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Haematological and serum biochemical indices of growing rabbits fed graded levels of Yam peel meal as replacement for maize

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Abstract

Haematological and serum biochemical parameters are indicators of physiological, nutritional and pathological status of animals. Investigation of these parameters provide information for diagnostic purposes. The study was conducted to determine the influence of feeding graded levels of yam peel meal (YPM) as a replacement for maize on haematology; blood chemistry was evaluated in rabbits. Thirty- six (New Zealand white X Chinchilla) were randomly assigned to four dietary treatments in a completely randomized design with nine rabbits per treatment. The rabbits were fed diets containing 0, 12.5, 25 and 37.5% of Yam peel meal (YPM) as a replacement for maize, designated as T1, T2, T3 and T4, respectively. The experimental diets and clean drinking water were supplied ad libitum throughout the experimental period of nine weeks. At the end of the feeding trial, three rabbits per treatment were randomly selected for hematological and serum biochemical analysis. All the haematological and serum biochemical indices except AST were affected (P<0.05) by dietary inclusion of YPM. Although most of the parameters investigated were affected by rabbits fed test ingredient, the values fell within the normal literature reference values for rabbits. It can therefore be concluded that up to 37.5% inclusion level of YPM can be fed to growing rabbits without deleterious effects on health status.

Keywords: Rabbits, Haematology, serum Biochemistry

Introduction

One of the major challenges confronting the livestock industry in Nigeria is the increase in the cost of feed ingredients especially protein and energy sources. Maize, the traditional energy source for feed, is increasingly competed for by the food and biofuel industries making it less available or at exorbitant prices for animal feeding (Diarra, 2018). According to USDA (2015), the price of maize increased by about 71% from September 2005 to September 2015. The present study focus is on alternative feed stuffs, mostly those which can either substitute directly for cereals grains and or protein concentrates or can be included at a certain level to attain a comparable quality of production with the conventional ones, but must not be deleterious to animal health (Agbabiaka *et al.,* 2012).Starchy roots and tubers, including cassava, potato, sweet potato and yam, are important food crops with an estimated global annual production of 836 million tonnes (FAO, 2013). Yam peel meals (YPM) havebeen reported to replace up to 20% of maize in rabbit diets without detrimental effect on haematology and serum biochemical parameters (Garba and Mohammed, 2015). Yam peel has been reported to contain high starch content (Funmilayo and Ayodele, 2011) and higher starch digestibility (Medoua *et al.,* 2007). Yam peel is low in cost, readily available and has no direct nutritional significance for humans. Many of these unconventional feed ingredients are fed to livestock without consideration to their health and physiological implication on the animal (Aro, *et al.,* 2013). A readily available and fast means of assessing clinical and

nutritional status of the animal on feeding trial is the use of blood analysis Olabanji *et al*., (2009). Haematological and serum profile are helpful in evaluation of rabbit's health and also provides valuable information on presence of metabolites and other constituents which are instrumental for detecting conditions of stress (Aderemi, 2004). Therefore, this study was conducted to assess the influence of dietary inclusion of YPM as replacement for maize on haematological and serum biochemical profile of rabbits.

Materials and methods

Experimental site

The study was carried out at Rabbit Unit, Teaching and Research Farm of Federal University Gashua, Nigeria. Gashua is located12^{0} 52'5" N and 11^{0} 2' 47" E in the semi-arid region of North Eastern Nigeria at average elevation of 299 meters above the sea level. The annualrainfall range of 500 to 1000mm and maximum summer temperature range of 38 º to 40° C (March-April) and minimum temperature as low as 23 to 28°C June to September.

Preparation of test ingredients

The yam peel meal (YPM) was procured from restaurants, yam frying point in Gashua. All extraneous materials were removed and samples were spread thinly on a tarpaulin and turned twice daily for 10 days. The test ingredients were grounded coarsely, bagged and stored ina cool dry place for use.

Experimental diets

Four experimental diets were formulated to meet the minimum requirements of the experimental animal. Diet (T1) is maize based dietwhich served as control contained 0% YPM while diets T2, T3 and T4 had 12.5, 25 and 37.50 % YPM as a replacement for maize (Table 1).

