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Effects of red onion peel extraction, *Allium cepa* on some productive performance and lipid profile status of broiler exposed to heat stress

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ABSTRACT

This study was carried out to see how adding *Allium cepa* peel extract can affect growth performance and lipid profile of the broiler chicken after heat stress. At first, the peels of red onion have been extracted using hot water. A total of 300 one-day-old chicks were examined. This experiment lasted for 28 days and employed a completely randomized design. The birds were grouped into 5 treatments (C-, C+, T_1, T_2, and T_3). Group C- fed with basal diet without any addition; C+ fed a basal diet with 0.5% synthetic antioxidant BHT; T1 fed basal diet + 3% red onion peels extract; T_2 with basal diet + 6% red onion peels extract and T_3 with basal diet + 9% red onion peels extract. In 30th day, all birds were exposed to heat stress by raising temperature to 30 ºC. Data were collected about feed intake and weight gain weekly. The results of the body weight performance of chicks were studied. The statistical analysis revealed that there was a significant ($p < 0.05$) elevation in productive performance of onion-supplemented groups, compared to the control positive and negative in dose-dependent manner. Furthermore, the results of the lipid profile revealed that all groups supplemented with red onion peel extracts (T_3, T_2, and T_1 respectively) experienced significantly ($p < 0.05$) reduced triglycerides, total cholesterol, low-density lipoprotein, and very low-density lipoprotein compared to control groups. However, they exhibited an insignificant effect on high-density lipoprotein and very low-density lipoprotein concentrations in comparison with the control group. In conclusion, dietary supplementation of red onion peel extract enhanced body weight gain, tissue antioxidants, lowered serum total cholesterol, triglycerides, and an immunomodulatory effect in a dose-dependent manner.

Keywords: Red onion, Chicks, Broiler, Growth performance, Lipid profile.
Article type: Research Article.

INTRODUCTION

Since heat stress causes domesticated animals to consume less food and have fewer offspring, it has a significant negative impact on poultry production (Naranjo-Gómez *et al.* 2021). In addition, changes in acid-base balance and ion exchange mechanism brought on by acute heat stress significantly reduce hens' reproductive performance (Sahoo 2022). Temperature rises cause an increase in pathogenic bacteria and parasites in the environment around the animals. Climate change promotes illness onset and transmission by increasing vectors and pathogens (Pandey *et al.* 2021). The onion, *Allium cepa* is a member of the Lily family, Liliacege, growing in abundance all over the world. It has been a staple ingredient in cuisines for centuries (Joshi *et al.* 2009). *A. cepa* has pharmacologically active ingredients such as flavonoids (quercetin), organosulfur compounds, phenol components, and a sulphur-containing organic compound known as diakyl polysulfides with antibacterial, antioxidant, and antihypertensive actions on humans and animals (Osipova *et al.* 2021). Due to their capacity to scavenge free radicals, antioxidants are utilised to prevent oxidation in broiler meat (Rajani *et al.* 2011). However, despite the widespread usage of synthetic antioxidants like butylated hydroxyl anisole (BHA), tertiary-butyl hydroquinone (TBHQ), and butylated hydroxyl toluene (BHT), scepticism of such chemicals has not subsided. Mutagenic and toxic effects of synthetic

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antioxidants may occur in the human body (Aditya *et al.* 2017). Many natural antioxidants have been studied as potential feed supplements in place of synthetic antioxidants (Wen *et al.* 2020). Polyphenols are natural antioxidant compounds found in plants that have the potential to mitigate the harmful effects of oxidative stress (Zhang *et al.* 2016). Simple phenols, phenolic acids, acetophenoues, phenylacetic acid, coumarins, anthocyanins, xanthous, lignans, and flavonoids are all examples of polyphenols (Halliwell 2007). There are also some reports about plant extracts on other organisms around the world (Naser AL-Isawi 2022; Al-Musawi 2022; Sgheer & Yassin 2022)

MATERIALS AND METHODS

Peel extraction

The used onion skins were gathered up from a market in the area. To prepare this dish, we peeled the onion and cleaned the skin and bulb separately in distilled water. Finally, after three days, the onion skins were hung to dry in the air. It was made using information from established sources (Chia *et al.* 2019).

