesterol (mmol/L)	7.77^{b}	8.30^{b}	7.80^{b}	8.70^{ab}	9.50^{a}	0.22
Glucose (mmol/L)	7.60^{bc}	9.40^{a}	7.50^{bc}	7.07^{c}	8.13^{b}	0.24
Total Protein (g/l)	66.00^{b}	76.67^{a}	66.67^{b}	76.00^{a}	72.67^{a}	1.31
Albumin (g/l)	26.67	28.67	26.67	31.00	27.67	0.77
Globulin (g/l)	39.67^{b}	48.00^{a}	40.00^{ab}	45.00^{ab}	45.00^{ab}	1.25

SEM - Standard error mean
a,b,c,d - Means on the same row with different superscript are significantly (P<0.05) different.

Conclusion

The present study showed that all parameters recorded were within the normal range for healthy WAD goats production indicating inclusion of *Pleurotus tuber regium* treated cassava peel in the rations had no anaemic related disease condition and therefore pose no health challenges. The use of *Pleurotus tuber regium* treated cassava peel is recommended for use in ration preparation for WAD goats.

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