Use of Cinnamon and Black Cumin as Effective Alternative of Antibiotics on Growth Performance of Broiler

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ABSTRACT

The experiment was conducted with Cobb-500 broiler strain. For this purpose 360 broiler chicks were purchased from Kazi Hatchery, Gazipur, Dhaka. The experiment was conducted in the month of November and December 2013 for 28 days at SAU Poultry farm. There were six treatments, Such as, T1: 0.25 % of cinnamon/ black cumin; T2: 0.50 % of cinnamon/ black cumin; T3: 0.75 % of cinnamon/ black cumin; T4: 1.0 % of cinnamon/ black cumin; T5: Basal Diets + Antibiotics and T6: Control (Basal Diet with no antibiotics or cinnamon/ black cumin) The number of replications was three for each treatment. So the total number of replications was 18 units which were randomly selected. Each replication had 10 chicks. Two experiment was conducted both for Cinnamon and Black Cumin at same time. The best common cinnamon and black cumin dose was 0.50% for feed consumption. For both cinnamon and black cumin, the height LW was found in 0.75 % level. The FCR results indicated that any dose of cinnamon and black cumin can be used for best FCR. The analytical results of mortality both for cinnamon and black cumin showed no significant difference ($P>0.05$) within them. So considering market price 0.25% or 0.50% dose of cinnamon or black cumin can be used for best survivevality. Similarly, lower doses of cinnamon and black cumin were suitable to keep lower blood glucose and blood cholesterol level. SP ratio for Gumboro disease were significantly higher ($P<0.05$) in all cinnamon supplementation groups which had positive effects on immune responses, whereas higher doses of black cumin showed positive effects on immune responses. SP ratio for Newcastle disease were significantly higher ($P<0.05$) in all cinnamon supplementation groups which had positive effects on immune responses. But, cumin supplementation groups had not positive effects on immune responses.

INTRODUCTION

Poultry farming has emerged as one of the fastest growing agribusiness industries in the world, even in Bangladesh. Research on meat production globally indicates poultry as the fastest growing livestock sector especially in developing countries. In poultry industry, antibiotic growth promoters (AGP) have been used as a feed additive to enhance gut health and control sub-clinical diseases. There has been growing concern about public health risks resulting from antibiotic resistance, carcinogenic responses and other side effects of the residues in animal products. The extensive use of antibiotic growth promoters in poultry industry has resulted in rapid appearance of resistant forms of microorganisms less sensitive to antibiotics. The most important potential route by which humans become infected with resistant bacteria is via the food chain, of which meat is the most significant source although other animal products, such as milk and eggs may be involved (Hinton, 1988).With increasing public concerns about bacterial resistance to antibiotics, the use of antibiotics in therapeutic or sub-therapeutic doses in poultry feed has been severely limited or eliminated in many countries. Now a day, antibiotics have been banned and thus removed from diets of poultry in many countries. As this may negatively affect the profitability of the poultry, feed industry will have to search for alternatives to those (Khan, *et al.*, 2011).

Synthetic growth enhancers and supplements in poultry nutrition are expensive, usually unavailable and possess adverse effects in bird and human. Sub-therapeutic levels of antibiotics given to poultry as growth enhancer may result to the development of antibiotic-resistant bacteria, which are hazardous to animal and human health (Sarica, *et. al*, 2005). A study was demonstrated that 19 and 81% of the poultry meat and environmental isolates analyzed were resistant to at least one of the following antibiotic molecules testedenrofloxacin, ciprofloxacin, tetracycline and erythromycin (Ma De Cesare, *et al.*, 2002). Possible alternatives to antibiotics may be represented by plant products. Indeed, plant products have been used for centuries as food and medicines. Natural medicinal products made with herbs and spices have also been used as feed additives for poultry (Guo, *et al.*, 2004). Meanwhile, the use of organic supplements such as herbs, are generally believed to be safer, healthier, and less subject to hazards. Thus, herbs and herbal products are incorporated in livestock feeds and water instead of synthetic products in order to stimulate or promote effective use of feed nutrients which result in more rapid gain, higher production and better feed efficiency. Moreover, herbs contain active substances that can improve digestion and metabolism and possess bacterial and immunostimulant activities (Ghazalah and Ali, 2008). Therefore, alternatives to AGP need to be proposed to poultry producers in order to maintain animal health, productivity and carcass quality.

