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Supplementing Of Tigernut (*Cyperus Esculenta Var Sativus*) Meal on Carcass Characteristics, Haematology and Blood Chemistry of Female Weaner Rabbits.

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ABSTRACT

This experiment was conducted to find the effect of feeding varying levels of tiger nut meal on weaner carcass quality, haematology and blood chemistry of female rabbits at graded levels of inclusion (0% $=T_1$, 10%$=T_2$, 20%$=T_3$ and 30%$=T_4$). Four (4) treatment diets were formulated to contain tigernut inclusion levels of 0% (control), 10%, 20% and 30%. Twenty-four (24) clinically healthy female weaner rabbits were used in the experiment to evaluate the effect of feeding varying levels of tigernut meal diet. They were randomly divided into 4 groups of 6 animals per treatment with 2 animals per replicate given 3 replicate per treatment, in a Completely Randomized Design (CRD). Water and feed were given ad libitum. The experiment lasted for 120 days. Simple descriptive statistics and analysis of variance (ANOVA) were used to analyze the data while the New Duncan's Multiple Range Test was employed to compare treatment means. The dry matter (DM) and crude protein (CP) digestibility values were affected ($P<0.05$) by dietary treatments. The carcass characteristics studied showed that in live weight, dressed weight and the head, they differed significantly ($P<0.05$) but had no significant different ($P>0.05$) between them (i.e, T_2, T_3 and T_4). But in the other parameters there were significant ($P<0.05$) difference among them except in loins which had no significant difference ($P>0.05$) among the treatments. In the Internal organs of rabbits fed tigernut, all parameters differed significantly ($P<0.05$) but T_2 having the highest increase in liver, kidney with no significant different ($P>0.05$) between T_1 and T_2 in the spleen. On the blood chemistry and haematology of rabbits, there were no significant different ($P>0.05$) in PVC, Hb, RBC while MCV and MHC differed significantly ($P<0.05$) between the treatments. In the

white blood cell count there were significant difference ($P<0.05$) between WBC, Neutrophil and Lympocyte for T_1 to T_2, T_3 and T_4 but T_2, T_3 and T_4 showed no significant different ($P>0.05$) among them. This study revealed that tigernut meal is rich in carbohydrate. It also showed that the tigernut meal could be used as a partial or total replacement for maize at up to 30% level of inclusion without any adverse effect on the growth, reproductive performance and blood indices of the female weaner rabbits.

INTRODUCTION

The physiology of farm animals is affected by several factors, one of which is nutrition (Ajao et al., 2013). Nutrition status of an individual is dependent on dietary intake and effectiveness of metabolic processes. These can be determined by either or combination of chemical, anthropometric, biochemical or dietary methods (Bamishaiye et al., 2009). Feed is an important aspect of livestock production. The importance of feed supplementation in animal production has increased in the last few years (Sharifi et al., 2011). Increase in meat production can be achieved through\proper nutrition, inclusion of feed ingredients at normal or required levels (Etim and Oguike, 2010).

Many attempts have been made to solve this problem through the use of some non-conventional energy sources in poultry such as maize offal (Vantsawa *et al.,* 2008), palm oil sludge (Esonu *et al.,* 2006), cassava (Udedibie *et al.,* 2009) and in rabbit nutrition, wild variegated cocoyam (Agbabiaka *et al.,* 2006), cocoyam corm (Omorege *et al.,* 2009, Aderolu and Sogbesan, 2010). These tuber crops have been found to be of good potential but with limited crude protein content which is often below 3%. Tigernut (*Cyperus esculentus* L.) has been reported to be rich in energy while its oil content (about 25%) is resistant to peroxidation (Belewu and Belewu, 2007). Tigernut has been reported to be eaten raw, fermented and processed as beverages. It has the medicinal quality of preventing colon cancer, heart attack and diabetics (Belewu *et al.,* 2007) Tiger nut is a tuber rich in energy content (starch, fat, sugar), minerals (mainly phosphorus and potassium), and vitamins E and C thus making the tuber also suitable for diabetic patients to take

