

## Growth Performance, Carcass Characteristics, And Economics of Replacing Maize with Irish Potato (*Solanum tuberosum L.*) Peel Meal in Broiler Chickens Diets

Idris Y. Z., Amaza I. B., Aminu, M. and Boyi, B.

Department of Animal Science Federal University Gashua, P.M.B.1005, Gashua, Yobe, Nigeria.

Correspondence Author: iliyaamaza20@gmail.com Phone: +234 7033789003

Target Audience: Poultry farmers, Researchers, and Animal nutritionists

### Abstract

*This study investigates the effects of dietary replacement of maize with Irish potato peels (IPPM) on growth performance, carcass characteristics, and cost savings for broiler chickens. A total of 180 Anak 2000, 14-day-old unsexed broiler chicks, with an initial weight of  $321 \pm 2$ g, were used. The birds were randomly allocated to 5 groups in a completely randomized design (CRD) and fed diets containing 0, 10, 20, 30, and 40 % Irish potato peel meal (IPPM) as a replacement for maize. The feed intake (FI) and feed conversion ratio (FCR) values were 74.86, 94.82, 93.90, 98.43, and 96.96 g/bird and 2.10, 2.35, 1.99, 1.98, and 2.05 for D1, D2, D3, D4, and D5 at the starter phase. No significant effect on feed intake (FI) and feed conversion ratio (FCR) at this phase. In contrast, FI and FCR values of 145.99, 159.54, 161.82, 170.87, 170.18, and 2.00, 2.32, 2.22, 2.29, and 2.72 were significant ( $p < 0.05$ ) at the finisher phase. Average daily weight gain values of 35.89, 40.87, 46.46, 48.85, and 46.60g/bird at the starter phase were significantly ( $p > 0.05$ ) affected but were statistically similar at the finisher phase. No significant effect ( $p > 0.05$ ) on the live weight, carcass weight, slaughtered weight, plucked, eviscerated weights, and dressing percentage. Significant dietary ( $p < 0.05$ ) effects on the relative weights of the heart, lungs, and liver were recorded. Birds on diet (D5) recorded a significantly higher shank ( $p > 0.05$ ) value (4.28g) while those in D2 recorded a significantly higher gizzard value (1.87g). The total feed cost per kilogram gain (₦) was statistically similar across groups, however, birds in D2-D5 had higher values numerically in contrast to the control. In conclusion, IPPM can replace maize by up to 40% without harming broilers.*

**Keywords:** Irish potato peels, performance, savings

### Description of problem.

Maize is the preferred grain for poultry feeding due to a combination of desirable nutritional characteristics such as high

energy, low fiber, and easy digestibility" (1). "A substantial amount of cereals and edible oilseed meals are used in poultry rations and thus compete directly with humans (2).

Drought is estimated to affect one-quarter of global maize areas annually (3). "In a world where the global population is constantly growing, the argument that producing feed for livestock conflicts with feeding hungry people is likely to persist for some time"(4). In light of this, poultry farmers worldwide continue to face high production costs for poultry feeding, owing largely to price volatility in basic feed ingredients such as maize. Because feed accounts for 60–70% of total production costs, looking for locally available and cheaper alternative feed ingredients has become unavoidable and will benefit end-users by lowering feed costs (5). In light of this, using unconventional (low-cost) feed resources readily available locally is one option for ensuring the least-cost feed formulation, resulting in cost savings for poultry feeds (2). A wide range of alternative energy-feed ingredients has been studied in Nigeria, but little attention has been given to Irish potato peels. The trial was conducted to investigate the effects of dietary replacement of maize with IPPM on growth performance, carcass characteristics, and cost-benefit of broiler chicken.

## **Materials and methods**

### **Experimental site**

The experiment was conducted at the Poultry Research Farm located at the Federal University Gashua, Yobe State, Nigeria. The experimental site is located between latitude 12° 52' oN and longitude 11° 2'oE, with annual rainfall ranging from 500 to 1000 mm, temperature of 38 - 40°C with relative

humidity between 13.06 and 71.09 %, and an elevation above sea level of 299 m (6)

### **Experimental diets**

Five diets were formulated during the starter and finisher phases of the experiment and represented as D1, D2, D3, D4, and D5 (Table 1). D1 was the control diet with maize as an energy source while D2 - D5 had maize in the control diet replaced by IPPM at 10, 20, 30, and 40%, respectively.

