Heamatological and Serum Biochemical Estimates of Weaner Pigs Fed Enzyme Supplemented Tigernut (*Cyperus esculentus*) Chaff Based Diets

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ABSTRACT

This study was carried out at the piggery unit of Alex Ekwueme Federal University Ndufu-Alike Ikwo, Abakaliki, Ebonyi State to evaluate the haematological and serum biochemical estimates of weaner pigs fed graded levels of tigernut chaff enzyme based diets. Sundried tigernut chaff (waste from tigernut processing) was collected from reputable tiger nut milk processors at Abakaliki, Ebonyi State, sun-dried for 5-7 days for the determination of proximate composition. Four experimental diets were formulated such that tigernut (Cyperus esculentus) chaff treated with multi-enzyme notably Growin ACT was included at 0%, 5%, 10% and 15% dietary levels coded (T_1), (T_2), (T_3) and (T_4) respectively. Data obtained from the study was subjected to the one-way analysis of variance (ANOVA) using general linear model of SPSS version. Results of the study showed that pigs fed enzyme supplemented tigernut chaff based diets showed significant ($P<0.05$) improvement in haematological parameters notably Hb, RBC, WBC, and PCV, with increasing dietary level of TNC while serum biochemical values such as albumin, serum glutamic oxaloacetic transferase (SGOT), Serum glutamic pyruvic transferase (SGPT) and creatinine reduced, as the dietary levels of TNC increased in the diets. In view of the above results, enzyme-supplemented tigernut chaff should be included in the ration of weaner pigs as a partial replacement for maize at 15% level for optimum haematological and serum biochemical profile, increased productivity and maximum economic benefits so as to make animal protein available at a reduced cost.

INTRODUCTION

Swine production in Nigeria despite its challenges ranging from high feed cost, religious taboos and environmental degradation (Amole *et al*., 2022) has been very prominent in reducing malnutrition among the Nigerian populace by bridging the animal protein supply and deficit gap (Nkwocha *et al*., 2024).

The Nigerian swine industry has been on the epic of development for the past two decades contributing meaningfully to Agri-food value chains. There is need therefore to encourage the production of pigs in the third world countries because of its potentials as an omnivorous polytoccus, fast growing animal with very high mortgage value accounting for 36% of worldwide meat production (Food Industry, 2024). The quest to enhance the production of swine in Nigeria stems from its geometric population growth (203,452,505) with an annual growth rate of 2.54% in 2018 (Central Intelligence Agency (2019) which if not marched with animal protein supplies will plunge the country to malnutrition and malnourishment challenges.

Livestock feeds and feed raw materials has been an important limiting factor to sustainable animal productivity in sub-Saharan African countries of which Nigeria is a classical example. Exploring the utilization of lesser-known unconventional feedstuff such as Tigernut (*Cyperus esculentus*) in swine feeding will be a step in the right direction. Tiger nut (*Cyperus esculentus*) is an underutilized crop belonging to the Cyperaceae family, characterized by its rhizomes and somewhat spherical tubers (Yu *et al*., 2022) Tiger nuts are nutritionally valuable, providing high-quality oil (up to 25.5% content) and approximately 8% protein (Adhikari *et al*., 2022). They are also rich in dietary fiber, carbohydrates, and other essential minerals such as iron and calcium, which are vital for growth and development (Pelegrin *et al*., 2022; Yu *et al*., 2022). Additionally, tiger nuts contain phosphorus, potassium, sodium, magnesium, zinc, traces of copper, and vitamins E and C (Yu *et al*., 2022; Pelegrin *et al*., 2022). Inclusion of alternative feed ingredients, such as tiger nut waste, in the diets of pigs holds promise as a sustainable solution to meet the growing demand for animal feed while reducing environmental waste (Olumide *et al*., 2020; Yu *et al*., 2022). However, the use of tigernut as a feed ingredient for pigs is limited by its high fiber content, which can reduce nutrient digestibility (Oyedeji *et al*., 2018).

Enzyme supplementation has been shown to improve nutrient digestibility and reduce the anti-nutritional effects of high fiber diets (Adeyemi *et al*., 2017). Despite much work done in tigernut, there is still dearth of information on the appropriate inclusion levels of Tigernut waste for optimum haematological and serum biochemical indices of weaner pigs hence, the relevance of this study.