(Ekeanyanwu and Ononogbu, 2010). Tiger nut tubers contain almost twice the quantity of starch as potato or sweet potato tubers. The oil of the tuber was found to contain 18.0% saturated (palmitic acid and stearic acid) and 82.0% unsaturated (oleic acid and linoleic acid) fatty acids (Ezeh *et al.,* 2014). The moderately high content of phytosterols further enriches the quality and value of tiger nut oil as a food source, according to Consejo Regulador de Chufa de Valencia (Regulating Council for Valencia's Tigernuts, 2002)

Milling of the dry tiger nuts is a common and practicable processing technique among the livestock farmers and feed millers. Hence, it attracts attention in this study. Of importance to farmers and animal scientists are the following information; growth performance, particularly how a test feedstuff affects the feed intake, weight gain, final live weight and the proportion of the live weights that are edible and inedible (Chineke *et al.,* 2002). Blood is very vital to life and for meaningful work to be done on the biology of rabbits, the blood must be studied (Oke *et al.,* 2001; Chineke *et al.,* 2002). Hence information on the effect of tested feedstuff on the blood constitutuents is equally important. There is paucity of information on its potential as rabbit feedstuff in Nigeria, this study is therefore designed to evaluate its suitability as replacement for maize in rabbit production and the increase rearing of rabbit will improve and complement the quantity and quality of meat supply in the country.

MATERIALS AND METHODS

The experiments were carried out at the Rabbitary Unit of the Teaching and Research Farm of Abia State University, Umuahia Location. The Campus is located within the Southeastern Nigeria and lies between Longitude 07^0 33^1 E and Latitude 05^0 29^1 N at about 8km East of the Umuahia-Ikot Ekpene road. It is 140 km North of Port Harcourt International Airport, 135 km South of Enugu Airport and 80 km East of Owerri Airport. The experiment lasted for 120 days. The tiger nut seeds were purchased from "Ama Hausa" in Umuahia in Abia State, Nigeria. The milling was done at Feed Mill Unit of National Root Crops Research Institute, Umudike. Twenty-four (24)

female weaner rabbits were used for the experiment and were assigned to the four treatment diets following the Completely Randomized Design (CRD). where each treatment had six rabbits which was further replicated 3times with 2 rabbits per replicate and the breed used for the studies was New Zealand White with an average weight of 980g and 6-8 weeks of age. The rabbits were purchased from the rabbit unit of National Root Crops Research Institute, Umudike. The rabbits were housed in galvanized metal hutches measuring 100×60×80cm^3. The hutches were placed in an open sided house with corrugated roofing sheets, the side walls built up to 1meter high and the remaining part of the sides covered with wire mesh. Four treatment diets containing 0%, 10%, 20% and 30% tigernut meal were compounded.

RESULTS AND DISSCUSSION

Table 1: Effect of Tigernut meal on the carcass weight of Rabbit.

Treatments of dietary levels of tigernut meal (%)

Parameters	T_1(0%)	T_2(10%)	T_3(20%)	T_4(30%)	SEM
Live weight (g)	1480^a	1120^b	1200^b	1240^b	68.07
Dressed weight (g)	1440^a	1080^b	1180^b	1200^b	85.78
Head (g)	151.2^a	124.6^b	128.6^b	128.5^b	6.06
Hind leg weight (g)	241.2^a	183.8^b	176.6^b	209.2^a	14.61
Fore leg weight	141.1^a	83.9^c	92.8^b	90.8^b	13.12
Fur (g)	92.6^a	72.7^b	94.9^a	87.7^a	4.99
Ribs weight (g)	135.6^a	98.9^b	118.0^a	102.9^b	8.37
Loins (g)	237.6	222.5	230	235.5	3.37
Backbone (g)	258.6^a	111.2^c	194.2^b	174.5^b	30.36

a, b, c: Means with different superscript on the same row differ significantly (P<0.05).

