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Effect of using onion as Anticoccidial agent on broiler physiology and production

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ABSTRACT
Coccidiosis is a common parasitic of animals and major diseases seen in industrial poultry houses, causing considerable economic loss in the poultry industry. Several anticoccidials are currently used; the emergence of drug-resistant strains of coccidia may present a major problem. Therefore, it has become necessary to develop alternative substances and strategies for animal growth promotion and disease prevention. Therefore, the objective of this study was to test the hypothesis that using onion will affect infections with internal parasite strains (Coccidia) in broilers. Four hundred 1-day old mixed sex broiler chicks (Hybrid) were randomly assigned to four experimental groups. Each treatment was included of 4 replicate. Experimental groups included control group with basal diet, the remaining groups receiving basal diet + 2.5 kg / ton, + 5 kg / ton and 7.5 kg / ton onion as a powder. Body weight and feed intake were measured once a week as well as the length of small intestine; and cecal microbial account. For measurement of carcass and organ weights and blood analysis, two birds per pen were slaughtered at 42 fowl per day. Results from our investigation showed that onion improved chicken performance and decreased cholesterol, and intestinal lesion score. Consumption of onion promoted small intestine length and depressed lesion scores of small intestine while lowering the coccidian egg account. It can be concluded that addition of onion as a powder reduces the costs of production through improve feed conversion ratio, weight gain and feeding efficiency of treated chickens.
Keywords: Broiler, Onion, Anticoccidial, Performance, Physiology.

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INTRODUCTION

Coccidiosis is pervasive protozoan disease seen in industrial poultry houses causing considerable economic loss in the poultry industry. When the birds' resistance declines, it becomes pathogenic, causing widespread disease. Subsequently, this results in depressed feed and water intake, weight loss, decrease egg production with reduced egg quality, and increase morbidity and mortality causing high economic costs [1]. Coccidiosis is still a main issue in poultry housing due to wet litter, contaminated drinkers and feeders, bad ventilation, and high stocking density can intensify the clinical signs. Consequently, several anticoccidials are currently offered besides antibiotics without concern over the withdrawal periods or contraindications restriction of these medications [2]. Thus, appearance of drug-resistant strains and detection of drug residue in the final meat products will be inspected on which can be harmful to consumers. Therefore, it has become necessary to develop alternative substances and strategies for animal growth promotion and disease prevention. Some attempts have been made to replace these additives with herbs. Plant extracts and spices as single or mixed compounds can be used as a promotion of performance and health condition of the animal [3].

Onion possess 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; mainly of sulphur compounds [4]. Most of the plant parts contain compounds with proven antibacterial, antiviral, antiparasitic, antifungal properties and has antihypertensive, hypoglycemic, antithrombotic,

antihyperlipidemic, antiinflammatory and antioxidant activity [5]. Therefore, the objective of this study was to test the hypothesis that using onion (*Allium cepa*) will affect infections with internal parasite strains (Coccidia) in broilers. Further assumption this plant ingredient could improve broiler production and some performance 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. In short, the objectives for these investigations are to produce a product that is free from antibiotic residual or chemical residual, improve broiler production and carcass quality through healthy chicken, improve broiler performance and reduce the spread of disease and parasites in broiler production cycles.

MATERIAL AND METHODS

Birds and management

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.

A total of 400 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. The dietary treatments included the basal diet (control), control + 2.5 kg / ton Onion, or control + 5 kg / ton Onion or 7.5 kg / ton Onion as powder.

The birds were fed a starter diet (CP: 21%; ME: 2 900 kcal) from day 0 to 21 and grower diet (CP: 18.5%; ME: 2 800 kcal) from day 22 to 42. All the dietary treatments were added to the basal diets. 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 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 are used in Jordanian farming under normal rearing system (day 1 and 7: Infectious Bronchi and New Castle, day 14: Gumboro; day 21: New Castle vaccine). During the experimental period, no medicaments were offered to the chickens groups either controlled or treated with onion.

Performance traits

Body weights of broilers were determined every week. Feed intake and weight gain were recorded during a 7 day period on a per cage basis and feed conversion ratio (FCR) was calculated. Mortality were recorded as it occurred and used to adjust the total number of birds to determine the total feed intake per bird and FCR.

Carcass traits

At 42 day 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 record as well. Veterinary specialist measured cecal microbial count and populations, mortality rate, and intestinal lesion scoring.

