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Effect of diets containing graded levels of Irish potato peel meal (IPPM) on carcass quality, haematological and blood biochemical profile of broiler chickens

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Target Audience: *Farmers, Nutritionists and Researchers.*

Abstract

In the search for alternative energy sources for poultry feeding, a 9-week experiment was conducted to ascertain the effect of diets containing graded levels of Irish potato peel meal (IPPM) for maize on 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 experimental diets, based on 23 and 20% crude protein in the starter and finisher respectively, were formulated to contain 0, 5, 10,15 % IPPM replacement for maize grain. Each treatment was replicated thrice in a complete randomised design. Data were collected on growth indices, haematological and blood biochemical profile. During the starter period (7-28 days), daily feed intake and feed cost/kg gain were not adversely affected by feeding the test ingredient, but weight gain and feed conversion ratio (FCR) were depressed above 5% replacement of maize with the test material. In the finisher phase (28-63 days), feed intake was significantly increased on the 15% replacement diet compared to the control but did not differ statistically amongst the treatment based diets. The highest daily gain was recorded on the 5% replacement diet, but its values did not differ markedly amongst the control, 10 and 15% diets. Feed conversion ratio was significantly increased above 10% replacement of maize with IPPM/YPM. There was no adverse effect of the test material on haematological and blood biochemical parameters as their values all fell within normal range.

Description of Problems

Prominence of Poultry production in Nigeria today is mainly due to its short generation interval and relatively quick returns on its investment and the high quality protein from poultry products. Poultry production is generally accepted as the fastest way of increasing animal protein consumption in developing countries of the World (1). Broilers grow rapidly, hence the need to provide high quality diets to cater for their nutrient requirements. Birds normally eat to satisfy their energy requirement, hence the need for an adequate energy diet.

In a developing country like Nigeria, there is inadequate supply of animal protein. An average Nigerian consumes about 8.6g of animal protein per day against the 54g recommended by (2), (3 and 4). According to (5) and (6) reports, poultry production is considered to be a means of livelihood and a way of achieving certain level of economic independence in Nigeria.(7) reported 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.(8) report states that the best logical solution to Nigeria's meat scarcity is to increase broiler chicken production.

Nutrition tackles the problems of supplying optimum nutrients required by animals at an economic level (9). It is the most

important consideration in livestock management. Inadequate feed supply, nutritionally unbalanced rations, adulterated ingredients or stale feeds are some factors responsible for low productivity of the livestock industry in the tropics (10). Apart from serving as food, poultry industry contributes significantly to family income. The major interest of the farmer is to reduce the feed cost, which accounts for 70-80% of the total cost of production (9, 11and 12). Research efforts are geared towards evaluating alternative, non-conventional feed ingredients for poultry. Such alternatives should have comparative nutritive value but cheaper than the conventional protein and energy sources. They should also be available in large quantities (13 and 14).

Maize has a lot of industrial and domestic uses, such as bio-fuel, brewing, starch industries and for human food etc. However, inadequate production of this grain and the intense competition for maize between man, industries and livestock has made poultry rations to be expensive. This situation has forced farmers and feed millers to think and search for non-conventional sources of feed ingredients which are available in large quantities and cheaper and can substitute for the scarce and expensive maize. Some of such are Irish potato (*Solanum tuberosum*) peels, which have great potentials as energy source in poultry nutrition and the pollution caused by the peels have even become an environmental concern as it is a waste product of some food industries. It poses a lot of disposal problem especially during the wet season as it decays easily and pollutes the environment. Yam peels are also abundant and are being wasted instead of being utilized in livestock nutrition.

Potato is processed into value added products by fast food industries. Potato is usually peeled 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 represent a severe disposal problem (15) 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 (15).Potatoes are good source of energy due to their carbohydrate level. They also contain some protein and are rich in organic micronutrients such as Vitamin C, some B vitamins and an appreciable level of minerals. (16) 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 product of processing present 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 (17). This study evaluated the possibility of it serving as feed ingredient in broiler production.

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 season are 21 and 72%, respectively, (18).

Two hundred and forty day-old (240) Hubbard broilers of mixed sexes with an average initial weight of 63.33g were used for the experiment. They were housed in a deep litter system. The birds were allocated into

four dietary treatments in a complete randomized design. Each treatment had three replicates with sixty birds per treatment. Feed and water were provided *ad-libitum.*

Irish potato peels were gathered from some households, restaurants and commercial fryers in Jos and Bukuru metropolis of Plateau State, Nigeria. The peels were sun-dried and milled before analysis and then incorporated into the diets. Four diets were formulated as shown on table 1: T1 which contained maize without peels serve as control while T2, T3 and T4 had Irish potato peels replacing maize at 5, 10 and 15%, respectively.

At the end of the feeding trial, six birds were selected from each treatment group according to average body weight. They were fasted overnight in order to empty the contents of the gastro-intestinal tract, they were slaughtered. And blood samples were collected for haematological and blood biochemical analysis. The birds were then de-feathered and dressed before they are cut into prime cuts and expressed as percentage of dressed weight while organ weight were also taken and expressed as percentage of live-weight. The data collected was subjected to analysis of variance, significant differences among treatment means were separated using 19 in 20.

