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Original Research

The effect of adding various levels of orange peelings powder to the diet on the production performance and some characteristics of carcass of broiler chicken

Authors:
Ahmed TA. Salih and Basil M. Ibrahim

Institution:
Department of Animal Production, Faculty of Agricultural College, University of Baghdad, Iraq.

Corresponding author:
Ahmed TA. Salih

ABSTRACT:

This study was performed in the poultry field in the Department of Poultry, Faculty of Agriculture, University of Baghdad, Abu Ghraib from 28.9.2017 to 2.11.2017 (35 days) to estimate the effect of adding various levels of dried orange peelings powder (0, 15, 20, 25 mg/kg) to the diet on the production performance of broiler chicken. One hundred and eighty unsexed broiler Rose 308 chicks were reared in this experiment at the age of one day. The chicks were fed on starter diet for the first three weeks of the age and fed on finisher diet in the fourth and fifth week. The chicks were distributed into four treatments (Tc) control treatment (without addition), the second (T_1) ,the third (T_2), the fourth (T_3) dried orange peelings powder at different levels (15, 20, 25 mg/kg). There were no significant difference between treatments in the body weight and weight increase values. A significant difference ($P<0.05$) was detected in the total feed consumption between treatments T_1, T_2 and T_3 compared to the control treatment. Significantly, total feed conversion coefficient was improved in T_1, T_2, and T_3 in addition, there was no losses in the experimental treatments. No significant differences were found in the values of the production index between the experimental treatments. The percentage of dissolution without or with the edible internal intestines, the relative weight of the main and secondary carcasses were recorded. A significant increase ($P<0.05$) in the relative weight of the heart in T_1 and T_2 was also observed.

Keywords:

Broiler chicken, Orange peelings, Body weight gain, Feed conversion coefficient.

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INTRODUCTION

Feed is considered the highest in production as it forms 70-75% of the production value (Zala and Shaikh, 2011). Thus, the new direction is to use cheapest and easy use of the available feed resources including secondary products of various agriculture industries such as *Citrus sinensis* including orange peelings which could substitute or added partly with traditional feed. These peelings were taken from the remains of foods industries in relatively less costs. *Citrus* such as sweat orange were used in producing juices and jam mainly and great amounts of secondary wastes resulted from this industry such as seeds peelings and cores (El-Adawy *et al*., 1999). Orange peelings are considered of industrial agricultural wastes and possible resource for secondary metabolism and basic oils (Andrea *et al*., 2003; Yang *et al*., 2011).

Citrus are main resources for biologic active materials such as antioxidant like ascorbic acid, carotenes, flavonoid and phenol compounds in human nutrition (Kamran *et al*., 2009) and good resources for folic acid, vitamin B (thiamine) and minerals such as potassium, phosphorous, calcium, magnesium, sodium, and sulfur (Agócs *et al*., 2007). The internal layer of orange peels enriched in dissolved sugar and contains great amounts of vitamin C, pectin, organic acids, various fibers and some minerals such as potassium (Ezejiofore *et al*., 2011). The secondary wastes are used in food industries, cosmetics and public medicine (Silalahi, 2002; Saidani *et al*., 2004). Dry orange peels was used in broiler chicken diet for its positive effect in production performance, availability and cheap prices (Ebrahimi *et al*., 2014) in addition to the ability of lowering levels of glucose, triglyceride and cholesterol (Abbasi *et al*., 2015). It has a harmful antibacterial activity (*E. coli*) and an increase in the number of beneficial bacteria (*Lactobacillus* bacteria) (Al-Efzadeh *et al*., 2016).

