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Effect of Feeding Garlic on the Performance and Immunity of Broilers

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Abstract: The present experiment was conducted to investigate the effects of adding graded levels (0, 0.15, 0.45, 0.3 and 0.6%) of garlic (*Allium sativum*) to the basal experimental diet on the broiler chicks growth performance and immune response. One hundred and fifty unsexed Ross broiler chicks were randomly distributed; 30 birds/dietary treatment and each treatment contained 3 replicates (10 birds/replicate). The results showed significant ($p<0.05$) improvement in feed conversion ratio of birds fed 0.3% garlic. The mortality rate followed the same trend of feed conversion ratio. Weight gain was found to be increased by inclusion of garlic, but was not statistically significant. Total White Blood Cells (TWBC) of birds fed 0.3% garlic was significantly ($p<0.05$) higher compared to these fed other dietary treatments and the lower TWBC was recorded by the control treatment. No significant differences in blood serum total protein, albumen and globulin were observed. Colour, flavour, tenderness and juiciness of sensory evaluated samples were not statistically different.

Key words: *Allium sativum,* ross broiler, alternative medicine

INTRODUCTION

The practice of complementary and alternative medicine is now on the increase in developing countries in response to World Health Organization directives culminating in several pre-clinical and clinical studies that have provided the scientific basis for the efficacy of many plants used in folk medicine to treat infections (Vijaya and Ananthan, 1997; Dilhuydy and Patients, 2003; Iwalokun *et al*., 2004). Previous studies have demonstrated positive effects of herbal supplements on production performance and carcass quality (Schleicher *et al*., 1998; Tekeli *et al*., 2006, 2008).

Garlic, a member of the Allium family (Liliaceae), has been used traditionally for ages to treat a wide array of diseases, namely, respiratory infections, ulcers, diarrhea and skin infections (Fenwick and Hanley, 1985). Reuter *et al.* (1996) reported garlic as a plant with antibiotic, anticancer, antioxidant, immunomodulatory, anti-inflammatory, hypoglycemic and cardiovascular- protecting effects.

Moreover, garlic is very rich in aromatic oils, which enhance digestion and positively influenced respiratory system being inhaled into air sacs and lungs of birds. Also it was found that garlic has strong antioxidative effects (Gardzielewska *et al*., 2003).

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In pursuit of improved broilers health and in order to fulfill consumer expectation in relation to food quality, poultry producers commonly apply natural feeding supplements, mainly herbs (Gardzielewska *et al*., 2003). Garlic extract and/or garlic components were able to prevent chemically induced tumors or acute toxic effects of chemicals. The chemo-preventive potential of garlic has been attributed to the presence of several bioactive organosulfur compounds. Theses compounds might act as antioxidants (Fanelli *et al*., 1998; Siegers *et al*., 1999). The antioxidative stress properties of garlic might result from the contributions of its sulfur component in different steps and not necessarily from the contribution of only one of them (Fanelli *et al*., 1998). Garlic also has been shown to have strong antimicrobial action (Iwalokun *et al*., 2004; Gbenga *et al*., 2009). Allicin and its derivatives have been shown to be a larvicidal and bacteriostatic, active against both Gram positive or Gram negative organisms as well as fungi such as *Candida albicans* and viruses including influenza viruses (Chang and Cheong, 2008). *Allium sativum* taken at a low dose may have some therapeutics potentials against gastric ulcers associated with *H. pylori* infection (Adeniyi *et al*., 2006). Garlic extracts do have significant inhibitory effects against microorganisms associated with dental caries Masaadeh *et al*. (2006). In the present study broiler starter and finisher diets were supplemented with graded levels of garlic to evaluate the effect of garlic supplemented broiler diets on broiler performance, carcass quality and broiler immune response.

MATERIALS AND METHODS

Experimental Site and Duration

The present experiment was conducted in the Poultry Unit of the College of Veterinary Medicine and Animal Production, Sudan University of Science and Technology at Hillat Kuku in the period from the 2nd of July to 16th of August 2009.

The Poultry-house and the equipments were cleaned and disinfected before starting the experiment.

Experimental Diets

The basal experimental starter was formulated according to NRC (1994) to meet the broiler requirements Table 1. The finisher formula of broiler requirements was as out lined by the NRC (1994) (Table 2).

Clean pure garlic was bought from local market, prepared by drying in shadow for three days and then ground soft. Chemical composition of garlic is presented in Table 3.

Garlic powder is added to the basal experimental diets in graded levels (00, 0.15, 0.3, 0.45 and 0.6%). Zero level is served as the control treatment.

