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Original Article

Use of garlic in feed and water influence growth performances of broiler

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A B S T R A C T

The aim of the investigation was to observe the effect of administration methods of garlic on productivity of broiler chickens. Three hundred and forty unsexed one-day-old broiler chicks were reared for 35 days. Chicks were assigned into five treatment groups, each treatment consisted of four replicates and each replicate contained 17 birds. The dietary groups were; control (basal diet; no additives), antibiotic (basal diet + antibiotic), garlic-0.25% (basal diet + 0.25% garlic powder), garlic-0.50% (basal diet + 0.50% garlic powder) and garlic in water (basal diet + 1 colve of garlic/2 lit drinking water). The experimental diets were consisted of broiler starter (0-21 days) and broiler grower (22-35 days). Body weight, body weight gain, feed intake and feed conversion ratio of the birds were recorded every week. Results of this experiment indicate that supplementation of garlic in broiler diets significantly effect overall growth performances. Addition of garlic in water showed higher ($P<0.05$) body weight as such as antibiotic and control groups compare to the garlic in feed groups. Data revealed that total feed intake in different dietary levels showed significant ($P<0.05$) difference. Control group showed significantly the higher feed intake over the other dietary groups. Improved ($P<0.05$) total feed conversion ratio was observed in garlic in water group as such as antibiotic group compare to the garlic in feed and control groups. However, feed conversion ratios in other weeks were not significant among treatments. These results suggest that addition of garlic with feed has little or no effect on growth performances. However, body weight and feed conversion ratio were significantly influenced by water based infusion of garlic. As garlic contains various bioactive components, it could be a potential feed additive in broiler diet.

Introduction

Feed additives are used in poultry industry to improve nutritive value of feed, increase growth rate and improve feed conversion ratio. Different feed additives such as antibiotic growth promoter, have been intensively used in broiler diet to improve productivity for a long time. However, these antibiotics are notorious for their negative impacts and bacterial resistance on the human health (Rehman and Haq, 2014). In January 2006, the European Commission banned the use of antibiotics in animal feeds apart from medical feeds (EC Regulation No. 1831/2003). Because some bacterial strains were resistant to antibiotics used in both humans and animals. This ban has triggered researchers of thinking on natural feed additives that exhibit antibacterial properties and also protect the digestive tract of poultry against various disease causing bacteria. Herbs could be the answer; they expected to serve as feed additives because of their suitability and preference, lower cost, availability, reduced risk of toxicity, minimum health hazards (Devegowda, 1996). Researchers are now working on phytogenic feed additives which have shown positive results as regards weight gain, feed efficiency, mortality and livability in poultry (Mishra and Singh, 2000; Babu *et al*., 1992).

Garlic (*Allium sativum*), a perennial bulb-forming plant, has been used for centuries as a flavoring agent, traditional medicine, and a functional food to enhance physical health. Furthermore, garlic contained abundant bioactive components like sulfur containing compounds (alliin, diallylsulfides and allicin, ajoene) which act as antimicrobial (Gebreyohannes and Gebreyohannes, 2013; Jaber and Al-Mossawi, 2007), antibacterial (Tsao and Yin, 2001), antifungal (Ledezma and Apitz-Castro, 2006), antiviral (Tsao and Yin, 2001), antioxidant (Prasad *et al*., 1995), antithrombotic (Fukao *et al*., 2007), anticancer (Dorant *et al*., 1996). Allicin help to reduce low density lipoprotein,

triglyceride and cholesterol in serum (Alder and Holub, 1997) and tissues in poultry (Stanacev *et al*., 2012). Specifically, in broilers, feeding garlic as a supplement improved broiler growth and feed conversion ratio (FCR), and decreased mortality rate (Stanacev *et al*., 2012). Elagib *et al*. (2013) found feed consumption was attained by the group of birds fed on diet containing 3 percent garlic powder. Onu (2010) showed that garlic supplementation at 0.25 percent level in broiler finisher diets enhanced the feed conversion ratio of the birds. However, Karim *et al*. (2017) found no significant differences in garlic fed broilers. Moreover, garlic has been found to lower serum and liver cholesterol (Qureshi *et al*., 1983) and abdominal fat percentage (Ashayerizadeh *et al*., 2009). Previous report described the beneficial effects of garlic on growth efficiency of broilers (Kumar *et al*., 2010). Ramakrishna *et al*. (2003) suggested that garlic supplementation enhances the activity of pancreatic enzymes and provides an environment for better absorption of nutrients.