MATERIALS AND METHODS

The experiment was conducted in the poultry field of the Department of Animal Production, Faculty of Agriculture, University of Baghdad (Abu Ghraib) for the period from 28.9.2017 until 2.11.2017 for five weeks (35 days), was used in the experiment 180 chick of broiler chickens meat strain (Ross 308), the broiler was randomized into four treatments with three replicates per treatment and each replicate containing 15 chicks. The continuous lighting system was used 23 hours a day and the birds were fed during the experiment period on the starter diet and finisher diet. Diet content and chemical composition as were given percentages listed in Table 1. Dried orange peel powder was used in the field experiment, prepared from the local markets in Baghdad from the juice shops where the orange peel of pulp and cores were cleaned, cut and dried, and the peels were grinded and turned into powder. The feed was provided *ad libitum* during the trial period. It was weighed and performed to the birds and then the remaining feed is weighed at the end of the week to determine the amount of feed consumed weekly, and the chicks were weighed at one day and then the birds were weekly weighed individually to calculate the weight of the live body and the weekly weight increase. The carcass was sliced according to the typical shredding of the carcass to the main and secondary catheters, separating the edible internal organs of the Giblets (heart, liver, and gizzard). Each of them was sacrificed from the rest of the viscera, and then weighed using an electronic sensitive balance, to extract the relative weights of each of the main and secondary organs and internal organs that could be eaten.

Orange peel's chemical contents

Orange peel contains, energy 97 kcal/kg, carbohydrates 25 g, protein 1.50 g, fat 0.20 g, fiber 10.6 g, vitamin B1 0.120 mg, vitamin B2 0.090 mg, folic acid 30 µg, vitamin B3 0.900 mg, vitamin B6 0.176 mg, vitamin A 420 IU, vitamin C 136 mg, vitamin E 0.25 IU,

Table 1. Feed composition and chemical analysis for the experimental diets (starter and grower diets)

S. No	Forage materials%	The starter diet (1-21 days)	The grower diet (22-35 days)
1	Yellow corn	56.5	64
2	Soybean meal	34	26
3	Plant protein concentration*	5	5
4	Sunflower oil	2.5	3
5	Limestone	1	1
6	Phosphate calcium	0.5	0.5
7	Table salt	0.3	0.3
8	Metals and vitamin mixture	0.2	0.2
9	Gross	100%	100%
	Calculated chemical analysis ***		
10	Protein (%)	18.88	21.76
11	Energy (kcal price / kg feed)	3121	3000
12	Calcium (%)	0.76	0.78
13	Phosphorus (%)	0.45	0.49
14	Methionine (%)	0.46	0.50
15	Lysine (%)	1.06	1.25
16	Methionine and cysteine (%)	1.31	1.55

* 40% protein concentrate, 2183.70 kcal/kg, calcium 3.53%, phosphorus 2.56%, methionine 3.70%, lysine 3.85%, methionine + cysteine 4.12%, vitamin 60 mg B1, vitamin 140 mg B2 and vitamin 80 mg B6, vitamin 700 mg B12, vitamin B-2mg, niacin 800 mg, folic acid 20 mg, vitamin 50 mgK3, calcium-D pantothenate 300 mg, chlorine 7 mg, chlorine 6.073 mg, copper 200mg, manganese 1.600mg, zinc 1.200mg, iron 1mg, iodine 20mg, selenium 5mg. ** Broiler Premix 1% vitamin A 1.250.000 IU/kg, vitamin D3, 310.000 IU/kg, vitamin E 5 mg/kg, vitamin K3 200 mg/kg, vitamin B1 250 mg kg, D-pantothenic acid 200mg/kg, vitamin B6 500 mg/kg, vitamin B12 2 mg/kg, vitamin PP 3.500 mg/kg, choline chloride 40.000 mg/kg, manganese 9.150 mg/kg, zinc 5,200 mg/kg, iodine 100 mg/kg, cobalt 100 mg/kg, selenium 10 mg/kg, amino acids 90.000 mg/kg *** according to the chemical composition of the animals according to NRC (1994).

sodium 3 mg, potassium 212 mg, calcium 161 mg, iron 0.80 mg, magnesium 22 mg and phosphorus 21 µg. This is the nutritional value per 100 g of orange peel as per USAD (2017).

