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Carcass quality, haematological and blood biochemical profile of broiler chickens fed diets with graded levels of irish potato peel meal supplemented with enzyme

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***Target Audience:** Farmers, Nutritionists and Researchers.*

Abstract

A study was carried out to search for alternative energy sources for maize in poultry diet. A 9-week experiment was conducted to ascertain the effect of diets containing feeding varying levels of Irish potato peel meal (IPPM) used to replace maize with enzyme supplementation on the carcass quality, haematological and blood biochemical profile of broiler chickens. Two hundred and forty (240) Anak-2000 broiler chicks aged 6 days were randomly assigned to 12 floor pens containing 20 birds each. Four diets were formulated based on 23 and 20% crude protein in the starter and finisher phases respectively, to contain 0, 5, 10 and 15% IPPM supplemented with enzyme to serve as replacement for maize. Each of the diets was fed to 3 pens of 20 birds in a completely randomized design. Data were collected on carcass quality and blood samples at the end of the experiment. There were no adverse effects of the test material on the carcass quality, haematological and blood biochemical profile of broiler chickens.

***Keywords;** Carcass, Haematology, Blood, Biochemical and Profile*

Description of the Problem

Poultry production in Nigeria gain prominence mainly due to its short generation interval, relatively quick returns on its investment and the high-quality protein from poultry products namely meat and egg. Poultry production is one of the fastest means of increasing animal protein consumption in developing countries of the World (1). Broilers grow rapidly, so they need high quality diets to meet their nutrient requirements. Birds normally eat to satisfy their energy requirement, hence the need for adequate energy diet.

In developing countries like Nigeria, there is inadequate supply and consumption of animal protein. An average Nigerian consumes about 8.6g of animal protein per day against the 54g recommended by (2,3). According to (4), poultry production is considered to be a means of livelihood and a way of achieving certain level of economic independence in Nigeria. It was reported by (5) that 41.23% of animal protein yield per annum in Nigeria is sourced from poultry meat and eggs, 9.77% from cattle and 12.43% from pigs while (6) stated that the best logical solution to Nigeria's meat scarcity is to increase broiler chicken production.

There is need for adequate knowledge and application of science of nutrition to the

problems of nutrient supply at optimum level required by farm animals for economic gains (7). This is because feed and feeding of the farm animals is an important factor for efficient livestock management. Inadequate feed supply, nutritionally unbalanced rations, adulterated ingredients and/or stale feeds have been identified as some of the factors responsible for low productivity of the livestock in the tropics (8). Poultry industry contributes significantly to family income apart from serving as food, The highest overhead cost in poultry production is feed which accounts for 70 - 80% of the total cost of production hence it is a major concern to poultry and livestock farmers (5, 6, 7). Energy and protein nutrient sources are very expensive in poultry because of the food-feed competition (8). From the forgoing, Research efforts today are geared towards evaluating alternative, non-conventional feed ingredients to replace the expensive conventional ones in poultry and livestock feeds. Such alternative should have comparative nutritive value, available and should be cheaper than the conventional protein and energy sources. They should also be available in large quantities (7, 11).

Irish potato (*Solanum tuberosum*) peels a waste product of potato chips food industry is one of the alternative feed resources with, great potentials as energy source in poultry diets. This waste constitutes a lot of disposal challenges If not used particularly during the wet season and leads to pollution which is of a great environmental concern.

Potato peel is obtained during processing either by steam, lye or abrasive peeling depending on the type of products. As a consequence, large quantities of peels are generated which presents a severe disposal problem (12) with increasing awareness and aims of minimizing environmental impact and sustainability. Potato peels contain some nutritionally and pharmacologically interesting compounds such as polyphenols and glycoalkaloids which may serve as natural antioxidants and precursors for steroid hormones (12). Potatoes are good source of energy due to their carbohydrate content. They also contain some protein and rich in organic micronutrients such as Vitamin C, some B vitamins and an appreciable level of minerals. Report by (13) estimated that 40-50% of potato production is unsuitable for human consumption, so the by-product can be divided into cull potatoes which are whole potatoes not suitable for human consumption, and potato processing waste, (the peels). The peels, which are the major portion of processing waste, represent a severe disposal problem to the industry since wet peels are prone to rapid microbial spoilage. Potato peels though a waste product of the food industry is a source of high value compounds (14).

