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Effect of Different Levels of Onion and Garlic Juice on The Redox Balance, Growth Performance and Carcass Traits of Broiler Chickens

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Abstract

THIS STUDY aimed to evaluate the effects of onion and garlic juice on the growth, redox balance, and carcass properties of broiler chickens. Total number of 150 Ross-308 broiler chicks, aged 1 day, were randomly assigned to five treatments . (30 chicks each divided to three equal replicates) The treatments were as follows: T1: (control treatment), T2 and T3 treated with onion juice which was added to drinking water in two concentrations (10 and 20ml /litter of drinking water, respectively), T4 and T5 given Garlic juice with two concentrations (10 and 20ml /litter of drinking water, respectively), Treatment started at the first three days of life for 5 weeks of age. The results demonstrated that the use of garlic juice during the first three days of life significantly increased ($p<0.05$) the broiler's final body weight (BW), decreased feed intake, mortality rate, and improved feed conversion ratio (FCR) in comparison to the control group. It also improved the broiler's redox balance, increasing the level of SOD, CAT, and TAC and decreased the MDA value. Overall, the experiment's findings demonstrated that broiler growth performance and redox balance can both be enhanced by adding 10 and 20 ml of garlic juice to drinking water.

Keywords: Garlic, onion, juice, redox balance, productive traits, broilers.

Introduction

Poultry farms may be exposed to many of stressors: which may be environmental (cold, heat, and ventilation); technological (high rearing density, delayed hatching, and prolonged egg storage); nutritional (dietary changes, mycotoxins, acid oil, toxic metals, and inadequate trace elements); and health and immune system (illnesses and vaccination schedules);[1].In healthy animals, protection against the harmful effects of free radicals is achieved through maintaining a delicate equilibrium between the production of free radicals, that are needed for certain physiological processes, and their destruction through the antioxidant defense system. (enzymes, glutathione, vitamins, mineral, etc.) This equilibrium is called “the redox balance.”

There are alternative strategies to control oxidative stressors. Some attempts have been made with herbs. It has been realized that the natural feed sources like herbs and its extracts overcome the adverse effect of stress on broiler performance [2-3]

Garlic (*Allium sativum*) and onion (*Allium cepa*) which belong to the family Liliaceae and the genus Allium [4] are among the common medicinal plants used as growth promoters [5] The antioxidant activities of components of onion and garlic have been reported [6-7]. Onion and garlic possess well defined antioxidant activity [8] corollary with the presence of efficient antioxidant enzymatic system such as superoxide dismutase, catalase and glutathione- S- transferase and also it associated with the total phenol content , and the flavonoids, mainly quercetin, which has powerful antioxidant activity that can protect against diseases caused by oxidative stress [9-10].

Garlic possesses antibacterial, antioxidant, and antihypertensive properties [11]which may be related to some bioactive compounds like diakyl polysufides, molecule containing sulphur[12-13] Such compounds may act as growth-promoters boost vitality and raise the feed efficiency ratio of chicks. When garlic extracts was added to chicken diets improved carcass quality and altered poultry performance [14-15].

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Additionally, this supplement increased bird's resistance to environmental stress [16].

Onions is rich in flavonoids, polyphenols, glycosides, anthocyanins, allicin, and quercetin [17]. They serve as a natural antioxidant to keep meat from oxidation. Their ability to scavenge for free radicals and release electrons or hydrogen atoms is what gives them this antioxidant action [18]. Red onions have a high total phenol content, while yellow onions have a high quercetin concentration (347 mg/kg), which is mostly linked to flavonoids. These factors have been linked to antioxidant activity [19]. Strong antioxidant activity seen in quercetin can help prevent illnesses brought on by oxidative stress [20, 21] Furthermore, studies have documented the positive effects of feeding onions on poultry production. The consumption of 30 g/kg onion juice by broiler chicks resulted in enhanced body weight gain, elevated serum levels of high-density lipoprotein (HDL) cholesterol, and lowered triglyceride levels [22].