RESULTS AND DISCUSSION

Table 2 shows the effect of the addition of different levels of dried orange peel powder to the diet in the weekly body weight. A significant difference ($P<0.05$) was noted in body weight in T_1, T_2 and T_3 in the first and third weeks with mean values of 331.33, 321.33 and 332.00 g respectively. No significant difference was observed at week 4 between Tc (1223.00), T_2 (1203.33) and T_3 (1150.67 g), while T_1 (1115.33 g) was

Table 2. Effect of adding different levels of powdered orange peel to the diet on the weekly body weight (g) for broilers (mean ± standard error)

S. No	Treatment	Age in weeks				
		1	2	3	4	5
1	Tc	6.69± 135.33^{a}	13.66± 382.33^{a}	14.19± 828.67^{a}	41.90± 1223.00^{a}	32.12± 1625.00^{a}
2	T_1	4.16± 114.00^{b}	10.52± 331.33^{b}	8.29± 720.33^{b}	10.08± 1115.33^{b}	11.53± 1533.00^{b}
3	T_2	8.02± 108.00^{b}	14.19± 321.33^{b}	30.36± 751.33^{b}	11.83± 1203.33^{a}	6.88± 1588.67^{ab}
4	T_3	2.60± 116.66^{ab}	5.00± 332.00^{b}	19.65± 783.00^{ab}	10.71± 1150.67^{ab}	21.19± 1569.00^{ab}
5	Significance level	*	*	*	*	*

Significant differences in the probability level ($P<0.05$). The different letters within the same column indicate significant differences between Tc, T_1, T_2 and T_3. Addition of dried orange peel powder to the diet at 0, 15, 20.25 g/kg feed respectively.

Table 3. Effect of adding different levels of powdered orange peel to the diet on the weekly weight gain of broilers (mean ± standard error)

S. No	Treatment	Age in weeks					Total weight increase
		1	2	3	4	5	
1	Tc	6.69± 135.33^{a}	7.02±247.00^{a}	6.11±446.33	28.28± 394.33^{ab}	41.35±402.00	31.37±1585.00^{a}
2	T_1	3.66±71.66^{b}	7.62±217.33^{b}	5.19±389.00	16.44±395.00^{ab}	4.17±417.67	10.39±1490.67^{b}
3	T_2	7.35±68.33^{b}	6.93±213.33^{b}	42.29± 430.00	25.96± 452.00^{a}	14.34±385.33	5.56±1549.00^{ab}
4	T_3	2.64±76.00^{b}	5.48±215.33^{b}	24.41± 451.00	15.96± 367.66^{b}	21.62±418.33	20.95±1528.33^{ab}
5	Significance level	*	*	NS	*	NS	*

* There were significant differences in the level of probability (P<0.05), N.S mean no significant differences between the transactions. Different letters within one column indicate significant differences between Tc coefficients. T_1, T_2 and T_3 Add dried orange peel powder to the diet at 0, 15, 20.25 g/kg feed respectively.

significantly reduced (P<0.05) compared to Tc, T_2 and T_3. At week five, Tc (1625.00 g) was significantly higher (P<0.05) compared to T_1 (1533.00 g) and not significantly different with T_2 (1588.671) and T_3 (1569.00 g).

Table 3 shows the effect of the addition of different levels of dried orange peel powder to the diet on the weekly and total weight gain rate of the broilers Ross 308. The table showed that there was a significant superiority (P<0.05) for Tc control on T_1, T_2 and T_3 in addition to a significant difference (P<0.05) was found in T_2 (452.00 g) when compared to T_3 (367.66 g) and did not differ from Tc (394.33) and T_1 (395.00 g). Total weight gain in week 1, 2 and 4 was significantly higher than the week 3 and week 5.

