Turkish Journal of Agriculture - Food Science and Technology, 5(5): 525-529, 2017

Turkish Journal of Agriculture - Food Science and Technology

Available online, ISSN: 2148-127X
www.agrifoodscience.com,
Turkish Science and Technology

Growth Performance, Carcass Characteristics and Serum Biochemistry of Broiler Chicken Fed Graded Levels of Sun-Dried Irish Potato Peel Meal

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A R T I C L E   I N F O

Research Article

Received 11 November 2016
Accepted 11 May 2017

Keywords:
Sun-dried Irish Potatoes
Broiler
Serum biochemistry

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A B S T R A C T

An experiment was conducted to evaluate the effect of substituting different levels of sun-dried Irish potato peel meal (SPPM) for maize in diets of broiler chickens. Five diets in which SPPM was replaced with 0 (0SPPM), 25 (25SPPM), 50 (50SPPM), 75 (75SPPM) and 100% (100SPPM) of maize in starter and finisher diets for a 8 week period using broiler chickens were examined. A total of 300 two weeks old broilers chicks *Anak* 2000 were randomly allotted to five experimental diets with six pen per treatment and 10 birds chicks per pen. Body weight and feed intake of broilers, and feed conversion ratio were determined at the beginning and 56th day of the experiment respectively. On day 56, four broilers from each pen were selected and slaughtered to determine some carcass characteristics and serum biochemistry. The result of growth performance showed that 100SPPM decreased daily weight gain of chickens when compared to other SPPM levels ($P<0.05$). Dietary SPPM did not affect feed intake and feed conversion ratio ($P<0.05$). Carcass weight, dressing percentage, and studied serum biochemistry values of chickens in 0SPPM were higher than that of other treatments ($P<0.05$).It can be concluded that SIPM can replace maize up to 75% in broiler chicken diets without any adverse effect on growth performance, carcass characteristics and serum biochemistry performance Carcass yield, Blood parameters.

DOI: https://doi.org/10.24925/turjaf.v5i5.525-529.1070

Introduction

Broiler production is one the livestock industries that offers the highest turnover rate and quicker returns on investment either in small, medium or large scale production (Afolayan et al., 2014). The potentials of the industry is affected by the high cost of feed especially energy and protein sources. The prices of energy source for livestock feed have been on increase in Nigeria (Midau et al., 2011). The major source of energy is maize. However, maize is required by humans and processing industries, thereby causing a tacit competition between human and animals. Price of maize have soared so high in recent times and is no longer economical to be use in poultry feeds formulation (Bot et al., 2013) Continual increase in prices of conventional feedstuff has necessitated the search for alternatives to the expensive energy and protein sources (Ekeyem et al., 2006)

One of such alternatives for replacement of maize in animal diets is the sundried Irish potatoes peel meal (PPM). Irish potatoes peel in Nigeria is always discarded as waste and often allowed to rot and thus pose a disposal problem in the environment. The relative availability and low cost of Irish potatoes peel make it an option in livestock feeding (Wafar and Tarimbuka, 2016). However, the authors further revealed that the metabolisable energy (ME),crude protein (CP), crude fibre (CF), ether extract and ash contents of PPM were 3118.42 kcal, 116.1, 80.1, 20.50 and 62.10 g/kg dry matter. Wafar and Tarimbuka (2016) reported that the PPM was enhanced the performance of rabbits without affecting growth performance and blood parameters. However, information on the effects of PPM based diets on the growth performance; carcass characteristics and serum biochemical of broiler chickens are scanty. The study was therefore aimed at investigating the effect of PPM on the growth performance, carcass characteristics and serum biochemical of broiler chickens.