According to Wen *et al.* [23], numerous natural antioxidants have been investigated as possible feed additives in place of synthetic antioxidants, indicating a strong demand for natural growth boosters as feed ingredients. plants contain naturally occurring antioxidant chemicals called polyphenols, which may be able to lessen the negative consequences of oxidative stress [24]. Polyphenols include simple phenols, phenolic acids, acetophenoues, phenylacetic acid, coumarins, anthocyanins, xanthous, lignans, and flavonoids ([25]Therefore, the aim of the current study was to determine the effect of different levels of onion and garlic juice on the redox balance, growth performance and carcass characteristics of broiler chickens.

Material and Methods

Ethical Approval

The authors certify that the relevant ethical review committee permission has been obtained and that the journal's ethical policies have been followed. The writers adhered to EU regulations for the safeguarding of animals employed in scientific research. The study was carried out in the National Research Center's Agricultural Research and Production Station in Al-Nubaria, Al-Beheira Governorate, Egypt.

Experimental Design

A total of 150 broiler chicks Ross-308 one day old, and body weight 45.38 +1.35 g and randomly divided into five groups (30 chicks for treatment (10 chick / replicate) for 5th week of age .There were in the following order: T1 was the control treatment. T2 and T3 were given onion juice mixed with drinking water with two concentrates (10 and 20 ml/litter of drinking water, respectively), but T4 and T5 were given garlic juice (10 and 20 ml/litter of drinking water, respectively). Basal diet (Table 1) was given within the first three days of life according to National Research Council's recommendation [26] for the nutritional needs of broilers was taken into consideration when creating the basal diet (table 1). The chicks were exposed to light for 23 hours and darkness for 1 hour during the study period. After being maintained at 32^{o}C for the first week, the temperature in the house was lowered by 3^{o}C each week until it recorded 22^{o}C.

Growth performance

The body weight of birds was recorded weekly from the 1st day until 5th week of age. The body weight gain (BWG) was calculated and The weekly feed intake (FI) was recorded, and feed conversion (FCR) was also calculated using the following equation: FCR= Feed intake (FI) (g)/body weight gain (BWG)(g)

Biochemical analysis of blood samples

Blood samples were collected from five chicks per treatment were collected in weatherman tubes, centrifuged at 4000rpm for 15min and serum samples were stored at -20°C until analysis. Total protein and triglycerides were measured using commercial kits.

Antioxidant Capacity

Catalase and superoxide dismutase (SOD) activities were measured calorimetrically at 405 nm using prepared bird liver tissue, which was thawed and manually homogenized in cellular phosphate and centrifuged at 12,000 rpm for 45 min at 0 to 4 °C, supernatant was removed after centrifugation [27], but Total antioxidant capacity (TAC) and malondialdehyde (MDA) were determined in serum using MDA or protein enzyme-linked immunosorbent test (ELISA) kits from Nanjing Jiancheng Bioengineering Institute (Nanjing, China).

Carcass traits

At the end of experiment (5th week of age), four birds per each treatment were fasted for 8 hours before slaughter. The individual body weight was recorded as (pre slaughter weight). Then birds were slaughtered and when bleeding was completed, the slaughter weight was recorded and birds were scalded and plucked to remove the feather, after that the carcass was opened and edible and non-edible organs were removed to obtain the edible organs weight and calculate the dressing % from live body weight. Also the weight of liver, spleen, heart and gizzard were recorded.

Statistical Analysis

Statistical analysis of experimental data was performed using SPSS 11.0 for one-way analysis of variance (ANOVA) [28]. Software for statistics Duncan's multiple range test [29] was used to find differences between means.

Results and Discussions

Growth Performance

Table 2 displayed the growth performance of the broilers. Which during the starter period (1-3 weeks), broilers that received 10 ml of onion juice in their drinking water had the highest BWG, lowest feed intake (FI and FCR) compared to other groups. However, during the finisher period (3-5 weeks), broilers that received 10 ml of garlic juice in their water had higher BWG, lower FI, and better FCR than those in the control group but total feed intake and feed conversion were lower in Broilers receiving 10 ml of onion juice during over all period. Similar results were obtained by Goodarzi, [30] who found that inclusion of garlic and onion in chicks feed diet yielded higher BWG than control. These results may be related to their enhancing effect on beneficial gut micro flora and their antimicrobial effect to other types of bacteria. Onion stimulates digestive enzyme secretion, which improves the efficiency of digestion to benefit from food intake and raises the feed efficiency coefficient [30]. Moreover, the antimicrobial and growth-inhibiting properties of garlic increase the number of beneficial microorganisms, which enhance digestion efficiency and speed up the absorption process. Tannins in garlic also stimulate some of the stomach's secreted digestive enzymes [31]