The results of Tables 2 and 3 showed no significant differences in weight and weight gain between T_1, T_2 and T_3 and control treatments. The two tables showed significant improvement in weight and weight gain in the addition of orange peel powder. The level of addition and the age of the last weeks of breeding were two factors that could affect the weight gain but if we imposed in the case of extension or increase of the period of breeding for more than 35 days and above there may be a significant improvement in weight and increase in weight in the additional treatments compared to control treatment may be due to the role of the active compounds content (Sturkie, 2000). These compounds act as natural oxidants in the body of birds, thus creating the necessary enzymes that are similar to the action of glutathione peroxidase. These enzymes protect the tissues by removing free radicals and protecting the body against the danger and damage of peroxides that break

Table 4. Effect of adding different levels of powdered orange peel to the diet on feed consumption (weekly and total) of broilers (average ± standard error)

S. No	Treatment	Age in weeks					Gross fodder consumption
		1	2	3	4	5	
1	Tc	6.42±129.00^{a}	7.21±293.33^{a}	18.18±527.33^{b}	30.59±680.67^{a}	56.41±789.67	2420.76±0.0083^{a}
2	T_1	8.41±92.33^{b}	15.77±265.67^{a}	15.30±499.67^{b}	2.96±559.33^{b}	28.10±726.67	53.74±2143.67^{b}
3	T_2	9.83±110.67^{ab}	8.96±226.33^{b}	30.36±751.33^{a}	39.85±621.67^{ab}	7.12±784.33	14.42±2458.33^{a}
4	T_3	3.92±108.33^{ab}	9.06±267.33^{a}	2.00±497.00^{b}	15.76±650.67^{a}	8.95±712.33	27.91±2235.67^{b}
5	Significance level	*	*	*	*	NS	**

There were significant differences in the probability level (P<0.05). ** There were significant differences in the level of probability (P<0.01), N.S mean no significant differences between the transactions. The different letters within the same column indicate significant differences between Tc, T_1, T_2 and T_3. Add dried orange peel powder to the diet at 0, 15, 20.25 g/kg feed respectively.

Table 5. Effect of adding different levels of dried orange peel powder to the diet in the feed conversion ratio (g feed /g bodyweight) increase in weekly and total meat (mean ± standard error)

S. No	Treatments	Age in weeks					Feed conversion coefficient
		1	2	3	4	5	
1	Tc	0.027±1.35	0.003±1.18^{ab}	0.049±1.18	0.059±1.73^{a}	0.350±2.03	0.071±1.52^{ab}
2	T_1	0.154±1.29	0.037±1.21^{a}	0.051±1.28	0.049±1.42^{b}	0.049±1.73	0.032±1.44^{b}
3	T_2	0.185±1.64	0.048±1.08^{b}	0.170±1.14	0.029±1.37^{b}	0.051±1.94	0.003±1.58^{a}
4	T_3	0.006±1.42	0.028±1.23^{a}	0.059±1.10	0.055±1.77^{a}	0.098±1.71	0.010±1.46^{ab}
5	Significance level	*	*	*	*	NS	**

There were significant differences in the probability level (P<0.05). ** There were significant differences in the level of probability (P<0.01), N.S mean no significant differences between the transactions. The different letters within the same column indicate significant differences between Tc, T_1, T_2 and T_3. Add dried orange peel powder to the diet at 0, 15, 20.25 g / kg feed respectively.

down the body's proteins (Dorman and Deans, 2000). In addition, these compounds prevent the breakdown of proteins and their building components and thus increase their concentrations in blood serum. Furthermore, the orange peel contains vitamin C, which has a strong and good relationship to increase the chemical reactions of amino acids, including tyrosine and phenylalanine necessary in the formation of thyroid hormones and (Table 4) indicates the results of adding different levels of powdered orange peel powder added to the diet. At week 1, the control treatment was significantly (P<0.05) higher (129.00) than T_1 (92.33 g) and was significantly different from T_2 (110.67) and T_3 (108.33 g) while no significant differences between T_1, T_2, and T_3 was detected. There were no significant differences between Tc and T_1, while T_3 (226.33 g) was significantly reduced (P<0.05) compared to Tc, T_1 and T_3 (293.33, 265.67 and 267.33 g). At the age of three weeks, T_2 (751.33 g) was significantly higher (P<0.01) than Tc (527.33), T_1 (499.67) and T_3 (497.00 g) in the feed consumption rate and no significant differences were observed (P<0.05) compared to Tc, T_2 and T_3 (680.67, 621.67 and 650.67 g), did not have a significant effect on feed consumption for Tc and 2458.33 (T_2 and 2420.00 g) compared with T_1 and T_3 (2143.67 and 2235.67 g).