Birds and managements

Laboratory work was performed at the College of Veterinary Medicine, University of Baghdad, Iraq. Local animal welfare regulations, rules, and procedures were followed in all aspects of the care and use of experimental animals. The temperature inside the room was between 30 and 35 ºC. Beginning on day zero and continuing through day 21, the birds were fed with a beginning meal containing carbohydrate (21%) and protein with 2900 calories per kilogram of body weight (kilogram equivalent). Neither the control nor the onion-treated chickens received any medicine over the course of the trial.

Experimental design

Three hindered (Ross308) one-day-old mixed-sex broiler chicks were randomly allocated to one of five experimental groups. Each treatment had 60 chicks. Control negative groups were fed simply with the baseline diet, whereas control positive with the basal diet + 0.5% BHT (synthetic anti-oxidant). The remaining groups were given a baseline diet + 3% onion peel extract powder (T_1), a basal diet + 6% onion peel extract (T_2), and a basal diet + 9% onion peel extract (T_3).

Determination of growth performance traits of onion extract

The growth performance of chicks supplemented with onion was assessed using the following traits: feed intake, feed conversion ratio, and live body weight. Daily feed intake was calculated by weighing the amount of feed supplied each day and deducting the amount that remained the following morning. The total feed intake each week or for the duration of the experiment was determined by summing the daily feeding intake and feed conversion ratio (FCR) using the method of Contreras Selani *et al.* (2011) as follow:

FCR = Feed intake (g)/Weight gain (g)

Lipid profile assessments

To determine serum lipid profile, blood samples were centrifuged (4000 g for 10 min at 20 °C) to obtain serum. Total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C) and triacylglycerols (TG) were measured using commercially-available kits (Cormay, Lublin, Poland), while low-density lipoprotein cholesterol (LDL-C) according to Manterys *et al.* (2016).

Statistical analysis

The statistical analyses of the experiment data were performed using the SAS (Statistical Analysis System; version 9.1), using One-Way and Two-Way ANOVA. Least significant differences (LSD) was performed to assess significant differences among means of the groups. The results were expressed as mean ± standard errors, and $p < 0.05$ was considered statistically significant (Walker & Shostak 2010).

RESULTS

Body weight

In the present study, the results of body weight of chicks were studied according to the age (Table 1). In the first week the statistical analyses revealed that there were significant ($p < 0.05$) increase in body weight of T_2 compared to other groups, while in the second week there were significant ($p < 0.05$) decrease in C+ group compared to all other groups. Furthermore, in the third and fourth weeks, the results of statistical analyses revealed significant ($p < 0.05$) increases in T_3 and T_2 (2015.3 ± 5.92 and 1591.15 ± 19.05 respectively), compared to C-, C+ and T_1.

Table 1. Effects of red onion peels extract on body weight of broiler chicken in different age groups.

Groups \ Periods	1st Week	2nd Week	3rd Week	4th Week
	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
C-	251.7 ± 2.83^b	777.18 ± 8.14^a	1410.48 ± 17.87^c	1873.73 ± 10.55^c
C+	246.25 ± 4.19^b	694.25 ± 15.31^b	1322.35 ± 39.58^d	1892.15 ± 36.94^c
T_1	252.5 ± 2.92^b	769.80 ± 9.37^a	1329.84 ± 22.18^d	1853.15 ± 22.57^c
T_2	266.7 ± 3.51^a	789.91 ± 13.77^a	1408.35 ± 25.93^b	1943.5 ± 16.57^b
T_3	250.9 ± 5.17^b	784.55 ± 9.28^a	1591.15 ± 19.05^a	2015.3 ± 5.92^a
LSD	10.90	32.82	74.41	61.02

Note: Small letters refers to significant at $p \leq 0.05$ level.

Feed intake, weight gain and feed conversion ratio

Tables 2, 3 and 4 and also Fig. 1 depict the weight gain, feed intake, and feed conversion ratio throughout the four weeks treatment period. During the starter period, different levels of red onion peels extract could increase ($p < 0.05$) the feed intake (FI), weight gain (WG), and feed conversion ratio (FCR) compared to control positive and control negative groups. Throughout the grower period, broilers of T_1 showed an increase ($p < 0.05$) in FI compared to other groups. The finisher period and overall performance results showed that different levels of red onion peel extract increased ($p < 0.05$) the FI and WG. Also, during the finisher period, the FCR at the third and fourth weeks, revealed significant ($p < 0.05$) increases in T_3 and T_2 (2015.3 ± 5.92 and 1591.15 ± 19.05 respectively), compared to C-, C+ and T_1. At the end of the study the birds in T_3 exhibited a better feed conversion ratio (1.63:1) compared to C+, T_2, C- and T_1 (1.77:1, 1.79:1, 1.91:1 and 2.02:1) respectively.