MATERIALS AND METHODS

Location of the study

This study was conducted at the Piggery unit of the Teaching and Research farm of the Department of Agriculture, Alex Ekwueme Federal University Ndufu-Alike Ikwo, Ebonyi State which lies between latitude $06^0 15^{'}$N and longitude $08^0 5^{'}$E of the Greenwich meridian and Altitude of 55m. The annual rainfall is between 1000-1500mm. The vegetation of the area is predominantly derived Savannah and mean annual temperature is about 28^0C while relative humidity is between 50-60% (Climate-Data, 2023).

Experimental animals and design

Twenty-four commercial strain of large White weaner pigs with an average live weight of 7.52±0.18kg were used for the study. The pigs were placed in 0.3-0.5m² individual concrete floored pens fitted with feeding and watering troughs. Weaner pigs were randomly allocated to four (4) dietary treatments and were replicated three (3) times with each replicate having two (2) pigs in a completely randomized design (CRD). One week equilibration period was observed before the commencement of the experiment. The routine management and prophylactic measures was observed accordingly. The experiment lasted for 28 days (4 weeks).

Collection and preparation of sample

The tiger nut chaff (TNC) was obtained from a reputable tiger nut milk processors at Abakaliki, Ebonyi State. After the collection, tigernut were sun-dried for 5-7 days to reduce the moisture content and prevent the growth of molds on the treatment material.

Experimental diets and feed formulation

Four (4) experimental diets were formulated such that tigernut (*Cyperus esculentus*) waste was included at 0%, 5%, 10% and 15% dietary levels coded (T_1), (T_2), (T_3) and (T_4) respectively. The control diet T_1 did not contain any tigernut chaff. The test ingredient was subjected to proximate analysis (AOAC. 2016). Table 1 shows the ingredient composition of the experimental weaners diets.

Table 1: Ingredient composition of the experimental weaners diets containing graded levels of enzyme-supplemented TNC based diets

Ingredients	T_1	T_2	T_3	T_4
Pure maize	50	47.50	45.00	42.50
Tigernut Chaff (TNC)	0.00	2.50	5.00	7.50
Groundnut cake	20.00	20.00	20.00	20.00
Wheat offal	13.50	13.50	13.50	13.50
Palm kernel cake	7.00	7.00	7.00	7.00
Soya bean meal	3.00	3.00	3.00	3.00
Fish meal	3.00	3.00	3.00	3.00
Bone meal	3.00	3.00	3.00	3.00
Salt	0.25	0.25	0.25	0.25
Vit/Min Premix	0.25	0.25	0.25	0.25
Enzyme	0.10	0.05	0.10	0.15
Total	100	100	100	100
Calculated composition				
Energy (Kcal/KgME)	2794	2768	2741	2715
Crude protein (%)	18.61	18.49	18.36	18.24
Crude fibre (%)	3.87	4.57	5.27	5.96
Ether extract (%)	3.99	4.06	3.15	4.21
Phosphorus (%)	0.63	0.49	0.58	0.60

Haematological and Serum biochemical Studies

During the last week of the pig feeding trial, one weaner pig was randomly selected from each treatment, ie one weaner per replicate, for blood sample collection through the vein from the ham section using a 10 ml hypodermic sterile syringe after local disinfection with methylated spirit. Ten (10) ml of blood samples were collected into Bijon bottles containing ethylene diamine tetra acetic acid (EDTA) as an anticoagulant and shaken vigorously to avoid coagulation, while the remaining 5 ml were used for haematological analysis. Blood samples for haematology and serum biochemical estimates were taken to the laboratory for analysis of the following parameters: haemoglobin (Hb), packed cell volume (PCV), red blood cells (RBC), White blood cells (WBC), mean cell volume (MCV), mean cell haemoglobin (MCH), and mean cell haemoglobin concentration (MCHC) were determined according to Merck Veterinary Manuals, (Aiello *et al*., 2016). Serum biochemical indices variables taken were blood urea, serum creatinine, cholesterol, serum total protein, albumin, globulin, alkaline phosphatase, Serum glutamic oxaloacetic transferease (SGOT), Serum glutamic pyruvic transferase (SGPT), Magnesium (Mg^{2+}) and Potassium (K^{+}) were determined according to Duncan and Prasse (2011).

