Journal of Natural Sciences Research
ISSN 2224-3186 (Paper) ISSN 2225-0921 (Online)
Vol.3, No.1, 2013

Effect of adding Garlic Powder (*Allium sativum*) and Black Seed (*Nigella sativa*) in Feed on Broiler Growth Performance and Intestinal Wall Structure

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The research is financed by Asian Development Bank. No. 2006-A171(Sponsoring information)

Abstract

This study was conducted to investigate the effect of garlic powder (GP) black seed (BS) and plant premix (GP and BS) in feed on broiler growth and intestinal wall structure. The result included 480 Hubbard broiler chicks(day-old) There were 4 treatment groups each consisting of 3 replicates .The four dietary treatments consisted of a control (basal diet) , basal diet + 0.5% GP , basal diet +0.5% BS and basal diet +0.5% plant premix (GP and BS) , to the starter and finisher diet. The experiment lasted 42 days. Body weight , body weight gain , feed intake and feed conversion ratio were determined weekly and intestinal characteristics were determined at the end of the study (42 day) .The addition of GP and BS plant premix (GP and BS) to the diet resulted in significantly higher body weight , body weight gain and feed intake as compared to that of control group. However , feed conversion ratio was not influenced by dietary treatment ($p>0.05$) . The villus height , crypt depth and crypt depth to villus height ratio was significantly higher in group garlic powder and plant premix (GP and BS) than other groups. While villus height , crypt depth and crypt depth to villus height ratio significantly lower in the control group compared with other treatment groups. It was found that the goblet cell were not affected by any treatment . Based on the results of this study it be could be advised to supplement broiler feed with 0.5% GP and plant premix.

Key words: Garlic , Black seed, Performance, wall intestinal structure .

1-Introduction

Recently , it has been reported that the usage of antibiotics has negative effects on animals health and production such as residua in the tissues long withdrawal period , and development of resistance in microorganisms allergies and genotoxicity , that is serious threat to human health. Therefore the use of antibiotic growth promoters has been banned in many countries especially in the European Union (Castanon 2007).Aromatic plants and essential oil extracted from these plants have been used as alternatives to antibiotics. For this reason these plants are becoming more important due to their antimicrobial effects and the stimulating effect on animal digestive system to increase production of digestive enzymes through enhance liver functions (Hemandez 2004). The garlic (*Allium sativum*) and black seed (*Nigalla sativa* L.) is a widely distributed and grown in various parts of the world and is commonly used in the food industry because of special aroma and natural safety (Khan *et al* .,2003) . In addition , the essential oil from these plants also exhibited strong antibacterial antifungal , antioxidant properties were reported by (Ertas , *et al* ., 2005). Black seed and Garlic also stimulates immune system and digestive enzymes (Durrani *et al* ., 2007).Consequently there is considerable research interest in the possible use of natural products such as essential oil from these plants to changing gastrointestinal tract conditions such as altered diet or altered composition of the intestinal microflora (Hall *et al* .,1994) .The intestine can change its surface by growing to length and by increasing or decreasing the height of its villi. Shortening and fusion of villi will result in loss of surface for digestion and absorption of food (Vidavarachchi,*et al* .,2006) .Santin *et al* ., (2001) reported that development of the morphology of gastrointestinal tract is greatly influenced by the diet of animal . Therefore , the aim of the present study was to determine the effect of GP , BS and premix (GP and BS) on the performance and the changes within the intestinal wall structure in broiler chickens.

2-Material and Methods

2-1-Experimental design:

A total of 480 day-old chickens of the commercial strain (Hubbard) chickens were randomly allocated one of four treatments (three replicate each) . Each replicate consisted of 40 broiler chickens. Between days 1 and 21 the chickens were fed a starter diet followed by a finisher diet between days 22 and 42 (Table 1) . The four dietary treatments consisted of a control (basal diet) , basal diet +0.5% garlic powder , basal diet + 0.5% black seed and basal diet +0.5% plant premix (GP and BS) . Body weight (BW) , body weight gain (BWG) of birds were measured individually and feed intake (FI) per pen were measured at 42 days of age. Feed intake per pen and body weight per pen were used to calculate the feed conversation ratio.

