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CARCASS QUALITY AND HAEMATOLOGICAL AND SERUM BIOCHEMICAL PARAMETERS OF BROILER CHICKENS FED COMBINATIONS OF IRISH POTATO PEEL AND YAM PEEL MEALS

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ABSTRACT
In the search for alternative energy sources for poultry feeding, a 9-week experiment was conducted to ascertain the replacement value of a combination of Irish potato peels and yam peel meals (IPYPM) for maize in broiler chickens' diets. 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, based on 23 and 20% crude protein in the starter and finisher respectively, were formulated to contain 0, 10, 20, and 30% IPYPM as replacement for maize grain. Each of the diets was fed to 3 pens of 20 birds in a completely randomized design. Birds were weighed at the beginning of the experiment, then weekly thereafter to get the weight gain. Known weight of feed is provided and left over feeds were weighed to get the feed intake. Vaccines were given at the appropriate age. Data were collected on carcass measurements and organs weights as well as haematological and serum biochemical parameters. Results of carcass measurements and organs weights did not show any disadvantage of feeding IPYPM, but there were beneficial effects of its feeding over the control maize-based diet with respect to breast meat at treatments 2 and 3 with values of 23.66 and 22.51g against 21.92g of the control and abdominal fat deposition where all the treatment groups were better than the control with values of 1.27, 1.35 and 1.52g against 1.04g of the control. Similarly, the results of haematological and serum biochemical parameters did not show any depressive effect of feeding IPYPM at all the levels as values obtained all fell within normal values. It was concluded that IPYPM combinations can replace maize up to 10 and 30% in broiler starter and finisher diets respectively without adverse effects on carcass measurement, haematological and serum biochemical profile.
***Keywords**: Biochemical, Carcass, Haematology, Irish potato, Peel, Meal, Yam.*

INTRODUCTION

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 (Ogundipe, 1999). 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 developing countries 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 FAO (1993). According to Ogundipe and Sanni (2002) and FAO (2006) reports, poultry production is considered to be a means of livelihood and a way of achieving certain level of economic independence in Nigeria. Adegbola (2004) 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. FAO (1995) report states that the best logical solution to Nigeria's Protein scarcity is to increase broiler chicken production.

Nutrition tackles the problems of supplying optimum nutrients required by animals at an economic level which 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 (Ogundipe, 1987). 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 (Igwebuike *et al.*, 2001; Ogundipe *et al*., 2003). Research efforts are geared towards evaluating alternative, non-conventional feed ingredients for poultry. Such alternative should have comparative nutritive value but cheaper than the conventional protein and energy sources. They should also be available in large quantities (Aduku and Olukosi, 1991; Alte and Ologbenla, 1993).

Maize and other conventional feed ingredients have 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 (Kpanja *et al*., 2019). 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 (Schieber *et al.*, 2009) 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 (Schieber *et al.,* 2009). Potatoes are good source of energy due to their carbohydrate level. They also contain some protein and rich in organic micronutrient such as Vitamin C, some B vitamins and an appreciable level of minerals. (Charmney *et al.,* 2006) 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 (Schieber *et al.*, 2001).

Yam peel is a waste product obtained when yam is peeled for cooking and other purposes. Yam peels have relatively high amino acid content (Eka, 1986) and dietary fibre of 6.30% (Akinmutimi and Onen, 2008). Presently, Yam peels do not form regular sources of dietary nutrients to Man. This means that there may be considerable cost advantage using it to replace a substantial amount of the maize component of poultry diet. The study is therefore designed to determine the carcass quality, haematological and serum biochemical profile of broiler chickens fed diets containing varying levels of combinations of Irish potato and yam peel meals.

MATERIALS AND METHODS.

Study Location.

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. (Meteorological unit, Institute of Agricultural Research, Ahmadu Bello University Zaria, 2009).

Experimental Birds and Management.

Two hundred and forty day-old Anak 2000 Broilers of mixed sexes with an average initial weight of 63.33g were used for the experiment. They were housed in a deep litter house. They birds were allocated into four dietary treatments in a complete randomized design. Each treatment had three replicates with sixty animals per treatment. Feed and water were provided ad-libitum throughout the 9 weeks experimental period.

Processing of Test Materials and Experimental Diets.

Irish potato peels were gathered from some households, restaurants and commercial fryers in Jos and Bukuru metropolis while yam peels were gathered at Kuraga Mbako Village of Wamba Local Government Area of Nasarawa State. 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 is devoid of the peels and serve as control while T_2, T_3 and T_4 had Irish potato and yam peels replacing maize at 5:5%, 10:10% and 15:15%, respectively.

Blood samples were collected into bottles containing ethylene di amine tetra acetic acid (EDTA) and bottles without EDTA were taken to the Clinical Pathology Laboratory at the Faculty of Veterinary Science, Ahmadu Bello University Zaria.

