

# Effect of dietary supplementation with crisp orange peel, turmeric (*Curcuma longa*) and their combination on growth performance and some carcass traits of broiler chicks (Ross-308)

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## Abstract

The present study aimed to investigate the effects of both dietary crisp orange peel and turmeric powder and their combination on growth performance and some carcass traits of broiler chicks. A total of 120 broiler chicks (one-day-old) were used in this study. The birds were randomly divided into four treatments consisting of a basal diet as a control (C), a diet of 0.5 g·kg<sup>-1</sup> crisp orange peel (T1), a diet of 0.5 g·kg<sup>-1</sup> turmeric powder (T2), and a diet of 0.25 g·kg<sup>-1</sup> crisp orange peel + 0.25 g·kg<sup>-1</sup> turmeric powder (T3). The bird chicks were weighed at 21 days of age. Weight gain, feed intake, feed conversion ratio, the weight of internal organs and carcass yield were measured throughout the experiment at the same intervals. The results showed that the birds treated with turmeric powder (T2) had higher ( $P \leq 0.05$ ) weight gain, lower ( $P \leq 0.05$ ) feed intake and the best feed conversion ratio during the starter period (1 – 21 days of age) and growth and in the finisher period (22 – 42 days of age) as compared with other treatments. It was observed that birds that received a basal diet with crisp orange peel (T1), turmeric powder (T2) and their combination had lower ( $P \leq 0.05$ ) abnormal fat, heart and liver weights as compared with the control treatment. The results showed that birds treated with turmeric powder (T2) recorded high ( $P \leq 0.05$ ) carcass weight and carcass yield percentage. It can be concluded that the treatment of birds with turmeric powder was more effective than other treatments and may be useful as a feed additive for improving growth performance and carcass yield.

*Broiler, carcass traits, carcass yield, crisp orange peel, performance, turmeric powder*

## Introduction

There are a number of requirements for the way in which animals should be managed so that the best performance is achieved in a way acceptable to those responsible for the care of the animals and to the community in general. These requirements are the keys to good management and may be used to test a poultry enterprise in relation to the standard of its management. These requirements are also called principles. The importance of each principle changes with the situation, for which reason the emphasis placed on each may alter from place to place and from time to time. This means that while the principles do not change, the degree of emphasis and method of application may. Every facet of the poultry operation should be tested against the relevant principles (Dayyani 2014).

A variety of feed additives are included in the diet of poultry to derive the maximum growth of broiler chickens. The use of in-feed antibiotics and hormones not only increases the cost of production, but also leads to residues in meat and the development of antibiotic resistance in microbes (Raghdad and Al-Jaleel 2012). The beneficial effects of bioactive plant substances in animal nutrition may include the stimulation of appetite and feed intake and the secretion and activation of anti-bacterial and antioxidant (Toghyani et al. 2010). Turmeric contains curcumin, demethoxycurcumin and bisdemethoxycurcumin which are present to an extent of 2.5% of the total spices in turmeric powder. Curcumin has been shown to have several biological effects, including an antioxidant effect (Iqbalet et al. 2003). Curcumin is used in gastrointestinal and respiratory disorders (Anwarul et al. 2006). The biological properties of turmeric powder make it a potential substitute

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for antibiotics in livestock diets (Toghyani et al. 2011). Previous studies have shown that turmeric powder could be used as a feed additive to improve growth performance and decrease the level of cholesterol in poultry birds (Sayed et al. 2013 and Siddiqui et al. 2015). Citrus is an important feed for humans and is produced in Iraq (Al-Shaehaaf 2000). The acid flavor is characterized by its high percentage of the pectin which is concentrated in orange peel (El-Maraphy 1995). Spread in the crust and extracted by the pectin (Lee et al. 2003). The outer crust contains pigment (mostly carotenoids), phenolic compounds and vitamins (Perrucci 1995). Citrus compounds are associated with flavored and aromatic compounds (Islamic 2011). The research was conducted to investigate the effects of dietary supplementation of crisp orange peel and turmeric powder and their combination on growth performance and some carcass traits of broiler chicks.