Compared to the control group, the mortality rate of all treatments was significantly reduced by onions and garlic juice treatment over the trial period (Fig. 1). This may be related to the pharmacotheraputic effect of onion and garlic juice that decrease mortality rate.

The tannins actively work to stop pathogenic bacteria from breaking down cell membranes and inhibit certain enzymes that are essential to the bacteria's growth and activity [32].

Blood constituents

The data presented in Figure (2) demonstrate a significant ($p<0.05$) increase in serum TP in hens given 10 ml of garlic juice in water during their first three days of life when compared to control and other treatments. The current data are consistent with the findings of Oleforuh-Okoleh *et al.* [33]which found that birds treated with garlic showed a substantial increase in total protein ($p < 0.01$) when compared to others in control group. However,, lower blood triglycerides were observed in all traded groups that drank either onion or garlic juice, particularly in those that drank 10 ml each. The present experiment's results are consistent with those of El-katcha *et al.,*[34], who found significant decrease in triglycerides and increase in total protein of broilers had garlic extract which could be explained by reducing the activity of the enzymes responsible for creating cholesterol and lipids [35].Which onion includes sulfur-containing organic compounds, such as S-Methylcysteine sulfoxide and Sallylcysteine suiloxide. According to Goodarzi *et al*. [30], these substances are connected to a reduction in blood triglycerides. On the other hand, broiler diets supplemented with garlic powder can significantly reduce the activities of glucose-6 phosphate dehydrogenase, fatty acid synthase, cholesterol 7α-hydroxylase, and 3-hydroxy-3-methyl-glutaryl-CoA (HMG-CoA) reductase [36].

Antioxidant Activity

Many factors, including rapid growth, a high metabolic rate, and intensive output, might cause broilers to release a lot of free radicals [37] , may induce disease in broilers, leading to significant financial losses [38-39]. GSH-Px, SOD, and CAT form the primary antioxidant enzyme system; the extent of its content indicates how well it scavenges free radicals [40].MDA is the last byproduct of the lipid peroxide process, which turns peroxyl radicals into inner peroxide, the amount of lipid peroxide is determined by the equilibrium between the synthesis of peroxide and the antioxidants' breakdown of those oxidants. Animals' ability to oxidize free radicals can be indirectly organized by plants or plant extracts acting on free radical-related enzymes [41 -42] Therefore, plants can act as antioxidants. The juices of onions and garlic are a great source of flavonoids and phenolic chemicals that have strong antioxidant activity. These include quercetin, allicin, salicylic acid, caffeic acid, gallic acid, para coumaric acid and vanillic acid. In the present study , When birds were given 20 ml of garlic juice in water during their first three days of life, their antioxidant status in terms of SOD, CAT, and TAC was considerably ($P >0.05$) better than that of the control group and other treatments as well as reduced MDA levels. Table (3). Our findings concurred with those of Ismail *et al*., [43] who reported that broiler antioxidant activity are enhanced by the addition of garlic powder to the diet. According to Pourali *et al*. [44], broiler feeds diet enriched with garlic decreased MDA concentrations by 30% in comparison to birds fed a basal diet. Moreover, studies by Alagawany *et al*. [45] demonstrated that increasing diet with garlic enhanced SOD and TAC activity.