### **Experimental birds and management**

A total of 180 14-day-old Anak 2000 unsexed broiler Chicks were procured from a commercial hatchery in Jos, Plateau state, weighed, and randomly assigned to 5 dietary treatment groups described earlier in a completely randomized design. Each treatment had 36 birds with three replicates with 12 birds each. Birds were reared in a deep litter system with an area dimension of 250 x 190 x 130 cm per replicate. Feed and fresh water were available *ad libitum* throughout the trial period. The diets were isocaloric and isonitrogenous, which met the nutritional requirements of birds. Birds were weighed weekly throughout the 6-week duration of the experiment. The lighting program and temperature were maintained according to normal management practices. All the experimental procedures and protocols were approved by the Departmental Research Committee, Federal University Gashua.

### **Data collection**

To determine the daily and weekly body weight gain of broilers during the experiment, birds were weighed at the beginning of the experiment and then once a week after that with a digital electronic balance. Feed intake was determined by deducting the leftover feed from the total amount of feed served for the day. The feed conversion ratio is calculated as feed intake divided by weight gain. Six birds per treatment were chosen at random, starved of feed for an entire night, weighed, and slaughtered using the jugular veins, and the carcasses were drenched with blood. The carcasses were scalded in warm water at about 80°C for three minutes before de-feathering, and the feathers were then manually removed. The viscera were then removed from the carcasses by cutting through the vent. The weights of the dressed carcasses were then determined using a sensitive electronic scale. The economic benefit of replacing maize with Irish potato peel meal in this broiler feeding trial was determined by computing the following metrics: Total feed intake/bird (kg), total feed cost/bird/kg (₦), total weight gain/bird (kg), and total feed cost/kg gain (₦).

### **Statistical analysis**

Data were statistically analyzed using a one-way analysis of variance (ANOVA) according to the procedure outlined in (7). Differences among means were compared using the procedure outlined by (8). The level of significance was based on a probability of 0.05.”

### **Results**

#### **Growth performance of broiler chickens fed varying levels of Irish potato peel meal as a replacement for maize.**

The growth performance indices of broiler chickens fed IPPM as a replacement for maize are presented in Table 3. In the starter phase, the feed intake values of 74.86, 94.82, 93.90, 98.43, and 96.96 g/bird were recorded for D1, D2, D3, D4, and D5 respectively. The broilers on dietary treatment D1 (control) consumed the least feed, while group D4 consumed the most. Similarly, the feed conversion ratio values of broiler chickens in dietary treatment groups D1, D2, D3, D4, and D5 were 2.10, 2.35, 1.99, 1.98, and 2.05 respectively (Table 3). The replacement of maize with IPPM did not influence feed intake (FI) or feed conversion ratio ( $p > 0.05$ ) at the starter phase. In comparison to control group D1 (35.89), the broilers in dietary groups D2–D5 had a noticeably higher weight gain of 40.87, 46.46, 48.85, and 46.60g/bird. These values are significantly higher ( $p < 0.05$ ) than the control. The higher weight gain may be attributed to increased feed intake. In contrast, the feed intake value of (145.99g/bird) at the finisher phase was significantly lower than the values of 159.54, 161.82, 170.87, and 170.18g/bird recorded for D2-D5 respectively. The feed conversion ratio of the control group D1 (2.00) differed significantly ( $p > 0.05$ ) from the values of 2.32, 2.22, 2.29, and 2.74 recorded for dietary treatments D1-D5 at the finisher phase. The reason for such variation may be attributed to the fiber levels of diets with

IPPM. Daily weight gain across the treatment groups at the finisher was statistically similar. No mortality was recorded across the treatment groups in either phase.

**Table 1: Gross compositions of broiler starter**

Ingredients	Levels of Irish potato peel meal				
	D1 (0%)	D2 (10%)	D3 (20%)	D4 (30%)	D5 (40%)
Maize	48.64	43.16	37.84	32.66	27.62
IPPM	0.00	4.86	9.72	14.59	19.45
GNC	17.73	18.03	18.27	18.42	18.51
SBM	17.73	18.05	18.27	18.43	18.52
Wheat offal	10.00	10.00	10.00	10.00	10.00
Fish meal	3.00	3.00	3.00	3.00	3.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Lysine	0.20	0.20	0.20	0.20	0.20
Methionine	0.20	0.20	0.20	0.20	0.20
Common Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100
Calculated analysis					
ME Kcal/kg	2880	2874	2872	2871	2869
Crude protein	22.08	22.22	22.41	22.52	22.60
Crude fiber	4.74	4.80	4.83	4.87	5.00