Poultry production in Bangladesh is constrained by the inadequate supply of good quality feed and their escalating costs. Therefore, there is a crucial need for sourcing for other available low cost materials that would substitute the raw materials already in the market. With continuing increase in demand of raw feed materials that will suffice the needs of poultry farmers, demand for extensive search on utilization of the cheap and quality alternative feed sources from plant species is highly increased. The development of the potential plants species as sources of poultry feed additives might not only decrease dependency of AGP as expensive imported inputs but relatively reduces the production cost leading to the poultry farmer's economic efficiency. The numerous uses of *Cinnamon and Black Cumin* as medicine for human have been documented. But for livestock and poultry trace medicinal doses may also works significantly.

Although knowledge has been acquired with regard to the nutrient contents of Cinnamon and Black Cumin through numerous studies, its potential for use as a supplement in the diets of broiler chickens is yet to be explored. Moreover, the effects of its supplementation as an alternative to AGP on the growth performance and different biochemical, pathetical aspects of poultry management practices of broiler chicken are needed to be understood in more comprehensive way so that effective protocol for its feeding in broiler could be established. Thus, the study is proposed to find out the potential use of Cinnamon and Black Cumin as alternatives of antibiotics in broiler production. The findings of performance index, biochemical and pathological report will significantly show the way to reduce the dependency on synthetic antibiotics supplementation for broiler production and thereby, would definitely help the poultry farmers to increase their profit.

MATERIALS AND METHODS

Materials: The experiment was conducted with Cobb-500 broiler strain. For this purpose 360 broiler chicks were purchased from Kazi Hatchery, Gazipur, Dhaka. The experiment was conducted in the month of November and December 2013 for 28 days at SAU farm Poultry. There were six treatments. The number of replications was three. So the total number of replications was 18 units which were randomly selected. Each replication had 10 chicks. Same time two experiment was conducted both for Cinnamon and Black Cumin.

Treatments Description
T1: 0.25 % of cinnamon/ black cumin
T2: 0.50 % of cinnamon/ black cumin
T3: 0.75 % of cinnamon/ black cumin
T4: 1.0 % of cinnamon/ black cumin
T5: Basal Diets + Antibiotics
T6: Control (Basal Diet with no antibiotics or cinnamon/ black cumin)

Brooding: Two electric brooders were used to brood each 180 broiler chicks for one week. Each brooder had one hover having 4 electric bulbs and a round chick guard. Thereafter the chicks were randomly distributed in each replication according to design of the experiments. The recommended brooding temperature was 35 -21^{0}C from 1st to 6th weeks of age. The common brooding was done for one week with four 200 watt electric bulbs to rise up brooder temperature. After one week a 200 watt electric bulb was hanged in every pen up to the marketing age of birds. Moreover, at that time the wall polythene sheet spread over the net-wire to protect the broiler chicks from cold and wind.

Litter materials: Rice husk was used as litter material. Lime powder was mixed with litter. The litter materials were distributed in the 36 experimental units of two experiments. All litter pens were 5 cm in depth. In every week the litter pens were racked to dry. After three weeks extra additional rice husk were spread in all litter pens.

Feeding and watering: Commercial readymade crumble and pellet feeds were used as starter (0-2 wks) and grower (3-4 wks) ration respectively for both experiments. The supplied energy in starter & grower rations was 3000 & 3100 ME Kcal/Kg; the supplied CP% was 22.0 & 21.0 %. *Ad libitum* feeding was allowed for rapid growth of broiler chicks up to the end of the 4 weeks. The dried cinnamon power was mixed with ration as per requirement doses (0.25%, 0.50%, 0.75% and 1.0% cinnamon) of the treatments and similarly black cumin powder was mixed with ration as per requirement doses (0.25%, 0.50%, 0.75% and 1.0% black cumin) of treatments. The antibiotic group chicks were given antibiotics (1g/L ampicillin and 1g/L oxitatracycline) which are practiced in general poultry farming and the control group chicks provided no cinnamon/ black cumin or antibiotics in diet. Fresh clean drinking water also supplied *Ad libitum*. Feeds were supplied 3 times morning, noon & night and water 2 times morning & evening daily. Left over feed was recorded to calculate actual intake. Digital balance was used to take record of feed. All feeders and drinkers were washed and sun dried before starting the trial. One plastic made round feeder and one drinker was kept in the experimental pen in connection with age of broiler chicken. Feeders were washed at the end of the week and drinkers once daily.

