RESPONSE OF WEANER RABBITS TO GRADED LEVEL OF OFFAL BASED DIETS OF TIGER NUT(*Cyperus esculentus*)

Alu, S. E.

Department of Animal Science, Faculty of Agriculture, Nasarawa State University, Keffi, P.M.B.135, Shabu-Lafia Campus, Nasarawa State, Nigeria.

Corresponding Author's E-mail:seafarms2000@yahoo.com.

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ABSTRACT

Twenty crosses of Californian x New Zealand breed of weaner rabbits averaging 4 to 6 weeks old of mix sexes were used to investigate the growth and haematological traits of rabbits fed on tiger nut offal (TNO) based diets in a 35- day experiment. They were randomly allotted to 5 treatment groups and replicated 4 times. Each replicate had 1 rabbit that was housed individually in a cage and were fed twice daily (7.00am and 4.00pm) and had access to drinking water at all times. Feeding troughs and drinkers were provided in each cage and a known quantity of feed was supplied daily. Five diets were compounded to be iso-nitrogenous (18% CP) and iso-caloric (2700 ME kcal/kg) and TNO was included in the diets at 0, 5, 10, 15 and 20%, respectively. Growth was observed and measured in the course of the feeding trial and the results showed non-significance (P>0.05) in feed intake (68.11-75.66 g/rabbit/day), body weight gain (5.39-8.40 g/rabbit/day), feed conversion ratio (6.64-7.82) and protein efficiency ratio (11.59-13.38); other parameter included feed cost per kg and mortality. Blood samples from rabbit treatments revealed that there was no variation (P>0.05) in packed cells volume (26.25-34.00 %), haemoglobin (9.30-10.10 g/dl), red blood cells (2.23-2.93 X1012) and white blood cells (6.00-7.75 X107). Mean corpuscular volume, mean corpuscular haemoglobin, mean corpuscular haemoglobin concentration, neutrophils and leucocytes were also not affected by the graded levels of TNO. Serum biochemistry analyses also showed that there was no variation (P>0.05) in the serum glucose (3.65-5.75 mol/l), cholesterol (2.80-5.00 mmol/l), total protein (48.50-52.50 g/dl), albumin (24.00-43.50 g/dl), creatinine (44.50-66.00 µ/l) and triglyceraldehyde (0.25-0.80 mmol/l). Similarly, serum enzymes, alkaline phosphatase, aspartate transaminase and alanine transaminase were not affected (P>0.05) by the inclusion of TNO in the diets. All the electrolytes analyzed, phosphate, calcium, sodium, chloride and bicarbonate were not influenced (P>0.05) by the treatments. The inclusion of TNO in the diet of rabbits did not affect their health status, nutrient bioavailability, and utilization as well as growth rate therefore; farmers can incorporate up to 20% of TNO in the diets of rabbits without causing any deleterious effect.

Keywords: *Weaner rabbits, haematology, growth rate, Tiger nut offal*

INTRODUCTION

Animal protein is a very important requirement in human diet, for the supply of all needed essentials amino acids the body cannot synthesize. In Nigeria, like many other developing countries of the world, there is inadequate dietary animal protein in terms of quality and quantity. This is contrary to the situation in many developed countries that have well developed animal production industries that meet the demand for dietary animal supply. Larger percentage of human population live on cereals and not root crops which are deficient in essential amino acid needed for growth and development. Tewe (1997) reported that animal protein consumption in Nigeria was 4.82g / caput / day as against the required minimum of 35g recommended by the FAO (2002). World Bank Assisted National Agricultural Research Strategy Plan (1999-2010) has projected animal protein supply of 5.322g / caput / day, for the estimated 159million population in 2010.

The problem of malnutrition in Nigeria is mainly attributing to low intake of animal protein both in quantity and quality. The livestock sub-sector of the Nigerian economy is not fulfilling its primary role of satisfying the protein requirement of the nation. This implies that livestock production has to improve radically if the ever increasing demands for animal products in the diets of people in the developing countries are to be met. The shortage and high price of animal protein have been aggravated by the high cost of conventional feed ingredients. The current high cost of commercial feeds is well known and that feed account for 60-80% of production cost of monogastric animals in developing countries compare to about 50-60% in developed countries. The level of cereal and oil seed production and processing, the ravage of drought and the competition from direct human consumption have all contributed to the high cost of grains which in turn has lead to folding up of many poultry farms, and general decline in livestock production.

The nutritionist has the long time challenge for research into least cost rations in order to sustain the farmers in production (Alu, 2015).

The scenario pointed to above has therefore forced animal nutritionists to expand the raw materials base for livestock feeds formulation to include an ever increasing range of agro-industrial by products into animal feeds which hold tremendous potentials for alleviating the short supply and high cost of feed. The use of non-conventional feedstuff as substitutes for grains and other feedstuff have been the most active area of animal nutrition research in the tropical world; one of such non-conventional agro-by-products that have the potential of reducing the cost of staple grains is Tiger nut offal.