Table 1: Composition and calculated analysis of starter experimental basal diet

Ingredient	MJ kg^{-1}	CP%	CF	Ca	AP	Lysine	Methionine
Sorghum 63	8.95	8.38	1.58	0.03	0.02	0.15	0.11
GNC 28	3.24	12.04	1.82	0.04	0.08	0.04	0.14
WB 2042	0.20	0.34	0.25	0.003	0.006	0.008	0.006
Concentrate 5	0.42	2	0.15	5	0.23	0.60	0.15
DCP 074	-	-	-	0.20	0.11	-	-
Limestone 0.63	-	-	-	0.24	-	-	-
Lysine 0.04	-	-	-	-	-	0.04	-
Methionine 0.09	-	-	-	-	-	-	0.09
Vegetable oil 0.45	0.17	-	-	-	-	-	-
Total %100	12.973	22.890	3.842	1	0.45	1.2	0.5

Table 2: Composition and calculated analysis of finisher experimental basal diet

Ingredient	MJ kg^{-1}	CP%	CF	Ca	AP	Lysine	Methionine
Sorghum 65	9.23	8.65	1.63	0.40	0.02	0.16	0.11
GNC 23	2.70	9.90	1.50	0.32	0.07	0.33	0.12
WB 3	0.24	-	0.36	0.004	0.01	0.01	0.01
Concentrate 5	042	2	0.15	0.50	0.23	0.60	0.15
Vegetable oil 3.4	0.54	-	0.50	-	-	-	-
DCP 0.8	-	-	-	0.20	-	-	-
Lime stone 0.56	-	-	-	0.20	-	-	-
Lysine 0.12	-	-	-	-	-	-	-
Methionine 0.12	-	-	-	-	-	-	0.12
Total %100	13.13	12	3.64	1.000	0.45	1.20	0.50

Table 3: Chemical composition of garlic

Items	Values
Constituents (g/100 g)	
Moisture	61.3
Crude protein	6.29
Carbohydrate	30.89
Fat	0.2
Crude fiber	1.5
Ash	1.5
Minerals (mL/l00 m)	
Ca	2900
P	220
Fe	150
K	52900
Mg	3600
Na	1900
Thiamine	25
Riboflavin Niacin	8
Niacin	50
Ascorbic acid	1500

Source: Watt and Merrill (1963)

Experimental Birds

One hundred and fifty one day old, broiler chicks (Ross) were bought from Coral Poultry and Feed Production Company Ltd., Khartoum, Sudan. The chicks fed the control diet for two weeks as adaptation period.

Water and Feed provided *ad libitum*, light was available 24 h per day. The experimental birds were randomly assigned to the 5 dietary treatments (30 birds/treatment). Each treatment consisted of three replicates (10 birds/replicate).

Methods

Data Collection

At age of 15 days the experimental diets were randomly distributed to the experimental birds. The starter basal diet was used for two weeks while the rest of the experimental period the birds fed the finisher diets.

Broiler Performance

At the end the experiment (6 weeks) the chicks had been fasted for 8 h and then it was weighted to determine the final body weight. Mortality was recorded when it occurred.

Carcass Preparation or Composition

Hot dressing percentage and cold dressing percentage were determined according to the equations below:

$$\text{Hot dressing percentage} = \frac{\text{Hot carcass weight}}{\text{Final body weight}} \times 100$$

$$\text{Cold dressing percentage} = \frac{\text{Cold carcass weight}}{\text{Final body weight}} \times 100$$

Sensory Evaluation

The right halves of the carcasses were stored in a deep freezer (-20°C) for 7 days. Then sensory panel sessions were conducted to determine the effect of garlic. The right halves of the carcasses from each treatment were thawed for (24 h) in a refrigerator (4°C) then the breasts, thighs and drumsticks were wrapped individually in aluminum foil and roasted at (175°C).

They were cut into pieces and served warm. Trays of randomized sample from the main treatment were evaluated at each session by panel of semi trained panelists (Cross *et al*., 1978).

Panelists were instructed to record their responses for each attributes (Colour, Flavor, Tenderness and Juiciness) on scale in the range 1-8 (8 being rated the most desirable).

Chemical Analysis

Chemical analysis was carried out according to AOAC (1995) method. Serum total protein, albumin and globulin were determined according to Watt and Merrill (1963).

Haematology Parameter

Total White Blood Cell Count (TWBC) was carried out according to Sturkie (1976).

Statistical Analysis and Experimental Design

A complete randomized design was used in this experiment. Collected data were subjected to analysis of variance and LSD test was used to determine the significance among treatments means according to Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Broiler Performance

The results of the effect of feeding graded levels of garlic on the broiler chick performance (4-6 weeks of age) are shown in Table 4. Birds fed 0.3% garlic basal diet had significantly ($p<0.05$) lower total feed intake (3892 g) compared to the other dietary treatment. This result was reflected on the feed conversion ratio (2.46) which revealed a significant

Table 4: Overall performances results affect by feeding garlic

	Treatment					
		Garlic %				
Parameters	Control	0.15	0.3	0.45	0.6	Level of significant
Total feed intake (g/bird)	3500[a]	4000[a]	3892[a]	4256[a]	3750a	*
Total weight gain(g/bird)	1565	1532	1582	1582	1650	NS
Total feed conversion ratio (g feed/ g) gain	2.94[a]	2.8[a]	2.46[b]	2.77[a]	2.77[a]	*
Mortality (%)	0.22[a]	0.67[a]	Zero [b]	1.11[a]	0.25[a]	*