Each kg of Mineral and vitamin premix contained the following: Vitamin A 1,800IU, Vitamin D 250IU, Vitamin E 8,000IU, Vitamin K 750 mg, B12 25 mg, B2 1000 mg, B6 800 mg, B1 750 mg, Folic 300 mg, Niacin 5000 mg, Pantothenate 3000 mg, Biotin 25 mg, Thyroxine 300 mg, Copper 0.4 g, Choline 160 g, Iron 4 g, Manganese 5.5 g, Iodine 0.2 g, Zinc 5 g, Cobalt 0.15 g, Selenium 0.15 g.

IPPM=Irish potato peel meal, GNC=Groundnut cake, SBM=Soya bean Meal, ME= Metabolizable energy, CP=Crude protein, CF= Crude fiber.

Table 2: Gross compositions of broiler finisher diet

Ingredients	Levels of Irish potato peel meal				
	D1 (0%)	D2 (10%)	D3 (20%)	D4 (30%)	D5 (40%)
Maize	53.08	47.77	42.46	37.16	31.85
IPPM	00	5.31	10.62	15.92	21.23
GNC	13.01	13.01	13.01	13.01	13.20
SBM	13.01	13.39	13.39	13.39	13.20
Wheat offal	15.00	15.00	15.00	15.00	15.00
Fish meal	3.00	2.62	2.62	2.62	2.62
Bone meal	2.00	2.00	2.00	2.00	2.00
Lysine	0.20	0.20	0.20	0.20	0.20
Methionine	0.20	0.20	0.20	0.20	0.20
Common Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>
Calculated analysis					
ME Kcal/kg	2992	2985	2980	2972	2970
Crude protein	19.50	19.32	19.25	19.18	19.07
Crude fiber	4.04	4.25	4.34	4.38	4.52

Each kilogramme of Mineral and vitamin premix contained Vitamin A 1,800IU, Vitamin D 250IU, Vitamin E 8,000IU, Vitamin K 750 mg, B12 25 mg, B2 1000 mg, B6 800 mg, B1 750 mg, Folic 300 mg, Niacin 5000 mg, Pantothenate 3000 mg, Biotin 25 mg, Choline 160 g, Thyroxine 300 mg, Copper 0.4 g, Iron 4 g, Manganese 5.5 g, Iodine 0.2 g, Zinc 5 g, Cobalt 0.15 g, Selenium 0.15 g.

IPPM=Irish potato peel meal, GNC=Ground nut cake, SBM=Soya bean Meal, ME=Metabolizable energy, CP=Crude protein, CF= Crude fiber,

Table 3: Growth performance of broiler chickens fed IPPM as a replacement for maize

Parameters	Percentage replacement levels of IPPM for Maize					LSD
	D1 (0%)	D2 (10%)	D3 (20%)	D4 (30%)	D5 (40%)	
14- 28 days						
FI (g/bird)	74.86	94.82	93.90	98.43	96.96	29.42 <sup>NS</sup>
ADWG (g/bird)	35.89 <sup>b</sup>	40.87 <sup>ab</sup>	46.46 <sup>a</sup>	48.85 <sup>a</sup>	46.60 <sup>a</sup>	8.50*
FCR	2.10	2.35	1.99	1.98	2.05	0.43
Mortality	0.00	0.00	0.00	0.00	0.00	0.00
28-42 days						
FI(g/bird)	145.99 <sup>b</sup>	159.54 <sup>ab</sup>	161.82 <sup>ab</sup>	170.87 <sup>a</sup>	170.18 <sup>a</sup>	24.04*
ADWG(g/bird))	74.28	71.29	73.30	74.80	63.74	14.93 <sup>NS</sup>
FCR	2.00 <sup>b</sup>	2.32 <sup>ab</sup>	2.22 <sup>b</sup>	2.29 <sup>ab</sup>	2.74 <sup>a</sup>	0.46*
Mortality	0.00	0.00	0.00	0.00	0.00	0.00

FI= Feed intake, ADWG=Average daily weight gain, FCR=Feed conversion ratio, “a, b, c= Means within the same row bearing different superscripts differ significantly (P<0.05)” “\*= Significant (P), LSD = Least significant difference, NS = Not significant (P>0.05), IPPM = Irish potato peels meal

**Carcass and internal organs characteristics of broiler chickens fed varying levels of Irish potato peel meal as a replacement for maize.**

Live, carcass, slaughtered, plucked, and eviscerated weights, and dressing percentage were not significantly ( $p > 0.05$ ) affected by dietary replacement of maize with IPPM (Table 4). However, dietary influence ( $p < 0.05$ ) was observed on organs such as the heart, lungs, and liver, except for the spleen and pancreas. In addition, the gizzard and shank were affected ( $p < 0.05$ ) by the dietary replacement of maize with different dietary levels of IPPM. There was no significant ( $p > 0.05$ ) dietary influence on the head, crop, large and small intestine, pro-ventriculus, and abdominal fat, respectively.