Table 2. Feed intake of different groups at different periods of study.

Groups	Feed intake (g)				LSD
	1st Week	2nd Week	3rd Week	4th Week	
	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	
C-	499.33 ± 9.24^{Ad}	1350.00 ± 11.55^{Cc}	2650.00 ± 11.55^{Bb}	3600.00 ± 28.87^{Ba}	24.12
C+	452.00 ± 1.15^{Bd}	1400.00 ± 23.09^{Bc}	2450.00 ± 40.41^{Eb}	3303.33 ± 31.80^{Da}	
T_1	480.00 ± 8.66^{Ad}	1500.00 ± 28.87^{Ac}	2750.00 ± 14.43^{Ab}	3754.00 ± 25.57^{Aa}	
T_2	463.33 ± 4.41^{Bd}	1420.00 ± 11.55^{Bc}	2550.00 ± 14.43^{Cb}	3350.00 ± 28.87^{Ca}	
T_3	443.00 ± 1.73^{Bd}	1298.33 ± 10.14^{Dc}	2480.00 ± 22.89^{Db}	3300.00 ± 17.32^{Da}	
LSD	26.966				

Note: Capital letter denote the significant between groups. Small letters denote significant within groups at the $p \leq 0.05$ level.

Table 3. Weight gain of different groups at different periods of study.

GROUP	Weight Gain (gm)				LSD
	1st Week	2nd Week	3rd Week	4th Week	
	Mean ± SE	mean ± SE	mean ± SE	mean ± SE	
C-	246.92 ± 8.67^{Bd}	681.58 ± 16.6^{Bc}	1324.90 ± 25.17^{Eb}	1887.38 ± 38.98^{Ba}	17.50
C+	252.63A ± 0.1^{Ad}	788.18 ± 17.42^{Ac}	1370.38 ± 36.16^{Db}	1864.77 ± 32.43^{Ca}	
T_1	252.17 ± 3.47^{Ad}	773.27 ± 13.37^{Ac}	1426.87 ± 14.74^{Bb}	1856.10 ± 34.62^{Ca}	
T_2	251.23 ± 0.62^{Ad}	777.18 ± 12.70^{Ac}	1408.81 ± 24.41^{Cb}	1872.91 ± 24.35^{Ba}	
T_3	266.23 ± 1.18^{Ad}	789.63 ± 10.32^{Ac}	1506.12 ± 33.10^{Ab}	2020.20 ± 23.30^{Aa}	
LSD	19.563				

Note: Capital letter denote the significant between groups. Small letters denote significant within groups at the $p \leq 0.05$ level.

Table 4. Feed conversion ratio of different groups at different periods of study.

Groups	1st Week Mean ± SE	2nd Week Mean ± SE	3rd Week Mean ± SE	4th Week Mean ± SE	LSD
	Feed conversion ratio (%)				
C-	2.02 ± 0.03^{Aa}	1.98 ± 0.02^{Ac}	2.00 ± 0.01^{Ab}	1.91 ± 0.01^{Bd}	
C+	1.79 ± 0.00^{Da}	1.78 ± 0.01^{Da}	1.79 ± 0.02^{Da}	1.77 ± 0.02^{Db}	
T_1	1.90 ± 0.01^{Bc}	1.94 ± 0.03^{Bb}	1.93 ± 0.01^{Bb}	2.02 ± 0.00^{Aa}	0.02
T_2	1.84 ± 0.02^{Ca}	1.83 ± 0.02^{Ca}	1.81 ± 0.02^{Cb}	1.79 ± 0.01^{Cc}	
T_3	1.66 ± 0.00^{Ea}	1.64 ± 0.01^{Eb}	1.65 ± 0.00^{Ea}	1.63 ± 0.00^{Eb}	
LSD	0.022				

Note: Capital letter denote the significant between groups. Small letters denote significant within groups at the $p \leq 0.05$ level.