Values are means of birds/treatment. Values are Means±SE. Means within columns not sharing common letter (s) are significantly different ($p<0.05$). * = ($p<0.05$), NS: No significant different

Table 5: Effect of feeding garlic on dressing percentage

	Treatment						
		Garlic %					
Parameter	Control	00.15	0.3	0.45	0.6	SEM	Level of significant
Hot dressing (%)	70.97	62.31	68.84	64.90	73.94	2.13	NS
Cold dressing (%)	57.27	57.42	61.45	61.45	62.13	0.000001	NS

Values are means of 30 birds/treatment. NS: No significant different

Table 6: Effect of feeding garlic on blood serum constituents

	Treatment						
		Garlic %					
Parameter	Control	00.15	0.3	0.45	0.6	SEM	Level of significant
Total Protein	2.86	2.48	3.00	3.30	3.31	0.114	NS
Albumin	1.30	1.62	1.57	1.52	1.76	0.009	NS
Globulin	1.56	1.5	1.44	1.51	1.55	0114	NS

Values means of/S sample/treatments. NS: No significant different

Table 7: Effect of feeding garlic on total white blood cells (TWBC)

	Treatment						
		Garlic %					
Parameter	Control	00.15	0.3	0.45	0.6	SEM	Level of significant
TWBC	107.050	179.050	820.500	420.806	206.206	176.43	*

Values are means of 15 sample/treatment. Values within a row different superscript are significantly different ($p<0.05$)

($p<0.05$) improvement compared to the other dietary treatments. No mortalities were recorded for birds. No significant changes in the total weight gain were observed but it tended to increase in birds fed higher inclusion rates of garlic 0.3, 0.45 and 0.6%.

Dressing Percentage

No changes were observed in hot and cold dressing percentage among all groups as shown in Table 5.

Blood Serum Constituents

Total protein concentration was higher in chicks fed 0.3, 0.45 and 0.6% while albumin showed high values in birds fed 0.3% garlic (Table 6).

Total with Blood Cells

TWBC showed significant differences ($p<0.05$) among the dietary treated groups. TWBC was increased by increased addition of garlic level. Birds fed 0.3% garlic revealed higher TWBC compared to other groups (Table 7).

Sensory Evaluation

There were no significant differences among dietary treatments in the tested characteristics (colour, flavor, tenderness and juiciness) (Table 8).

Garlic (*Allium sativum*) is uncommonly used as plant supplement in poultry feeds. It was found that it has some positive effects on human and animal health and immune response which reflected in positive effects on the animal performance (Fanelli *et al*., 1998).

Table 8: Sensory characteristics effect by feed garlic

	Treatment						
		Garlic %					
Parameter	Control	00.15	0.3	0.45	0.6	SEM	Level of significant
Colour	6.67	7.67	7.67	9.67	7.33	0.118	NS
Flavour	7.00	7.00	7.00	7.00	7.33	0.206	NS
Tenderness	6.67	7.00	7.00	7.33	7.00	0.236	NS
Juiciness	7.00	7.33	7.33	7.00	6.67	0.279	NS

Values are means of I5 sample/treatment. Values are points out of 8 points. NS: No significant difference between treatments

The results of the present study showed a significant ($p<0.05$) improvement in feed conversion ratio of birds kept on a diet containing 0.3% garlic. Tekeli *et al.* (2006) was reported that another plant extract contribution (*Z. officinale* 120 ppm) such as garlic improved live weight gains and feed conversion ratio of broiler also increased population of intestinal lactic acid bacteria. The improvement in feed conversion ratio might be due to lower ($p<0.05$) feed intake and improved weight gain livebody. Weight gain tended to improve by inclusion of garlic. These results might be due to the good health status which may be caused by the inclusion of garlic.

It was reported by Birrenkott *et al.* (2000) that including garlic in the laying hens garlic inclusion resulted in increased TWBC which reflecting good immune response. It was also found that garlic powder decreases external parasites by inhibition of its growth (Barowski and Boyd, 1944). The result of the present study in TWBC was in agreement with that reported by Sumiyoshi (1997) and Oluwole (2001). In addition to that the improved broiler performance might be due to the garlic chemical composition (Reuter, 1995; Sumiyoshi, 1997).

In the present study, the 0.3% inclusion rate of garlic was found to be the best and optimum inclusion rate in growth performance, TWBC, blood serum constituent content which might be due to the optimum Low Density Lipids (LDL) and low density cholesterol caused by garlic inclusion as reported by Reuter *et al.* (1996). Propolis also from natural alternative products such as garlic significantly reduced plasma triglyceride concentrations in broilers (Tekeli *et al*., 2008).

In conclusion, using garlic in broiler chicks feed resulted in a significant positive effect on broiler chicks' growth performance and carcass yield.

The optimum inclusion rate of garlic for growth performance and carcass yield was found to be 0.3%. Further studies in the area of the effects of garlic powder inclusion on immune response are recommended.

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