Phytogenic feed additives can be nutritional or non-nutritional substance that improves the nutrient availability in the feed. As an alternative of the artificial growth promoter, natural growth promoters like prebiotics, probiotics, enzymes, plant extracts etc. can be used to feed the broilers (Borazjaniz *et al*., 2011). Garlic can be potential alternatives for the common artificial growth promoters like antibiotics (Rehman, and Munir, 2015; Karim *et al*., 2017). There are scanty of information about the administration methods of garlic on growth performances of broiler. Therefore, the aim of this investigation was to observe the use of garlic in feed and water on productivity of broiler chickens.

Materials and methods

Experimental design and broiler diets

A total of 340 day-old straight run Cobb 500 commercial broiler chicks were randomly divided into five dietary treatment groups and then each treatment group into four replications with 17 chicks per replicate. The experiment was carried out over a period of 35 days. The dietary treatment groups were; control (basal diet; no additives), antibiotic (basal diet + antibiotic), garlic-0.25% (basal diet + 0.25% garlic), garlic-0.50% (basal diet + 0.50% garlic) and garlic in water (1 colve of garlic/2 lit). Two types of broiler diets were formulated namely starter (0-21 days) and grower (22-32 days). Antibiotic and garlic were mixed with basal diet. The nutrient requirements (ME, CP, CF, EE, Ca, P, Lysine and Methionine) were satisfied as per recommendation of Cobb-500 broiler strain (Cobb-Vantress, 2018). Composition of ingredients and estimated nutrient contents of basal diets are shown in Table 1.

Preparation of the experimental house

A gable type open sided house was used for the experiment. The room area was 500sq. ft. The room was partitioned into 20 pens of equal size by using wire net. Area of each pen was 21 sq. ft. (7 feet x 3 feet). At the entrance, foot bath was maintained, where TH4+ solution was used as disinfectant.

Table 1. Ingredient composition of broiler starter and grower diet

Ingredients (kg)	Starter	Grower
Maize	54.99	60.00
Soybean meal	31.00	24.09
Protein concentrate	7.00	8.00
Di calcium phosphate	1.35	1.35
Limestone	0.8	0.7
Soybean oil	4.00	5.00
Lysine	0.10	0.10
Methionine	0.12	0.12
Vitamin mineral premix	0.25	0.25
Choline chloride	0.03	0.03
Common salt	0.36	0.36
Total	100	100
Chemical composition (Calculated)		
Metabolizable energy (Kcal/kg)	3050	3150
Crude protein %	23.66	20.59
Lysine %	1.24	1.06
Methionine %	0.50	0.63
Methionine + Cystine %	1.00	0.92
Calcium %	1.21	1.05
Available phosphorus %	0.45	0.42

Management practices

Experimental shed and necessary equipment's were properly cleaned, washed, dried, disinfected and subsequently left empty for a week before the arrival of chicks. Feeders were cleaned in every week and drinkers were cleaned twice daily. Starter diet was provided for the first 21 days and grower diet was provided to the broiler up to 35 days of age. In all cases, *ad libitum* feed was offered to the broilers. Feed was supplied four times daily, once in the morning, noon, afternoon and again at night in such a way that feeder was not kept empty. Fresh and clean water was made available at all times. Fresh and dried rice husk was used as litter material and spread over the floor at a depth of about 3 cm. After first two weeks, the upper part of the litter with droppings was removed and replaced with new one. After 14 days, litter was stirred in every alternative day to dry up quickly and to remove harmful gases. The chicks were brooded in respective pens using one 100 watt electric bulbs in each pen. The chicks were provided with a temperature of 35°C at first week of age, decreasing gradually at the rate of 3°C per week continued up to 4 weeks of age. The birds were exposed to a continuous lighting period of 23 hours and 30 minutes and a dark period of 30 minutes in each 24 hours.