Materials and Methods

The study was carried out at the Teaching and Research Farm of the Department of Animal Science, Faculty of Agriculture, Ahmadu Bello University, Zaria. Zaria is located within the Northern Guinea Savanna Zone on latitude $11^0$9’ 06” N and longitude $7^0$38’55’ E, at an altitude of 706m above sea level. The maximum temperature varies from 26-32^{0}C depending on the season while the mean relative humidity during the dry and wet seasons are 21 and 72%, respectively. (15).

Table I: Composition of Broiler Starter Diets (0 – 4 weeks)

	Composition			
Ingredients	T1	T2	T3	T4
Maize	53.50	48.50	43.50	38.50
SBM	38.00	38.00	38.00	38.00
Wheat Offal	5.00	5.00	5.00	5.00
IPPM	0.00	5.00	10.00	15.00
YPM	0.00	5.00	10.00	15.00
Bonemeal	2.50	2.50	2.50	2.50
Limestone	0.30	0.30	0.30	0.30
Salt	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10
Maxigrain®	0.00	0.10	0.10	0.10
Total	100.00	100.00	100.00	100.00
Calculated Analysis				
ME (Kcal/Kg)	2874.18	2785.35	2826.52	2777.32
CP (%)	23.00	23.00	23.00	23.00
CF (%)	4.33	4.65	4.96	5.26
Fat (%)	2.99	3.59	3.53	3.47
Calcium	1.10	1.10	1.12	1.13
Available P	0.89	1.02	0.94	0.96
Lysine	0.10	1.22	1.20	1.13
Methionine	0.10	0.33	0.31	0.29
Cost/Kg	97.75	93.50	89.25	85.27

Vit-Mineral Premix provides per kg diet: Vitamin A 10,000iu, Vit. D_3 2000 i.u, Vit E 23mg, Vit K 2mg, Vit $B_1$1.8mg, Vit $B_{2,,}$5.5mg, VitB_6 6.0mg, Niacin 27.5mg, pantothenate 10.0mg, Biotin 0.06mg, VitB_{12} 0.015mg, Folic acid 0.75mg, choline chloride 300mg, Manganese 40mg, Iron 20mg, Zinc 30mg, Iodine 1mg, Selenium 0.2mg, Cobalt 0.2mg, Antioxidant 1.25mg

SBM= Soyabean meal, IPPM= Irish potato peel meal, P= Phosphorus

Two hundred and forty day-old (240) broiler chicks, Hubbard breed and of mixed sexes with an average initial weight of 63.33g were used for the experiment. They were housed in a deep litter house. The birds were allocated into four dietary treatments in a complete randomized design. Each treatment had three replicates with sixty (60) birds per treatment and 20 birds per replicate. Feed and water were provided *ad-libitum* throughout the 9 weeks of the experimental period.

Irish potato peels were gathered from some households, restaurants and commercial fryers in Jos and Bukuru metropolis of Plateau State. The peels were sun-dried and milled before being incorporated into the diets. Four diets were formulated as shown onTable 1: T_1 is devoid of the peels and serve asthe control while T_2, T_3 and T_4 had Irish potato peel meal replacing maize at 5, 10 and 15%, respectively and Maxigrain® was introduced into the experimental diets at a uniform rate.

Initial weights of the birds were taken on the 1st day of the experiment, they were then weighed weekly thereafter to know the weight gain which is used to calculate average weight gain. At the end of the fourth week (Starter phase), the birds from the same

treatments were pooled together and fed a common diet for a week before being randomized for the finisher phase of the experiment. At the end of the experiment, three birds from each treatment representing the average weight of the treatment were selected for carcass analysis. The birds were fasted overnight to allow for the emptying of the gastro-intestinal tract. The birds were then slaughtered and blood was collected into bottles containing ethylene di-amine tetra acetic acid (EDTA) as an anti-coagulant as well as bottles without EDTA and taken to the Clinical Pathology Laboratory, Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria for the determination of Packed cell Volume (PCV), leucocyte count (WBC), erythrocyte count (RBC), total protein (TP), haemoglobin (Hb), neutrophils, lymphocytes, monocytes, eosinophils, basophils and band. These analyses were performed within two hours of blood collection according to the methods described by (16). Bio-chemical analysis of the blood was carried out at Ahmadu Bello University Teaching Hospital, Zaria for the determination of Cholesterol, tryglicerides, alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP), Urea, albumin and glucose levels of the blood.