Carcass characteristics

Table (4) displays the carcass characteristics of broilers that were given different levels of onion and garlic juice. In comparison to the other treatments, slaughter weight, dressing percentage, and gizzard % of control group were significantly decreased. On the other hand, broilers given 10 ml of garlic juice during the first three days of life have significant ($P > 0.05$) increase in the percentages of their liver, heart, and spleen in comparison to other treatments. A similar pattern was previously noted by Ashayerizadeh *et al.* [46], who demonstrated that

adding 1 kg/ton of garlic to the feed of broilers increased carcass yield in comparison to the control. However, Raeesi *et al*. [47] discovered that heart weight of broiler was the only thing that dropped when garlic was fed at 0.5%, 1.0%, and 3% levels. These results are in opposition to those of Gbenga *et al*. [48], who found that the carcass yield of broilers fed onion and garlic did not differ much. This outcome might be explained by the lipotropic properties of spice extracts. Through the transfer of fatty acids, some of the active ingredients in spices influence lipid metabolism. This may reduce belly fat and raise lipid utilisation [49].

Conclusion

It was concluded that giving chickens 10 ml of onion and garlic juice in their drinking water during the first three days of life may improve the birds' growth and carcass characteristics. Moreover, giving chickens 20 ml of garlic juice may decreased the mortality rate and improve the oxidative status of birds.

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For all stuff in the department

Conflict of interest

The authors declare that they have no conflict of interest

Authors' statement

AS: biochemical and statistical analysis, SAY: Writing – Review, GME: biological study and statistical analysis, GEA: Writing – Review, MGS: Methodology, Data creation

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TABLE 1. Composition and analysis of the experimental diet

Ingredient	%
Yellow Corn	67.0
Soybean meal (44%)	26.3
Wheat bran	3.0
Limestone	1.0
Di calcium phosphate	2.0
DL-Methionine	0.1
NaCl	l0.3
Premix*	0.3
Total	100
Calculated values	
ME (Kcal/Kg	(2860)
Crude protein (%)	19.04
Crude fiber (%)	3.43
Crude fat (%)	2.65
Calcium (%)	0.93
Available phosphorus (%)	0.45
Methionine (%)	0.42
Lysine (%)	0.93
Sodium (%)	0.24
Analyzed values	
Crude protein (%)	19.39
Crude fiber (%)	3.97
Crude fat (%)	3.17
Crude ash (%)	5.73

*Each kg of vitamin mineral premix: contains: vitaminA=1200000IU; vitamin D3=300000IU; vitamin E=700mg;vitamin K3=500mg; vitamin B1=500mg; vitamin B2=200mg;vitamin B6=600 mg; vitaminB12=3mg; folic acid=300mg;choline chloride=1000mg;Niacin=3000mg;Biotin=6mg;panathonicacid=670mg;manganesesulphate=3000mg;iron sulphate=10000mg;zincsulphate=1800mg;coppersulphate=3000mg;iodine=1.868mg;cobaltsulphate=300mg;selenium=108mg

TABLE 2. Effect of onion and garlic juice on growth performance of broilers

	Control	Onion juice		Garlic juice		SEM	P Value
		10ml	20 ml	10ml	20 ml		
Initial BW	43.84	43.20	43.51	42.90	43.79	0.439	0.96
Final BW	2045.1^{bc}	2086.8^{b}	1966.5^{c}	2230.3^{a}	2220.6^{a}	27.88	0.001
StarterPeriod							
BWG1-3	590.36^{bc}	665.4^{a}	562^{c}	581.6^{bc}	602.4^{b}	9.32	0.000
FI 1-3	1173.28^{a}	745.16^{b}	860.2^{b}	1105.7^{a}	1074.8^{a}	0.093	0.010
FCR1-3	1.987^{a}	1.119^{d}	1.53^{c}	1.90^{ab}	1.78^{b}	41.34	0.000
Finisher Period							
BWG3-5	1411.1^{b}	1378.4^{b}	1360.2^{b}	1605.7^{a}	1574.4^{a}	27.56	0.000
FI 3-5	1890.46^{a}	1320.0^{b}	1435.53^{b}	1452.68^{b}	1837.4^{a}	55.75	0.000
FCR 3-5	1.34^{a}	1.00^{d}	1.05^{c}	0.90^{d}	1.16^{b}	0.046	0.025
Over all performance							
BWG1-5	2001.26^{bc}	2043.5^{b}	1923.0^{c}	2187^{a}	2176.8^{a}	50.19	0.644
FI 1-5	3063.74^{a}	2065.61^{d}	2295.73^{c}	2558.38^{b}	2911.8^{a}	10.46	0.000
FCR 1-5	1.53^{a}	1.01^{d}	1.19^{c}	1.16^{c}	1.34^{b}	0.14	0.000

Data were expressed as Mean ± SE. Means with different superscripts (a,b,c,d) within row differ significantly at P<0.05

TABLE 3. Effect of onion and garlic juice on antioxidant activity of broilers.