The data on carcass weight are as presented in Table4.5. This result indicated that treatment 2, 3 and 4 did not differ (P>0.05) in live weight, dressed weight and head. But they differed significantly (P<0.05) from T_1 (control)There was no significant difference (P>0.05) between T_1 and T_4 in the weight of the hind leg. There was also no significant difference (P>0.05) between T_2 and T_3 in the weight of the legs. While treatments T_1 and T_4 differed significantly (P<0.05) from T_2 and T_3. In the fore legs weight there were significant different (P<0.05) between T_1, T_2, T_3 and

T_4, but there was no significant different (P>0.05) between T_3 and T_4. There were no significant differences (P>0.05) among T_1, T_3 and T_4 in fur weight but they differed significantly from T_2. There was no significant difference (P>0.05) between T_1 and T_3 in the rib weight. There was also no significant difference (P>0.05) between T_2 and T_4 in the rib weight, but treatments 1 and 3 differed significantly (P<0.05) from treatments 2 and 4. In loins there were no significant differences (P>0.05) among all the treatments. In the backbone there is significant different (P<0.05) between T_1, T_2, T_3 and T_4, but there was no significant different (P>0.05) between T_3 and T_4. The inclusion of tigernut meal in the diet did not affect weight of most carcass parts like fur, ribs weight and loins. This was in agreement with the results obtained by Adama and Haruna (2002), Adama and Danwake (1999) and Sankhyan *et al.,* (1991) but was contrary to the report of Collin (1976) when he compared the effect of 10 and 17% crude fibre in rabbit diets and observed that the carcass yield was reduced at the higher crude fibre level.

Table 2: Effect of Tigernut on the Internal organs of rabbit

Treatments of dietary levels of tigernut meal (%)					
Parameters	**T_1(0%)**	**T_2(10%)**	**T_3(20%)**	**T_4(30%)**	**SEM**
Liver (g)	40.3^c	46.7^a	41.3^c	43.7^b	1.42
Kidney (g)	8.5^b	10.6^a	10.1^a	8.6^b	0.53
Heart (g)	4.0^a	3.2^b	2.5^c	3.6^b	0.32
Lungs (g)	7.6^a	5.8^c	6.5^b	7.9^a	0.49
Spleen (g)	6.9^a	6.7^a	0.4^c	1.85^b	1.67
Intestine (g)	207.7^b	180.7^c	169.0^c	252.9^a	18.63

a, b, c: Means within row with different superscripts are significantly different (P<0-05).

Table 2 Showed effects of levels of inclusion of tigernut meal on internal organs of rabbit. The result indicated significant (P<0.05) effect of levels of inclusion (0%, 10%, 20% and 30%) of tigernut meal in the percentages of liver, kidney, heart and lungs, spleen and intestine. The liver was highest in T_2 (10%) and was followed by T_4(30%), T_3(20%) and T_1(0%), respectively. But there were no significant differences (P>0.05) between T_1 (10%) and T_3 (20%). The kidney was highest in T_2 (10%) and was followed by T_3 (20%), T_4 (30%) and T_1 (0%) respectively. There were no significant differences (P>0.05) between T_2 and T_3, but

they differed significantly (P<0.05) from T_1 and T_4. The heart was highest inT_1 (0%) while the least level was T_3 (20%). There was no significant difference (P>0.05) between T_2 (10%) and T_4 (30%). There was no significant difference (P>.05) between T_1 (0%) and T_4 (30%) which differed significantly (P>0.05) from T_2 (10%) and T_3 (20%).
The spleen had no significant (P>0.05) difference between T_1 (0%) and T_2 (10%) but were significantly (P<0.05) different from T_3 (20%) and T_4 (30%) which were significantly (P<0.05) different. The intestine was highest in T_4 (30%) and lowest in T_3 (20%), but there was no significant (P>0.05) difference between T_2 (10%) and T_3 (20%) inclusion level of tigernut. Similarly, the high fibre content resulted in less absorption in the intestine. Zhang *et al., (2009)* stated that the lining of the intestine has numerous tiny projections called villi, which are used for absorption.