Experimental animals and management

A total of thirty-six weaned rabbitsof mixed breed (NewZealand white and Chinchilla) were procured froma reputable source and used for the study. Before the arrival of the rabbits, all sanitary procedures such as cleaning, washing and disinfection of the hutches and other equipment was observed. The rabbits were allowed to acclimatize to the environment for a period of 7 days and thereafter balanced for weight and randomly allotted to four dietary treatment groups with 9 rabbits per treatment with three replicates. The mean weights of the rabbits at the commencement of the trial were 696+2g. The rabbits were housed in hutches measuring 60 x 43 x 43 cm according to Aduku and Olukosi, (1990). The hutches were raised at 100cm above the groundlevel. Daily cleaning of the hutch floor was observed throughout the period of the experiment which lasted for 9 weeks. Experimental diets were offered ad-libitum and rabbits had access to clean water daily throughout the experimental period.

Blood collection

At the end of the experimental period, three rabbits were randomly selected from each treatment groups and 5 mL of blood samples were collected from lateral Saphenous vein located in the lower rear hind leg as recommended by Parasuraman *et al.* (2017). The rabbits were restrainedand the hair from the lateral saphenous vein was shaved making Saphenous vein visible. It was cleaned and dried with alcohol and sterile gauze. A sterilized disposable 20gauge needle on a 3ml syringe was insertedinto the occluded vessel and blood aspirated into syringe prefilled with air according to procedure outlined by Michael, (2011). Samples were transferred into labeled sample collection tubes containing ethylene diamine-tetra-acetic acid (EDTA) as anticoagulants. Other blood samples were collected in plainbottles without anticoagulants for biochemical indices. Rabbits are known to have short prothrombin time, and blood quickly clot at

room temperature hence samples were transported in ice blocks container and haematological analysis were carried out within two hours after sample collection using SYSMEX 550 XN-L series automatic haematology analyzer (SYSTEX AMERICA INC. LINCOINSHIRE, ILLINOIS, USA). The Electrolytes was determined using ION SELECTIVE ELECTRODE ISE GE 300 (Mettler Teledo International Inc. USA) while the Urea, creatinine was determined using CHEMRAY RAYTO 240 (Rayto life Analytical Services Co. ltd. China)

Experimental design

A total of 36 rabbits weaned rabbits of mixed breed (New Zealand white and Chinchilla) were used for this study for a period of 9 weeks. The rabbits were randomly allotted to four dietary treatments group of nine replicated three times in a completely randomized design

Statistical analysis

Data obtained from the study were subjected to analysis of variance (ANOVA) using (SAS, 2012), and where significant differences occurred, means were separated using Duncan's multiple range test (Duncan, 1955). The results were considered significant at 5% level of probability.

Table : 1 Proximate composition of yam peel meal

Nutrients	Values
Crude protein (%)	7.78
Ether Extract (%)	0.80
Dry matter (%)	95.86
Crude fiber (%)	5.29
Ash (%)	7.19
ME/Kcal/kg	1045

Triplicate samples values

Table 2: Composition of the experimental diet

	Graded levels of yam peel meal			
	T1(0 % YPM)	T2(12.5 % YPM)	T3 (25% YPM)	T4 (37.5%YPM)
Ingredient				
Maize	38.00	33.50	28.50	23.75
Wheat offal	8.11	8.11	8.11	8.11
Soybean (full fat)	25.59	25.59	25.59	25.59
Yam peel meal	0.00	4.50	9.50	14.25
Rice offal	21.50	21.50	21.50	21.50
Fish meal	3.00	3.00	3.00	3.00
Bone meal	3.00	3.00	3.00	3.00
Premix	0.25	0.25	0.25	0.25
Methionine	0.20	0.20	0.20	0.20
Lysine	0.10	0.10	0.10	0.10
Salt	0.25	0.25	0.25	0.25
Cal. analysis				
Crude protein	16.81	16.76	16.71	16.61
Crude fiber	10.52	11.40	12.37	13.23
ME/Kcal/kg	2507	2400	2280	2053
Calcium	1.39	1.39	1.39	1.39
Phosphorus	0.76	0.75	0.74	0.73

Table 3: Haematolgical values of growing rabbits fed graded levels of yam peal Meal.

