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Research article

EVALUATION OF LOCALLY AVAILABLE HERBS AND SPICES ON PHYSICAL, BIOCHEMICAL AND ECONOMICAL PARAMETERS ON BROILER PRODUCTION

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ABSTRACT: In this study, locally available eleven herbs and spices were selected in broiler diet to evaluate the growth performance, some biochemical and economical parameters of broiler. Different herbs like- cumin, myrobalan, turmeric, garlic, ginger, mushroom, black cumin, coriander, cinnamon, chilli powder and neam leaves were applied on 390 broiler chicks. A basal diet was supplemented with 1g/L antibiotic (positive control), 0g antibiotic (negative control), 1% dose of concentration of cumin, myrobalan, turmeric, garlic, ginger, mushroom, black cumin, coriander, cinnamon, chilli powder and neam leaves. At the age of 28 days, the FCR value of chilli powder, cinnamon, antibiotics, and black cumin were better (lower) than control. Significantly higher ($p<0.05$) dressing percentage was found in black cumin compared to the control. In this research, black cumin, cinnamon and antibiotics were showed significantly ($p<0.05$) lower blood glucose level than control. At 28 days of age, blood cholesterol was significantly lower ($p<0.05$) in neam leaves and black cumin than antibiotics and control. All treatments were significantly ($p<0.05$) higher antibody SP ratio for Gumboro disease compared to the control. Black cumin and cinnamon were significantly ($p<0.05$) higher antibody SP ratio for Newcastle disease compared to the antibiotics and control. All treatments were found significantly lower ($p<0.05$) *E. coli* population than the control. In this research cinnamon, antibiotics, black cumin and chilli were significantly ($p<0.05$) more profitable compared to the control. In conclusion, 1% black cumin, 1% cinnamon and 1% chilli powder were significantly ($p<0.05$) better for FCR, body growth, cholesterol level, sugar level in blood, immunity level, cecal microbial population, profit per bird, benefit cost ratio and can be used as good alternative of antibiotics in broiler diet.
Key words: Herbs, spices, antibiotics, profitable, broiler

INTRODUCTION

Antibiotics are widely used as therapeutic agents and also as growth promoters in poultry production all over the world. There has been growing concerm about public health risks resulting from antibiotic resistance, carciongenic 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. 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 tested- enrofloxacin, ciprofloxacin, tetracycline and erythromycin [12]. The population of antibiotic-resistant becteria, which was established during the time when antibiotics were used routinely, has survived from generation to generation for over 60 years even in the absence of antibiotic exposure [11]. 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 [7]. 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 [10]. 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 [5].

Antibiotics have residue effect. So, it can easily enter in human body through meat and egg. It is the threat for public health. Therefore, the purpose of the study was to investigate the effect of herbs and spices as antibiotics alternatives on performance, blood parameters, microbial population and profit of broilers.

MATERIALS AND METHODS

The study was conducted at Sher-e-Bangla Agricultural University Poultry farm, Dhaka, Bangladesh. Locally available eleven herbs and spices were selected and they were cumin (*Cuminum cyminum)*, myrobalan (*Terminalia chebula)*, turmeric (*Curcuma longa)*, garlic (*Allium sativum*), ginger (*Zingiber officinale*), mushroom (*Agaricus bisporus)*, black cumin (*Nigella sativa*), coriander (*Coriandrum sativum* L.), cinnamon (*Cinnamomum verum)*, chilli (*Capsicum annuum)* and neam leaves (*Azadirachta indica)*. About 390 "Cobb-500" strain day old broiler chicks were collected and divided into treatment groups 1 to 13, each having 30 birds. The chicks of treatment groups 1 to 11 were respectively treated with 1% dose concentration of cumin, myrobalan, turmeric, garlic, ginger, mushroom, black cumin, coriander cinnamon, chilli, neam leaves. Cumin, myrobalan, turmeric, ginger, black cumin, coriander, cinnamon, chilli and neam leaves were sun dried and grinding before mix with basal feed. Only raw garlic and mushroom were made pest due to protect their biochemical properties. The chicks of treatment group 12 were given antibiotics (1g/L ampicillin and 1g/L oxitatracycline), dose are practiced in general poultry farming. The chicks of treatment group 13 were maintained an untreated control i.e. no herbs and spices or antibiotics were utilized in control diet. For proper handling and data collection, the chicks of each treatment group were divided into three replications and in each replication there were 10 birds. Different managemental practices were followed like- brooding of baby chicks, adlibitum of feeding and drinking, 23 hours lighting, proper ventilation, vaccination and proper sanitation. After 28 days of nursing and feeding data were collected for the following parameters: feed intake (g), live weight (g), feed conversion ratio, blood antibody level (sp ratio- SP means ratio of sample & positive control), blood glucose level (mmol/L), blood cholesterol level (mg/dl), dressing percentage, *E. coli* present in cecum (nos.), profit per bird (TK) (1$=78TK) and benefit-cost ratio (total income/total cost of production). Means, standard errors (SE), coefficients of variation (CV), least significant difference (LSD) value of different parameters were analyzed in factorial experiment with randomized completely block design (RCBD) for ANOVA table by using MSTAT-C computer package program [20].