Materials and Methods

The study was carried out at Concordia College farm located at Ngurore, Adamawa State, Nigeria. Ngurore lies between latitude 9°16'59" North and longitude 12°13' 59" East. Temperature is high in February, March and April because of high radiation, which is evenly distributed throughout the year (Adebayo and Tukur, 1999). The Irish potatoes peel were sourced within Jimeta metropolis, sun dried on a clean cemented floor for 8 days. The dried samples were ground using hammer mill, packed in a sack and stored at room temperature (Wafar and Tarimbuka, 2016)

In this study, a total of 300 day old Anak 2000 broiler was used. The birds were randomly allotted to five dietary treatments of six replicates, with ten birds each in a completely randomized design. The experimental diets consisted of a control group and four levels of SPPM replacing 25, 50, 75 or 100% of maize, respectively. Hence, treatments were: control (0SPPM), 25 SPPM, 50SPPM, 75SPPM and 100SPPM. All diets were offered *ad libitum*. Clean and fresh water was available at all times. The experiment lasted for 8 weeks. The composition and calculated nutrient and energy levels of experimental diets (starter from 1 to 35 days of age; finisher from 35 to 56 days of age) are given in Table 1.

Table 1 ingredient composition experimental diets (starter and finisher)

Ingredient (g/kg)	Starter (from 1 to 35 day of age)				
	0PPM	25PPM	50PPM	75PPM	100PPM
SIPM	0.00	12.00	24.00	36.00	48.00
Maize	48.00	36.00	24.00	12.00	0.00
Soybean meal	28.70	28.70	28.70	28.70	28.70
Wheat offal	16.00	16.00	16.00	16.00	16.00
Fishmeal	3.00	3.00	3.00	3.00	3.00
Bone meal	2.50	2.50	2.50	2.50	2.50
Premix*	0.25	0.25	0.25	0.25	0.25
Limestone	1.00	1.00	1.00	1.00	1.00
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.20	0.20	0.20	0.20	0.20
Salt	0.25	0.25	0.25	0.25	0.25
Analysed nutrition composition					
Dry matter	89.21	89.00	88.12	89.41	86.21
Crude protein	21.21	23.02	23.42	23.07	23.09
Crude fibre	4.12	4.25	6.21	6.02	6.09
Ether extracts	6.2	5.40	4.89	5.05	5.02
Ash	4.42	5.13	5.26	5.29	5.32
NFE	64.05	62.20	65.11	60.57	60.48
Calculated nutrition composition					
ME Kcal/kg	2809.01	2804.00	2815.08	2811.00	2810.22
Ca	1.08	1.09	1.11	1.10	1.12
Available P	0.50	0.62	0.61	0.60	0.62
Ingredient (g/kg)	Finisher (from 35 to 56 day of age)				
SIPM	0.00	14.00	28.00	42.00	56.00
Maize	56.00	42.00	28.00	14.00	0.00
Soybean meal	25.70	25.70	25.70	25.70	25.70
Wheat offal	11.00	11.00	11.00	11.00	11.00
Fishmeal	3.00	3.00	3.00	3.00	3.00
Bone meal	2.50	2.50	2.50	2.50	2.50
Premix*	0.25	0.25	0.25	0.25	0.25
Limestone	1.00	1.00	1.00	1.00	1.00
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.20	0.20	0.20	0.20	0.20
Salt	0.25	0.25	0.25	0.25	0.25
Analyzed nutrition composition					
Dry matter	86.21	90.21	89.23	88.45	90.32
Crude protein	20.12	19.02	19.00	19.06	19.20
Crude fibre	4.35	5.78	7.05	8.52	9.00
Ether extracts	3.55	3.25	3.02	3.01	3.00
Ash	4.42	5.30	5.62	5.92	6.21
NFE	67.56	66.65	65.31	63.49	62.59
Calculated nutrition composition					
ME Kcal/kg	3072.0	3049.50	3040.60	3047.40	3043.00
Ca	1.09	1.10	1.20	1.00	1.11
Available P	0.55	0.56	0.62	0.60	0.62

*0.25 kg of mineral and vitamin premix contained the following: Vitamin A 1,800IU, Vitamin D 250IU, Vitamin E 8,000IU, Vitamin K 750 mg, B1 750 mg, B2 1000 mg, B6 800 mg, B12 25 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.

