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Effect of using Liquid onion on Broiler Physiology, Production and Behaviour

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ABSTRACT
Excessive use of antibiotics in broiler chicken production has been the material for public criticism and raising the global concern of its public health impact due to the resulting development of microbial resistance. Consequently, it has become necessary to develop alternative substances and strategies for animal growth promotion and disease prevention. Therefore, the objectives of this study were to test the hypothesis that using onion extract will affect infections with internal parasites strains (Coccidia) in broilers and improve broiler production and some performance characteristics of broiler chicken. Results from our investigation showed that onions improved chicken performance (Body weight, feed intake, FCR, carcass and eviscerated yields) and decreased body fatness, cholesterol, and intestinal lesion score. Using onion promote small intestine longest and depressed in lesion scores of the small intestine and lowering the coccidian eggs account. It can be concluded that; the addition of onion extract reducing the costs of production through improving feed conversion ratio, weight gain and feeding efficiency of treated chickens.
Keywords: *Broiler, Onion, Anticoccidial, Performance, Behavior.*

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IMPLICATIONS

There are global concerns over the use of antibiotics as growth promoters or for therapeutic purposes due to the potential for some medications to enter the human food chain, passing the rigorous withdrawal measures and testing exists to prevent this. This will lead to the problem of increasing antibiotic resistance in both animals and humans with a largely unproven potential link to human antibiotic-resistant infections and detection of drug residue in the final meat products that can be harmful to consumers.

INTRODUCTION

Enteric diseases are an important concern to the poultry industry because of production losses, increased mortality, the reduced welfare of birds and increased risk of contamination of poultry products for human consumption [1]. Avian coccidiosis is an enteric parasitic disease caused by multiple species of the protozoan parasite of the genus Eimeria. Coccidiosis is still a major problem worldwide possibly due to poor diagnosis and biosecurity measures. Identification of different species based on morphology of oocysts is very challenging and requires expertise that is dependent upon the following characteristics: zone of intestine parasitized, the gross appearance of the lesion, oocyst morphology, minimum sporulation time, minimum prepatent time, schizont size, location of parasite in the host intestinal epithelium, and cross-immunization tests. Thus, mortality and morbidity are usually high and production performances are altered. Prevention of the disease is based on the hygienic measures, on chemoprevention, and on vaccination. As a consequence, it has become necessary to develop alternative substances and strategies for animal growth promotion and disease prevention. Some attempts have been made to replacing these additives with herbs [5].
Onion possesses numerous organic Sulphur compounds including trans-S-(1-propenyl) cysteine sulfoxide, s-methyl-cysteine sulfoxide, spropylcycteine sulfoxides and cycloallicin, flavinoids, phenolic

acids, sterols including cholesterol, stigma sterol, b-sitosterol, saponins, sugars and a trace of volatile oil compounds mainly of sulphur compounds [9]. Most of the plant parts contain compounds with proven antibacterial, antiviral, antiparasitic, antifungal properties and has antihypertensive, hypoglycemic, antithrombotic, antihyperlipidemic, antiinflammatory and antioxidant activity [7]. Therefore, the objectives of this study were to test the hypothesis that using onion extract (*Allium cepa*) will affect infections with internal parasites strains (Coccidia) in broilers. Further assumption using onion extract could improve physiological, performance and behavioural characteristics of broiler chicken (i.e. body weight, feed intake, water intake, feed conversion ratio, feeding cost, carcass yield and mortality rate) and reduce the spread of diseases and parasites in broiler production cycle.

MATERIAL AND METHODS

The experiment was conducted at Livestock Field Research Station; Department of Animal Production, Faculty of Agriculture, at Jerash University / Jordan. The care and use of experimental animals complied with local animal welfare laws, guidelines and polices.

Animals and dietary treatments

Four hundred one-day-old chicks of mixed sex (Hybrid) were weighed and randomly assigned to each of the four treatment groups, each with 4 replicate pens of 25 chicks. Experimental groups included control group receiving basal diet without onion extract in drink water, the second group receiving basal diet + onion extract as 2.5 % in drink water, third group receiving basal diet + onion extract as 5 % in drink water, and the fourth group receiving basal diet + onion extract as 7.5 % in drink water.