	Graded levels of yam peel meal				
Parameters	T1(0%YPM)	T2(12.5%YPM)	T3(25%YPM)	T4(37.5%YPM)	SEM
WBC (10^3/uL)	6.97^{c}	7.09^{c}	15.28^{b}	19.73^{a}	0.68*
RBC (10^6/uL)	6.19^{b}	7.82^{a}	5.01^{c}	4.73^{c}	0.23*
HGB (g/dL)	12.00^{b}	15.97^{a}	10.37^{c}	9.60^{c}	0.57*
HCT (%)	38.40^{b}	50.90^{a}	31.47^{c}	30.33^{c}	1.83*
MCV (fl)	63.33^{b}	65.53^{a}	63.80^{ab}	63.83^{ab}	0.92*
MCH (pg)	19.93^{b}	20.60^{a}	20.70^{a}	20.10^{b}	0.25*
MCHC (g/dL)	30.70^{c}	30.83^{c}	32.73^{a}	31.33^{b}	0.16*
Neutrophils (%)	41.35^{a}	30.15^{b}	41.85^{a}	11.25^{c}	1.66*
Lymphocyte (%)	47.15^{c}	60.40^{b}	40.20^{d}	75.24^{a}	1.33*
Monocytes (%)	10.90^{bc}	9.77^{c}	17.53^{a}	13.00^{b}	1.52*
Basophils (%)	0.63^{b}	0.80^{a}	0.28^{c}	0.60^{b}	0.08*
Platelets (10^3/uL)	299.30^{a}	197.00^{b}	215.30^{b}	169.00^{b}	39.73*

Superscript abcd = Means within the same row having different superscripts are significantly different (P<0.05), WBC=White blood cell, RBC=Red blood cell, HGB= Haemoglobin, HCT= Haematocrit, MCV= Mean Corpuscular volume, MCH= Mean Corpuscular haemoglobin, MCHC= Mean corpuscular haemoglobin concentration.

Table 4: Serum biochemical indices of growing rabbits fed graded levels of Yam peel meal

	Graded levels of yam peel meal				
Parameters	T1(0%YPM)	T2(12.5%YPM)	T3(25%YPM)	T4(37.5%YPM)	SEM
Sodium (mmol/L)	139.70^{b}	141.70^{b}	467.30^{a}	138.30^{b}	71.96*
Potassium (mmol/L)	6.27^{b}	7.07^{a}	5.70^{c}	5.90^{c}	0.16*
Chloride (mmol/L)	103.00^{b}	106.67^{a}	95.00^{c}	101.00^{b}	1.48*
Bicarbonate (mmol/L)	19.00^{ab}	19.33^{a}	18.33^{c}	18.67^{bc}	0.22*
Urea (mg/dL)	7.40^{d}	19.00^{a}	11.87^{b}	9.63^{c}	0.76*
Creatinine (mol/l)	77.67^{c}	69.67^{d}	99.33^{a}	92.00^{b}	2.11*
GOT/AST (IU/I)	43.33	44.67	43.33	47.33	2.85^{NS}
GPT/ALT (IU/I)	56.67^{b}	46.33^{d}	52.67^{c}	60.67^{a}	0.17*
T. Bilirubin (mol/l)	0.83^{c}	2.33^{c}	4.67^{b}	6.97^{a}	1.08*
Con. Bilirubin (mol/l)	2.93^{ab}	1.73^{b}	3.23^{a}	4.13^{a}	0.64*
Total Protein (g/l)	61.33^{b}	63.33^{b}	66.33^{a}	54.67^{c}	1.41*
Albumin (g/l)	40.00^{a}	41.00^{a}	37.33^{b}	33.33^{c}	1.08*
A. Phosphatase (IU/I)	84.00^{a}	85.00^{a}	35.00^{c}	62.00^{b}	11.07*
Amylase (U/L)	223.67^{a}	119.33^{b}	138.33^{b}	189.33^{a}	16.35*