Table 2: Composition of Broiler Finisher Diets

	Composition			
Ingredients	T1	T2	T3	T4
Maize	61.35	56.35	51.35	46.35
SBM	30.00	30.00	30.00	30.00
Wheat Offal	5.00	5.00	5.00	5.00
IPPM	0.00	5.00	10.00	15.00
YPM	0.00	5.00	10.00	15.00
Bonemeal	2.50	2.50	2.50	2.50
Limestone	0.30	0.30	0.30	0.30
Salt	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10
Maxigrain®	0.00	0.10	0.10	0.10
Total	100.00	100.00	100.00	100.00
Calculated Analysis				
ME (Kcal/Kg)	3008.00	2828.00	2910.00	2861.00
CP (%)	20.00	20.00	20.00	20.00
CF (%)	4.03	4.33	4.65	4.96
Fat (%)	3.68	3.87	3.56	3.51
Calcium	1.18	1.09	1.11	1.12
Available P	0.77	0.73	0.75	0.74
Lysine	1.44	1.02	1.00	0.98
Methionine	0.32	0.29	0.28	0.26
Cost/Kg	104.03	99.78	94.73	98.85

Vit-Mineral Premix provides per kg diet: Vitamin A 10,000iu, Vit. D_3 2000 i.u, Vit E 23mg, Vit K 2mg, Vit $B_1$1.8mg, Vit $B_{2,}$5.5mg, VitB_6 6.0mg, Niacin 27.5mg, pantothenate 10.0mg, Biotin 0.06mg, VitB_{12} 0.015mg, Folic acid 0.75mg, choline chloride 300mg, Manganese 40mg, Iron 20mg, Zinc 30mg, Iodine 1mg Selenium 0.2mg, Cobalt 0.2mg, Antioxidant 1.25mg

SBM= Soyabean meal, IPPM= Irish potato peel meal, P= Phosphorus

The data collected were subjected to analysis of variance, significant differences among treatment means were separated using the Dunnutte test in the SAS package.

Results and Discussion

Carcass characteristics of broiler finisher chickens fed diets containing varying levels of IPPM supplemented with enzyme is presented on Table 3. The breast was significantly (P<0.05) higher in treatment 2 compared to the other treatments. Drumstick, thigh, back and wings were significantly (P<0.05) higher in treatment 4 than the other treatments but similar to treatments 1 and 3 in the drumstick, treatments 1 in thigh, back and wings.

Table 3: Carcass characteristics of Broiler Starter Fed Diets containing Varying Levels of Irish Potato Peel Meal with Enzyme Supplementation

	IPYPM Inclusion levels (%)				
Parameters	T1	T2	T3	T4	SEM
	0	5:5	10:10	15:15	
Final Live-weight (g)	2050.00	1975.00	2033.33	2550.00	219.99
Slaughter weight (g)	2000.00	1900.00	1975.00	2400.00	224.23
Carcass weight (g)	1900.00	1820.00	1883.33	2366.67	184.13
Dressing %	73.17	78.48	73.61	71.89	7.71
Prime cuts expressed as percentage of Carcass weight					
Breast (%)	17.89^{b}	17.89	18.61	18.00	3.32
Drumstick (%)	10.00^{b}	8.89	9.56	10.85	1.55
Thigh (%)	11.58^{b}	9.72	10.62	12.00	1.55
Back (%)	13.16^{b}	11.11	11.95	14.54	2.43
Wings (%)	7.63^{b}	6.04	7.26	8.54	1.39
Internal organs expressed as percentage of live-weight					
Full gizzard (%)	3.20	2.47	3.98	2.61	0.65
Empty gizzard (%)	2.37	1.68	1.80	1.91	0.42
Liver (%)	1.64^{b}	1.65	2.09	1.42	0.31
Lungs (%)	0.73^{a}	0.59	0.58	0.51	0.12
Kidney (%)	0.96^{a}	0.53	0.55	0.39	0.12
Heart (%)	0.52^{a}	0.47	0.55	0.39	0.05
Spleen (%)	0.13^{c}0.	120.12	0.14	0.09	

abc= means on the same row with different superscript differs significantly among treatments,
SEM= standard error of means