The birds were fed a starter diet (CP: 21%; ME: 2900 kcal) from day 1 to 21 d and grower diet (CP: 18.5%; ME: 2800 kcal) from 22 to 42 d. The basal diet was formulated agreeing with nutrient requirements of broilers recommended by National Research Council (NRC, 1994). Chicks were raised on floor pens (120 cm×120 cm×80 cm) for 6 weeks and had free access to feed and water throughout the entire experimental period. The lighting program consisted of a period of 23 h light and 1 h of darkness. The ambient temperature in the experimental house was maintained at 32 °C during the first week, and gradually decreased by 3 °C in the second and third weeks, and finally fixed at 22 °C thereafter. At day 10 of the experiment, all chicks were infected orally inoculated with Eimeria tenella-sporulated oocysts by specialist veterinarian. Both groups either control or treatment groups were vaccinated according to vaccination schedule that is used in Jordanian farming under normal rearing system. (d 1 and 7: Infectious Bronchi and New Castle, d 14: Gumboro; d 21: New Castle vaccine). During the experimental period, no medicaments were offered to the chicken's groups either controlled or treated with garlic.

Performance and carcass components

Body weights of broilers were determined every week. Feed intake and weight gain were recorded during a 7 d period on a per cage basis and feed conversion ratio (FCR) was calculated. Mortality was recorded as it occurred and was used to adjust the total number of birds to determine the total feed intake per bird and FCR. At 42 d of age, two birds per replicate were randomly chosen, based on the average weight of the group and slaughtered through cutting carotid arteries. Carcasses weights, dressing percentages, carcass cuts that included wings, back, breast and legs, abdominal fat were weighed. Internal organs (Crop, proventriculus, gizzard, liver, heart, and small intestine) were weighed separately. The length of small intestine and the weight were recorded also. Meat samples from (Breast, leg, liver) after boneless, were separately ground in a meat grinder and samples from each part were used for dry matter, protein and fat determination. Cecal microbial count and populations, mortality rate, meat sensory quality test, and intestinal lesion scoring were measured by veterinary specialist.

Behavioral data

Live observations of bird's behaviour were carried out 3 times a daily from 0800 to 0900, 1200 to 1300, and 1500 to 1600 h on 16 cages evenly distributed throughout the room using instantaneous scan sampling at 5 min intervals per h. The numbers of birds in each cage performing the activities of drinking, feeding, standing, sitting, running and peering were recorded. Chickens were monitored daily for their clinical health condition and a veterinarian diagnosed any health disorders. Observer(s) were counted the number of birds in each cage performing each activity (drinking; feeding; preening; standing; sitting and running) every 5 minutes during observation hours.

Statistical Analysis

Data from the randomized design were subjected to an analysis of variance using the MIXED model procedure of SAS. An ANOVA with repeated measures was used. The mean differences among different treatments were separated by Tukey-Kramer test. A level of ($P<0.05$) was used as the criterion for statistical significance.

RESULTS

Results from our investigation showed that's onions improved chicken performance body weight increases significantly every week with higher weight when we offered onion at 5 % level. Using onion extract showed a significant effect in body weight changes after the third week of uses onion with higher body weight compared with control group. Chicks offered onion with 5 % showed higher body weight from three weeks to the end of the study at 6 weeks of age compared to using onion at 2.5 and 7.5 % (Table 1). Feed intake was increased significantly ($P<0.001$) within treated group with higher feed intake were noticed at the third week of age until the end of the experiment (Table 2). Using 5% onion extract showed better-feed conversion ratio (FCR) compared with control group (1.04±0.13, 1.08±0.11 respectively). Furthermore, increasing body weight result in increasing carcass and eviscerated yields at 5 % onion (Table 3). With heavier chest, thigh, back and wings weight when we offered onion at 5 % to the water. The internal organs including the digestive tract, and other inedible parts which form a large part of the weight further have lighter weight when onion were offered compared to control group (Table 3). Nevertheless, body fatness, cholesterol, and intestinal lesion score were decreases with using onion (Table 4). Moreover, using onion promote small intestine longest in compare with control group and depressed in lesion scores of small intestine and lowering the coccidian eggs account when onion were used as shown in table (5).