Statistical Analysis

All data collected were subjected to analysis of variance (ANOVA) using Statistical Package for Service Solution (SPSS, 2017) version 23. The treatment means were separated by Fisher's Least Significant Difference (LSD) Test (Williams and Abdi, 2010).

RESULTS AND DISCUSSION

The test ingredient (Table 2) revealed that it contains relatively low moisture content of 9.91%. The low moisture content observed in tiger nut chaff (TNC) was in agreement with Olumide *et al*. (2020) who reported lower moisture content of below 10%. The relatively low moisture content of TNC after sun drying will enhance good shelf life, relatively due to the low water activity as reported by (Frazier and Wstoff, 2010).

Table 1 Proximate analysis of dried tigernut chaff

Parameters	Composition
Moisture content	9.91
Crude protein	4.07
Ether Extract	5.55
Ash	3.37
Crude Fibre	30.23
Carbohydrate(NFE)	47.98
Energy value(Kcal/Kg)	2571.43

The proximate composition of tiger nut waste (Table 2) shows that it contains relatively low protein of 4.07% which implies that the TNC cannot be used as good source of protein in pig production. The value of protein obtained in this study aligns with the value of 4.40% obtained by (Olumide *et al*., 2020). However, Nkwocha *et al*. (2018) obtained higher values of 7.46% which might be attributed to the use of whole tiger nut meal and not the waste product. The high metabolisable energy of TNC based diets is attributed to high carbohydrate and crude fat content of the tiger nut chaff. The crude fibre value of 30.23% obtained in this study was higher than 21.45% obtained by (Olumide *et al*., 2020)) in a similar study on the evaluation of tiger nut (*Cyperus Esculentus*) waste as feed ingredient in broiler chicken diet. However, Nkwocha *et al*. (2018), obtained crude fibre values of 25.33% which is lower than the value obtained in this present study which appears to be attributable to the treatment of the tigernut with bakery yeast to enhance digestibility and biotransformation of organic synthesis.

According to Cherian (2020) the crude fiber of plant cell walls is a combination of the acid detergent fiber and neutral detergent fiber.

The packed cell volume (PCV) values obtained from this study indicated that the concentration followed a definite trend thus directly proportional to dietary inclusion of TNC. The highest value was recorded from weaner pigs in T_4 (15%) followed by T_2 (10%). The packed cell volume provides accurate evaluation of the RBC status and the inclusion of TNC positively improved the PCV of weaner pigs.

In this present study, it was observed that haematological parameters notably HB, RBC, WBC, and PCV, increased significantly ($P<0.05$) with increase in dietary level of TNC. Liu *et al*. (2020), Adeola and Ogundipe, (2020) reported that the haematological parameters of animals in good health varies with species, age, diets and clinical conditions of the animals and that diets can positively influence hematological indices.

The positive trend of WBC among weaner pig fed multi-enzyme supplemented TNC shows that weaner pigs placed on TNC will develop stronger immune system hence better combat of disease and infections. In line with the above report, Esonu (2000) stated that high WBC improves the immunological status of animals so as to help fight against diseases. Moreover, improved health and growth rates minimize disease related losses and reduce veterinary expenses. Apart from PCV, RBC and WBC, other haematological variables like HB, MCV, MCH and MCHC of weaner pigs placed on TNC based diets also performed marginally better than pigs placed in the control diet.

The serum biochemistry of the weaner pigs revealed that the albumin, serum glutamic oxaloacetic transferase (SGOT), Serum glutamic pyruvic transferase (SGPT) and creatinine reduced, as the dietary levels of TNC increased in the diets.

The globulins and albumins are classes of soluble proteins abundant in animal cells blood serum, milk and eggs. From the study, serum globulin result did not follow any definite trend but falls above the normal range (2-4g/dl) recommended for pigs. Globular proteins plays dynamic role in body metabolism. Adeola and Ogundipe (2020) examined the impact of enzyme supplementation in diets containing alternative feed ingredients, such as tiger nut waste and found that pigs fed enzyme-supplemented diets showed significantly higher serum protein levels and lower liver enzyme activities compared to those on non-supplemented diets. This indicates that enzyme supplementation not only enhances nutrient digestibility but also supports better metabolic health in weaner pigs.