Superscript abcd = Means within the same row having different superscripts are significantly different (P<0.05), GOT= Glutamate Oxalo-acetate transminase, GPT= Glutamate Pyruvate transaminate,

Results and discussion

The haematological and serum biochemical response of rabbits fed diets containing graded levels of Yam peel meal (YPM) as replacement of maize are presented in Table 3 and 4. The result showed dietary effect (P<0.05) on WBC counts. Rabbits fed37.5% YPM diet had higher (P<0.05) WBC followed by those fed on 25% YPM but, there was no difference (P>0.05)

between 0% and 12.5%replacement diets. The range values of 6.97 to 19.73 $x10^3/mm^3$obtained in this study is higher the range of 8.45 to 15.84 $x10^3/mm^3$ for male and female New Zealand rabbits Saad *et al*. (2017). Normal WBC ranges values of2.5 – 12.5 x10 $^3mm^3$ for rabbits have been reported by Postgraduate Committee in Veterinary Sciences (1990). The higher values of WBC observed in rabbits fed on diets T3 and T4is an indication that the rabbits immune system may have been challenged probably the anti-nutritional factors associated with high dietary content of the test ingredients which lead to production of more WBC. Wild species of yam harvested for food in periods of food scarcity, have been reported to contain toxic substances, Phenolic compounds (Bhandari *et al*., 2003; Medoua *et al.,* 2007; Olatunji *et al.,* 2007), protease inhibitors, amylase inhibitors, oxalate, phytate (Bhandari *et al.,* 2003; Medoua *et al.*, 2007) and alkaloids (Olatunji *et al.,* 2007). The redblood cell (RBC), haemoglobin (Hb), and packed cell volume (PCV) of rabbits fed 12.5% replacement diets were significantly ($P<0.05$) higher. The range of values of 4.73 to 7.82 x10 $^3/mm^3$, 9.60 to 15.97g/dl and 30.33 to 50.90 % for RBC, Hb and PCV obtained in this study compare reasonably well with range of 3.22 to 7.2 x 10 $^6/mm^3$, 7.57 to 16.81g/dl and 34.68 to 51.50 % for male and female New Zealand rabbits (Saad, *et al.,* 2008). There were slight declines in RBC, Hb and PCV values observed as the inclusion levels of test ingredient exceed 12.5%. However, these values fell within reference range values of 30 to 50%,10 to 15 and 4 to 7 for PCV, Hb and RBC respectively (Gillet., 1994, Alessandro., 2007, Vicki and Ian 2012). This result indicates that dietary inclusion level of up to 37.5% of YPM support RBC, Hb and PCV synthesis. Pack cell volume (PCV) and haemoglobin (Hb) are very strong indicators of nutritional status ofanimals (**Jiwuba *et al*. 2016)**. According to Togun *et al*. (2007), when the haematological values fall within the normal range for rabbits, it is an indication that the diets did not show any adverse effects on haematological parameters, this indicates that feeding of YPM up to 37.5% has no adverse effect on PCV. The MCV values of rabbits fed on 0, 25 and 37.5% diets as replacement in this study were similar but differed significantly($P<0.05$) from rabbits fed 12.5% replacement. The variation may be due to nutrition and physiological status of animal (Esonu *et al.,* 2001). The range values of 63.33 to 65.53 fl obtained in this study was lower than the normal range of 78 to 95fl reported by RAR (2009). The MCH range values of19.93 to 20.70pg were within the normal reference range19.2 to 29.5pg and 18 .55 to 25.52pg reported by (Hewitt et.al, 1989) and Saad *et al,* 2017). The MCHC values of 30.70 to 32.73 g/dL were within the normal range values of 27 to 37 g/dL reported by RAR (2009). The neutrophils and lymphocytes values differed significantly ($P<0.05$) among the dietary treatments groups. According to Gillet (1994) the proportion of neutrophils and lymphocytes should be ratio 1:1, variation is an indication of infection. The variation recorded in rabbits fed 12.5 and 37.5% dietary levels of the test ingredients indicates that immune system might have been challenged probably due to antinutritional factors associated with higher content of the test ingredient. The range values of 11.25 to 41.35 % and 40.20 to 75 % recorded for neutrophils and lymphoctes in this study fell within 34 to70%and 43 to 80% reported for rabbits (Medirabbit, 2007). Monocytes range values of 9.77 to 17.53 %recorded in this study are higher than 2 to 10 %reported by Gillet (1994). Rabbits placed on 12.5 and 37.5% replacement diets had platelets