The composition of basal diet in different periods of experiments and their calculated chemical analysis are shown below:

Ingredients %	**1-2 weeks**	**3-4 week**
Yellow corn	58	64
Soybean meal (45%)	34	27
Fish meal	5	5
Methionine	0.15	0.15
Lysine	0.1	0.1
Vitamin-mineral premix*	0.25	0.25
Soybean oil	2	3
Salt	0.5	0.5
Calculated chemical analysis of the diet		
ME (Kcal/kg)	2989	3109
Crude protein (%)	22.07	21.11
Calcium (%)	0.80	0.95
Lysine	1.05	0.98
Methionine	0.55	0.43
Methionine+cystine	0.80	0.75

*Provided per kilogram of diet:

Vitamins

Vitamin A-12,500IU, Vitamin D3- 2,500IU, Vitamin E- 20mg, Vitamin K3- 4mg, Vitamin B1- 2.5mg, Vitamin B2- 5mg, Vitamin B6- 4mg, Nicotinic acid- 40mcg, Pantothenic acid- 12.5mg, Vitamin B12- 12mcg, Folic acid- 0.8mg, Biotin- 0.1mg

Minerals

Cobalt- 0.4 mg, Copper 10mg, Iron 40mg, Iodine- 0.4mg, Manganese- 60mg, Zinc- 50mg, Selenium- 0.15mg, Di-Calcium-Phosphate- 0.38gm

Others

DL-Methionine- 100mg, L-Lysine- 60mg, Zinc-bacitracin- 4mg, Anti-Oxidant- 5mg, Carrier (lime stone)- 2.5g

RESULTS

Physical Parameters

Physical parameters are feed intake (FI), body weight (BW), feed conversion ratio (FCR) and dressing percentage (DP). Data of FI, BW, FCR and DP are presented in Table- 1. Significantly higher ($p<0.05$) FI was found in treatment ginger (2841.67±212.19g) compared to control (2623.57±8.40g). No significant difference ($p<0.05$) of BW and FCR was found (Figure A). DP of treatments black cumin (75.21±1.019%) and chilli (73.57±1.079%) were significantly higher ($p<0.05$) than control (68.26±0.872%).

Table 1. Effect of herbs, spices and antibiotics on different physical aspects of poultry management practices

Treatments	Physical Parameters		
	Average Feed intake (g) ±SE	**Average Body wt. (g) ±SE**	**Average Dressing % ±SE**
Cumin	2629.07±3.49^{b}	1550.30±20.82^{ab}	70.68±0.183^{abc}
Myrobalan	2624.60±7.17^{b}	1549.97±45.09^{ab}	71.00±2.106^{abc}
Turmeric	2607.23±4.84^{b}	1533.23±8.82^{ab}	70.36±0.488^{abc}
Garlic	2627.93±2.65^{b}	1553.40±21.86^{a}	71.65±0.913^{abc}
Ginger	2841.67±212.19^{a}	1604.43±54.64^{a}	71.46±0.123^{abc}
Mushroom	2624.07±2.08^{b}	1443.27±48.42^{b}	70.23±1.239^{bc}
Black cumin	2629.47±5.84^{b}	1580.00±23.09^{a}	75.21±1.019^{a}
Coriander	2641.57±5.79^{b}	1579.93±30.55^{a}	72.77±1.873^{abc}
Cinnamon	2606.30±11.86^{b}	1593.50±14.53^{a}	71.98±0.820^{abc}
Chilli	2595.33±3.84^{b}	1603.30±40.96^{a}	73.57±1.079^{ab}
Neam leaves	2593.67±14.63^{b}	1530.10±35.12^{ab}	70.53±3.219^{abc}
Antibiotics	2636.30±6.05^{b}	1610.23±20.82^{a}	71.46±0.761^{abc}
Control	2623.57±8.40^{b}	1510.10±36.06^{ab}	68.26±0.872^{c}
CV%	**3.85**	**3.67**	**3.47**
LSD (0.05)	**171.20**	**96.26**	**4.18**