Behavioral observation did not show any significant difference when onion was added to drinking water compared with control group (Table 6).

DISCUSSION

The use of antibiotic in livestock as either growth promoters or medicament treatments is presently facing serious criticism and has raised global concern as some reports revealed their ill effects among which are the development of microbial resistance to the products and their potentially harmful effects on human health [10]. Therefore, searching for alternative substances that reduce antibiotic uses are the main demand nowadays. Recently there is also an increasing interest in the utilization of growth promoters of natural origin [1, 11]. Probiotics and medicinal plants as natural feed additives are currently used in poultry diets to enhance the performance and immune response of birds [11].

Onion (*Allium cepa*) which belong to the family Liliaceae and the genus Allium (Ebesunun et al., 2007) has several beneficial effects on both humans and animals by having antimicrobial, antioxidant as well as antihypertensive properties [6]. These functions were attributed to bioactive components present in Onion [6], one of which is a sulphur-containing organic compound known as Allicin which possess antimicrobial activity that could be responsible for the growth promoting effect of onion [1, 6].

The most predominant contents of these genuine organosulphur compounds are the amino acids cysteine and methionine, which improve growth performance of chicks receiving onion. Similar to our results, Aji *et al*. [1] reported an enhancement in body weight, FCR of broilers offered diets containing fresh onion bulbs in comparison with broilers fed basal diet.

Onion contains numerous organic sulphur compounds. Thus, the presence of these compounds may explain the anticoccidial activity of these plants. These compounds by decreasing harmful microbial population in gut improve healthy level and performance [8]. Body weight and other organs can increase by improving the nutrient absorption. In addition, as it mentioned the using of onion in feed ration resulted in increasing of feed intake, this in turn can increase daily weight gain. The using onion in diet reduced the blood cholesterol. Onion contains sulfur organic compounds including S-Methylcysteine sulfoxide and S-allyl cysteine sulfoxide [9]. These compounds are related to decreasing of blood lipid, liver protein and glucose [9]. Therefore, in our investigation, it is possible onion could improve growth performance of chicks due to the content of organosulphur compounds that reduce the growth of some harmful bacteria in the gastrointestinal tract of broilers [1]. This can result in a higher efficiency in the feed utilization, and it can lead to a higher weight gain and better feed efficiency [2, 3].The effect of onion on broiler performance probably is due to antibacterial and antifungal effects originated from some of its compounds. Like to our results Aji *et al*. [1] reported the positive influence in body weight, feed conversion ratio of broilers fed diets containing fresh onion compared with broilers fed diet without any onion and antibiotics. Using onion or their extracts have lipotropic effects that affect lipid metabolism through fatty acid transportation. This can increase the lipid utilization and decrease abdominal fat.

CONCLUSION

It can be concluded that the using onion extract in water for broiler significantly enhanced growth, economic and productive performance of broiler chicks. Physiological measurements (body weight, weight gains, feed intake, feed conversion ratio, carcass weight and internal organs) showed the better characteristic of treated chicken with onion compared with control group under same rearing system.

The results showed lower mortality rate compared to control group and lower susceptibility to diseases and medicament treatment. Blood and meat characteristics showed lower cholesterol, Triglyceride, LDL, HDL levels compared with control group. It could be concluded that; the addition of onion extract reducing the costs of production through improving feed conversion ratio, weight gain and feeding efficiency of treated groups compared with control group.

Table 1: Average body weight (gram / bird) when supplementary onion extract (0, 2.5, 5, and 7.5 %) added to the drinking water per week.*

Age	Onion extract level in drinking water (%)			
(wk)	0	2.5	5	7.5
First	162.9 ± 4.0^{a}	164.7 ± 4.0^{a}	166.9 ± 4.0^{a}	166.1 ± 4.0^{a}
Second	377.4 ± 4.0^{a}	364.8 ± 4.0^{a}	383.2 ± 4.0^{a}	372.3 ± 4.0^{a}
Third	700.2 ± 4.0^{a}	693.0 ± 4.0^{ae}	790.1 ± 4.0^{bc}	744.2 ± 4.0^{bd}
Fourth	1142.4 ± 4.0^{a}	1158.7 ± 4.0^{ae}	1222.8 ± 4.0^{bc}	1181.0 ± 4.0^{bd}
Fifth	1549.7 ± 4.0^{a}	1601.0 ± 4.0^{bd}	1695.3 ± 4.0^{bc}	1608.7 ± 4.0^{bd}
Sixth	2127.1 ± 4.0^{a}	2276.5 ± 4.0^{be}	2356.2 ± 4.0^{bc}	2319.5 ± 4.0^{bd}