values lower than the values of 201 to 716 $x10^9$/l reported for growing rabbits Archetti *et al.* (2008) and normal range of values of 290 to 650 reported by Vicki and Ian (2012). The low levels of platelets recorded in rabbits fed dietary treatments 2, 3 and 4 may be attributed physiological reaction to anti-nutrient. According to Lucile (2012) low level of platelet may be attributed to allergic reaction, massive bleeding, anaplastic anaemia, systemic bacterial and fungal infection and storing samples for long time before it is analyzed. The serum sodium concentration of the rabbits fed diets T1, T2 and T4 (139.70, 141.70, 138.30mmol/l) were significantly($P<0.05$) lower than value of 476.30mmol/l recorded for T3. These values except T3 fall within the range values 138 to 148 mmol/l, 132 to 151mmol/l (Hewitt *et al.,* 1989, Saad *et al.*, 2017). The serum potassium values of the rabbits fed diets T3 and T4 (5.70 and 5.90mmol/l) were similar but differed significantly ($P<0.05$) from value of 6.27 and 7.07mmol/l recorded for rabbits fed diets T1and T2. The results of serum potassium obtained in this study were higher than biochemical range values of 1.01 to 1.96 and 1.07 to 1.85mmol/l for male and female New Zealand rabbits reported by Saad *et al.* (2017). The serum bicarbonate, urea, creatinine and ALT significantly ($P<0.05$) differed among treatment groups. The blood urea (BUN) of rabbits fed test ingredients were higher than those placed on control diets. The results obtained from this study revealed that dietary inclusion YPM influenced potassium, bicarbonate, urea, creatinine and ALT levels suggesting that the differences observed could be attributed to some other physiological factors. The AST values were not significantly ($P<0.05$) affected by experimental diets. Rabbits placed on T4 diet (37.5%) inclusion of yam peels meal had significantly ($P<0.05$) higher value of ALT (60.67) while the lowest value was recorded in rabbits fed diet T2 (46.33). The total bilirubin values of rabbits fed control and T2 diets were similar but, differed significantly from values recorded for T3 and T4. It is within the range values of 0.86 to 5.16 mmol/l of total bilirubin reported by Saad *et al.* (2017). The conjugated bilirubin values of 3.23 and 4.14 mmol/l recorded for rabbits fed diets T3 and T4 are similar but differed significantly from the values of 2.93 and 1.73mmol/l recorded in T1 and T2. The total protein values of 61.33 and 63.33 g/dL recorded for the rabbits fed diets T1 and T2 were similar but, significantly differed from other treatment groups. The albumin and alkaline phosphate values were similar in T1 and T2 but differed significantly from other treatment groups. The significant differences recorded for the serum total proteins, albumin and bilirubin in this study, is an indication that dietary inclusion of YPM influenced the protein metabolism in the experimental animals, since the synthesis of serum protein is mainly associated with the quantity of the available protein in the diet. Amylase value of 223.67 recorded for rabbits placed on control based diet was the highest and significantly differed from values of 119.33 and 138.33 recorded for T2 and T3 but similar to T4. Amylase helps the body breakdown sugars and may increase in the blood of animals with inflammation (pancreatitis). Increasing dietary levels of YPM beyond 12.5% in this study has shown to cause an increase in WBC and slight decrease in RBC especially in rabbits placed on diets T3 and T4 indicative of anti-nutritional factors. This result, validate the finding of Abdel *et.al* (2014) who observed increase in WBC values with increasing dietary levels of *Khaya senegalensis* leaves in rabbits diets. The result of this study revealed that dietary inclusion YPM 37.5% level have no detrimental effect on haematological and serum biochemical

profile of the experimental animals.

Conclusion

The study showed that up to 37.5% inclusion level of yam peel meal can be fed to growing rabbits without deleterious effects on health status.

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