Mean with different superscripts within the same column are significantly different ($p<0.05$)

Biochemical Parameters

Biochemical parameters are blood glucose level (BGL), blood cholesterol level (BCL), sp ratio of Gumboro disease (SPG), sp ratio of Newcastle disease (SPN) and *E. coli*. populations in cecum contents (ECP). The degree of BGL, BCL, SPG, SPN and ECP are presented in table 2. Feeding antibiotics, cinnamon and black cumin resulted in 14.97±0.463 mmol/L, 15.43±0.406 mmol/L and 15.53±0.285 mmol/L BGL which were significantly more reduction ($p<0.05$) of BGL from the control (19.3±0.586 mmol/L). BCL was significantly lower ($p<0.05$) in chilli (120.70±5.925 mg/dl), black cumin (127.67±7.535 mg/dl), neam leaves (135.17±4.256 mg/dl), antibiotic (149.40±2.963 mg/dl), cinnamon (156.17±2.848 mg/dl), coriander (160.17±3.528 mg/dl) and garlic (163.27±3.844 mg/dl) compared to control (176.57±4.041 mg/dl). SPG varied ($p<0.05$) greatly according to different herbs in broiler diets. SPG of treatments cumin (1.054±0.170), myrobalan (1.032±0.179), turmeric (1.248±0.260), garlic (1.220±0.230), ginger (1.221±0.613), mushroom (1.269±0.188), black cumin (1.318±0.100), coriander (1.137±0.130), cinnamon (1.380±0.112), chilli (1.334±0.289) and neam leaves (1.205±0.216) were significantly higher ($p<0.05$) than control (0.425±0.022). SPN of treatments turmeric (0.532±0.041), garlic (0.894±0.026), ginger (0.783±0.039), mushroom (0.539±0.027), black cumin (1.068±0.032), coriander (0.519±0.034), cinnamon (0.998±0.054), chilli (0.775±0.033), neam leaves (0.712±0.042) and antibiotics (0.655±0.030) were significantly higher ($p<0.05$) than control (0.336±0.030). ECP per g in cecum contents of broiler chicken of all treatments were significantly lower ($p<0.05$) than the control.

Economical Parameters

Economical parameters are profit per broiler (PPB) and benefit cost ratio (BCR). The data of PPB and BCR are presented in Table 3. Cinnamon (48.51±5.667 TK), antibiotic (48.49±2.986 TK), black cumin (46.28±3.048 TK) and chilli (46.17±5.667 TK) were significantly higher ($p<0.05$) profit than control (41.95±5.288 TK). The treatments of garlic (1.27±0.21), ginger (1.28±0.26), black cumin (1.29±0.21), cinnamon (1.29±0.23), chilli (1.28±0.19) and antibiotics (1.27±0.26) were significantly higher BCR ($p<0.05$) compared to control (1.25±0.28).