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/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
Total	100.00	100.00	100.00	100.00
Calc. analysis				
ME (Kcal/Kg)	3008	2998	2969	2929
CP (%)	20.00	20.00	20.00	20.00
CF (%)	4.03	4.16	4.42	4.71
Lipids (%)	3.68	3.77	3.86	3.95
Calcium	0.08	0.07	0.08	0.10
Available P	0.37	0.36	0.36	0.38
Lysine	1.44	1.03	1.02	1.01
Methionine	0.32	0.29	0.30	0.28
Cost/Kg (N)				

Vitamin-mineral premix provide per kg diet;Vit. A, 13340I.U; Vit D_3, 2680I.U; Vit E, 10 I.U.; Vit K, 2.68mg; Calcium pentothenate, 10.68; Vit. B_{12} 0.022mg; folic acid, 0.668mg, choline chloride,400mg; Chlorotetracycline, 26.68mg; Manganese, 13mg; Iron,66.68mg; Zinc,53.34mg; Copper,3.2mg; Iodine, 1.86mg; Cobalt,0.268mg; Selenium, 0.108mg.

IPPM = Irish Potato Peel Meal ; YPM = Yam Peel Meal; SBM = Soyabean Meal;

ME = Metabolisable Energy; CP = Crude Protein; CF = Crude Fibre

Results and Discussion

The effect of varying levels of IPPM on carcass characteristics of broiler finisher chickens showed significant differences in all parameters except empty and full gizzard. This could probably be linked to the fibrous nature of the feed ingredients. Gizzard is known to be influenced by the degree of feed coarseness resulting from muscular activity of the gizzard during grinding (21). The superior dressing percentage in treatment 1 agreed with (22) who observed the same trend when broilers were fed YPM. This could probably be due to increasing levels of IPPM and YPM.

Table 3: Carcass Characteristics of Broilers fed the experimental Diets

IPPM inclusion levels (%)					
Parameters	T1	T2	T3	T4	SEM
Live- weight	1825.00	1700.00	1775.00	1650.00	42.08
Carcass weight	1400.00	1175.00	1200.00	1200.00	52.56
Dressing %	76.71^{a}	68.12^{b}	67.61^{b}	71.72^{b}	5.45
Prime cuts expressed as percentage of Carcass weight					
Breast	2.91^{b}	25.28^{a}	25.83^{a}	23.52^{a}	4.33
Thigh	14.74	15.74	17.50	17.07	4.33
Drumstick	13.33^{c}	14.07^{b}	15.56^{a}	12.70^{d}	0.99
Back	16.69^{a}	17.16^{a}	17.75^{a}	16.45^{a}	1.57
Wings	10.24	11.01	12.39	12.70	3.11
Organ Weight expressed as percentage of live weight					
Heart	0.32^{b}	0.71^{a}	0.45^{b}	0.42^{b}	0.24
Empty Gizzard	3.51	4.75	4.54	4.40	1.84
Full Gizzard	2.48	2.98	3.02	2.69	0.56
Liver	1.81^{b}	2.49^{a}	1.95^{b}	2.12^{a}	0.45
Lungs	0.60^{a}	0.80^{a}	0.58^{a}	0.69^{a}	0.29
Kidneys	0.33^{b}	0.59^{a}	0.39^{b}	0.28^{b}	0.19
Spleen	0.09^{b}	0.16^{b}	0.32^{a}	0.12^{b}	0.13
Abdominal Fat	1.04^{b}	1.10^{b}	1.24^{a}	1.35^{a}	0.30

abcd= means on the same row with different superscript differs significantly among treatments,
SEM= standard error of means LOS=level of significance, NS=not significant

Table 4: Haematological Parameters of Broiler Fed the Experimental Diets

IPPM inclusion levels (%)						
Parameters	T1	T2	T3	T4	SEM	Range
PCV(%)	37.00	39.33	33.00	41.00	7.06	30 - 49
Hb(g/dl)	10.96	11.63	12.60	12.60	0.38	10.2 - 15.1
WBC($10^{10/L}$)	8.60	8.20	4.37	3.97	0.66	1.9 - 9.5
RBC($10^{12/L}$)	3.1	2.9	2.5	3.82	0.28	2.5 - 3.9
Total Protein(g/dl)	3.5	3.1	3.2	3.8	0.21	NA
Heterophils(%)	3.33	4.33	5.67	4.33	0.77	0.5 - 7.6
Lymphocytes(%)	0.96	0.91	0.90	0.92	0.04	0.0 – 1.00
Monocytes(%)	0.46	0.33	0.51	0.34	0.22	0.0 – 1.0
Eosinophils(%)	1.10	1.00	1.05	1.03	0.50	0.5 – 7.6
Basophils(%)	0.00	0.00	0.00	0.00	0.00	0.0 – 1.8
Band(%)	1.60	2.00	2.00	2.07	0.20	NA

abcd= means on the same row with different superscript differs significantly among treatments,PCV= Packed Cell VolumeWBC=White Blood Cell RBC= Red Blood Cell SEM= Standard Error of Means Hb= Haemoglobin NA=not available, Range Source = Clinical Avian Medicine Volume 11(608)

The significantly higher values of liver, lungs, spleen and kidney in treatment 6 may be due to the activities of these organs as they were known to play excretory roles removing toxic substances from the body. The result of these organs agreed with the works of (22and 23) when 15% sun-dried and fermented CPM were fed with fishmeal in place of ground-nut cake (GNC).