EFFECT OF TIGERNUT MEAL ON BLOOD CHEMISTRY AND HAEMATOLOGY OF RABBITS

Table 3: Effect of levels of inclusion of tigernut meal on Haematology of female Rabbits. Treatments of dietary levels of tigernut meal (%)

Parameters	T_1(0%)	T_2(10%)	T_3(20%)	T_4(30%)	SEM
Packed cell volume (%)	36.67	37.52	35.45	38.54	0.65^{ns}
Haemoglobin (g/dl)	11.34	12.15	13.00	11.05	0.44^{ns}
Red blood cell ($x10^6/mm^3$)	4.35	4.50	4.51	4.53	0.44^{ns}
MCV (fl)	67.30^a	53.12^b	55.60^b	56.40^b	3.14
MCH (pg)	22.20^a	18.50^b	18.70^b	19.00^b	0.87

a, b, c: Means with different superscript on the same row differ significantly (P<0.05).
n. s= Not significantly different
SEM= Standard error of mean.

Effect of levels of inclusion of tigernut meal on haematology is as presented in Table 3. The result showed no significant (P>0.05) effect on packed cell volume (PCV), haemoglobin (HB) and red blood cell (RBC). In mean corpuscular volume (MCV) there were no significant differences (P>0.05) among T_2 (10%), T_3 (20%) and T_4 (30%) but they differed significantly (P<0.05) from T_1 (0%). The PCV, HB and RBC values obtained in this study are similar to the values reported by

Mohammed *et al. (2005)* who fed similar diets to growing rabbits. In mean corpuscular haemoglobin (MCH) of rabbits that consumed diets containing 10%, 20% and 30% of tigernut meal. The parameters (MCV and MCH) had similar trend indicating lack of abnormality. The values are close to the normal range of 60 – 73 fl and 16.23 pg for MCV and MCH respectively (Anon, 1980). The study generally indicated that incorporation of tigernut meal into the diet did not negatively affect haematological indices like red blood cell count and packed cell volume (Ewuola, E.O. 2010). It also means that it is not toxic to feed rabbits with diets containing 0% to 30% tigernut meal.

Table 4: Effect of feeding tigernut on White Blood Count of female rabbits Treatments of dietary levels of tigernut meal (%) Parameters

	T_1 (0%)	T_2 (10%)	T_3 (20%)	T_4 (30%)	SEM
WBC ($\times 10^3$/ui)	11.74^a	8.12^b	8.13^b	8.10^b	0.91
Neutrophil (%)	53.00^a	37.15^b	36.00^b	34.13^b	4.35
Lymphocyte (%)	62.44^a	48.24^b	43.34^c	41.35^c	4.76
Basophil (%)	0.00	0.00	0.00	0.00	0.00
Eosinophils (%)	0.00	0.00	0.00	0.00	0.00

a, b, c: Means within each row and with different superscripts are significantly ($P<0.05$) different.

The effect of levels of inclusion of tigernut meal on white blood count is as presented in Table 4. In White blood cells there were no significant differences ($P>0.05$) among T_2 (10%), T_3 (20%) and T_4 (30%) but they differed significantly ($P<0.05$) from T_1 (0%) and it was the same in the case for Neutrophil. In Lymphocyte T_1 differed significantly ($P<0.05$) from T_2, T_3 and T_4 but there was no significant difference ($P>0.05$) between T_3 and T_4. The values are similar and fall within the normal range for health rabbits as reported by Ahamefule *et al.* (2006). In Basophil and Eosinophils there were no result.The white blood cell counts (%) of monocytes, lymphocytes, basophils, neutrophils and eosinophils were also not significantly different ($P>0.05$). The values are similar and fall within the normal range for healthy rabbits as reported by Ahamefule *et al.*, (2006).