Vaccination: Vaccination was used against Infectious Bronchitis, Ranikhet and Gumboro diseases. A composite dose of vaccine against Infectious Bronchitis and Ranikhet was applied to the chicks at day old. Vaccine against Gumboro was applied at 9^{th} and 18^{th} day.

Lighting: At night there was provision of light in the broiler farm to stimulate feed intake and body growth. For first 2 weeks 24 hours light was used. Thereafter 22 hours light and two hour dark was scheduled up to 28 days.

Bio security measures: To keep disease away from the broiler farm recommended vaccination, medication and sanitation program was undertaken in the farm and its premises.

Ventilation: The broiler shed was south facing and open-sided. Due to wire-net cross ventilation it was easy to remove polluted gases from the farm. Besides, on the basis of necessity ventilation was regulated by folding polythene screen.

Data collection

Live weight: The initial day-old live weight and weekly live weight record of each replication was kept to get final live weight record per bird.

Feed consumption: Weekly feed consumption record of each replication was kept to get total feed consumption record per bird up to marketing age.

Mortality record of chicks: Daily death record for each replication was counted up to 28 days of age to calculate mortality.

Blood Collection: Blood sample were collected from each replication to find out blood glucose level (mmol/L), blood cholesterol level (mg/dl) and blood antibody level for Gumboro and Newcastle diseases (sp ratio- SP means ratio of sample & positive control).

Formulae for Calculation different parameters

Following formula were used to find out different parameters-

$$\text{Feed consumption (g/bird)} = \frac{\text{Feed intake in a replication}}{\text{No. of live birds in a replication}}$$

$$\text{Live weight (g/bird)} = \frac{\text{Total live weight in a replication}}{\text{No. of live birds in a replication}}$$

$$\text{Feed Conversion Ratio (FCR)} = \frac{\text{Feed intake (g)/bird in a replication}}{\text{Live weight (g)/bird in a replication}}$$

$$\text{Mortality (\%)} = \frac{\text{No. of death bird in a replication}}{\text{No. of initial birds in a replication}} \times 100$$

Statistical Analysis: Data were analyzed in Randomized Completely Block Design (RCBD 1 factor) for ANOVA table. MSTAT-C computer package program (Russel, 2004) was used for data analysis. Duncan Multiple Comparison Range Tests were done at 5% level of significant. Excel Program was practiced for preliminary data calculation.

RESULTS AND DISCUSSION

Effect of different doses of cinnamon (0.25%, 0.50%, 0.75% and 1.0% cinnamon) and black cumin (0.25%, 0.50%, 0.75% and 1.0% cinnamon) level on broiler performance, biochemical and pathological aspects of poultry management is presented in Table 1 and 2.

Feed consumption (FC)

Cinnamon: Only significant difference ($P<0.05$) in FC was observed in 0.50% (2286g) cinnamon level than 1.0% (2232g) cinnamon level group (Table 1) . But, individually mentioned two treatments showed no significant difference ($P>0.05$) with other treatments. Symeon, *et al.* (2014) reported that cinnamon oil supplementation did not affect feed intake.

Black Cumin: FC was not affected (Table 2) significantly ($P>0.05$) by different treatment groups of black cumin, antibiotics and control group. But, the highest FC was 2311g in 0.75% black cumin group.

The birds of cinnamon level 0.50% and cumin level in 0.75% consumed highest feed. Although FC is one of the indicator of a healthy bird, but without FCR calculation it cannot be concluded which dose is more economic.

Live Weight (LW)

Cinnamon: The height LW was found (Table 1) at cinnamon level 0.75 %(1553g), but showed no significant difference ($P>0.05$) with other treatments of cinnamon, antibiotics and control groups. Symeon, *et al.* (2014) reported that cinnamon oil supplementation did not affect body weight.