### Materials and Methods

#### The animals and experimental diets

The experiment was conducted at the poultry shed under the Veterinary Department at the Shaqlaw Technical Institute with the co-operation of a private farm. A total of 120 one-day-old broiler chicks (Ross 308) were purchased from a local private hatch in the city of Erbil. The day-old chicks were reared in a brooder house to adjust to the environmental conditions for up to 7 days. After 7 days, the chicks were randomly allocated to four dietary treatment groups of 30 chicks; each treatment was composed of three replications with 10 birds. The chickens were kept in cage conditions. Each cage was equipped with a feed dispenser and water intake was ensured *ad libitum* by a self-feed pump. Heating was provided by a central heater. The temperature was 33 °C on the first day and then reduced by about 2 °C every week, with the final temperature being 19 °C. The lighting regime was continuous during the feeding period (42 days). Each group of birds was fed the same complete starter feed mixture until day 21 of age and growth at finisher feed mixture from day 22 to 42 of age.

#### Preparation of turmeric powder and crisp orange peel

Table 1 show the diet prepared in a local farm. Dried turmeric (*Curcuma longa*) rhizomes were purchased from a local spice market in Erbil. The samples were further ground into powder in a milling machine. The powder obtained was packed in a polyethylene bag and preserved in freezer storage until used; crisp orange peel was collected from various shops selling orange juices and crisped at once with an electric machine. The chemical composition of the turmeric and crisp orange peel can be seen in Table 1.

The feed starter diet and grower and finisher diet were produced without antibiotics or coccidiostatics

The chemical composition of turmeric contains 13.1, 6.3, 69.4, 5.1, 3.5 and 0% moisture, protein, carbohydrate, fat, minerals and amino acids, respectively. Orange peel contains 20, 5.8, 55 and 15 non-soluble fiber, 6.2, 4.6 and 16 essential and non-essential % for moisture, protein, carbohydrate, fat, minerals and amino acids, respectively (Chattopadhyay et al. 2004).

#### The design of the experiment

The experimental period was divided into two phases (broiler-starter and broiler-starter and finisher). A broiler starter diet was provided between days 1 to 21, a broiler grower and finisher was fed from 22 to 42 days. Turmeric powder was incorporated into the experimental diets manually in appropriate doses. The composition of manually prepared experimental diets according to the NRC (1994) was used in different treatments for the broiler. A total of 120 one-day-old broiler chicks (Ross 308) were assigned randomly to one of four treatments with three replicates of 10 chicks based on a completely randomized design. The dietary treatment consisted of:

- C: basal diet (control; without supplementation)
- T1: basal diet + 0.5 crisp orange peel / kg diet
- T2: basal diet + 0.5 g turmeric (*Curcuma longa*) powder / kg diet
- T3: basal diet + 0.25 g crisp orange peel + 0.25 g turmeric (*Curcuma longa*) powder / kg diet

#### Growth performance and carcass traits

The experimental birds were randomly assigned to diets; feed and water were provided *ad libitum* throughout the experimental period (42 days). Broiler chicks were individually weighed on arrival and at 21 and 42 days of age on a pen basis. Feed intake was measured throughout the experiment and the feed conversion ratio (FCR, feed intake, weight gain) was calculated at intervals. The survivability percentage was calculated as the total number of surviving broilers divided by the initial number of birds multiplied by 100. The birds were slaughtered at 42 days of age, and the carcass yield estimated according to Elimam (2014) by the following equation:

Table 1. Composition of broiler diets

Ingredients [%]	Starter	Grower and finisher
	[1 to 21 days of age]	[22 to 42 days of age]
Wheat	35.00	35.00
Maize	36.00	41.00
Soybean meal [48 % N]	21.55	18.95
Fish meal [71 % N]	3.80	2.00
Ground limestone	1.00	1.05
Monocalcium phosphate	1.00	0.70
Fodder salt	0.10	0.15
Sodium bicarbonate	0.15	0.20
Lysine	0.05	0.07
Methionine	0.15	0.22
Bergafat palm kernel oil	0.70	0.16
<sup>1</sup> Premix Euromix BR 0.5 %	0.50	0.50
Analyzed composition [g·kg <sup>-1</sup> ]		
Crude protein	210.76	190.42
Fiber	30.19	29.93
Ash	24.24	19.94
Ca	8.16	7.28
P	6.76	5.71
Mg	1.41	1.36
ME [MJ kg <sup>-1</sup> ]	12.02	12.03

<sup>1</sup>active substances per kilogram of premix: vitamin A 2 500 000 IU; vitamin E 50 000 mg; vitamin D3 800 000 IU; niacin 12 000 mg; d-pantothenic acid 3 000 mg; riboflavin 1 800 mg; pyridoxine 1 200 mg; thiamine 600 mg; menadione 800 mg; ascorbic acid 50 000 mg; folic acid 400 mg; biotin 40 mg; vitamin B12 10.0 mg; choline 10 000 mg; betaine 50 000 mg; Mn 20 000 mg; Zn 16 000 mg; Fe 14 000 mg; Cu 2 400 mg; Co 80 mg; I 200 mg; Se 50 mg.

$$\text{Carcass yield [\%]} = \frac{\text{carcass weight (g)} + \text{giblet weight (g)}}{\text{live body weight (g)}}$$

#### Statistical analysis

Data on different variables were subjected to analysis of variance (ANOVA) in a completely randomized design (CRD) (Steel and Torrie 1980). Significant differences between the treatments were calculated by Duncan's Multiple Range Test (DMRT). All analyses were performed by the program SPSS (2009).

## Results

### Effect of treatments on body weight, feed intake, FCR and survivability

The Table 2 showed that there were no significant results ( $P \geq 0.05$ ) in different dietary treatments. The period of rearing (1 – 21 days) observed that there were significant results ( $P \leq 0.05$ ) among all treatments for live body weight. The highest value was found in T2 (582.66 g) and the lowest in T3 (550.47 g). At period (22 – 42 days) for live body weight recorded different significant results ( $P \leq 0.05$ ) in all treatments. The highest value was found in C (1 665.03 g), while the lowest weight was in T2 (1 594.74 g). The feed intake of broilers in different dietary treatments was statistically significant from 1 to 21 days of age ( $P \leq 0.05$ ). The highest value was seen in C (467.33 g·bird<sup>-1</sup>) in one hand neither in other

hand nor from 22 to 42 days of age birds received a mix of crisp orange peel + turmeric powder (T3) was highest value ( $2\,330.46\text{ g}\cdot\text{bird}^{-1}$ ) and was significant ( $P \leq 0.05$ ) among all treatments. Body weight gain was attained by broilers receiving  $0.5\text{ g}\cdot\text{kg}^{-1}$  diet of additive turmeric powder ( $35\,765\text{ g}/\text{bird}^{-1}$ ), but between 22 and 42 days of age the highest value was also observed in T2 ( $134.85\text{ g}\cdot\text{bird}^{-1}$ ). Feed conversion ratio. It was observed that no significant result was found ( $P \geq 0.05$ ) between T2 and T3 during the period 1 – 21 days for FCR, but significant opposite C and T1, which they significant among them also, the best value was found in T2 (1.16) followed by T3 (1.31). At the end of the trial (42 days of age), the FCR was lowest and best value observed continual in T2 (1.60). Survivability did vary significantly ( $P \leq 0.05$ ) among different treatment groups during the whole experimental period and the highest percentage was found in the control group (7.5%).