Tiger nut was reported as noxious, invasive and injurious weed in the tropical and temperate zones; they are edible tubers with a slightly sweet, nutty flavour. The nuts have excellent nutritional qualities with a fat composition similar to olive oil. The nuts are also very rich in mineral content especially phosphorus and potassium (Eteshola and Oraedu, 1996) which makes it a suitable ingredient for feeding poultry. The objective of the study is therefore; to investigate the response of weaner rabbits fed graded levels of Tiger nut offal based diets.

MATERIALS AND METHODS

Study area

The experiment was carried out at the Nutrition and Biochemistry laboratory of Animal Science Department, Nasarawa State University, Keffi, Shabu-Lafia Campus. It is located in the Guinea Savanna zone of Nigeria. It is found on latitude 08035'N and longitude 08033'E. The mean monthly maximum and minimum temperatures were 35.060C and 20.160C respectively at the time of the experiment while the mean monthly relative humidity and rainfall were 74.67% and 168.90mm respectively (Nigerian meteorological Agency, 2008).

Source of Tiger nut offal and other feed ingredients

Tiger nut offal (TNO) was sourced from local drink vendors within Lafia metropolis, Nasarawa state, Nigeria. It was sun dried and used to compound the experimental diets. Other feed ingredients included maize, full fat soybean, common salt methionine, vitamins-mineral premix, palm oil rice offal, groundnut cake, lysine and bone meal.

Chemical analyses

The proximate analysis of TNO and experimental diets were done at Faculty of Agriculture, Nasarawa State University, Keffi using the procedure outlined by AOAC (1990). Nitrogen free extract (NFE) was calculated using the formula: NFE (%) =100-(%CP+%CF+%EF+%ASH +Moisture).

Management of the rabbits and experimental design

Twenty weaner crosses of Californian x New Zealand breeds of rabbits of mix sexes averaging 4 to 6 weeks old were randomly allotted to 5 treatment groups and replicated 4 times. Each replicate had 1 rabbit that were housed individually in a cage. Anti stress and worming drugs were administered to the animals before the commencement of the experiment to reduce the stress that may arise from transportation and handling as well as possible presence of endo and ecto parasites.

The rabbits were fed twice daily (7.00am and 4.00pm) and had access to drinking water at all times. The experiment lasted for a period of 35 days after an initial adjustment period of 7 days.

Experimental diets

Five iso-nitrogenous (about 18% CP) and iso-caloric (2779 kcal / kg, ME) diets were compounded to contain 0, 5, 10, 15 and 20 % levels of TNO in treatments T_1, T_2, T_3, T_4 and T_5, respectively such that T1 served as the control diet. The percentage composition of TNO and experimental diet are presented in Tables 1 and 2.

DATA COLLECTION

Collection of blood

At the end of the 6th week 2 rabbits per treatments were randomly selected, a 2 ml sterilized disposable syringe and needle was used to collect blood sample from the heart according to the methods outlined by Schalm *et al.* (1972).

Haematological studies

A portion of the blood samples were emptied into sample bottles containing EDTA to prevent clotting and used for the hematological analysis. The parameters analyzed included packed cell volume, red blood cell, white blood cell, hemoglobin, mean cell haemoglobin, mean cell haemoglobin concentration and mean cell volume.

Serum biochemical studies

Another portion of the blood samples were emptied into sample bottles without EDTA and used to analyze for serum biochemistry. The parameters analyzed included total protein, triacylglyceridehyde, glucose, cholesterol, albumin, creatinine and globulin.

Enzyme

Blood sample were being collected in sample bottles without anti-coagulant to allow for clotting for serum enzyme analysis according to the methods outlined by Schalm et al. (1972). The enzymes analyzed included glutamine transaminase, aspartate transaminase, alanine transaminase, alkaline phosphatase, were analyzed.

Electrolytes

Blood samples collected in separate sample bottles without anti-coagulant to allow for clothing were used for serum electrolyte analysis according to the method outlined by Feteris (1965). Parameters analyzed included calcium, phosphate, sodium, potassium, chloride and bicarbonate.

Statistical analysis

Data obtained were subjected to One Way Analysis of Variance (ANOVA) and where significance differences (P?0.05) were observed, means were separated using Duncan's Multiple Range Test as described by Steel and Torrie (1980).