At 42 days of age, 6 chickens per replicate pen (3 male and 3 female) were randomly sampled for morphometric analysis, and then killed. The intestinal tract was removed immediately and severed from the gizzard and the pancreas was removed. Three 1-centimeter tissue segments were taken from the proximal, middle and distal parts of duodenum, jejunum and ileum sections. All samples from each of those birds were taken from the same area of each section of the tract. Samples stored in 10% buffered neutral formalin for fixation, where they were gently shaken to remove any adhering intestinal contents. Cross sections (5 µm thick) of each intestinal segment were processed in low-melt paraffin and stained with Hematoxylin and Eosin. This procedure causes a longitudinal section of villi. Using a Zeiss light microscope, 13 measurements per intestinal section were made for each parameter and averaged into one value per bird. As a matter of fact, each histological data obtained from the mean of 40 records (2 sections and 20 villi per section).

Data on villus height, epithelial thickness, goblet cell number, crypt depth and ratio of crypt depth to villus height, were analyzed with the general linear model procedure and differences among treatments means were classified by Duncan's multiple range test (Version 6.12, SAS Institute, Inc.)

3-Results and Discussion

The effect of dietary supplementation with either GP or BS or plant premix (GP and BS) on body weight , body weight gain , feed consumption and feed conversion ratio of broiler on day 0 to 42 of the experiment are given in Table 2 .Dietary supplementation with plant premix (GP and BS) and BS positively influenced BW , BWG and FC compared to the control group. However, there no differences ($p>0.05$) in the FCR between GP , BS groups and Control group .The birds offered the diet containing 0.5% plant premix (GP and BS) feed increased ($p<0.05$) BW, BWG and improved feed efficiency as compared with control group ($p<0.05$) .The results of the present study support the findings of Al-Homidan *et al* (2002) who reported improvement in growth rate in broiler by supplementing 2% black seed in ration. Similar results have been obtained by Durrani *et al* (2007) who observed that the addition of black seed at the rate of 40 g/kg^{-1} feed resulted in maximum weight gain. Osman and Barody (1999) also found increased feed consumption in broilers by feeding black seed. However in contrast to finding by Durrani *et al* (2007) in which the higher feed consumption was recorded in the control group as compared to other groups .Birds in the present study , receiving dietary of BS , GP and plant premix (GP and BS) exhibited advantages in feed consumption throughout the study compared with control birds. Feed conversion was also improved for birds consuming plant premix (GP and BS) as compared to the control .Similar results have been obtained by Al-Homida *et al* .(2002) and Osman and Barody (1999) in broilers . Other factors which could have contributed to the beneficial effects of the plant premix (GP and BS) on the growth performance of birds , were their probable due to antibacterial , antioxidant and antifungal properties of these plant were reported by Erats *et al* .(2005) .Black seed and garlic also stimulates immune system and digestive enzymes (Durrani *et al* .,2007). ToIlba and Hassan (2003) found that garlic as a natural feed additive, improved broilers growth, feed conversion ratio (FCR), and decreased mortality rate.

The measures of the histological examination of intestinal wall are given in Table 3 and Figure 1 The addition of either GP , BS and plant premix (GP and BS) to the basal diet increased villus length , crypt depth and crypt depth to villus length ratio. However , goblet cells number (per 100 µ villus height) was not affected .There is evidence to suggest that plant premix (GP and BS) , GP and BS effect may be due to greater efficiency in the utilization of feed , resulting in enhanced development of intestinal morphology of poultry (Apajalahti *et al* .,2004).

Our finding are in agreement with those of Montagne (2003) who studied that villus : crypt ratio is a indicator of the likely digestive capacity of small intestine .

However, several researchers have studied intestinal morphology in poultry during the last decade but predominantly from the standpoint of normal development and not with regard to effects of antibiotics and other growth promoters (Uni *et al*., 1999 Geyra *et al*., 2001).It has been hypothesized that gut microflora decrease nutrient absorption by increasing GIT thickness, the rate of digesta passage, and also increase nutrient requirements of the host by increasing turnover of the gut mucosae and by competing with the host for a portion of the dietary energy and (Ravindran *et al*., 1984 ; Apajalahti *et al* ., 2004).

Krinke and Jamroz (1996) reported reduced cell proliferation and a thinner epithelial in chicks fed antibiotic, which is in agreement with the observed effect of garlic meal in present Thinner intestinal epitheliums enhance absorption and reduce the metabolic demands of the gastrointestinal system (Visek , 1978).A shortening of the villi decreases the surface area for nutrient absorption. The crypt can be regarded as the villus factory , and a large crypt indicates fast tissue turnover and a high demand for new tissue (Yason *et al*., 1987). A decrease in either villus height or crypt may lead to a reduction in nutrient absorption.