Table 5: Effect of feeding tigernut on Serum biochemistry of female rabbits.Treatments of dietary levels of tigernut meal (%) Parameters

	T_1(0%)	T_2 (10%)	T_3 (20%)	T_4 (30%)	SEM
Total Serum Protein (g/dl)	4.52	4.42	5.53	5.01	1.19^{NS}
Albumin (g/dl)	2.81	3.01	3.51	3.39	0.94^{NS}
Globulin (g/dl)	1.71^{a}	1.41^{b}	2.02^{a}	1.62^{a}	0.02 *
Glucose (mg/dl)	6.50^{a}	4.80^{b}	6.40^{a}	7.60^{b}	1.32 *
Urea (g/dl)	3.10^{a}	2.90^{b}	2.60^{b}	3.00^{a}	0.71*
Creatinine (ms/dl)	63.10^{a}	67.11^{a}	54.11^{b}	52.10^{b}	4.65*

Mean within the same row with different superscripts significantly different (P<0.05); NS=Non significant (P>0.05); *=significant (P>0.05); SEM= Standard Error of Means.

The effect of levels of inclusion of tigernut meal on serum biochemistry are as presented in Table 5. The albumin values showed no significant difference (P>0.05) among treatments and the values fell within the normal range of 2.5 to 4.0 g/dl reported by Anon (1980). The globulin values (1.02 to 2.02 g/dl) showed significant differences (P<0.05) among treatments. The values for T_1, T_2, $T_3$and T_4 were lower than the values reported by Anon (1980) but similar to 1.94-2.26 g/dl obtained by Onifade and Tewe (1993) who fed various tropical energy feed resources to growing rabbits. The total serum protein values (4.42 to 5.53 g/dl) were within the range reported by Anon (1980) but lower than 5.81-6.75 g/dl reported by Onifade and Tewe (1993). Since total serum proteins, albumin and globulin are generally influenced by total protein intake (Onifade and Tewe, 1993), the values obtained in this study indicate nutritional adequacy of the dietary proteins. Abnormal serum albumin usually indicates an alteration of normal systemic protein utilization (Apata, 1990). Awosanya *et al.* (1999) demonstrated the dependence of blood protein on the quality and quantity of dietary protein. The values for blood glucose (Table 4.8) recorded in this study ranged from 4.80 to 7.6 mmol/1 and 2.20 to 4.80 mmol/l respectively.Glucose level was significantly different (P<0.05) among treatments, the blood glucose was within the range 4.2-8.9 mmol/1 reported by Fudge (1999). Since glucose level was within the normal range, possibilities of anorexia, diabetes, liver dysfunction and mal-absorption of fat, which are the symptoms of abnormal glucose level in the blood (Bush, 1991) is ruled out. The blood urea values were within the range of 2.50 to 5.80 mmol/l

reported by Njidda and Hambagda (2006), who fed sesame seed meal to growing rabbits in tropical environment. Decreased blood urea may be associated with severe liver disease or protein malnutrition (Bush, 1991). There was no sign of ill-health observed in the rabbits and from the result of the feed analysis all the diets met the minimum levels required in the diets of growing rabbits. Serum creatinine levels were within normal range and did not differ ($P>0.05$) among treatment groups. The values obtained for animals on diets T_1, T_2 and T_3 were in consonance with the findings of Ahamefule *et al.,* (2009), who fed cassava peels processed using different methods. The results also suggest that there was no wasting or catabolism of muscle tissues, and that animals were not surviving at the expense of body reserve. This was a good indication that dietary protein was well utilized by rabbits.