RESULTS AND DISCUSSION

Table 3 summarizes the effect of graded levels of TNO meal-based diets on growth performance of weaner rabbits. There was no significant variation (P>0.05) in feed intake (68.11-75.66 g / rabbit / day), body weight gain (5.39-8.40 g / rabbit / day), feed conversion ratio (6.64-7.82) and protein efficiency ratio (11.59-13.38) of weaner rabbits; the non-significant difference recorded could be attributed to the nutritional adequacy and safety of the test ingredients. The values recorded in this study fell within the normal ranges for rabbits as earlier reported by Lebas (1980) and Dalikeh *et al.* (2012). Dalikeh *et al.* (2012) reported lower values of 40.22 to 44.60g / rabbit / d for feed intake as compared to the ones recorded in the present study.

Table 4 shows the effect of graded levels of TNO meal-based diets on the haematological constituents of weaner rabbits. The values recorded were not significantly affected (P?0.05) by different dietary treatments. Packed cells volume (26.25-34.00 %), haemoglobin (9.30-10.10 g / dl), red blood cells (2.23-2.93 X1012) and while blood cells (6.00-7.75 X107) and other haematological variables evaluated were not affected by the various levels of inclusion of TNO in the diets. The non significant difference suggests the wellness of the animals throughout the period of the experiment as normal haematological parameters of an animal are direct indication of absence of disease (Olafedehan, 2010).

The effect of graded levels of TNO on the serum biochemical variables of weaner rabbits is presented in Table 5. The results show that there was no variation (P>0.05) in the glucose (3.65-5.75 mol / l), cholesterol (2.80-5.00 mmol / l), total protein (48.50-52.50 g / dl), albumin (24.00-43.50 g / dl), creatinine (44.50-66.00 µ / l) and *triglyceraldehyde* (0.25-0.80 mmol / l) however, the values recorded in the present study were close to those reported previously (Dalikeh *et al*., 2012) when they fed eggshell meal to weaner rabbits.

The values of the serum electrolytes (Table 5) analyzed were not significantly (P>0.05) affected by different dietary treatments which could be related to the nutritional adequacy and safety of the test ingredients (Olabanji *et al.*, 2007). An electrolyte imbalance exists when the serum concentration of an electrolyte is either too high or too low; stability of the electrolytes balance depends on adequate intake of water and the electrolytes, and on homeostatic mechanisms within the body that regulate the absorption, distribution and excretion of water and its dissolved particles. The results of serum electrolytes level in the present study imply that the rabbits were healthy.

The values of the serum enzymes (Table 5) indices analyzed were not significantly (P>0.05) affected by different dietary treatments. This observation could be related to the nutritional adequacy and safety of the test ingredients (Alu, 2015); the serum enzymes obtained for all the treatments groups were within the normal range as earlier reported by Lebas (1980).

Table 1: Proximate composition and energy value of Tiger nut offal

Nutrients	(%)
Caloric value (ME, kcal/g)	522.6
Crude protein	8.50
Crude fibre	5.50
Ether extract	2.12
Moisture (%)	6.77
Total Carbohydrate	65.50
Total Ash	1.86
NFE	64.00

Table 2: Percent gross composition of the experimental diets for weaner rabbits

Ingredients	T_1 (0%)	T_2 (5%)	T_3 (10%)	T_4 (15%)	T_5 (20%)
TNO	0%	5%	10%	15%	20%
Premix	0.25	0.25	0.25	0.25	0.25
NaCl	1.00	0.25	0.25	0.25	0.25
Bone ash	1.35	1.50	1.00	1.00	1.00
Palm oil	2.00	4.00	4.00	4.00	5.00
Methionine	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
GNC	22.00	14.50	13.65	17.50	18.00
Rice offal	29.90	16.00	14.00	7.00	-
Maize bran	-	20.50	15.00	5.00	2.00
FFSB	8.00	12.50	16.00	15.00	17.00
Maize	35.00	25.00	25.35	34.50	36.00
Total	100	100	100	100	100
Energy (kcal/kg, ME)	2795.74	2779.93	2710.60	2706.59	2711.12
CP (%)	18.46	18.02	18.08	18.15	18.00
CF (%)	5 84	5.92	5.26	3.71	2.72
Ca (%)	0.21	0.88	0.70	0.70	0.77
P (%)	0.83	0.52	0.50	0.42	0.31

*Premix, the vitamins and mineral premix supplied the following per 100kg of diet. Vitamin A 15,000 I.U, vitamin D_3 300,000 I.U ,vitamin E 3,00 I.U, vitamin K 2.50mg, thiamin,(B_1) 200mg, riboflavin (B_2) 600mg, pyridoxine (B_6) 600mg, niacin 40.0mg, vitamin B_{12} 2mg, panthothenic acid 10.0mg, folic acid 100mg, biotin 8mg, choline chloride 50g, antioxidant 12.5g, manganese 96g, zinc 6g, iron 24g, copper 0.6g, iodine 0.14g, selenium 24mg, cobalt 214mg.
TNO- Tiger nut offal, GNC- Ground nut cake