The empty gizzard and liver were significantly (P<0.05) higher in treatment 3 compared to the other treatments. The lungs, kidney and heart were significantly (P<0.05) higher in birds in the control group (Treatment 1) compared to the other treatments but similar to treatment 3 in heart. The spleen was significantly higher in treatment 4. Treatment group 4 had better results for most of the cuts. This was in agreement with (17) and (18) who observed the same trend when they fed IPPM and YPM to broiler finishers, respectively. This could probably be due to increasing levels of IPPM and the enzyme used. It also agreed with (19) who fed broilers with a

combination of yam and sweet potato peel meals.

Gizzard percentage did not follow any particular pattern or trend. This could be due to the use or action of the enzymes introduced in the diet which helped to digest the fibrous nature of the feed ingredients. Gizzard is known to be influenced by the degree of feed coarseness resulting from muscular activity during grinding (17; 20). There were significant differences for liver, lungs, kidney, heart and spleen. The differences may be due to the activities of these organs as they were known to play excretory roles removing toxic substances from the body. This work did not agree with (21) who reported non-significant difference in these organs when she fed broilers with rice offals.

Table 4: Haematological Parameters of Broiler Finisher Chickens Fed Diets Containing Varying Levels of Combinations of Irish Potato Peel and Yam Peel Meal with Enzyme Supplementation.

	IPYPM Inclusion levels (%)				
Parameters	T1	T2	T3	T4	SEM
	0	5:5	10:10	15:15	
PCV (%)	39.000	34.00	36.00	32.00	5.00
Hb (mg/dl)	11.50	10.50	11.54	11.00	1.00
WBC ($x10^{9/l}$)	8.77[a]	6.57	6.00	5.40	1.54
RBC ($x10^{12/l}$)	2.29[b]	1.88	2.03	1.74	0.51
Heterophils (%)	3.33[a]	4.33	5.67	4.33	1.47
Lymphocytes (%)	52.73[a]	49.10	58.27	49.27	18.57
Monocytes (%)	0.00[b]	2.33	3.00	2.00	1.73
Eosinophols (%)	0.00[b]	0.67	0.67	0.00	0.66
Basophils (%)	0.00	0.00	0.00	0.00	0.00
Band (%)	0.00[c]	1.33	1.33	1.33	1.23
MCV (fl)	121.20[a]	114.87	118.17	112.70	4.07
MCH (pg)	35.17b	35.20	37.87	35.63	1.96
MCHC (%)	39.33[b]	39.00	41.33	42.33	1.99
Platelets (10^6/m)	6.00[b]	5.00	6.67	4.67	2.71

abc= means on the same row with different superscript differs significantly among treatments, PCV= packed cell volume, Hb= haemoglobin, WBC+ white blood cells, RBC= red blood cells, MCV= mean corpuscular volume, MCH= mean corpuscular haemoglobin, MCHC= mean corpuscular haemoglobin concentration, SEM= standard error of mean

Result of the prime cuts such as breast, back, thigh and drumstick, all showed improvement in all the groups but treatment 4 was superior than all others. This result agreed with the report of (22) when 15% sun-dried and fermented cassava peel meal (CPM) were fed with fishmeal in place of ground-nut cake (GNC). Therefore, 15% was recommended and the level did not have any deleterious effect on the performance and carcass characteristics. In another study by (23), he observed that the good performance may be as a result of feeding very high level of fishmeal rather than GNC used in the study. He also observed that at 15% CPM inclusion in broiler diet, there was no

adverse effect on the carcass characteristics of the birds. They concluded that inclusion of cassava peels up to 20% in broiler diets will promote satisfactory biological activity. This work concluded that up to 15% inclusion of IPPM supplemented with enzyme in broiler diets had no adverse effect on their performance and carcass characteristics.