Initial weights of the birds were taken on the 1st day of the experiment; they were 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 for a week before being re-randomized for the finisher phase of the experiment. Feed consumption was also measured weekly as well as water consumption. At the end of the feeding trial, six birds were randomly selected from each treatment and used for carcass analysis. The birds were fasted overnight and weighed before being slaughtered, eviscerated and dissembled into whole cut and each primal parts as well as organs were weighed at the Teaching and Research Farm of the Department of Animal Science. Blood samples were collected from the slaughtered birds and taken to the Clinical Pathology Laboratory of the Faculty of Veterinary Medicine for haematology and serum biochemical analyses. The data collected were subjected to analysis of variance, significant differences among treatment means were separated using the Duncan multiple range test in the SAS package.

RESULTS AND DISCUSSION.

Carcass analysis of broilers fed diets containing varying levels of IPYPM is presented on Table 3. Dressing percentage was significantly higher in T1 with value of 76.71% and differed significantly ($P<0.05$) from the other treatments that were statistically similar. The result showed significant ($P<0.05$) differences in most parameters. Carcass weight was significantly ($P<0.05$) higher in the control group (Treatment 1) with value of 1400.00g compared to the other treatments with values of 1166.67, 1300.00 and 1075.00g for treatments 2, 3 and 4, respectively. The breast was significantly ($P<0.05$) higher in treatments 2 and 3 with values of 23.66 and 22.51g compared to treatments 1 and 4 that were similar with values of 21.91 and 21.61g. The drumstick was significantly ($P<0.05$) higher in birds in treatments 2 and 3 with values of 14.37 and 14.03g compared to treatments 1 and 4 with values of 13.33 and 13.61g. The back was significantly ($P<0.05$) lower in treatment 4 with a value of 14.88g compared to the other treatments which were all similar with values of 16.69, 16.51 and 17.28g, respectively for treatments 1, 3 and 4. Abdominal fat was significantly ($P<0.05$) lower in birds in the control (T1) with a value of 1.04g compared to the other treatments that were similar with values of 1.27, 1.35 and 1.52 g, respectively for treatments 2, 3 and 4. Akinmutimi and Onen (2008) observed the same trend when they fed YPM to broiler finishers. This could probably be due to increasing levels of IPYPM.

The heart and spleen did not differ in all the treatments, liver and abdominal fat were similar in the treatment groups but differed significantly from treatment 1 (control) and kidneys were similar in treatments 2 and 3 with values of 0.63 and 0.52 g and were significantly higher than birds on treatment 4 which was similar to the control with values of 0.33 g. The lungs were similar in all treatments except treatment 4 that contained 15:15% of IPYPM.

The result showed no significant differences in 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 (Fanimo *et al.*,1996).

The overall result agreed with the report of Osei and Duodu, (1988ab) when 15% sun-dried and 15% 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 characteristics. In another study by Tewe (1983), 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. Mohammed *et al*. (2015) replaced maize with combinations of yam and Irish potato peel meals in rabbit diets and reported that there was no adverse effect on carcass quality even at total replacement. This present study indicated that up to 10% inclusion of IPPM/YPM combinations in broiler diets had no adverse effect on their performance and carcass characteristics.

Blood haematological parameters are shown on Table 4. They serve as indicators of the physiological state of birds (Chowdhury *et al.*, 2005). 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 0.5-7.6x10^9/L as reported by Kpanja *et al*. (2017) and Nse-Abasi *et al.* (2013). Total protein and white blood cells were within the normal range of 1.9-9.5x10^9/L reported by Mitruka and Rawnsky (1977). Lymphocytes and heterophils make up the majority of white blood cells in birds Ruply (1997).

All the parameters measured were within the normal range reported by Swenson and Recce (1993) and Ani and Adiegwu (2006). PCV obtained were within normal range of 30 - 49, it is an index of toxicity, any reduction in its concentration in the blood usually suggested presence of toxic factors (haemagluttinins) which has adverse effect on blood formation (Oyawoye and Ogunkunle, 1998). 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 (Hacbath *et al.*, 1983) and to assess the health of the animals.

Biochemical parameters as presented on table 5 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 Frank *et al.* (1983) 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 Mitruka and Rawnskey (1977) and Akinola and Abiola (1999).

All values fell within the normal range as obtained from the Laboratory. They also agreed with the report of and Ani and Adiegwu (2006) and Swenson and Recce (1993) who reported on blood biochemical profile of broilers.

CONCLUSION AND RECOMMENDATIONS.

From the trial and based on carcass quality and blood parameters, it was concluded that;

- 15% level compares favourably with control in carcass quality
- Sun-dried Irish potato peel and yam peel meals can replace maize up to 15:15% level in broiler chickens nutrition without compromising productivity

It is recommended from the study that farmers and feed millers use treatment 2 (5:5% IPYPM) in feed formulation as it will reduce the cost of feed production and has no adverse effect on Carcass quality and blood parameters.