Proximate composition of the experimental diets and SPPM were analyzed by the method of AOAC, (2000). The birds were reared on deep litter in an open-sided wire mesh constructed poultry house to allow for adequate ventilation. The chicks were housed in groups in floor pens with wood-shavings (122cm×125 cm×120 cm) and the pens were fitted with feeders and waterers. Average ambient temperature was 30°C and the relative humidity was maintained within a range of 40-55%. Medications, vaccinations and other routine management practices as described by Abdo et al. (2015) were strictly followed. The birds were offered experimental diets throughout the period of the experiment. Growth performance was assessed by measuring feed intake (FI) and body weight (BW) weekly, and from these data daily weight gain (DWG, g), daily FI (DFI, g) and feed conversion ratio (FCR, g feed:g gain) were calculated. Mortality was recorded as it occurred.

On day 56, four broilers from each replication with body weight within 1 standard deviation of the mean treatment weight (16 birds per treatment) were selected and fasted for 16 h, and then slaughtered to determine carcass yield, some non-carcass parts and internal organs characteristics, and serum biochemistry. Two of these birds were sacrificed by severing their jugular veins with sharp surgical knife. The birds were immersed in hot water (80°C) for two minutes, de-feathered. The birds were eviscerated and internal contents were neatly removed and weighed followed by the cutting of the carcass into retail parts and weighed as described by Kleczek et al. (2007). Weights of non-carcass parts and internal organs were expressed as a portion of body weight (g/100 g body weight).

Other two birds per replicate were used for blood collection. Blood was collected using a 2 ml disposable sterile syringe and needle from wing vein into sterile test tubes without anticoagulant for serological study. Parameters (Albumin, Creatinine, Globulin and total protein) were determined using the standard clinical chemistry procedure by Reitman and Frankel, (1957) as cited by Okpanachi et al. (2014).

Statistical Analysis

For performance data, pen means served as the experimental unit for statistical analysis. For data on relative weights and length of the gut, individual birds were considered as the experimental unit. All data were analysed according to the anova model, using the ONEWAY procedure of Statistix version 10 Software. When the F-test was significant, differences were determined by Duncan's multiple range test using the Duncan option of the same statistical software. Results are presented as means and a pooled standard error of mean (SEM)

Result and Discussion

The proximate composition of SPPM is shown in Table 2. All the proximate composition determined in the present study was higher than the values of unfermented Irish potatoes peel reported by Akintomide and Antai, (2012). Differences in the nutrient composition could be as a result of environmental factors such soil type, season when the peel was collected and processing methods employed and depth of peeling during processing. The nutrient compositions of the diets are adequate and within the recommended range for broiler starter and finishers as reported by (NRC, 1994; Olomo, 1995; Oluyemi and Robert, 2000).

Table 2 Proximate Composition of sun dried Irish potatoes peel meal SIPM (%DM)

Constituents	Percentage composition
Dry matter	93.21
Crude protein	11.61
Crude Fibre	8.01
Ether extracts	2.05
Ash	6.21
Nitrogen Free Extracts	72.08
ME (kcal/kg)	3118.42

Metabolizable Energy = ME (kcal/kg) = 37 x % CP + 81 x % EE + 35.5 x % NFE. Calculated according to the formula of Pauzenga, (1985

The performance of broiler chicken is presented in Table 3. The results showed that final weight were statistically similar significantly (P<0.05) up till 75% (R4). 100% SPPM (R5) resulted in significant (P<0.05) decreased in final weight. Feed intake was not significantly affected (P>0.05) by diets with the replacement of maize with SPPM but appeared to decrease on the SPPM – based diets. This result agreed with the report by Okapanchi et al. (2015) who reported non- significant (P>0.05) on feed take of birds fed yam peel. Bird on R3 diet recorded the highest feed intake. The increased in feed intake in R3 diet was probably due to the ratio of 50% maize and 50% SPPM effect on the metabolisable energy of the diet, since birds according to (Dafwang and Damang, 1995) are known to eat in order to meet their energy requirement. The decreased in feed intake observed in this study as the SPPM increases, negates the finding of Okapanchi et al. (2015) who reported that high fibre diets increase feed intake in broiler chicken. The feed conversion ratio (FCR) did not show significant difference (P<0.05) across the dietary treatments. The range observed in this study is within the value 1.00 – 2.5 reported by (Amaefule et al., 2005).