Table 2. Effect of herbs, spices and antibiotics on different biochemical aspects of poultry management practices

Treatments	Biochemical Parameters				
	Average Blood Glucose Level ±SE (mmol/L)	Average Blood Cholesterol Level ±SE (mg/dl)	SP Ratio for Gumboro (IDB) Disease±SE	SP Ratio for Newcastle (ND) Disease±SE	Average *E.coli* per g Cecum Contents ±SE
Cumin	18.23±0.491^{abcd}	177.63±1.764^{a}	1.054±0.170^{a}	0.343±0.039^{f}	391X10^{4}±23.116^{b}
Myrobalan	17.17±0.318^{d}	172.47±1.764^{ab}	1.032±0.179^{a}	0.398±0.035^{f}	47X10^{4}±14.978^{f}
Turmeric	19.63±0.517^{a}	176.73±2.848^{a}	1.248±0.260^{a}	0.532±0.041^{e}	363X10^{4}±57.981^{b}
Garlic	17.67±0.617^{bcd}	163.27±3.844^{bcd}	1.220±0.230^{a}	0.894±0.026^{b}	273X10^{4}±27.538^{c}
Ginger	16.83±0.517^{de}	168.80±4.256^{abc}	1.221±0.613^{a}	0.783±0.039^{c}	123X10^{4}±9.615^{e}
Mushroom	18.10±0.551^{abcd}	174.73±2.028^{ab}	1.269±0.188^{a}	0.539±0.027^{e}	32X10^{4}±4.583^{f}
Black cumin	15.53±0.285^{ef}	127.67±7.535^{fg}	1.318±0.100^{a}	1.068±0.032^{a}	123X10^{4}±4.807^{e}
Coriander	17.60±0.153^{cd}	160.17±3.528^{cde}	1.137±0.130^{a}	0.519±0.034^{e}	197X10^{4}±10.088^{d}
Cinnamon	15.43±0.406^{ef}	156.17±2.848^{de}	1.380±0.112^{a}	0.998±0.054^{ab}	26X10^{4}±6.692^{f}
Chilli	18.00±0.624^{abcd}	120.70±5.925^{g}	1.334±0.289^{a}	0.775±0.033^{c}	55X10^{4}±3.756^{f}
Neam leaves	19.37±0.762^{ab}	135.17±4.256^{f}	1.205±0.216^{a}	0.712±0.042^{cd}	237X10^{4}±4.583^{cd}
Antibiotics	14.97±0.463^{f}	149.40±2.963^{e}	0.943±0.177^{ab}	0.655±0.030^{d}	40X10^{4}±4.055^{f}
Control	19.30±0.586^{abc}	176.57±4.041^{a}	0.425±0.022^{b}	0.336±0.030^{f}	573X10^{4}±27.185^{a}
CV%	**5.16**	**4.09**	**27.72**	**9.41**	**19.74**
LSD (0.05)	**1.52**	**10.91**	**0.5302**	**0.1066**	**63.42**

Mean with different superscripts within the same column are significantly different ($p<0.05$)
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 3. Effect of herbs, spices and antibiotics on different economical aspects of poultry management practices

Treatments	Economical Parameters	
	Average Profit/Bird (TK) ±SE	Benefit Cost Ratio ±SE
Cumin	36.84±3.012^{d}	1.20±0.18^{c}
Myrobalan	42.26±6.041^{c}	1.24±0.22^{b}
Turmeric	36.68±1.295^{d}	1.21±0.13^{c}
Garlic	46.02±3.155^{bc}	1.27±0.21^{a}
Ginger	45.60±0.709^{bc}	1.28±0.26^{a}
Mushroom	22.11±6.835^{e}	1.12±0.11^{d}
Black cumin	46.28±3.048^{ab}	1.29±0.21^{a}
Coriander	45.86±4.241^{bc}	1.26±0.19^{ab}
Cinnamon	48.51±5.667^{a}	1.29±0.23^{a}
Chilli	46.17± 5.667^{ab}	1.28±0.19^{a}
Neam leaves	45.83±4.446^{bc}	1.26±0.25^{ab}
Antibiotics	48.49±2.986^{a}	1.27±0.26^{a}
Control	41.95±5.288^{c}	1.25±0.28^{b}
CV%	**18.19**	**15.53**
LSD (0.05)	**13.11**	**0.38**

Mean with different superscripts within the same column are significantly different ($p<0.05$)