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

	Composition			
Ingredients	**0**	**10**	**20**	**30**
Maize	53.50	43.50	33.50	23.50
SBM	18.00	18.00	18.00	18.00
GNC	20.00	20.00	20.00	20.00
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
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

Table 2: Ingredient Composition of Broiler Finisher Diets (0 – 4 weeks)

	Composition			
Ingredients	**0**	**10**	**20**	**30**
Maize	61.35	51.35	41.35	31.35
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	2.65	2.65	2.65	2.65
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
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

Table 3: Carcass characteristics of Chickens Broiler fed Diets containing Varying Levels of Combinations of Irish potato peel and Yam peel meals

	IPYPM Inclusion levels (%)				
Parametres	T1	T2	T3	T4	SEM
	0	5:5	10:10	15:15	
Live weight (g)	1825.00	1700.00	1875.00	1525.00	42.08
Carcass weight (g)	1400.00	1166.67	1300.00	1075.00	52.56
Dressing %	76.71^{a}	68.63^{b}	69.33^{b}	70.49^{b}	5.45
Prime cuts expressed as percentage of Carcass weight (%)					
Breast	21.91	23.66	22.51	21.61	4.33
Thigh	14.74	17.09	17.69	15.32	4.33
Drumstick	13.33^{b}	14.37^{a}	14.03^{a}	13.61^{b}	0.99
Back	16.69^{a}	16.51^{a}	17.28^{a}	14.88^{b}	1.57
Wings	10.24	11.57	11.15	11.63	3.11
Organs expressed as percentage of live-weight (%)					
Heart	0.32	0.43	0.46	0.37	0.24
Full gizzard	3.51	4.39	4.04	5.15	1.84
Empty gizzard	2.48	2.67	2.72	2.95	0.56
Liver	1.81	2.12	2.25	2.19	0.45
Lungs	0.60^{a}	0.57^{a}	0.87^{a}	0.44^{b}	0.29
Kidney	0.33^{b}	0.63^{a}	0.52^{a}	0.33^{b}	0.19
Spleen	0.09^{b}	0.12^{b}	0.16^{a}	0.11^{b}	0.03
Abdominal fat	1.04^{b}	1.35^{a}	1.27^{a}	1.35^{a}	0.30

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

Table 4: Haematological Parameters of Broiler Chickens fed Diets Containing Varying Levels of Combinations of Irish Potato Peel and Yam Peel Meals.

	IPYPM Inclusion levels (%)				
Parameters	T1	T2	T3	T4	SEM
	0	5:5	10:10	15:15	
PCV (%)	37.00^{a}	39.33^{a}	33.00^{b}	41.00^{a}	7.06
Hb (g/dl)	10.96^{c}	11.63^{b}	12	12.30^{a}	0.38
WBC ($10^{10/L}$)	8.60^{a}	8.20^{a}	4.	3.97^{b}	0.66
RBC ($10^{12/L}$)	3.10^{b}	2.90^{c}	2.50	3.82^{a}	0.28
Total Protein(g/dl)	3.50^{b}	3.10^{c}	3.20^{c}	3.80^{a}	0.21
Heterophils (%)	3.33^{c}	4.33^{b}	5.67^{a}	4.33^{b}	0.77
Lymphocytes(%)	0.96^{a}	0.91^{b}	0.90^{b}	0.92^{b}	0.30
Monocytes (%)	0.46^{b}	0.33^{b}	0.34^{b}	0.34^{b}	0.20
Eosinophils (%)	1.10	1.00	1.05	1.03	0.50
Basophils (%)	0.00	0.00	0.00	0.00	0.00
Band (%)	1.69^{b}	2.00^{a}	2.00^{a}	2.07^{a}	0.20

abc= means on the same row with different superscript differs significantly among treatments, PCV= Packed Cell Volume WBC=White Blood Cell RBC= Red Blood Cell SEM= Standard Error of Means Hb= Haemoglobin

Table 5: Serum Biochemical Profile of Broiler Chickens fed Diets Containing Varying Levels of Combinations of Irish Potato Peel and Yam Peel Meals.

	IPYPM Inclusion levels (%)				
Parameters	T1	T2	T3	T4	SEM
	0	5:5	10:10	15:15	
Cholesterol (mg/dl)	124.93[a]	125.40[a]	125.00[a]	122.33[b]	0.79
Triglyceride g/dl)	1.60[b]	2.87[a]	2.00[b]	1.27[c]	0.80
AST (u/l)	121.00[a]	124.00[a]	110.33[b]	121.67[a]	1.64
ALT (u/l)	28.00	29.63	28.00	28.67	1.69
ALP (u/l)	6.50[b]	8.67[a]	7.00[a]	4.67[c]	0.70
Urea (mg/dl)	3.00[b]	4.33[a]	4.00[a]	2.77[c]	0.90
Albumin (mg/dl)	29.00[a]	35.33[a]	28.33[a]	24.67[c]	8.03
Glucose (mg/dl)	211.27[b]	210.77[b]	229.77[a]	210.47[b]	2.20
Creatinine (mmol/l)	0.70[c]	1.07[b]	1.30[a]	1.00[b]	0.26
Globulin (g/dl)	3.30[b]	3.70[a]	4.00	3.17	0.66

abc= means on the same row with different superscript differs significantly among treatments, SEM= Standard Error of Means, AST= Aspartate amino transferase, ALT= Alanine amino transferase, ALP= Alkaline Phosphatase