Table 4 shows the result of carcass and internal organ characteristics of broiler chickens fed SIPM based diets. The live weight, carcass weight and dress weight and dressing percent were significantly (P<0.05) affected by replacement levels of SPPM. Prime cut parts (breast, thigh and drumstick) weight differs significantly (P<0.05) among the dietary treatments except for wing and back, which was not significantly (P<0.05) affected by replacement. Internal organs such as gizzard, liver and lungs were significantly (P<0.05) influenced by the level of replacement. Birds fed SIPM -based diets were higher (P<0.05) on carcass weight.

Table 3 initial body weights (IBW), daily weight gain (DWG), daily feed intake (DFI) and feed conversion ratio (FCR) of broilers fed graded levels of sun-dried Irish potatoes peel meal incorporated into diets

Parameter	0PPM	25PPM	50PPM	75PPM	100PPM	SEM	**P**
IBW, g per bird	156.00	156.01	155.99	156.05	156.04	1.57^{NS}	NS
Final weight, g per bird	2514.20^{a}	2202.71^{a}	2519.92^{a}	2225.22^{a}	2151.22^{b}	23.22	*
DWG, g per bird	42.11^{a}	36.54^{b}	42.21^{a}	36.94^{b}	35.62^{c}	0.38	*
Total Feed Intake, g per bird	3022.44	3048.48	3106.16	3040.66	2986.31	16.36	NS
Average daily feed intake	53.97	54.43	55.46	54.29	52.43	0.54	NS
FCR	1.28	1.48	1.31	1.46	1.47	0.04	NS

Means within rows with different superscript letters are different (P<0.05). *P<0.05; NS, P>0.05. SEM, standard error of mean. Data represent the mean value of 6 replicate pens of 10 birds.

Table 3 Carcass yield, relative weight (g/100 g body weight) of non-carcass parts, and internal organs of broilers fed graded levels of sun-dried Irish potatoes peel meal incorporated into diets

Parameter	0PPM	25PPM	50PPM	75PPM	100PPM	SEM	P
Carcass weight (g)	1791.3^{b}	1983.2^{a}	1985.3^{a}	1975.3^{a}	1995.9^{a}	7.09	*
Relative weight of							
Carcass	79.6^{b}	83.3^{a}	88.0^{a}	86.9^{a}	87.0^{a}	2.18	*
Breast	17.80^{c}	19.40^{b}	21.30^{a}	20.10^{a}	22.60^{a}	2.00	*
Thigh	18.34^{c}	18.98^{c}	20.14^{ab}	25.11^{a}	25.35^{a}	1.08	*
Wing	9.30	9.24	9.44	9.32	9.82	1.11	NS
Back	13.23	14.53	15.22	13.32	14.35	3.00	NS
Drumstick	17.36^{b}	16.25^{c}	18.19^{ab}	17.02^{b}	24.35^{a}	2.98	*
Lungs	0.53^{b}	0.74^{a}	0.78^{a}	0.61^{a}	0.75^{a}	0.05	*
Kidney	0.76	0.78	0.79	0.72	0.76	0.90	NS
Heart	0.52	0.52	0.55	0.50	0.54	0.08	NS
Gizzard	1.74^{a}	1.43^{b}	1.43^{b}	1.56^{b}	1.42^{b}	1.00	*
Liver	1.86^{a}	1.89^{a}	1.13^{b}	1.29^{b}	1.25^{b}	1.10^{b}	*

a,b: Means within rows with different superscript letters are different (P<0.05). *P<0.05; NS, P>0.05. SEM, standard error of mean. Data represent the mean value of 12 birds (6 replicate pens × 2 birds per pen).