Data collection and record keeping

Each pan was used as experimental unit in the experiment. The broilers were weighed by pen at the end of every week. After measuring the remaining feed at the end of the week, feed intake and feed conversion ratio (FCR) were calculated.

Statistical analysis

Data of body weight, body weight gain, feed consumption and FCR were analyzed by using SAS (2009**)** to estimate variance components with a completely randomized design. Duncan's multiple comparison tests were used to examine significant differences among the treatment means. In the result $P<0.05$ was considered statistically significant.

Results

Body weight of broiler

Body weight of broiler in different dietary groups is presented in the Figure 1. Data in the figure indicates that weekly body weight was not significant (P>0.05) during the experimental period. Final body weight showed significant difference (P<0.05) among the dietary groups. Supplementation of garlic with water showed higher (P<0.05) body weight as such as control and antibiotic groups compare to the garlic in feed groups.

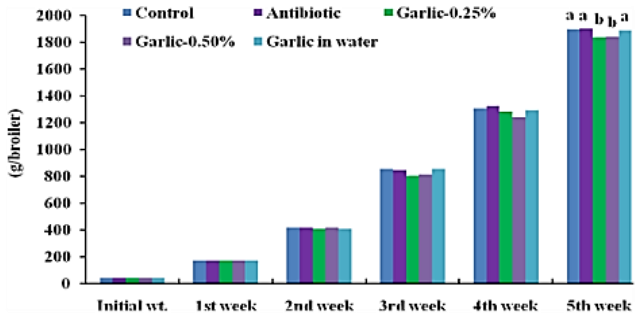

Figure 1. Weekly body weight of broiler in different dietary treatments

Body weight gain of broiler

Body weight gain of broiler in different dietary groups is presented in the Table 2. Final body weight gain showed significant difference (P<0.05) among the dietary groups. Control, antibiotic and garlic in water groups showed higher body weight gain compare to the garlic in feed groups. Highest body weight gain was found in antibiotic group, followed by control, garlic in water, garlic 0.50% and garlic 0.25%. However, body weight gain in other weeks were not significant (P>0.05). Among the garlic supplemented group garlic in water group showed better body weight gain compared to the garlic-0.25% and garlic-0.50% groups.

Table 2. Body weight gain (g/bird) in different dietary treatments

Week	Treatment					PSE
	Control	Antibiotic	Garlic-0.25%	Garlic-0.50%	Garlic in water	
1st week	129.88	129.46	129.75	129.94	129.96	15.23
2nd week	246.63	246.90	240.24	245.00	237.00	20.12
3rd week	439.57	429.15	395.19	398.18	445.76	28.45
4th week	450.06	479.09	477.59	427.59	437.47	32.15
5th week	588.84	574.11	550.57	599.20	596.47	40.25
Total	1854.99[a]	1858.70[a]	1793.33[b]	1799.90[b]	1846.66[a]	55.78

a, b values with different superscripts in the same row differ significantly (P<0.05). PSE= Pooled Standard Error.

Feed intake of broiler

Data revealed in Table 3 that total feed intake in different dietary levels showed significant (P<0.05) difference. Control group showed significantly the higher feed intake over the other dietary groups. There was significant difference among control, antibiotic, and garlic groups. However, there were no significant effect (P>0.05) on 1st, 2nd, 3rd, 4th and 5th week of feed intake of broiler in different treatments.

Table 3. Feed intake (g/bird) of broiler in different dietary treatments

Week	Treatment					PSE
	Control	Antibiotic	Garlic-0.25%	Garlic-0.50%	Garlic in water	
1st week	165.88	155.88	175.88	170.88	160.88	15.22
2nd week	400.15	400.53	383.53	400.53	383.53	34.54
3rd week	793	750.94	700.94	705	780.24	45.65
4th week	800.82	813.38	830.29	755.71	771.91	48.55
5th week	1020.31	990.88	960.41	1030.53	1018.82	75.12
Total	3180.16[a]	3111.61[b]	3051.05[c]	3062.65[c]	3115.38[b]	65.46

a, b values with different superscripts in the same row differ significantly (P<0.05). PSE= Pooled Standard Error.