Statistical Analysis

A randomized design was employed. Data collected over the age of the birds were subjected to an ANOVA with repeated measures using the MIXED model procedure of the SAS Institute [6]. The main fixed effects were treatment (onion supplementation vs. control) and age of the birds. 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 onion improved dietetic performance in poultry significantly each week with higher weight when we offered onion at 5 kg / ton level. Using onion as powder showed significant effect in body weight changes after the third week of uses onion with higher body weight compared with control group (Table 1). Chicks offered onion with 5 kg / ton showed higher body weight from three week to the end of the study at 6 weeks of age compared to using onion at 2.5 and 7.5 kg / ton as shown in Table 1.

Table 1: Average body weight (gram / bird) when supplementary powder onion (0, 2.5, 5, and 7.5 kg / ton) added to broiler ration per week.*

Age (wk)	Dietary Treatment (kg / ton) 0	2.5	5	7.5	SEM	P- Value* Trt	wk	Trt*wk
First	158.3[a]	161.3[a]	164.5[a]	163.4[a]	5.8	***	***	***
Second	365.4[a]	375.1[a]	372.3[a]	363.0[a]	5.8	***	***	***
Third	677.3[a]	678.8[be]	744.5[bc]	709.6[bd]	5.8	***	***	***
Fourth	1 099.3[a]	1 118.4[be]	1 194.7[bc]	1 158.5[bd]	5.8	***	***	***
Fifth	1 519.5[a]	1 551.8[be]	1 621.5[bc]	1 591.6[bd]	5.8	***	***	***
Sixth	2 013.3[a]	2 074.2[be]	2 234.0[bc]	2 170.4[bd]	5.8	***	***	***

* P- Values for treatment (Trt), week (wk) and treatment*week (Trt*wk); *** for < 0.001
SEM: Standard error mean.
[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 kg/ton)

Feed intake increased significantly within treated group with higher feed intake were noticed at week four of age until the end of the experiment (Table 2).

Table 2: Average feed intake (gram / bird) when supplementary powder onion (0, 2.5, 5, and 7.5 kg/ ton) added to broiler ration per week.

Age (wk)	Dietary Treatment (kg / ton) 0	2.5	5	7.5	SEM	P- Value* Trt	wk	Trt*wk
First	137.0[a]	137.8[a]	163.4[a]	137.8[a]	7.0	***	***	***
Second	264.9[a]	265.8[a]	259.8[a]	266.3[a]	7.0	***	***	***
Third	519.3[a]	511.3[a]	542.3[a]	520.0[a]	7.0	***	***	***
Fourth	798.0[a]	795.5[be]	796.3[ad]	819.8[ac]	7.0	***	***	***
Fifth	874.0[a]	832.0[b]	813.5[b]	862.8[a]	7.0	***	***	***
Sixth	1 075.5[a]	1 068.3[ad]	1 211.5[bc]	1 177.3[bc]	7.0	***	***	***

* P- Values for treatment (Trt), week (wk) and treatment*week (Trt*wk); *** for < 0.001
SEM: Standard error mean.
[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 kg/ton)

Increasing body weight result in increasing carcass and eviscerated yields at 5 kg / ton onion as shown in table 3. With heavier chest, thigh, back and wings weight when we offered onion at 5 kg / ton to the rations. The internal organs, including the digestive tract, and other inedible parts which form a large part of the weight further, had heavier weight when onion was offered compared to control groups (Table 3a,b). Nevertheless, internal body weight was decreased significantly (65%) when onion was compared in the control group (Table 3a,b).

Table 3a: Average edible live, carcass weight (gram / bird) and dressing percent when supplementary onion powder (0, 2.5, 5, and 7.5 kg/ ton) added to broiler ration.

Variable	Dietary Treatment (kg / ton) 0	2.5	5	7.5	SEM	P-Value Trt
Live weight	2 013.3[a]	2 074.3[be]	2 234.0[bc]	2 170.3[bd]	12.6	***
Carcass weight	1 469.4[a]	1 540.3[be]	1 679.5[bc]	1 610.4[bd]	13.0	***
Chest weight	512.2[a]	549.3[bd]	618.9[bc]	579.6[bcd]	10.3	***
Thigh weight	475.2[a]	485.2[a]	503.3[a]	496.2[a]	9.8	NS
Back weight	198.1[a]	219.6[a]	231.3[a]	211.8[a]	5.2	**
Wings weight	159.8[a]	171.6[a]	194.8[b]	182.1[a]	7.6	*
Neck weight	84.0[a]	91.3[a]	106.3[b]	98.5[a]	4.0	***
Liver weight	46.8[a]	53.0[ac]	39.7[ad]	46.1[ac]	2.4	***
Heart weight	13.6[a]	10.7[bd]	10.1[bde]	11.5[bcd]	0.3	***

* P- Values for treatment (Trt); *, **, *** for < 0.05, <0.01 and < 0.001, respectively
SEM: Standard error mean.
[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 kg/ton)

Table 3b: Average nonedible weight (gram / bird) and dressing percent when supplementary onion powder (0, 2.5, 5, and 7.5 kg/ ton) added to broiler ration.