Table 2. Mean  $\pm$  SD effect of additive curcuma powder and orange crisp peel powder on broiler performance

Performance Parameters	Treatments			
	C	T1	T2	T3
Initial body weight [g·bird <sup>-1</sup> ]	41.35 $\pm$ 0.92*	40.93 $\pm$ 1.49	42.25 $\pm$ 1.71	40.43 $\pm$ 1.05
Live body weight [g·bird <sup>-1</sup> ]				
1 – 21 days	555.21 $\pm$ 0.90 b	532.76 $\pm$ 0.24 d	582.66 $\pm$ 1.16 a	550.47 $\pm$ 2.61 c
22 – 42 days	1 665.03 $\pm$ 0.82 a	1 636.4 $\pm$ 1.34 b	1 594.74 $\pm$ 1.27 c	1 560.85 $\pm$ 3.10 d
		Feed intake [g·bird <sup>-1</sup> ]		
1 – 21 days	467.33 $\pm$ 1.31 a	437.92 $\pm$ 1.89 c	418.21 $\pm$ 0.71 d	440.76 $\pm$ 0.59 b
22 – 42 days	2 204.94 $\pm$ 145 b	2 195.94 $\pm$ 4.16 c	2 189.17 $\pm$ 0.69 d	2 330.46 $\pm$ 317 a
		Weight gain [g·bird <sup>-1</sup> ]		
1 – 21 days		305.21 $\pm$ 3.88 d	322.73 $\pm$ 0.24 c	357.65 $\pm$ 1.16 a
335.47 $\pm$ 2.61 b				
22 – 42 days	1 115.03 $\pm$ 0.82 d	1 226.47 $\pm$ 1.34 c	1 369.28 $\pm$ 1.27 a	1 345.85 $\pm$ 3.10 b
		Feed conversion ratio		
1 – 21 days		1.53 $\pm$ 0.003 a	1.36 $\pm$ 0.006 b	1.16 $\pm$ 0.005 c
1.31 $\pm$ 0.008 c				
22 – 42 days	1.97 $\pm$ 0.002 a	1.79 $\pm$ 0.005 b	1.60 $\pm$ 0.002 d	1.75 $\pm$ 0.03 c
Survivability from 1 – 42 days [%]	7.5 $\pm$ 0.77 a	5.63 $\pm$ 1.05 ab	4.17 $\pm$ 0.97 b	4.79 $\pm$ 2.19 b

\*Insignificant a,b means with different superscript within row are significantly different ( $P < 0.05$ ) and values will increase from (a) to (c) value. Values mean  $\pm$  S.D. standard deviation of 60 birds.

#### Effect of turmeric powder on carcass traits

Data on carcass yield and organ weights are presented in Table 3. This study showed that abnormal fat content in broilers was decreased significantly by supplementation of turmeric powder mixed with orange peel in the broiler ration ( $P < 0.05$ ) and T3 had the best and lowest value ( $1.89\text{ g}\cdot\text{bird}^{-1}$ ). The weight of the heart, liver and gizzard seems significant ( $P \leq 0.05$ ) between different dietary treatments and the best value for all traits was found in group C (11.83, 52.20 and  $41.86\text{ g}\cdot\text{bird}^{-1}$ , respectively). This study demonstrated significant

( $P \leq 0.05$ ) differences in carcass yield. The highest percentage carcass yield was found in T2 (turmeric powder) (73.21%) as compared to our control diet (67.96%).