Black Cumin: Significant ($P<0.05$) difference was observed (Table 2) in LW among different treatment groups of black cumin, antibiotics and control groups. The height LW (1593g) was found at 0.75 % black cumin level and lowest (1501g) in control group.
Higher or lower LW does not indicate the good or bad performance but FCR indicates the actual growth performance of broiler. For both cinnamon and black cumin, the height LW was found in 0.75 % level compared with control and antibiotic group. Molla, *et al.* (2012) found similar result by using nishyinda, black pepper and cinnamon extract (1 mL/L drinking water).

Feed Conversion Ratio (FCR)

Cinnamon: No significant difference ($P>0.05$) was found among the treatment groups (Table 1). But the best FCR was found in cinnamon level 0.75% (1.47). Symeon, *et al.* (2014) reported that cinnamon oil supplementation did not affect feed conversion ratio.

Black Cumin: Significant ($P<0.05$) difference was observed in FCR among different treatment groups (Table 2). The best FCR (1.44) was found in 0.25% black cumin. No significant ($P>0.05$) difference with other black cumin level and antibiotics. The control group showed worst FCR (1.54) which had no significant ($P>0.05$) difference with other treatments except 0.25% black cumin. Khan *et al.* (2012) reported that feed efficiency significantly improved ($P<0.05$) in broilers fed diets with 2.5 or 5% black cumin seed compared to the 1.25% black cumin seed diet and the controls.

Table 1: Effect of different doses of Cinnamon on broiler performance, biochemical and pathological aspects of poultry management practices

Treatments	General Performance Index				Biochemical Parameters		Pathological Parameters	
	Feed Consu-mption (g)	Live Weight (g)	Feed Convers-ion ratio (FCR)	Mortality (%)	Blood Glucose (mmol / L)	Blood Choleste-rol Level mg/dl	SP Ratio for Gumboro (IBD)	SP Ratio for Newcastle (ND)
Cinnamon (0.25%)	2259^{ab}	1531^{a}	1.48^{a}	0.33^{a}	16.40^{a}	148.8^{c}	0.505^{a}	0.388^{b}
Cinnamon (0.50%)	2286^{a}	1511^{a}	1.51^{a}	0.33^{a}	14.90^{a}	149.0^{c}	0.544^{a}	0.389a^{b}
Cinnamon (0.75%)	2281^{ab}	1553^{a}	1.47^{a}	0.33^{a}	16.33^{a}	150.2b^{c}	0.548^{a}	0.400^{ab}
Cinnamon (1.00%)	2232^{b}	1478^{a}	1.51^{a}	0.67^{a}	16.13^{a}	153.1^{b}	0.568^{a}	0.408^{a}
Antibiotic treated group	2261^{ab}	1483^{a}	1.53^{a}	0.67^{a}	15.00^{a}	158.4^{a}	0.333^{c}	0.148^{c}
Control group	2273^{ab}	1479^{a}	1.54^{a}	1.00^{a}	17.03^{a}	145.1^{d}	0.462^{b}	0.386^{b}
Mean±SE	2265.28 ±14.64	1506.0 ±29.71	1.51 ±0.032	0.556 ±0.29	15.97 ±0.75	150.76 ±1.15	0.497 ±0.0183	0.353 ±0.0058
$LSD_{(0.05)}$	46.14	93.62^{NS}	0.099^{NS}	0.920^{NS}	2.378^{NS}	3.630	0.0575	0.0182

Mean within a column with different superscripts is significantly ($P < 0.05$) different
Mean within a column with same superscripts don't differ significantly ($P > 0.05$)
SE= Standard Error
LSD= Least Significant Difference
NS= Non Significant
In case of IBD, if SP is equal to or greater than 0.2, the sample is positive for IBD antibody
In case of ND, if SP is equal to or greater than 0.35, the sample is positive for ND antibody

Table 2: Effect of different doses of Black Cumin on broiler performance, biochemical and pathological aspects of poultry management practices