* P- Values for treatment, week and treatment*week (P≤ 0.001)
$^{a, b}$: Significant Values Between treatments (Control vs. Treatment addition)
^{c,d,e}: Significant differences within the treatment addition (2.5 vs 5 vs 7.5 %)

Table 2: Average feed intake (gram / bird) when supplementary onion extract (0, 2.5, 5, and 7.5 %) added to the drinking water per week.

Age	Onion extract level in drinking water (%)			
(wk)	0	2.5	5	7.5
First	137.0 ± 1.8^{a}	138.8 ± 1.8^{a}	147.5 ± 1.8^{a}	138.3 ± 1.8^{a}
Second	268.8 ± 1.8^{a}	271.0 ± 1.8^{a}	263.8 ± 1.8^{a}	268.8 ± 1.8^{a}
Third	526.8 ± 1.8^{a}	518.8 ± 1.8^{ad}	548.3 ± 1.8^{bc}	525.3 ± 1.8^{ad}
Fourth	808.5 ± 1.8^{a}	805.5 ± 1.8^{ac}	806.8 ± 1.8^{ac}	832.8 ± 1.8^{bd}
Fifth	889.0 ± 1.8^{a}	857.3 ± 1.8^{bc}	827.5 ± 1.8^{be}	841.3 ± 1.8^{bd}
Sixth	1090.5 ± 1.8^{a}	1082.8 ± 1.8^{ae}	1218.5 ± 1.8^{bc}	1190.0 ± 1.8^{bd}

* P- Values for treatment, week and treatment*week (P≤ 0.001)
$^{a, b}$: Significant Values Between treatments (Control vs. Treatment addition)
^{c,d,e}: Significant differences within the treatment addition (2.5 vs 5 vs 7.5 %)

Table 3: Average live, carcass weight (gram / bird) and dressing percent when supplementary onion extract (0, 2.5, 5, and 7.5 %) added to the drinking water.

Variable	Onion extract level in drinking water (%)			
(g)	0	2.5	5	7.5
Live weight	2115.5±21.0^{a}	2280.0±18.3^{bd}	2341.3±30.1^{bc}	2292.5±22.5^{bd}
Carcass weight	1562.8±12.5^{a}	1698.3±15.4^{bd}	1756.5±26.1^{bce}	1720.8±19.0^{bde}
Chest weight	544.6±4.3^{a}	606.3±5.5^{bd}	647.3±9.6^{bc}	619.1±6.8^{bd}
Thigh weight	504.8±4.0^{a}	534.9±4.8^{b}	526.4±7.8^{b}	530.0±5.9^{b}
Back weight	211.0±1.7^{a}	234.4±2.1^{bc}	230.1±3.4^{b}	227.1±2.5^{bd}
Wings weight	169.9±1.4^{a}	189.2±1.7^{be}	203.8±3.0^{bc}	194.4±2.2^{bd}
Neck weight	89.2±0.7^{a}	100.7±0.9^{be}	107.3±1.0^{bc}	105.3±1.2^{bd}
Abdominal fat weight	129.7±1.0^{a}	44.7±0.4^{bc}	38.3±0.6^{bd}	44.7±0.5^{bc}
Digestive tract weight	180.8±1.4^{a}	179.5±1.6^{ad}	172.5±2.6^{be}	183.6±2.0^{ac}
Crop weight	8.8±0.1^{a}	8.0±0.1^{bd}	6.9±0.1^{be}	8.4±0.1^{bc}
Proventriculus weight	8.6±0.1^{a}	8.7±0.1^{ad}	8.6±0.1^{ad}	9.6±0.1^{bc}
Gizzard weight	49.7±0.4^{a}	58.4±0.5^{bc}	41.5±0.6^{be}	49.6±0.5^{ad}
Small intestine weight	65.8±0.5^{a}	73.0±0.7^{bc}	55.6±0.8^{bd}	71.9±0.8^{bc}
Liver weight	49.7±0.4^{a}	58.4±0.5^{bc}	41.5±0.6^{be}	49.6±0.5^{ad}
Heart weight	14.4±0.1^{a}	11.9±0.1^{bc}	10.5±0.2^{bd}	12.0±0.1^{bc}