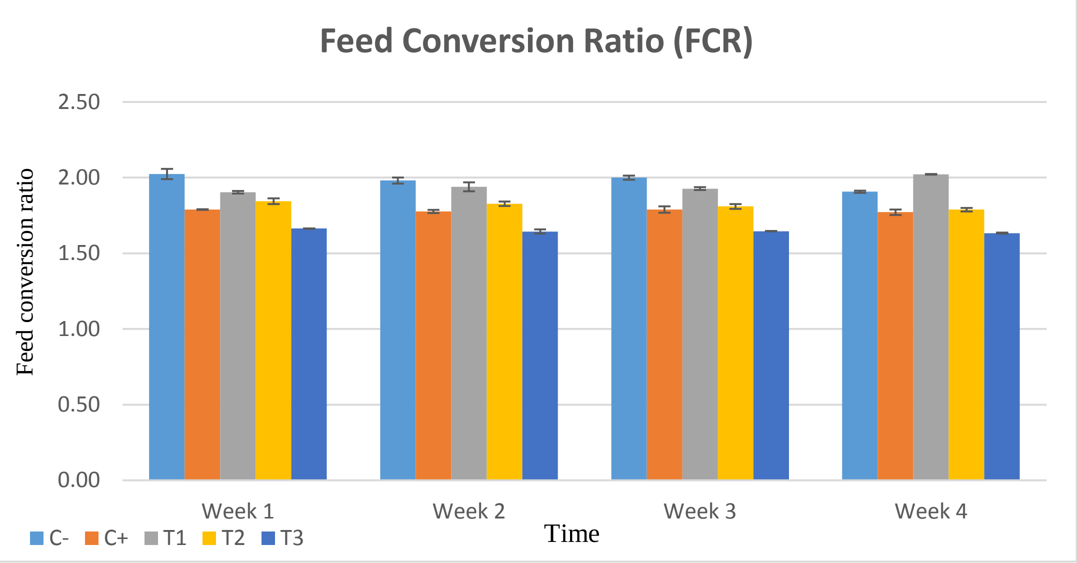

Fig. 1. Feed conversion ratio of different groups at different periods of study.

Serum lipid profile

Results illustrated in Table 5 indicated that in all treatments fed with supplemented red onion peel extract, serum total lipids, triglycerides, total cholesterol, low density lipoprotein and very low-density lipoprotein were significantly ($p < 0.05$) reduced compared to control groups. However, insignificant effects on high density lipoprotein and very low-density lipoprotein concentrations were observed in comparison with the control groups. Generally, it was observed that 9% red onion peels extract was more effective in decreasing serum total lipids, total cholesterol and low-density lipoprotein.

Table 5. Effects of red onion peels extract on lipid profile in different groups of broiler chickens.

Parameter / Groups	TSP Mean ± SE (mg dL^{-1})	Total Cholesterol Mean ± SE (mg dL^{-1})	TG Mean ± SE (mg dL^{-1})	HDL Mean ± SE (mg dL^{-1})	LDL Mean ± SE (mg dL^{-1})	VLDL Mean ± S.E (mg dL^{-1})
C-	4.71 ± 0.03^{A}	129.06 ± 3.26^{A}	37.75 ± 0.57^{A}	67.54 ± 2.48^{A}	79.87 ± 6.42^{A}	6.34 ± 0.11^{A}
C+	3.87 ± 0.51^{A}	119.51 ± 9.63^{A}	30.40 ± 5.63^{A}	71.28 ± 5.06^{A}	38.83 ± 4.53^{B}	7.45 ± 1.12^{A}
T_1	3.07 ± 0.20^{B}	112.27 ± 2.85^{B}	33.69 ± 7.16^{A}	69.75 ± 4.65^{A}	30.45 ± 3.44^{C}	9.57 ± 1.43^{A}
T_2	3.62 ± 0.10^{B}	103.74 ± 1.78^{B}	28.43 ± 4.98^{B}	77.06 ± 3.27^{A}	26.27 ± 1.57^{C}	7.48 ± 0.99^{A}
T_3	2.53 ± 0.41^{C}	76.22 ± 10.10^{C}	21.26 ± 6.18^{C}	74.93 ± 1.85^{A}	19.07 ± 6.73^{D}	8.41 ± 2.24^{A}
LSD	0.899	18.885	9.61	10.51	7.76	3.932

Note: Capital letter denote the significant between groups at the $p \leq 0.05$ level.