Effect of diets containing IPPM supplemented with enzyme on haematological parameters of broiler finisher chickens is presented in Table 4. The Packed cell volume (PCV), Haemoglobin (Hb) and Red blood cells (RBC) were significantly (P<0.05) higher in treatments 1 and 3 compared to the other treatments but are similar to treatment 4 in Hb and RBC, while white blood cell (WBC) was higher in treatment 1.

Heterophils were significantly (P<0.05) higher in treatments 3 and while lymphocytes were higher in treatments 1 and 3 compared to the other treatments. Eosinophils were significantly (P<0.05) higher in treatments 2 and 3 while band did not differ significantly. Mean corpuscular volume (MCV) was significantly (P<0.05) higher in treatments 1, 2 and 3. Mean corpuscular haemoglobin (MCH) was significantly (P<0.05) higher in treatment 3 while mean corpuscular haemoglobin concentration (MCHC) was higher in treatments 3 and 4 compared to the other treatments. PCV and haemoglobin values were within the normal range of 30-49% and 10.2 – 15.1mg/dl, respectively as reported by (9, 24, 25. White blood cells count of broilers on the treatment and control groups were within the normal range as reported by (24). This indicated that the test materials used did not have any harmful effect on the immune system and health status of the birds. It has been established that PCV, haemoglobin and total protein are strongly influenced by diet and are strong indicators of the nutritional status of animals (26) and therefore used to assess the health of the animals.

Table 5: Serum Biochemical Profile of Broiler Finisher Chickens Fed Diets Containing Varying Levels of Combinations of Irish Potato and Yam Peel Meals with Enzyme Supplementation

	IPYPM Inclusion levels				
Parameters	T1	T2	T3	T4	SEM
	0	5	10	15	
Total protein (g/dl)	4.40^{b}	5.47	5.77	4.70	0.79
Albumin (g/dl)	1.57^{b}	1.73	1.77	1.57	0.31
Globulin (g/dl)	3.30^{b}	3.70	4.00	3.17	0.66
Urea (mg/dl)	7.17^{a}	8.37	5.70	6.50	1.61
Glucose (mg/dl)	326.40	326.47	325.50	330.27	7.65
Cholesterol (mg/dl)	149.67^{b}	146.00	161.77	158.27	8.30
Triglyceride(mg/dl)	20.17^{b}	22.20	34.63	17.23	15.45
AST (µ/l)	136.96^{b}	136.37	139.33	132.00	5.05
ALT (µ/l)	17.13	19.47	19.80	18.70	4.13
ALP (µ/l)	9.46	7.80	9.07	9.47	14.02
Creatinine (mmol/l)	0.70^{c}	1.07	1.30	1.00	0.26

abc= means on the same row with different superscript differs significantly among treatments, AST= aspartate aminotransferase, ALT= ,alkanine aminotransferase, ALP=alkaline phosphatase SEM= standard error of mean

Result of diets containing IPPM supplemented with enzyme on the serum biochemical profile of broiler chickens is presented in Table 5 where there were significant differences across treatments in all parameters tested except glucose and ALT. The total protein, albumin and globulins were significantly ($P<0.05$) higher in treatments 2 and 3 compared to the other treatments. Cholesterol was significantly ($P<0.05$) higher in treatments 3 and 4 while triglycerides was higher in treatment 3 compared to the other treatments. Aspartate amino transferase (AST) was significantly higher ($P<0.05$) in treatment 3. Alkaline phosphatase (ALP) was higher in treatments 1 and 4 compared to the other treatments. Urea was significantly ($P<0.05$) higher in treatments 1 and 2 while creatinine was significantly ($P<0.05$) higher in treatments 2and 3 compared to the other treatments. Cholesterol was observed to be high in birds fed diets with 10% IPPM (treatment3). This could be attributed to the supplementation of enzymes. Enzymes have been known to help in the regulation of cholesterol level in the serum by working in conjuction with the bile acids (28); (29) suggested that co precipitation with bile acids may be of importance for decreasing of serum cholesterol concentrations. High levels of serum total protein recorded in the experiment could be due to the high protein intake and quality as reported by (30) and (31). All values obtained from the experiment fell within the normal range for poultry as recorded by (32) and (33).

Conclusion and Applications

1. This showed that the birds were in good health and concluded that IPPM supplemented with enzyme can be added up to 15% without any adverse effect on the serum bio-chemical profile of broiler chickens.

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