* P- Values for treatment, week and treatment*week (P≤ 0.001)
$^{a, b}$: Significant Values Between treatments (Control vs. Treatment addition)
^{c,d,e}: Significant differences within the treatment addition (2.5 vs 5 vs 7.5 %)

Table 4: Average blood cholesterol, Albumin, Triglyceride and HDL levels when supplementary onion extract (0, 2.5, 5, and 7.5 %) were added to the drinking water.

Variable	Onion extract level in drinking water (%)				
(mg / dl)	0	2.5	5	7.5	Standards
Blood Cholesterol	283.1±89.0[a]	241.1±60.8[ad]	235.0±49.4[ad]	228.1±43.0[ad]	311.0±38.1[ac]
Blood Albumin	5.1±0.4[a]	5.6±0.9[ad]	4.7±0.6[ad]	5.3±0.8[ad]	6.1±1.6[ac]
Blood Triglyceride	101.1±5.4[a]	107.1±18.4[a]	106.1±17.7[a]	115.5±4.6[a]	119.5±20.8[b]
HDL	172.3±11.3[a]	170.6±10.2[a]d	169.3±9.8[ad]	163.9±5.6[ad]	203.6±4.0[bc]
LDL	90.7±91.6[a]	48.2±56.4[a]	44.6±47.6[a]	41.3±42.8[a]	83.3±39.2[a]

* P- Values for treatment, week and treatment*week (P≤ 0.001)
[a, b]: Significant Values Between treatments (Control vs. Treatment addition)
[c,d,e]: Significant differences within the treatment addition (2.5 vs 5 vs 7.5 %)

Table 5: Average small intestine long (cm) when supplementary onion extract (0, 2.5, 5, and 7.5 %) were added to the drinking water.

Variable	Onion extract level in drinking water (%)			
	0	2.5	5	7.5
Small intestine long (cm)	203.8±6.5[a]	209.5±6.2[ad]	234.5±11.2[bc]	222.0±6.8[bcd]
Small Intestine lesion score (n)	11.8±1.5[a]	9.0±2.7[a]	2.3±4.2[b]	8.5±2.4[a]
Coccidia eggs account (n X104)	4.5±1.3[a]	4.5±2.1[a]	2.8±1.7[a]	4.8±2.9[a]

* P- Values for treatment, week and treatment*week (P≤ 0.001)
[a, b]: Significant Values Between treatments (Control vs. Treatment addition)
[c,d,e]: Significant differences within the treatment addition (2.5 vs 5 vs 7.5 %)

Table 6: Average drinking, eating, sitting, standing, running and peering behavior in broilers when supplementary onion extract (0, 2.5, 5, and 7.5 %) were added to the drinking water per day.

Action	Onion extract level in drinking water (%)			
(n / d)	0	2.5	5	7.5
Eating	3.6±1.6[a]	3.2±1.6[a]	3.3±1.4[a]	3.8±1.7[a]
Drinking	3.4±1.5[a]	3.4±1.6[a]	3.1±1.3[a]	3.2±1.5[a]
Sitting	3.1±1.2[a]	3.3±1.5[a]	3.0±1.3[a]	2.9±1.4[a]
Standing	13.9±1.2[a]	13.8±1.5[a]	14.0±1.3[a]	14.1±1.4[a]
Running	2.2±0.9[a]	2.3±1.2[a]	2.1±1.0[a]	2.4±1.3[a]
Peering	2.2±1.2[a]	2.3±1.2[a]	2.4±1.1[a]	2.4±1.2[a]

* P- Values for treatment, week and treatment*week (P≤ 0.001)
a, b: Significant Values Between treatments (Control vs. Treatment addition)
c,d,e: Significant differences within the treatment addition (2.5 vs 5 vs 7.5 %)

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