Table 4 Serum Biochemistry of broilers fed graded levels of sun-dried Irish potatoes peel meal incorporated into diets

Parameters	0PPM	25PPM	50PPM	75PPM	100PPM	SEM	P
Total protein (mmol/L)	36.21^{b}	38.21^{ab}	40.23^{a}	44.76^{a}	46.21^{a}	0.41	*
Albumin(mmol/L)	9.23^{b}	10.10^{a}	10.75^{a}	10.75^{a}	11.75^{a}	0.10	*
Globulin (mmol/L)	27.72^{b}	30.21^{a}	33.25^{a}	34.30^{a}	28.21^{b}	0.31	*
Alkaline phosphates (i.u/l)	13.13^{b}	15.72^{ab}	17.23^{a}	18.34^{a}	21.52^{a}	0.17	*
Creatinine (mmol/L)	21.34^{a}	19.20^{a}	18.32^{ab}	16.76^{ab}	15.11^{c}	0.18	*

Means within rows with different superscript letters are different (P<0.05). *P<0.05; NS, P>0.05. Data represent the mean value of 12 birds (6 replicate pens × 2 birds per pen). SEM, standard error of mean.

The dressing percent also followed the same trend as live weight however; broilers fed R3, R4 and R5 diets had comparable (P>0.05) thigh weight. Broilers fed 0.0% SPPM had significantly (P<0.05) smaller thigh and breast weights compared to birds on other treatment groups.

Lung weight of bird fed SPPM were significantly (P<0.05) heavier than those on control diet. Gizzard weight followed the same trend as lung weight. Higher value of gizzard weight was recorded by birds on control diet which was significantly (P<0.05) higher than birds fed SIPM – based diets

The result obtained for breast and thigh weights in this study is in line with the findings of (Okorie, 2010 and Okpanachi et al., 2015) who observed an increase in breast and thigh weight with an increase in inclusion level of cassava peel meal and brewers dried grains. Furthermore, the higher breast and thigh weight in this study with increasing levels of SIPM in diet may be an indication of better conversion of nutrients in the SIPM based-diet into meat.

Table 4 shows that Albumin level is lower in R1 diet with a value of 9.23 and highest in R5 diet with a value of 11.75. The value of alkaline phosphatase and total protein increased as the level of SIPM increased in the dietary treatments, ranging from 13.13 in R1 to 21.52 in R4 and to 36.21 to 46.21 respectively. Creatinine values however, decreased as the level of SIPM increased from 21.34 in R1 to 15.11 in R5. Diet 3 however had the highest globulin level of 34.33 while diet 1 had the lowest globulin level of 26.67. Despite the differences in albumin levels across the treatment groups, the values are within the ranges of 12.5mmol/l to 22mmol/l reported by (Akinmutimi and Onen, 2008). This is an indication that SIPM substitution did not adversely affect the nutritive quality of the experimental diets.

Unlike all other parameters measured, birds on R1 recorded higher value (21.34) of Creatinine as the level of replacement increases. The finding in this study is similar to Okpanachi et al. 2015) who reported similar trend on birds fed Cassava tuber Meal, brewer's dried grain and palm Oil mixture.

According to Okpanachi et al. (2015) total proteins are the most abundant compound in serum. This is because they are involved in enzyme, hormones and antibodies synthesis. The values of total protein recorded in this study are within the normal physiological range of 32.5mmol/l to 76.1mmol/l reported by (Rajurker, 2009). This is an indication that the quality of protein in the experimental diet was adequate. Although globulin value differed among treatment groups, they were however within the normal range of 21.3mmol/l to 30.2mmol/l reported by (Adeyemo, 2008 and Okpanachi et al., 2015).

Conclusion

Proximate composition of SPPM contains moderate amounts of feed nutrients that can sustain broiler chickens for optimum performance. From the results of the feeding trial, it can be concluded that SPPM can substitute maize up to 75% in broiler chicken diets without any adverse effect on growth performance, carcass characteristics and serum biochemistry.

Acknowledgement

We wish to acknowledgment the management of Concordia College. Our appreciation goes to Mallam Tukur Isa and Ali Isa for their technical support

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