It was concluded that the improved intestinal morphology characteristics of birds receiving garlic powder, black seed and plant premix (GP and BS) may explain the improved performances. Longer villi increase the surface area for nutrient absorption, while small crypt indicates lower tissue turnover and a lower demand for new tissue. Changes in intestinal morphology, as described above, can lead to better nutrient absorption, decreased secretion in the gut and better overall performance.

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Table 1 : Composition of the broiler diets.

Ingredients	Started (0-21 day) %	Finisher (22-42 day) %
Corn	48.2	58.7
Wheat	8	7.5
Soybean meal(40%)	28.5	20.5
Protein Concentration (50%)	10	10
Vegetable oil	4	2.5
Salt	1	0.5
Vitamin/Minerale mix*	0.3	0.3
Total	100	100
Calculated composition**		
ME(kcal/kg)	3079	3106
Crude protein(%)	22.06	19.37
Crude fiber(%)	3.54	3.2
Lysine	1.21	1.03
Methionine+Cystine	0.82	0.75
Ca(%)	1.2	0.95
P(%)	0.44	0.42

*Provided the following per kilogram of dite : Vitamin A (as all-trans-retiiol acetate) 12000IU; vitamin E 10IU ; K_3 3mg; Vit. D3 ,2200 IU;riboflavin, 10mg; Ca pantothenate, 10mg; niacin, 20 mg; choline chloride, 500mg; vitamin B12, 10Ug ; vitamin B_6 ,105mg.; thiamine (as thiamine mononitrate), 2.2 mg; Folic acid, 1mg; D-biotin, 50ug. Trace minerals (mg/kg diet): Mn, 55; Zn, 50; Fe, 30; Cu, 10; Se, 1 and Ethoxyquin 3 mg.

**Calculated composition was according to NRC (1994)

Table 2: Effects of garlic powder , black seed and plant mixed on performance of broilers (42 day)

Groups	Body weight (g/bird)	Feed intake (g/bird)	Body weight gain(g)	Feed conversion (kg/kg)
Control	2001.34±21.56^{c}	4357.0±2.1^{b}	1964.34±16.7^{b}	2.174±0.22^{a}
Garlic powder(0.5%)	2156.81±14.87^{b}	4363.5±2.3^{b}	2119.76±10.5^{a}	2.044±0.44^{ab}
Black seed (0.5%)	2196.83±25.27^{a}	4393.8±2.3^{a}	2159.34±8.1^{a}	2.011±0.08^{ab}
Plant mixed (0.5%)	2240.68±24.39^{a}	4435.0±2.6^{a}	2203.15±12.2^{a}	1.988±0.03^{a}

a,b: Mean within same row lacking common supplement differ significant($p<0.05$)

Table 3: Effects of black seed, garlic powder and mixed intestinal morphology of broiler(42day)

Groups	Duodenum	Jejunum	Ileum
	Villus height (µm)		
Control	911.38±1.90^{c}	762.78±0.18^{b}	660.22±0.16^{c}
Garlic powder(0.5%)	988.13±1.72^{b}	778.30±0.13^{ab}	670.09±0.19^{b}
Black seed (0.5%)	1020.31±1.88^{a}	851.22±0.20^{a}	677.00±0.20^{b}
Plant premix (0.5%)	1081.19±0.89^{a}	885.56±0.22^{a}	692.35±0.11^{a}
	Crypt depth (µm)		
Control	140.30±0.36^{c}	111.83±0.22^{b}	110.33±0.02^{c}
Garlic powder(0.5%)	150.44±0.34^{b}	121.18±0.24^{ab}	113.85±0.01^{b}
Black seed (0.5%)	168.50±0.39^{a}	127.90±0.19^{a}	117.23±0.04^{a}
Plant premix (0.5%)	169.71±0.29^{a}	130.74±0.17^{a}	120.90±0.04^{a}
	Crypt depth to Villus height(c/v)		
Control	0.153±0.005^{b}	0.146±0.08^{b}	0.167±0.03^{b}
Garlic powder(0.5%)	0.152±0.003^{b}	0.155±0.08^{a}	0.169±0.02^{ab}
Black seed (0.5%)	0.165±0.003^{a}	0.150±0.07^{a}	0.173±0.03^{a}
Plant premix (0.5%)	0.159±0.001^{a}	0.147±0.06^{b}	0.174±0.01^{a}
	Goblet cell number (per 100 µm villus height)		
Control	7.39±0.25	10.01±0.15	11.28±0.21
Garlic powder(0.5%)	7.10±0.20	10.00±0.18	10.30±0.17
Black seed (0.5%)	7.81±0.22	9.95±0.20	9.90±0.16
Plant premix (0.5%)	7.92±0.21	8.90±0.11	10.23±0.18

a,b: Mean within same row lacking common supplement differ significant($p<0.05$)