Treatments	General Performance Index				Biochemical Parameters		Pathological Parameters	
	Feed Consumpt-ion (g)	Live Weight (g)	Feed Convers ion ratio (FCR)	Morta-lity (%)	Blood Glucose (mmol/ L)	Blood Cholest-erol Level mg/dl	SP Ratio for Gumboro (IBD)	SP Ratio for Newcastle (ND)
Black Cumin (0.25%)	2227^{a}	1544^{ab}	1.44^{b}	0.33^{ab}	14.67^{b}	170^{b}	0.188^{d}	0.155^{c}
Black Cumin (0.50%)	2265^{a}	1493^{b}	1.52^{ab}	0.33^{ab}	15.30^{ab}	171^{b}	0.189^{d}	0.166^{c}
Black Cumin (0.75%)	2311^{a}	1593^{a}	1.45^{ab}	0.00^{b}	14.93^{ab}	172^{b}	0.274^{c}	0.192^{c}
Black Cumin (1.00%)	2279^{a}	1546^{ab}	1.47^{ab}	0.33^{ab}	16.23^{ab}	171^{b}	0.336^{a}	0.274^{b}
Antibiotic group treated	2301^{a}	1515^{b}	1.52^{ab}	0.66^{ab}	15.33^{ab}	180^{a}	0.186^{d}	0.135^{c}
Control group	2306^{a}	1501^{b}	1.54^{a}	1.33^{a}	17.03^{a}	178^{a}	0.316^{b}	0.483^{a}
Mean±SE	2281.67 ±29.36	1532 ±20.17	1.49 ±0.03	0.50 ±0.33	15.58 ±0.63	174 ±0.97	0.25 ±0.005	0.23 ±0.025
$LSD_{(0.05)}$	92.53^{NS}	63.55	0.08	1.05	1.99	3.06	0.001	0.081

Mean within a column with different superscripts are significantly ($P < 0.05$) different
Mean within a column with same superscripts don't differ significantly ($P > 0.05$)
SE=Standard Error
LSD= Least Significant Difference
NS=Non Significant
In case of IBD, if SP is equal to or greater than 0.2, the sample is positive for IBD antibody
In case of ND, if SP is equal to or greater than 0.35, the sample is positive for ND antibody

FCR indicates the real growth performance of broiler. Lower FCR means better performance. Lower FCR indicates the eating of lower feed and gaining of higher body weight. From the results it can be concluded that 0.75% level of cinnamon and 0.25% black cumin showed best FCR. Molla, *et al.* (2012) observed that nishyinda, black pepper and cinnamon extract (1 mL/L drinking water) caused improvement in FCR as compared to control group.

Mortality percentage

Cinnamon: Mortality data showed (Table 1) no significant difference (P>0.05) among them, but highest mortality was observed in control group (1%). Ciftci, *et al.* (2009) and Symeon *et al.* (2014) also reported that cinnamon oil supplementation did not affect mortality of broiler chicken.

Black Cumin: Mortality were affected significantly (P<0.05) by different treatment groups (Table 2). Highest mortality (1.33%) was observed in control group and nil in 0.75% black cumin which showed no significant (P>0.05) difference with other black cumin level and antibiotics.

The analytical results of mortality both for cinnamon and black cumin point out that any dose of can be used for best survivality.

Mortality rates were not significantly different among the treatment groups, as was also demonstrated by Ciftci *et al.* (2009) in broilers fed a cinnamon oil (500–1000ppm) supplemented diet.

Blood glucose

Cinnamon: Blood glucose (mmol/L) data (Table 1) was not affected significantly (P>0.05) by different level of cinnamon doses, antibiotics and control groups, but lowest blood glucose level (14.90 mmol/L) was found in 0.50% cinnamon treated group than control and antibiotic groups. The result agreed with the German researchers (Mang, 2006) who treated 79 patients diagnosed diabetes mellitus type 2 with either a cinnamon extract (3 g of cinnamon powder per day) or a placebo capsule three times a day for 4 months in a double-blind study. They found a moderate beneficial effect of cinnamon extract in reducing fasting plasma glucose concentrations in diabetic patients with poor glycaemic control. However, researchers from Netherlands (Vanschoonbeek *et al.*, 2006) did not found any improvement in glycemic control in patients with type 2diabetes by cinnamon supplementation.

Black Cumin: Blood glucose (mmol/L) data showed significant (P<0.05) difference among the treatments (Table 2). Highest (17.03mmol/L) blood glucose level was found in control group and lowest (14.67mmol/L) in 0.25% black cumin which was insignificant (P>0.05) with other treatment groups.Lower blood glucose level was found in lower cinnamon and black cumin level.