Feed conversion ratio of broiler

Result from the Table 4 indicates that improved (P<0.05) FCR was observed in antibiotic group as such as garlic in water group compare to the garlic in feed and control groups. However, FCR in other weeks were not significant among treatments. Garlic in water showed better FCR compared to the other garlic treatment groups.

Table 4. Feed conversion ratio (feed/gain) of broiler in different dietary treatments

Week	Treatment					PSE
	Control	Antibiotic	Garlic-0.25%	Garlic-0.50%	Garlic in water	
1st week	1.28	1.24	1.36	1.34	1.24	0.12
2nd week	1.62	1.62	1.60	1.63	1.62	0.10
3rd week	1.80	1.75	1.77	1.77	1.75	0.13
4th week	1.78	1.70	1.74	1.77	1.76	0.11
5th week	1.73	1.73	1.74	1.72	1.71	0.08
Total	1.71[a]	1.68[b]	1.70[a]	1.70[a]	1.69[ab]	0.09

a, b values with different superscripts in the same row differ significantly (P<0.05). PSE= Pooled Standard Error.

Discussion

Body weight and body weight gain

Addition of garlic to experimental diets showed very little influence on body weight and body weight gain as compared to the control and antibiotic group. This finding was in general agreement with Karim *et al*. (2017) who found no effect of garlic on the body weight and body weight gain in broiler. Fadlala *et al*. (2010) also found that diet supplemented with garlic up to 0.6% did not significantly affect final weight of broiler chickens. On the other hand, Zekić *et al*. (2014) found higher body weight through the addition of garlic compared the chicken in control group. Langhout (2000) showed that herbal plant could stimulate the digestion system of birds, improve the function of liver and increase the pancreatic digestive enzymes and thus enhancement the metabolism. Garlic powder contains different bioactive components. It has proved that garlic significantly enhanced villus and goblet cell numbers in the duodenum, jejunum and ileum of birds (Adibmoradi *et al*., 2006). As a result of these intestinal morphological changes, the entire absorptive process in the birds is better activated.

In this way nutrient absorption is enhanced with the resultant growth promoting effect (Tatara *et al*., 2005; Masoud, 2006). But in this study, we found no impact of garlic on body weight and body weight gain when mixed with feed whereas, administration in water gives body weight as such as antibiotic group. This can be explained that garlic quality (type, preparation method, dose, feeding interval) and quantity may also provide noticeable roles on determining final body weight. Issa and Omar (2012) reported that content of bioactive compounds in herb plants might also vary, depending on geographical condition, climate, storage condition, and maturity.

Feed intake and feed conversion ratio

No improvement was noticed in feed intake of broilers fed with garlic compared with control chicks under same rearing system. This finding is more or less similar with some of the previous observations, where no effect of garlic was found over feed intake (Canogullar *et al*., 2009 and Raeesi *et al*., 2010). This finding is also contrasted with Javandel *et al*. (2008) who reported that feed consumption was significantly higher in birds fed diets with lower concentration of garlic 0.125% and 0.25%. In this experiment, no effect of garlic supplementation was found over the feed conversion ratio among control and garlic supplemented groups. However, garlic in water group showed little improvement compared to the other garlic supplemented groups. Rehman *et al*. (2012) reported that mean feed conversion ratio was significantly influenced by water based infusion of garlic. The study findings also support the findings of Javed *et al*. (2009) which showed a positive effect of aqueous extract of garlic on the performance of broiler chicks in term of FCR. On the other hand, Onyimonyi *et al*. (2012) and Galib and Huda (2013) reported positive effect of garlic on FCR of broiler. Incharoen *et al*. (2010) proved that garlic supplementation in broiler ration can increase the intestinal villus height, villus area, cell area, cell mitosis in the intestine and results in better feed efficiency.

Conclusion

It can be concluded from the study that, addition of garlic with feed has little or no effect on growth performances. However, body weight and FCR were significantly influenced by water based infusion of garlic. Garlic as a valuable feed additive is used in many areas of world but the somewhat controversial reports about its effects and recommended dosage in commercial diets can be misleading. The weight gain and feed intake reduction in birds fed garlic means that herbal additives have their limitations too and need more investigation. As garlic contains various bioactive components, it could be a potential feed additive in broiler diet.

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