DISCUSSION

The results in the present study, showed a ameliorative effect of red onion peels extract as a dietary supplement on body weight of broiler chickens, and the best results were found with the highest level of supplementation in the T_3 and T_2 which were received 9% and 6% respectively, appeared clearly at third and fourth weeks. According to several studies (Omer *et al.* 2020), this general improvement in growth criterion may be attributable to the birds' improved health, amino acid digestibility, intestinal health, and increased absorptive surface. Omer *et al.* (2020) reported that the total phenolic compounds and total flavonoids are 70.55 mg GAE g^{-1} DW and 11.8 mg QE g^{-1} DW, respectively. Total phenolic compounds were measured in several onion cultivars and varied from 4.6 to 74.1 mg g^{-1} GAE for red, purple, white, and green onion cultivars (Lee *et al.* 2008; Nile *et al.* 2013). Data on flavonoids was also collected (Prakash & Singh 2007). Furthermore, herbal supplements suppress the growth of numerous pathogenic and non-pathogenic microorganisms in the broiler gut, enhancing feed efficiency and growth rate (Elgot *et al.* 2018). Onion extract also includes active chemicals such as phenols, polyphenols, terpenoid, polypeptides, lectin, alkalis, and essential oils, which aid digestion and growth (Cross *et al.* 2007; Mirzaei 2012). Onion also boosts bile acid production and pancreatic enzyme activity, particularly lipase and amylase, eventually enhances fat digestion (Farahani *et al.* 2015). The bird's improved health is mirrored at the end outcome of its productive performance. As a result, the explanation for the improvement of the aforementioned features may be attributed to the involvement of the oil and onion seeds in enhancing bird health by combating or blocking the action of diseased bacteria and fungi. Onions include antioxidants such as Allicin, flavonoids, Quercetin, and selenium (Vahdani & Khaki 2014). Antioxidant activity increases bile production and secretion, which breaks down fat and reduces cholesterol synthesis since more cholesterol is utilised to make bile (Putri *et al.* 2016). In the present study, the antioxidant of onion extract increased the production of bile that will be used for fat metabolism. Bile acids were produced as a by-product of fat metabolism, and these bile salts were reabsorbed, whereas cholesterol was excreted. As a result, it may lower cholesterol levels. As a consequence, the current findings are in accordance with Sujana *et al.* (2007), who indicated that the reduction of cholesterol in blood and meat happens as a result of blood cholesterol in the body being widely employed to synthesis bile. Gong *et al.* (2014) pointed out that Saponin (a component of allicin) may limit cholesterol absorption in the small intestine, and may also reduce the plasma cholesterol levels. In addition to its antioxidant content, the onion peel extract can reduce cholesterol levels in the body of broilers due to its fibre content which acts as a mediator to enhance bile acid excretion in order to lower cholesterol levels (Gong *et al.* 2014). In contrast, the mechanism of cholesterol production inhibition mediated by dietary crude fibre can enhance the intestinal peristaltic activity, resulting in suboptimal feed absorption. This mechanism decreases basic chemicals as precursors of cholesterol in blood vessels and tissue, as well as regenerating lost bile salts in the duodenum, causing the heart to require more cholesterol to create bile salts by absorbing cholesterol from the tissue (Alfiko *et al.* 2022). According to Descotes (1998) cholesterol is a fat component. If the quantity of fat in the body was low, the level of cholesterol would also be low. This was consistent with the findings of the present investigation, which revealed that the broilers fed diets containing 9% onion extract exhibited the lowest blood levels of fat and cholesterol. In the present study, the result showed that there were no significant differences in HDL levels in all treatments (T_1, T_2 and T_3) compared to control groups (C- and C+). In contract, Goodarzi *et al.* (2013) reported that broilers receiving 30 g kg^{-1} onion displayed a significantly higher HDL and lower triglyceride concentrations compared to control group and dietary supplementation of 10 g onion bulb/kg diet. Also, An *et al.* (2015) pointed out that the concentrations of serum free cholesterol and triacylglycerol in broilers fed diet containing onion extract were significantly ($p < 0.01$). decreased compared to control or the group fed diet containing antibiotic.

CONCLUSION

Based on our results, we conclude that using the red onion peel extract as a feed additive in broiler chicken diets can enhance their growth performance represented by increased body weight, average daily gain, and average daily feed intake in a dose-dependent manner by improving the intestinal status. It can also improve the birds' behaviour and tonic immobility, along with enhancing the lipid profile.

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