Table 6. Effect of adding different levels of dried orange peel powder to the diet in the meat production index at 35 days (mean ± standard error)

S. No	Treatment	Production manual
1	Tc	18.33±305.77
2	T_1	6.69±304.37
3	T_2	0.990±286.63
4	T_3	5.32±307.03
5	Significance	N.S.

N.S. means that there are no significant differences between the transactions. The different letters within the same column indicate significant differences between Tc, T_1, T_2 and T_3. Add dried orange peel powder to the diet at 0, 15, 20, 25 g/kg feed respectively.

Table 5 shows the results of the addition of different levels of powdered orange peel to the diet on the meat conversion coefficient for broilers. The table shows no significant differences between the four experimental treatments in the first week, the third and the fifth week. There were no differences between the Tc and Tc control treatments for the same treatment. At the age of four weeks, a significant improvement was observed (P<0.05) in the feed conversion coefficients of T_1 (1.42 g) and T_2 and (1.37 g) compared to Tc (1.73 g) and T_3 (1.77 g). As for total feed conversion, the table showed that T_1 (1.44 g) was significantly better (P<0.05) in the feed conversion than the T_2 (1.58 g) but did not differ significantly with Tc (1.52) and T_3 (1.46 g).

In terms of feed consumption and feed conversion ratio, Table (4 and 5) indicated that a difference in the increase and decrease in total feed consumption in T_1, T_2 and T_3 compared to the control

Table 7. Effect of adding different levels of powdered orange peel powder to the diet on the dressing percentage without or with edible organs and abdominal fat for broilers (mean ± standard error)

S. No	Adjective	Treatments				Significant level
		T_c	T_1	T_2	T_3	
1	Percentage of excretion without edible internal organs %	0.669±66.98	0.537±66.55	0.589±67.53	1.14±66.55	NS
2	Percentage of digestion with edible internal organs	0.654±72.56	0.569±72.03	0.657±72.51	0.836±71.86	NS
3	Relative weight of the heart	$0.058±0.561^{ab}$	$0.038±0.640^{a}$	$0.033±0.671^{a}$	$0.024±0.503^{b}$	*
4	Relative weight of the liver	0.092±2.35	0.158±2.46	0.031±2.43	0.197±2.45	NS
5	The relative weight of the quince	0.110±1.67	0.067±1.80	0.124±1.89	0.163±1.97	NS
6	The relative weight of belly fat	0.134±0.866	0.190±0.748	0.051±0.763	0.112±0.653	NS

* There were significant differences in the level of probability ($P<0.05$), N.S mean no significant differences between the transactions. Different letters within one column indicate significant differences between Tc coefficients. T_1, T_2 and T_3 add dried orange peel powder to the diet at 0, 15, 20.25 g/kg feed respectively.

treatment. Table 5 shows a significant improvement in the total feed conversion ratio due to the increase in the number of beneficial bacteria and the decrease in the number of harmful bacteria in the gastrointestinal tract leads to increase nutrient absorption and transfer to the liver (Scanes, 2014). Metabolism and build-up increase the ability of the intestines to absorb nutrients such as amino acids, sugars and fatty acids. The reduction of harmful bacteria such as *E. coli* gland responsible for the growth of the body (Darwish and El-Habak, 2003; Mourao *et al*., 2008). Regarding the results of this study, it was agreed with the results of Oluremi *et al*. (2010) who showed no significant differences in mean body weight, weight gain, feed consumption, and feed conversion coefficients (Oluremi *et al*., 2006; Ebrahimi *et al*., 2013). The increase in weight, the feed consumption rate and the feed conversion T_1, T_2, T_3 compared with Tc. Thus, the intestines' ability to absorb nutrients such as amino acids, sugars, fatty acids, and the availability of these substances increases the activity of thyroxine from the thyroid gland responsible for the growth of the body and therefore reflected on the increase in the rate of body weight and the increase in weight (Tables 2 and 3). Consequently reflected on the absence of losses between the treatments of adding powder peels and the improvement in the values of the feed conversion coefficient, which is positively reflected in the values of the production index.