The reduction of creatinine values in the serum indicates optimum utilization of nutrients hence reduced muscle wastage. Moreover, the moderate increase in globulin denotes that TNC positively contributed to the

synthesis of such blood forming metabolites like magnesium, Iron copper etc. which also enhances effective transportation of oxygen, glucose and other feed nutrients in the animal's body (Agbabiaka *et al.,* 2014; Aiello *et al*., 2016).

Table 3: Haematological values of weaner pigs fed tigernut chaff multi-enzyme supplementation

	Dietary Treatments					
PARAMETERS	T_1	T_2	T_3	T_4	SEM	P-values
Hb (g/dl)	9.60^{b}	9.95^{a}	9.35^{d}	9.49^{c}	0.06	0.021
PCV (%)	31.75^{b}	32.40^{a}	30.95^{c}	32.59^{a}	0.21	0.001
RBC ($X10^6$/l)	11.70^{b}	12.00^{a}	11.30^{d}	11.45^{c}	0.07	0.141
WBC ($X10^3$/l)	9.05^{b}	9.95^{b}	11.25^{ab}	12.25^{a}	0.99	0.027
MCV (C-u)	24.45^{b}	24.51^{b}	24.40^{b}	25.45^{a}	0.52	0.417
MCH (Pg)	7.05^{a}	7.15^{a}	7.20^{a}	7.25^{a}	0.99	0.943
MCHC (%)	31.90^{a}	31.95^{a}	31.97^{a}	31.65^{b}	0.12	0.679

^{abcd} Mean along the row having different letters differ significantly $P<0.05$

SEM = Standard error of the means HB = Hemoglobin; PCV – Packed cell volume, RBC = Red Blood Corpuscles; WBC = white blood Corpuscles, MCV = Mean Corpuscular Volume, MCH = mean Corpuscular Hemoglobin; MCHC = Mean Corpuscular Hemoglobin concentration; BT = Blood Clotting time.

Table 4: Serum biochemistry of weaner pigs fed tigernut chaff (TNC) multi-enzyme supplementation

	Dietary Treatments					
PARAMETERS	T_1	T_2	T_3	T_4	SEM	P-values
Urea (mg/dl)	31.19^{b}	33.09^{a}	30.64^{b}	32.14^{ab}	1.10	0.309
Creatinine(mg/dl)	0.91	0.93	0.79	0.84	0.10	0.027
Cholesterol (mg/dl)	74.50^{a}	75.98^{a}	75.58^{b}	72.28^{a}	2.20	0.386
Total protein (g/dl)	9.60	9.35	8.71	9.20	1.50	0.667
Albumin (g/dl)	4.40	3.90	3.96	3.95	1.00	0.815
Globulin(m/l)	5.20^{a}	5.45^{a}	4.75^{b}	5.25^{a}	0.25	0.021
SGOT (m/l)	32.93^{a}	32.64^{b}	29.00^{d}	30.09^{c}	1.05	0.016
SGPT (m/l)	10.00^{d}	13.00^{a}	12.00^{b}	11.02^{c}	0.50	0.001
ALK Phos. (m/l)	200.01^{b}	213.04^{a}	214.75^{a}	210.70^{a}	5.35	0.646
Mg^{2+} (mg/dl)	42.00	43.70	41.20	42.50	1.02	0.245
K^{+} (mmol/dl)	0.78^{a}	0.79	0.70^{b}	0.79^{a}	0.04	0.044

^{abcd} Means along the row having different letters differ significantly at ($P<0.05$)

ALK Phos = Alkaline phosphatase; Mg^{2+} = Magnesium; K^{+}= Potassium; Hco_3^{-} = Bicarbonate; CL = Chlorine; SGOT = Serum glutamic oxaloacetic transferease; SGPT = Serum glutamic pyruvic transferase

CONCLUSION AND APPLICATION

The results obtained from this study aptly demonstrated that Tigernut chaff has relatively good nutritional composition, capable of enhancing the haematological and serum biochemical posture of weaner pigs. The results shows that T_4 (15% inclusion) performed better than other levels of inclusion.

In view of the above results, enzyme-supplemented tigernut chaff should be included in the ration of weaner pigs as a partial replacement for maize at 15% level for optimum haematological and serum biochemical profile, increased productivity and maximum economic benefits so as to make animal protein available at a reduced cost.

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