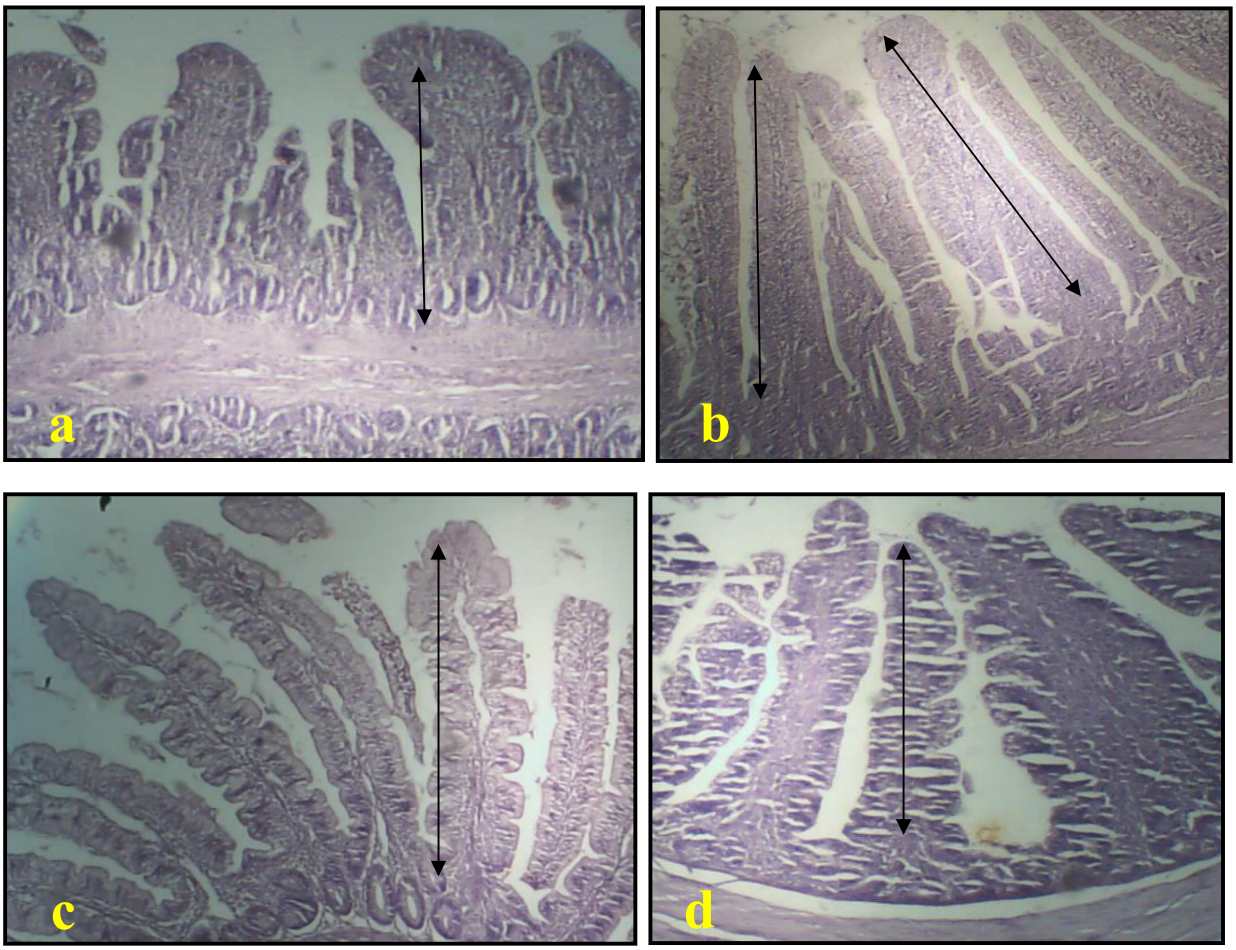

Fig.1 a: Control , b: 0.5% GP , c: 0.5% BS , d: 0.5% Plant mixed (100x , Mallory trichromical coloration)

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