	Control	Onion juice		Garlic juice		SEM	P Value
		10ml	20 ml	10ml	20 ml		
TAC (nmol/mL)	165.43^{c}	173.72^{c}	268.62^{b}	263.62^{b}	337.3^{a}	18.52	0.000
SOD (nmol/mL)	120.85^{d}	147.34^{c}	157.85^{c}	243.07^{b}	268.06^{a}	15.63	0.000
CAT (nmol/mL)	0.06^{c}	0.07 ^{bc}	0.08 ^{abc}	0.095^{ab}	0.11^{a}	0.0064	0.041
MDA (nmol/mL)	27.96^{a}	18.51^{b}	16.92^{c}	15.57^{d}	15.38^{d}	1.257	0.000

Data were expressed as Mean ± SE. Means with different superscripts (a,b,c,d) within row differ significantly at P<0.05

TABLE 4. Effect of onion and garlic juice on carcass characteristics of broilers.

	Control	Onion juice		Garlic juice		SEM	P Value
		10ml	20 ml	10ml	20 ml		
Live body weight (g)	1773.20^{c}	2105.51^{a}	2113.50^{a}	1921.22^{b}	2019.80^{ab}	43.88	0.064
Slaughter weight (g)	1589.50^{c}	1927.80^{a}	1753.50^{b}	1913.51^{a}	1833.20^{ab}	32.04	0.000
Dressing %	70.11^{c}	71.74^{a}	71.2^{b}	71.60^{a}	71.60^{a}	0.146	0.004
Liver(%)	4.28^{a}	4.01^{a}	3.42^{b}	4.08^{a}	3.982^{a}	0.079	0.000
heart(%)	0.69^{c}	0.73^{b}	0.66^{c}	0.83^{a}	0.75^{a}	0.009	0.005
Spleen (%)	0.21^{d}	0.27^{b}	0.18^{d}	0.30^{a}	0.25^{c}	0.033	0.001
Gizard (%)	1.57^{b}	1.80^{a}	1.77^{a}	1.88^{a}	1.89^{a}	0.016	0.000

Data were expressed as Mean ± SE. Means with different superscripts (a,b,c,d) within row differ significantly at P<0.05