**Economic analysis of replacing maize with varying levels of Irish Potato peel meal in broiler chicken**

The economic analysis of feeding IPPM to the broilers as a substitute for maize is presented in Table 5. The feed cost per kilogram in naira values both at the starter and finisher phase, were 111.17, 109.38, 107.62, 105.90 and 105.02, 103.07, 101.16, 99.32, and 97.52 respectively. These values decreased with increasing dietary levels of the test ingredient due to the lower cost of the test ingredient. Feed intake values of 1.33, 1.30, 1.38, 1.36 kg/bird for D2-D5 were higher than (1.05kg/bird) for the control group (D1) at the starter phase. Total weight gain per bird per kilogram was relatively higher in comparison with the control group.

A similar trend was observed at the finisher phase. The total feed cost per kilogram gain (₦) values of (.341.88, 290.82, 290.67) for D2, D4, and D5 and 533.25, 512.07, 545.95, 635.95 for D2-D5 at the starter and finisher phase were higher than values recorded for the control group.

**Discussion**

In this investigation, the dietary replacement of maize with IPPM had no effect on feed intake or feed conversion ratio during the starter phase ( $p > 0.05$ ), as presented in Table 3. Though birds fed with test ingredients consumed relatively more than the control group, the difference was not statistically significant ( $p > 0.05$ ). Reduced metabolizable energy may be the cause of the notable increase in feed intake observed when diets contain higher amounts of Irish potato meal. This result is consistent with the findings of (8), (9), and (12), whose report also shows no significant effect on feed intake in a feeding trial using a mixture of yam and sweet potato peels and yam and Irish potato peels on broilers, growing rabbits and broilers. The total feed intake figures recorded in this study were lower than the values reported by (10). The lack of a significant change in feed intake and feed conversion ratio is consistent with (10) findings in a feeding trial with broiler chickens fed IPPM. The total feed cost/kg gain (₦) recorded in this study was not affected significantly by the dietary replacement of maize with IPPM. However, the total feed cost per kg gained increased

numerically in birds fed with the test ingredient in comparison with the control group. This is attributed to higher feed intake. The values recorded in this study were higher than the values reported by (12). The significant difference in feed cost per kg gain in weaner rabbits fed Irish combined with yam peel was reported by (13). In both the starter and finisher phases (Table 3), the utilization of potato peel meals progressively decreased the cost per kg as the levels of Irish potato peel meals increased in the diets. This is because Irish potato peel is cheaper than maize. This aligns with the findings of (12), which indicated decreased feed cost per kilogram gain when Irish potato peel meal was added to the broilers' chicken diet. Thus, incorporating Irish potato peel meals into the diets of broilers lowered the feed cost, but the cost per kg gain was similar to the control group. There was no dietary effect on live, slaughtered, plucked, eviscerated, or carcass weights on carcass indices. Other carcass parameters not affected by dietary replacement of maize with IPPM are dressing percentage, crop, small and large intestine, and spleen, respectively. This result did not agree with the findings of (12), whose result indicates a significant difference ( $P < 0.05$ ) in breast, back, thigh, drumstick, wings, dressing percentage, and carcass weight. In dietary treatment groups, the heart, liver, lung, and gizzard differed significantly ( $p < 0.05$ ). This is consistent with the observation reported by (12), particularly on the heart, liver, and spleen, whose report showed a significant difference. The significant effects

of diets on gizzards reported in this study confirm the early report of (10) but differ from the report of (14), who fed IPPM to broiler chickens. The non-significant difference ( $p > 0.05$ ) in values recorded for the heart in this study is in agreement with a study conducted by (15), who reported the same when growing rabbits were fed with yam and IPPM peels as replacements for maize in their diet. The dressing percentages recorded in this study are similar to the values reported by (12). The dressing percentage in all treatments reported in this study is within an acceptable range for broilers.