Result of prime cuts such as breast, thigh and drumstick showed that the test material did not have any deleterious effect on the performance of broiler chickens. This result agreed with the report of (22 and 23) when 15% sun-dried and fermented CPM were fed with fishmeal in place of ground-nut cake (GNC), 15% was recommended and the level did not have any deleterious effect on the performance and carcass quality. In another study by (24), 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 quality of the birds. (25) replaced maize with CPM at 0, 10, 20 and 30%. They concluded that inclusion of cassava peels up to 20% in broiler diets promoted biological activity satisfactorily. (26) replaced maize with combinations of yam and Irish potato peel meals to rabbits and reported that there was no adverse effect on carcass quality even at total replacement. This work concluded that up to 15% inclusion of IPPM/YPM combinations in broiler diets had no adverse effect on their performance and carcass quality.

Haematological parameters showed that packed cell volume (PCV) and haemoglobin were significantly ($P<0.05$) higher in T3 while white blood cells (WBC) was significantly ($P<0.05$) higher in T1 which differed significantly ($P<0.05$) from T2 and T3 that are similar which also differed significantly ($P<0.05$) from T4. Red blood cells (RBC) showed that T1 and T3 were similar and differed significantly from T2 and T4 that were similar. Blood haematological parameters serve as indicators of the physiological state of birds (27). All the parameters measured were within the normal range for broilers. The haematological parameters showed that the haemoglobin was within the normal range of 10.2 to 15.1mg/dl and eosinophils was also within the normal range of $0.5\text{-}7.6x10^9$/L as reported by (28) and (29). Total protein and white blood cells were within the normal range of $1.9\text{-}9.5x10^9$/L as reported by (30). Lymphocytes and heterophils make up the majority of white blood cells in birds (31).

All the haematological parameters measured were within the normal range reported by (32) and (33). PCV obtained were within normal range of 30 – 49%. it is an index of toxicity, any reduction in its concentration in the blood usually suggest presence of toxic factors (haemagluttinins) which has adverse effect on blood formation (34). It had been established that PCV, haemaglobin and total protein were strongly influenced by diet and were strong indicators of the nutritional status of animals (26; 35) and used to assess the health of the animals.

Biochemical parameters as presented showed there were significant differences in all the parameters measured except ALT. The high cholesterol and albumin recorded in treatments 1, 2 and 3 agreed with the report of (36) who reported that differences in cholesterol, albumin and glucose by growing birds were basically due to differences in the fibre content of the diet. The cholesterol levels are within the range of 3.33 – 5.40g/d which agreed with the values reported by (30) and (37).

All values fell within the normal range. They also agreed with the report of and (33) and (32) who reported on blood biochemical profile of broilers.

Table 5: Biochemical Parameters of Broiler Chickens Fed the Experimental Diets.

IPPM inclusion levels (%)						
Parameters	T1	T2	T3	T4	SEM	Range
T/ Protein(g/dl)	4.40^{b}	5.47^{a}	5.77^{a}	4.70^{b}	0.79	4.40^{b}
Cholesterol(mg/dl)	124.93^{a}	125.40^{a}	125.00^{a}	12.33^{b}	4.79	124.93^{a}
Triglyceride(g/dl)	1.60^{b}	4.87^{a}	2.00^{b}	1.27$^{c.}$	0.43	1.60^{b}
AST (µ/l)	121.00^{b}	124.00^{a}	110.33^{c}	121.67^{b}	4.54	121.00^{b}
ALT (µ/l)	28.00	29.63	28.00	28.67	0.21	28.00
ALP (µ/l)	6.50^{c}	8.67^{a}	7.00^{b}	4.67^{d}	0.89	6.50^{c}
Urea (mg/dl)	3.00^{b}	4.33^{a}	4.00^{a}	2.77^{b}	0.75	3.00^{b}
Albumin(mg/dl)	29.00^{a}	35.33^{a}	28.33^{a}	24.67^{b}	1.25	29.00^{a}
Glucose(mg/dl)	211.27^{a}	210.77^{a}	229.77^{b}	210.47^{a}	5.65	211.27^{a}
Creatinine (mmol/l)	0.70^{c}	1.07^{a}	1.30^{a}	1.00^{b}	0.08	0.70^{c}
Globulin(g/dl)	3.30^{b}	3.70^{a}	4.00^{a}	3.17^{b}	0.74	3.30^{b}

Conclusions and Applications

Based on carcass quality, it was concluded that;

- Sun-dried Irish potato peel can replace maize up to 15% level in broiler diets without adverse effect on carcass quality.
- Sun-dried Irish potato peel can replace maize up to 15% level in broiler diets without adverse effect on haematological and blood biochemical parameters.

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