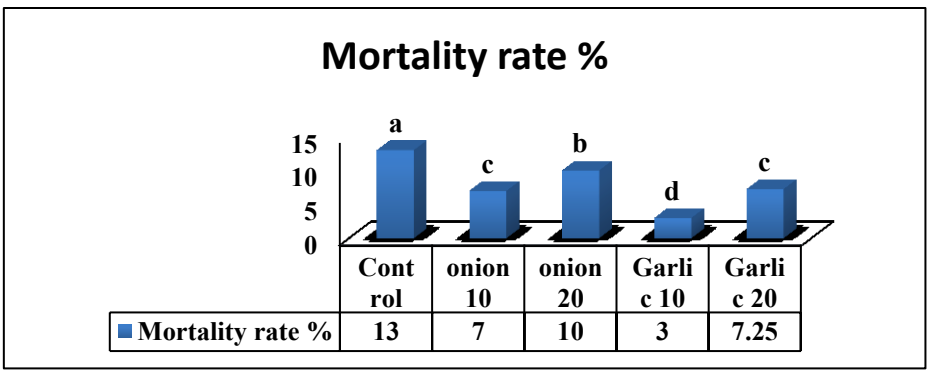

Fig. 1. Effect of onion and garlic juice on mortality rate of broilers

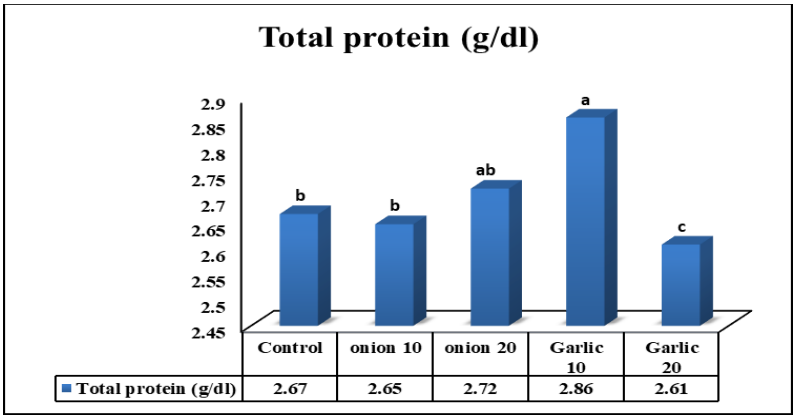

Fig. 2. Effect of onion and garlic juice on total protein (TP) of broilers

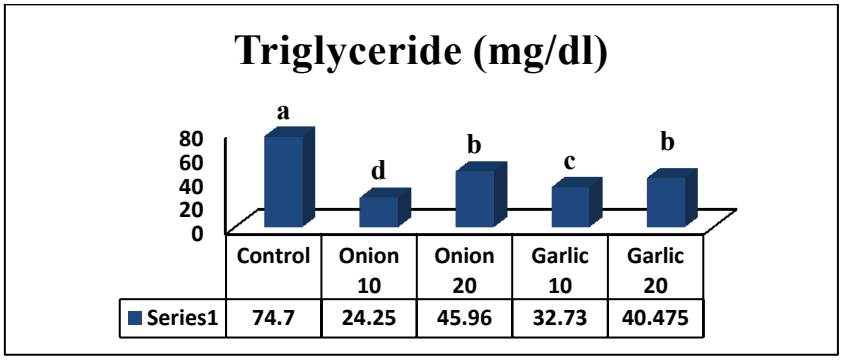

Fig. 3. Effect of onion and garlic juice on Triglyceride in serum of broilers

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تأثير مستويات مختلفة من عصير البصل والثوم على توازن الأكسدة والاختزال وأداء النمو وصفات الذبيحة في دجاج اللحم

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الملخص

تهدف هذه الدراسة إلى تقييم تأثير عصير البصل والثوم على النمو وتوازن الأكسدة وخواص الذبيحة في دجاج اللحم . تم توزيع عدد 150 فرخاً من فراخ اللحم Ross-308 بعمر يوم واحد عشوائياً على خمس معاملات. تم وضع 30 كتكوت فى ثلاث مكررات للمعاملة (10 كتكوت / مكرر).وكانت المعاملات على النحو التالي :T1 (المعاملة الضابطة)، في حين أضافت T2 و T3 عصير البصل بتركيزين 10 و 20 مل / لتر ماء الشرب على التوالي ولكن، تمت إضافة T4 و T5عصير الثوم بتركيزين 10 و 20 مل / لتر من ماء الشرب على التوالي خلال الأيام الثلاثة الأولى من العمر لمدة 5 أسابيع من العمر. أظهرت النتائج أن استخدام عصير الثوم خلال الأيام الثلاثة الأولى من العمر أدى إلى زيادة كبيرة (P <0.05) في وزن الجسم النهائي لدجاج التسمين(BW) ، وانخفاض كميه العلف، ومعدل الوفيات، وتحسين نسبة التحويل الغذائي (FCR) مقارنة بالمجموعة الضابطة. كما أنه أدى إلى تحسين توازن الأكسدة والاختزال في دجاج اللحم، مما أدى إلى زيادة مستوى SOD و CATو TACوخفض قيمة .MDA بشكل عام، أظهرت نتائج التجربة أنه يمكن تحسين أداء نمو دجاج التسمين وتوازن الأكسدة والاختزال عن طريق إضافة 10 و20 مل من عصير الثوم إلى مياه الشرب .

الكلمات داله : الثوم، البصل، العصير، توازن الأكسدة، الصفات الإنتاجية، دجاج اللحم.