Table 6: Effect of feeding tigernut meal on Electrolyte of female rabbits Treatments of dietary levels of tigernut meal (%) Parameters

	T_1 (0%)	T_2 (10%)	T_3 (20%)	T_4 (30%)	SEM
Calcium (mg/dl)	14.35	10.21	11.15	12.24	0.89
Phosphorus (mg/dl)	5.24	5.35	3.36	3.26	0.57
Potassium ($mmol L^{-1}$)	3.50	4.13	4.31	4.15	0.18
Chloride ($mmol L^{-1}$)	102.11	113.00	114.00	114.00	2.90
Bicarbonate ($mmol L^{-1}$)	26.21	29.13	30.25	32.00	1.22

In calcium, Treatment 1 (0%) had the highest amount (14.35 mg/dl) of calcium, followed by T_4 (12.24mg/dl), T_3 (11.15mg/dl) and T_2 (10.21mg/dl) in that order. The differences among the treatments were not significant ($P>0.05$). In Phosphorus, T_2 (10%) had the highest amount (5.35 mg/dl), followed by T_1 (5.24 mg/dl), T_3 (3.36 mg/dl) and T_4 (3.26 mg/dl) in that order. The differences among the treatments were not significant ($P>0.05$). The calcium and phosphorus values compared favorably with normal ranges of 5.6 – 12.7mg/dl and 2.3 – 6.9mg/dl for calcium and phosphorus levels of rabbits respectively (Onifade and Tewe, 1993). In Potassium ($K+$), T_3 (20%) had the highest amount (4.31 $mmol L^{-1}$), followed by T_4 (4.15 $mmol L^{-1}$), T_2 (4.13 $mmol L^{-1}$) and T_1 (3.50 $mmol L^{-1}$) in that order. The differences among the treatments were not significant ($P>0.05$). Potassium is the major positive ion found inside of cells. Some of the functions of $K+$ are the regulation of heartbeat and muscle function. The proper level of potassium is essential for

normal cell function. Any seriously abnormal increase or decrease in K+ can profoundly affect the nervous system and increase change of irregular heartbeats. An excess of calcium (>15g/kg) increases the calcification of soft tissues and can reduce the absorption of phosphorus and zinc, which will lead to deficiencies in those minerals. An excess of dietary phosphorus (>9g/kg) may reduce feed intake and reduce fertility (de Blas & Wiseman, 2003).In Chloride, T_3 (20%) and T_4 (30%) had the same and highest amount (114.00 mmolL^{-1}), followed by T_3 (113.00 mmolL^{-1}) and T_1 (102.11 mmolL^{-1}) in that order. The differences among the treatments were not significant ($P>0.05$). Chloride (Cl) is the major anion (negatively charged ion). Cl- is found in the fluid outside of the cells and in the blood. The balance of chloride ion (Cl) is closely regulated by the body. Seawater has almost the same concentration of chloride ion as human body fluids. Cls plays a role in helping the body maintain a normal balance of fluids. In Bicarbonate, T_4 (30%) had the highest amount (32.00 mmolL^{-1}), followed by T_3 (30.25 mmolL^{-1}), T_2 (4.13 mmolL^{-1}) and T_1 (3.50 mmolL^{-1}) in that order. The differences among the treatments were not significant ($P>0.05$). Bicarbonate levels are measured to monitor the acidity of the blood and body fluids. The acidity is affected by foods or medications that we ingest and the function of the kidneys and lungs.The calcium, Phosphorus, Potassium, Chloride and Bicarbonate values compared favorably with normal ranges of 5.6 – 12.7mg/dl and 2.3 – 6.9mg/dl for calcium and phosphorus levels of rabbits respectively, (Onifade and Tewe, 1993).

CONCLUSION

The result of this study indicated that the tigernut inclusion up to 30% had positive reliable effect on the carcass with no adverse effect on haematology and serum biochemical indices on the female weaner rabbits, while basophil and eosinophils showed no result.

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