Table 6 shows the results of the addition of different levels of dried orange peel powder to the diet in the production index. The table showed no significant differences between treatments in the production index.

Table 8. Effect of the addition of dried orange peel powder (DOPP) to the diet on the relative weight of the main and secondary meat carcass carcasses (average ± standard error)

S. No	Relative weights of carcass (%)	Treatments				Significant level
		T_c	T_1	T_2	T_3	
1	Breast	0.996±33.31	0.669±32.86	0.741±32.200	0.512±32.78	NS
2	Thigh	0.513±29.08	0.495±28.26	0.500±28.90	0.476±28.51	NS
3	Wing	0.261±11.38	0.249±11.88	0.176±11.46	0.242±11.68	NS
4	Neck	0.233±6.93	0.406±6.38	0.185±7.16	0.242±6.48	NS
5	Back	0.380±19.26	0.468±20.50	0.616±20.36	0.309±20.53	NS

N.S. means that there are no significant differences between the transactions. The different letters within the same column indicate significant differences between Tc, T_1, T_2 and T_3. Add dried orange peel powder to the diet at 0, 15, 20.25 g/kg feed respectively.

Table 7 indicates that the results of the addition of different levels of dried orange peel powder to the diet did not have any significant effect in the dressing percentage without or with the internal organs that can be eaten and the relative weight of the liver, gnat and abdomen among all the experimental treatments. The relative weight of the heart was significantly higher ($P<0.05$) in T_1 (0.640%) and T_2 (0.671%) than T_3 (0.503%). The control treatment Tc (0.561%) did not differ from other experimental treatments (T_1, T_2 and T_3).

The results shown in Table 8 indicate that there are no differences between the main and significant secondary carcass carcasses of the broilers among all treatments at the age of 35 days.

The results of Table 7 showed a significant improvement in the relative weight of boiler carcasses for DOPP supplementation at 15 and 20 g/kg feed. This is due to the increase in thyroid activity and increased absorption of intestinal glucose, thus reducing the conversion of glucose to calcification, This is due to the increase in blood sugar and hypertrophy in the heart and kidneys, which may be due to the increase of thyroid activity and increase the absorption of intestinal glucose and thus increase in the blood, which in turn leads to hypertrophy in the heart and kidney that is observed when using orange peel extract (Muller and Setiz, 1984; Alefzadeh *et al*., 2016; Ahaotu *et al*., 2017) had a significant increase in the relative weight of the heart, kidney, spleen and gallbladder and were inconsistent with the results of Agu *et al*. (2010) when using different levels 0, 10, 20, 30, 40, 50 of DOPP g/kg. Table 7 showed that there was a significant reduction in the relative weight of the abdominal fat when added DOPP to the diet which may be due to the fact that orange peel has a role in lowering cholesterol in the blood through the effect of thyroid activity. It contains effective compounds such as flavonoids, that includes hesperidin, which is effective as an antioxidant, which inhibits the formation of compounds that play a role in granting the formation of lipid-binding compounds such as acid phenolic acid to the donor (OH) and the formation of free radicals (H_2O_2) Of oxidation of fat, so hesperidin prevents or inhibits the formation of hydroxide or peroxide, and also works to inhibit free radicals (Surai *et al*., 2003). It acts as a defensive antibody against peroxides and glutathione, such as vitamin E (Fellenberg and Speisky, 2006). Low fat belly weight is one of the desirable traits in producing meat carcasses (Fayyad and Naji, 1989; Ebrahimi *et al*., 2014).

CONCLUSION

We conclude from the present study that the addition of levels of powdered orange peel (1.5, 0.2 and 2.5%) to the meat broiler coat for the duration of the experiment (35 days) resulted in a significant improvement in body weight and weight increase, as well as the moral improvement in the feed conversion factor. And a significant increase in the relative weight of the heart of the meat broiler.

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