Blood Cholesterol

Cinnamon: Lowest blood cholesterol (145.1mg/dl) was found in control group and highest (158.4 mg/dl) in antibiotic group (Table 1). No significant difference (P>0.05) was found in blood cholesterol (mg/dl) at the level of 0.25%, 0.50% and 0.75% cinnamon. Significantly (P<0.05) decreased blood cholesterol levels were found in cinnamon treated group than antibiotic group. Ciftci, *et al.* (2009) found that supplementing different concentrations of cinnamon oil in diet decreased cholesterol levels of serum and chicken meat.

Black Cumin: Antibiotic (180mg/dl) and control (178mg/dl) groups showed (Table 2) significantly (P<0.05) higher blood cholesterol level than black cumin treatment groups (170-172mg/dl). No significant (P>0.05) difference was observed in blood cholesterol among black cumin treatment groups. Lower doses (0.25% and 0.50%) of cinnamon and black cumin were suitable to keep lower blood cholesterol level.

SP ratio for Gumboro (IBD) disease

Cinnamon: Different doses of cinnamon showed (Table 1) significantly (P<0.05) highest sp ratio for Gumboro disease which is above 0.5 followed by control (0.462) and antibiotic group (0.333). So, all treatment groups are positive for IBD antibody. SP ratios for Gumboro disease were significantly higher (P<0.05) in cinnamon supplementation groups. The result agreed with Ciftci, *et al.* (2009) who cited that cinnamon had positive effects on immune responses.

Black Cumin: SP ratio for IBD showed significant (P<0.05) results (Table 2) among the treatments. The highest sp ratio (0.336) found in 1.0% black cumin followed by control (0.316) and 0.75% black cumin (0.274). The mentioned sp ratio is greater than 0.2, so 1.0% and 0.75% black cumin level are positive for IBD antibody. SP ratio for Gumboro disease were significantly higher (P<0.05) in all cinnamon supplementation groups which had positive effects on immune responses. But, only 1.0% and 0.75% black cumin doses had positive effects on immune responses.

SP ratio for Newcastle disease (ND)

Cinnamon: Antibiotic treated group showed (Table 1) significantly (P<0.05) lowest sp ratio (0.148) than other treatment groups (above 0.35). So, all cinnamon and control group are positive for ND antibody. SP ratios for Newcastle disease were significantly higher (P<0.05) in cinnamon supplementation groups. The result agreed with Ciftci, *et al.* (2009) who cited that cinnamon had positive effects on immune responses.

In this research, significantly (P<0.05) high SP ratios for Newcastle disease were found in treatments cinnamon compared to control. The result agreed with Dessie (1996) and Rahimi *et al.* (2011) who stated that the beneficial effects of herbal extracts or active substances in animal nutrition may include the stimulation of appetite and feed intake, the improvement of endogenous digestive enzyme secretion, activation of immune response, increase antibody level, antioxidant and antihelminthic actions.

Black Cumin: The control group showed (Table 2) significantly (P<0.05) highest sp ratio (0.483) than antibiotic (0.135) group. Except control group the sp ratio of all treatments are less than 0.35 which are not positive for ND antibody. SP ratio for Newcastle disease were significantly higher (P<0.05) in all cinnamon supplementation groups which had positive effects on immune responses. But, black cumin supplementation groups had not positive effects on immune responses.

CONCLUSION

Considering feed consumption results the best common cinnamon and a black cumin dose was 0.50%. For both cinnamon and black cumin, the height LW was found in 0.75 % level. The FCR results indicated that any dose of cinnamon and black cumin can be used for best FCR. The results for mortality showed no significant difference. Considering market price lower dose of cinnamon or black cumin can be used. Lower doses of cinnamon and black

cumin were suitable to keep lower blood glucose and blood cholesterol level. SP ratio for Gumboro disease were significantly higher ($P<0.05$) in all cinnamon supplementation groups which had positive effects on immune responses, whereas higher doses of black cumin showed positive effects on immune responses. SP ratio for Newcastle disease were significantly higher ($P<0.05$) in all cinnamon supplementation groups which had positive effects on immune responses. But, cumin supplementation groups showed negative effects on immune responses.

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