Variable	Dietary Treatment (kg / ton) 0	2.5	5	7.5	SEM	P-Value Trt
Abdominal fat weight	56.3[a]	40.5[b]	36.8[b]	41.9[b]	1.7	***
Digestive tract weight	169.9[a]	162.7[a]	165.0[a]	171.8[a]	2.7	NS
Crop weight	8.2[a]	12.4[bc]	6.6[ad]	8.0[ad]	19.6	***
Proventriculus weight	8.1[a]	7.9[a]	8.2[a]	9.0[a]	0.3	**
Gizzard weight	31.2[a]	29.7[a]	31.1[a]	29.6[a]	1.3	NS
Small intestine weight	61.8[a]	29.7[be]	53.3[bd]	67.3[ac]	1.8	***

* P- Values for treatment (Trt); *, **, *** for < 0.05, <0.01 and < 0.001, respectively
SEM: Standard error mean.
[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 kg/ton)

Control groups show using onion promoted small intestine length, and depressed in lesion scores of small intestine, and a reduction in coccidian eggs account when onion were used as shown in table (4).

Table 4: Average small intestine long (cm) when supplementary onion (0, 2.5, 5, and 7.5 kg/ ton) were added to broiler ration.

Variable	Dietary Treatment (kg / ton) 0	2.5	5	7.5	SEM	P-Value Trt
Small intestine long (cm)	299.8[a]	319.2[be]	406.0[bc]	379.7[bd]	4.0	***
Small Intestine lesion score (n)	5.8[a]	4.5[ad]	11.5[ac]	12.5[bc]	1.5	***
Coccidia eggs account (n X10^4)	5.5[a]	4.3[ac]	2.0[bcd]	3.8[ac]	0.5	***

* P- Values for treatment (Trt); *** for < 0.001
SEM: Standard error mean.
[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 kg/ton)

DISCUSSION

The use of antibiotic and anticoccidial in livestock either as growth promoters or as medicament treatments is presently facing serious criticism. There has been a rise in global concern as some reports revealed their ill effects among which are primary cause of microbial resistance to the products and their potential harmful effects on human health [7]. These shortcomings lead to the search for alternative substances that eliminates these threats. Recently there is also increasing interest in utilization of growth promoters of natural origin [7,8]. Probiotics and medicinal plants as natural feed additives currently used in poultry diets to enhance the performance and immune response of birds [7].

Onion (*Allium cepa*) which belong to the family Liliaceae and the genus Allium (9) are among common medicinal plants used as growth promoters [10]. Onion has several beneficial effects on both humans and animal such as having antimicrobial, antioxidant, as well as antihypertensive properties [11]. These functions were attributed to bioactive components present in Onion [11], one of which is a sulphur-containing organic compound known as Allicin (antimicrobial activity that could be responsible for the growth promoting effect of onion) [8,11]. The most predominant contents of these genuine organosulphur compounds are the amino acids cysteine and methionine, which improve growth performance of chicks receiving either garlic or onion. Similar to our results, Aji *et al.* [8] 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, improve healthy level and performance [12]. There are suggestions that body weight and other organs increased by improving nutrient absorption as a result of an increase in the size of the small intestine founded in slaughtered birds. To review, the use of onion in feed ration resulted in increase of feed intake; this in turn can increase daily weight gain. Therefore, in our investigation, it is possible onion could improve growth performance of chicks due to content of organosulphur compounds. As our results Aji *et al.* [8] 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 resulted in an increase in the intestinal health of the fowl.

Onion contains sulfur organic compounds including S-Methylcysteine sulfoxide and Sallylcysteine suiloxide. These compounds are related to decrease of blood lipid, liver protein, and glucose. Therefore, in

our investigation, it is possible onion or its extracts have lipotropic effects that affect lipid metabolism through fatty acid transportation. This can increase the lipid utilization and decrease abdominal fat.

CONCLUSION

In conclusion, the result indicate that incorporation of onion powder in broiler diet as feed additive 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) improved greater in chicken treated with onion compared with control group under same rearing system. The results showed lower mortality rate in certain control groups and reduction in susceptibility to diseases and medicament treatment. Subsequently, addition of onion as a growth promoter reduces the costs of production and minimizes coccidian infection through improved feed conversion ratio, weight gain, and feeding efficiency by treated chicken in comparison to other groups in the control group.

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