Table 3: Effect of graded levels of TNO meal-based diets on growth parameters of weaner rabbits

Parameters	T1 (0%)	T2 (5%)	T3 (10%)	T4 (15%)	T5 (20%)	SEM	LOS
Initial weight (g/rabbit)	725.00	775.00	787.50	787.50	775.00	57.19	NS
Final weight (g/rabbit)	1087.48	1001.12	1089.33	1108.19	1109.23	69.78	NS
Weight gain (g/rabbit/d)	8.48	5.39	7.07	7.65	7.95	0.34	NS
Feed intake (g/rabbit/d)	69.44	70.77	68.11	75.66	72.08	1.29	NS
Feed conversion ratio	6.64	7.09	7.60	7.82	6.84	0.69	NS
Protein efficiency ratio	12.59	12.72	13.38	12.61	11.59	1.22	NS
Feed cost/kg (N/kg)	78.24	99.70	104.91	76.36	104.63	-	-
Mortality (%)	0	25	0	0	50	-	-

SEM-Standard Error of Mean **NS**- Not Significantly different (P>0.05), **LOS**-Level of significance

Table 4: Effects of graded levels of TNO meal-based diets on the haematological parameters of weaner rabbits.

Parameters	T_1 (0%)	T_2 (5%)	T_3 (10%)	T_4 (15%)	T_5 (20%)	SEM	LOS
PCV (%)	29.50	29.50	30.50	26.25	44.00	5.65	NS
Hb (g/dl)	9.95	10.10	9.95	9.30	10.05	3.14	NS
RBC ($X10^{12}$)	2.91	2.93	2.75	2.23	2.91	1.66	NS
MCV (fl)	100.20	100.85	111.20	104.15	100.60	10.18	NS
WBC($X10^7$)	7.25	6.00	7.05	7.75	6.35	2.62	NS
MCH (p/g)	33.75	34.20	35.35	35.95	34.45	5.89	NS
MCHC (g/dl)	33.75	34.20	31.90	35.25	34.00	5.82	NS
Lymphocyte (%)	60.50	63.00	55.50	55.75	63.00	7.72	NS
Neutrophils (%)	39.50	37.00	44.50	43.00	37.00	6.34	NS

SEM= standard error of mean, **LOS**= level of significant, **NS**= not significant (P>0.05), **LOS**-Level of significance,
PVC- Packed cell volume, **Hb**- Haemoglobin, **RBC**- Red blood cells, **MCV**- Mean corpuscular volume, **WBC**- White blood cells, **MCH**- Mean corpuscular haemoglobin, **MCHC**- Mean corpuscular haemoglobin concentration

Table 5: Effect of graded levels of TNO meal-based diets on the serum biochemical parameters of weaner rabbits.

Parameters	T_1(0%)	T_2(5%)	T_3(10%)	T_4(15%)	T_5(20%)	SEM	LOS
Glucose (*mol/l*)	5.55	5.62	5.45	3.65	5.75	2.28	NS
Cholesterol (*mmol/l*)	4.90	4.20	5.00	2.80	4.70	2.07	NS
Total protein (*g/dl*)	52.50	49.00	50.50	48.50	48.50	7.05	NS
Albumin (*g/dl*)	24.00	25.00	28.50	28.50	43.50	5.07	NS
Creatinine (*µ/l*)	52.50	44.50	53.33	46.00	66.00	7.24	NS
TG (*mmol/l*)	0.75	0.80	0.80	0.25	0.25	0.75	NS
Alkaline phosphatase (*µ/l*)	64.00	63.50	64.00	65.50	70.00	8.08	NS
Aspartate transaminase (*µ/l*)	44.00	38.50	37.00	38.00	43.58	6.34	NS
Alanine transaminase (*µ/l*)	17.25	18.95	17.90	20.80	19.40	4.80	NS
Phosphate (%)	0.80	0.85	0.65	0.60	0.75	1.30	NS
Calcium (%)	2.60	2.25	2.50	2.65	2.20	1.56	NS
Potassium (%)	0.80	0.85	0.65	0.60	0.75	0.85	NS
Sodium (%)	3.75	4.55	5.25	1.40	2.40	1.85	NS
Chloride (%)	93.00	95.00	91.50	92.00	98.50	9.69	NS
Bicarbonate (%)	25.00	29.50	27.00	25.00	25.50	5.14	NS

SEM= standard error of mean, **LOS**= level of significant, **NS**= not significant (P>0.05), **TG**-Triglyceraldehyde, LOS-Level of significance

CONCLUSION

From the results of this study farmers can use up to 20% of TNO as a source of energy for rabbit feeding without affecting nutrient bioavailability and utilization to the animals.

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