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EFFECT OF IRISH POTATO PEEL (*SOLANUM TUBEROSUM L.*) AND YAM PEEL (*DIOSCOREA SPP*) MEALS ON PERFORMANCE AND CARCASS CHARACTERISTICS OF BROILER CHICKENS

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ABSTRACT

The effect of replacing maize with combinations of Irish potato peel meal (IPPM) and yam peel meal (YPM) in the diets of broiler chickens was investigated. Two hundred and forty broilers of mixed sexes were randomly allotted to four dietary treatments of sixty (60) birds per treatment in a completely randomized design (CRD). Diet 1 was the control devoid of Irish Potato and yam peel meals (IPYPM) while diets 2, 3 and 4 contained IPYPM at 5:5, 10:10 and 15:15% levels, respectively. Feed and water were provided *ad–libitum* throughout the study period that lasted 9 weeks. Routine management practices and vaccines were strictly adhered to. Data were collected on feed intake, weight gain and were used to calculate other growth parameters. At the end of the trial, two animals from each replicate were slaughtered, de-feathered, eviscerated and dissembled for carcass evaluation. There were significant ($p<0.05$) differences in weight gain, feed intake, feed cost/kg gain but mortality did not differ across treatments. Diets 2 and 3 compared favorably with the control. Result of carcass analysis shows significant ($p<0.05$) differences in dressing percentage and percentages of primal cuts such as drumstick, thigh, chest and back. Organs such as liver, lungs, heart, spleen, gizzard and kidneys also differ significantly but intestines did not differ across treatments. Results indicate that combinations of sun–dried IPYPM can be included up to 15% level in broiler feed thus reducing the cost of production without adverse effect on the performance of the broilers.

Keywords: Irish potato, Yam peel meal, Carcass and Performance

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 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 FAO (1993), (Ogundipe, 1996; Ojo, 2003). 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 meat scarcity is to increase broiler chicken production.

Nutrition tackles the problems of supplying optimum nutrients required by animals at an economic level (Nworgu *et al*, 1999). 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 (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 (Nworgu *et. al.*, 1999; 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).

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 (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.

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. (Meteorological unit, Institute of Agricultural Research, Ahmadu Bello University Zaria, 2012).

Two hundred and forty day-old 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 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.

Irish potato peels were gathered from some households, restaurants and commercial fryers in Jos and Bukuru metropolis of Plateau State and yam peels were collected at Kuraga Mbako Village of Wamba LGA of Nasarawa State. The peels were sun-dried and milled before being 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 peel meals replacing maize at 5:5%, 10:10% and 15:15%, respectively.

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 randomized for the finisher phase of the experiment. Feed consumption is measured weekly. 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, defeathered and cut into parts for carcass analysis. Primal parts as well as organs were weighed. The data collected were subjected to analysis of variance, significant differences among treatment means were separated using the Dunnutte test in the SAS package.

Table 1: Ingredient Composition of Broiler Starter Diets (0 – 4 weeks)

	Composition			
Ingredients	**T1**	**T2**	**T3**	**T4**
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
Bone-meal	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

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

RESULTS AND DISCUSSION

Results of feeding a combination of Irish potato peels and Yam Peel meals on the performance of broiler starter chickens is presented in Table 3. The result showed significant (P<0.05) differences in all parameters measured except mortality. Treatment 1 performed significantly (P<0.05) better in all parameters measured. It performed better than those on the test material groups. Average daily weight gain (ADWG) of T1 was significantly (P<0.05) higher than T2 which also performed significantly (P<0.05) better than treatments 3 and 4 that were statistically similar with values of 15.86 and 15.10g, respectively. This result disagreed with Inaku (2011) who recorded the least weight in treatment 1 (control), the author also reported a non-significant difference across treatments when she fed yam peel meal to broilers.

Average daily feed intake (ADFI) was highest in T2 with a value of 38.72g and was significantly different from the other treatments that were statistically similar. Feed conversion ratio (FCR) was best in T1 with a value of 1.87 and differed significantly (P<0.05) from T2 which also differed significantly (P<0.05) from treatments 3 and 4 that were statistically similar with values of 2.41 and 2.51, respectively and feed cost per kg gain also showed significant differences where T1 had the least value of N182.79 and differed significantly (P<0.05) from the other treatments that were statistically similar. However, the work agreed with the report of Opara (1996), Iyayi (2001) and Ekenyem *et al.* (2006) who observed depressed growth with additional levels of fibre in animal diet. Diarra *et al*. (2012) also reported depressed growth and feed conversion ratio with higher values of the test material when they fed a mixture of yam and sweet potato peels to broiler chickens.

Performance of broiler finisher chickens fed diets containing varying levels of IPYPM is presented on Table 4. There were significant differences in all parameters measured except initial weight and mortality. Treatments 1 and 2 were similar in ADWG with values of 57.75 and 50.77g, respectively and they differed significantly (P<0.05) from treatments 3 and 4 that were statistically similar with values of 40.87 and 38.81g, respectively. ADFI did not differ significantly across the treatments, it was statistically similar. FCR also showed that treatments 1 and 2 were statistically similar with values of 1.68 and 1.94, respectively and they differed significantly from treatments 3 and 4 that were statistically similar with values of 2.12 and 2.55, respectively and feed cost per kg gain was better in T1 which differed significantly (P<0.05) from T2 which also differed significantly (P<0.05) from T3 which also differed significantly (P<0.05) from T4. This work agreed with the work of Inaku, (2011) and Diarra *et al.* (2012) who reported increased feed consumption as the level of the test material increased. It is also in tandem with Osei and Duodu (1988a) who reported significant feed consumption increase with the addition of sun-dried CPM. It was pointed out that CPM is a low energy material, so the metabolisable energy decreased with increase in CPM level. This made the birds consume more at higher levels in order to balance for the low level of metaboliseable energy. They also reported higher feed to gain ratio at levels more than 5%. Osei, (1989) reported a non-significant increase on feed consumption but feed to gain ratio was impaired with increasing levels of CPM inclusion. Aduku *et al.* (1991) reported that CPM could be fed up to 15% level on maize-soybean practical diet for broiler. They pointed out that the bulky nature of CPM limited feed consumption to meet energy requirements of broilers at levels above 15%. They ate more to compensate for their low energy level. They also reported depressed weight gain.