Table 3. Effect of additive curcuma powder and orange crisp peel powder on carcass traits

Parameters [g·bird <sup>-1</sup> ]	Treatment			
	C	T1	T2	T3
Carcass weight [g]	1 020.97 ± 049 b	992.18 ± 0.58 c	1 057.54 ± 6.52 a	907.55 ± 0.78 d
Carcass yield [%]	67.96 ± 0.57 b	66.86 ± 1.008 c	73.21 ± 0.77 a	64.58 ± 0.21 d
Abnormal fat	4.69 ± 0.14 a	2.79 ± 0.01 b	3.40 ± 0.29 c	1.89 ± 0.12 d
Heart	11.83 ± 0.56 a	10.50 ± 0.48 b	10.68 ± 0.21 b	9.64 ± 0.91 c
Liver	52.20 ± 0.73 a	49.40 ± 0.43 b	44.88 ± 0.55 c	39.92 ± 0.28 d
Gizzard	41.86 ± 0.11 a	39.23 ± 0.29 b	51.01 ± 0.02 c	49.00 ± 0.08 d

a,b means with different superscript within row are significantly different ( $P < 0.05$ ) and values increase from (a) to (c) value. Values mean ± S.D. standard deviation of 60 birds.

## Discussion

The significant increase in body weight with 0.5% turmeric powder may be due to the optimum antioxidant activity of turmeric (*Curcuma longa*) at the level of 0.5% that can stimulate protein synthesis by the birds' enzymatic system. This can be attributed to the fact that the significant effect of turmeric powder and orange peel together working on body weight was in agreement with the findings of some previous reports (Toghyani et al. 2010). The results related to live body weight gain can be explained by an improvement to the digestive system at an advanced age. Synchronized the combination of orange peel + turmeric (*Curcuma longa*) powder. The above results were in agreement with some earlier studies (Nouzarian et al. 2011; Wuthi-Udomlert et al. 2000). In these studies, feed intake with different broiler treatments did not differ significantly ( $P < 0.05$ ). However, the results of the present study disagreed with Raghdad and Al-Jaleel (2012) who found a significant difference in feed intake. The results of Durrani (2006), Raghdad and Al-Jaleel (2012), Osawa et al. (1995), Samarasinghe et al. (2003) and Wuthi-Udomlert et al. (2000) agreed with the results of our experiment that using different levels of turmeric did not significantly affect body weight gain. They explained that it reduces appetite for feed intake (Table 3), indicating that the best feed efficiency was due to the optimum antioxidant activity of turmeric powder mixed with crisp orange peel at an equal level of both curcuma and orange peel. A similar result was found by Durrani et al. (2006), Raghdad and Al-Jaleel (2012) and Wuthi-Udomlert et al. (2000) who reported that broilers that received a diet with 0.5% turmeric powder utilized their diets more efficiently. However, Yaghobfar et al. (2011) stated that there was no significant effect of feeding turmeric powder on the feed conversion ratio at the level of 0.4 and 0.8%. In relation to the survivability of broilers, Daneshyar et al. (2012) reported that the addition of turmeric powder to broilers' diets reduces the mortality rate due to increases of antioxidants from both curcuma and crisp orange peel. As is clear in Table 3, the best value was found in T3 (Samarasinghe et al. 2003; Steel Torrie 1980). The data on carcass characteristics and organ weights are presented in Table 4. These agreed with some other researchers (Nouzarian et al. 2011) who reported a lower fat content in broilers fed a diet containing 0.5% turmeric powder.

The explanation for this is the content of turmeric and orange peel material of antioxidant and voltaic fatty acids which play an important role in reducing the accumulation of abnormal fat. The significant ( $P < 0.05$ ) effect of turmeric powder and orange peel in single or combined use on the weight of the internal organs (heart, liver and gizzard) of broilers

fed experimental rations was in close agreement with the observations of Raghdad and Al-Jaleel (2012) who reported that feeding turmeric did not alter the size of the liver and heart. Raghdad and Al-Jaleel (2012) explained that used turmeric powder and found carcass dressing percentage at level of 0%, 0.5%, 1.0% and 1.5%, recorded high ( $P < 0.05$ ).

## Conclusions

It can be concluded from the results of this study that utilization of some herbs as additives in the diet of broilers leads to an improvement in some performance characteristics, especially if mixing them, as in our study, with turmeric powder and orange crisp peel powder, and can also lead to good properties of natural bird meat.

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