Carcass analysis of broilers fed diets containing varying levels of IPYPM is

presented on Table 5. Dressing percentage was significantly higher in T1 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 and dressing percentage were significantly ($P<0.05$) higher in the control group (Treatment 1) compared to the other treatments. The breast was significantly ($P<0.05$) higher in treatments 2 and 3 compared to treatments 1 and 4 that were similar. The drumstick was significantly ($P<0.05$) higher in birds on diets containing 10:10% IPYPM compared to the other treatments. The back was significantly ($P<0.05$) lower in treatment 4 compared to the other treatments which were all similar. Abdominal fat was significantly ($P<0.05$) lower in birds in the control (T1) and diets containing 5% IPYPM groups compared to the other treatments that were similar. 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 and were significantly higher in birds on diets containing 15:15% IPYPM which was similar to the control. 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, (1988 a and b) 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. Pido and Adeyanju, (1978) replaced maize with CPM at 0, 10, 20 and 30% and concluded that inclusion of cassava peels up to 20% in broiler diets promoted biological activity satisfactorily. Mohammed *et al*. (2015) replaced maize with combinations of yam and Irish potato peel meals in rabbit diets and reported that there were 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.

Table 2: Ingredient Composition of Broiler Finisher Diets (4 - 8 weeks)

	Composition			
Ingredients	**T1**	**T2**	**T3**	**T4**
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
Bone-meal	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

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

Table 3: Performance of Broiler Starter Fed Diets containing Varying Levels of Combinations of Irish Potato Peel and Yam Peel Meals

	IPYPM Inclusion levels (%)				
Parameter	**T1**	**T2**	**T3**	**T4**	**SEM**
	0	**5:5**	**10:10**	**15:15**	
Initial Wt (g)	63.33	63.33	63.33	63.33	NS
Final Wt (g)	642.22[a]	540.11[b]	506.67[c]	486.11[c]	16.23
Wt gain (g)	578.89[a]	476.78[b]	443.34[b]	422.78[b]	63.68
ADWG (g)	20.67[a]	17.03[b]	15.86[c]	15.10[c]	0.58
ADFI (g)	38.56[b]	38.72[a]	38.26[c]	37.94[c]	0.40
FCR	1.87[a]	2.27[b]	2.41[c]	2.51[c]	0.10
FC/Kg gain(N)	182.79[a]	212.25[b]	215.09[b]	214.03[b]	13.37
Mortality	0.00	0.00	0.00	0.00	0.00

abc= means on the same row with different superscript differs significantly among treatments, Wt= weight ADWG= average daily weight gain, ADFI= average daily food intake, FC= feed cost, SEM= standard error of means

Table 4:Performance of Broiler Finisher Fed Diets containing Varying Levels of Combinations of Irish Potato Peel and Yam Peel Meals

	IPYPM Inclusion levels (%)				
Parameter	**T1**	**T2**	**T3**	**T4**	**SEM**
	0	**5:5**	**10:10**	**15:15**	
Initial Wt (g)	578.30	580.09	579.97	575.38	NS
Final Wt (g)	2195.43[a]	2005.07[b]	1730.00[c]	1657.10[d]	111.89
Wt gain (g)	1617.01[a]	1421.76[a]	1144.29[b]	1086.72[b]	324.52
ADWG (g)	57.75[a]	50.77[b]	40.87[c]	38.81[c]	3.98
ADFI (g)	97.02	97.57	86.79	98.99	12.01
FCR	1.68[a]	1.94[b]	2.12[c]	2.55[d]	0.28
FC/Kg gain(N)	174.77[a]	191.76[a]	201.17[c]	232.76[d]	51.0
Mortality	0.00	0.00	0.33	0.67	1.22

abc= means on the same row with different superscript differs significantly among treatments, ADWG= average daily weight gain, ADFI= average daily food intake, FC= feed cost, SEM= standard error of mean

Table 5: Carcass analysis 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**	
Live wt (g)	1825.00	1700.00	1875.00	1525.00	42.08
Carcass wt (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[b]	23.66[a]	22.51[a]	21.61[b]	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[b]	2.25[a]	2.19[a]	2.25[a]	0.45
Lungs	0.60[a]	0.69[a]	0.57[a]	0.44[b]	0.29
Kidney	0.33[b]	0.63[a]	0.52[a]	0.33[b]	0.19
Spleen	0.09	0.12	0.16	0.11	0.13
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 mean

CONCLUSION AND RECOMMENDATION

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

- 5:5% inclusion level of Irish potato and yam peel meals compared favourably with the control in weight gain, feed conversion ratio and feed cost/kg gain.
- 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 chicken nutrition without compromising productivity

It is recommended from the study that farmers and feed millers use treatment 2 in feed

formulation as it will reduce the cost of feed production and give good performance.

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