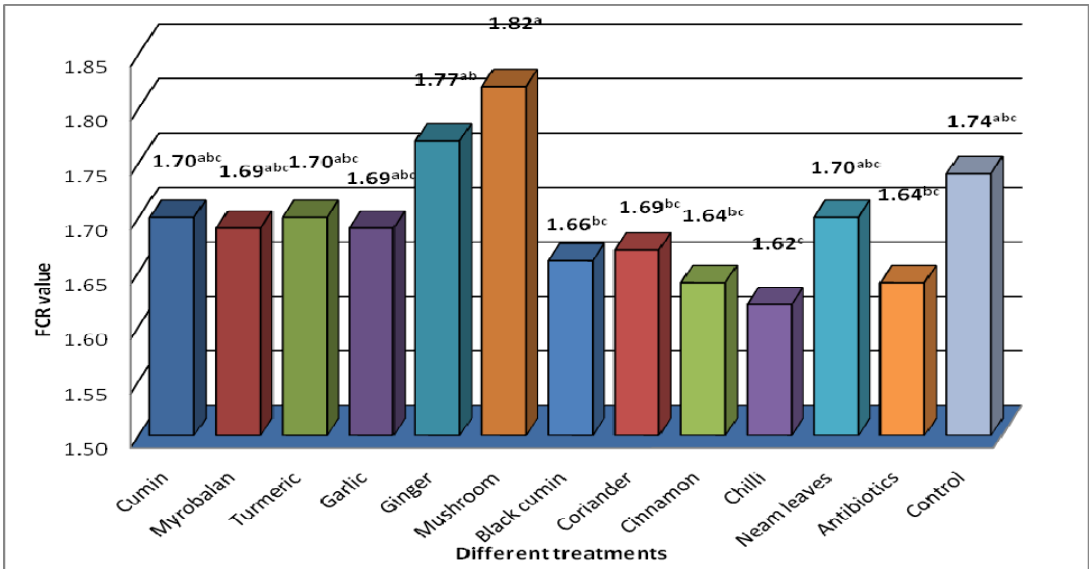

Figure A: FCR of different treatment groups
(Different superscripts are significantly different; p<0.05; CV%= 4.06; LSD value= 0.12)

DISCUSSION

Physical Parameters

Higher or lower FI and BW do not indicate the good or bad performance but FCR indicates the actual growth performance of broiler. Lower FCR means better the performance. Lower FCR which indicates that taking lower feed intake and their body weight gain is higher. Among the thirteen treatments better FCR was found in the treatment chilli followed by cinnamon and black cumin compared to the control. There is no evidence that FCR is correlated with chilli. But scientists found that nishyinda, black pepper and cinnamon extract 1 mL/L drinking water caused significant increase in live body weight, improvement in weight gain and FCR as compared to control group [14]. Feed efficiency significantly improved ($p<0.05$) in broilers fed diets with 2.5 or 5% black cumin seed (BCS) compared to the 1.25% BCS diet and the controls [9].

Significantly ($p<0.05$) higher DP was found in treatment of black cumin compared to the control. Most of the scientists are not agree with finding of this result. They concluded that supplementation with black cumin seed did not have significantly affect carcass characteristics [1, 6, 22]. On the contrary, Guler [4] reported that black cumin seed extract significantly affected carcass characteristics.

Biochemical Parameters

Among the all treatment groups, birds that received antibiotics showed significantly ($p>0.05$) lower BGL followed by cinnamon and black cumin than control. These result agreed with Rauf [17] who showed that antibiotics reduced blood glucose level in human body. Khan [8] who found that investigational uses of cinnamon bark include use as a hypoglycemic agent. But disagreed with other scientists who recorded that non significant effect for *N. sativa* on glucose level was found [22]. Significantly lower ($p<0.05$) BCL was found in treatment chilli followed by black cumin than control. This was similar to the findings of Power [15] who showed that chilli also found to reduce LDL cholesterol levels in obese persons. *N. sativa* significantly decreased serum levels of cholesterol and triglyceride [1], while Toghyani [22] found that serum triglyceride and total cholesterol concentrations were not significantly affected by supplementation of *N. sativa*.

In this research, significantly ($p<0.05$) high SPG was found in treatments cumin, myrobalan, turmeric, garlic, ginger, mushroom, black cumin, coriander, cinnamon, chilli and neam leaves compared to control. The result agreed with some scientist 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 [3, 16]. SPN was found significantly ($p<0.05$) high in the treatments of black cumin followed by cinnamon compared to control. Al-Beitawi [2] showed that adding crushed black cumin seed instead of bacitracin to broiler diets increased antibody titre against Newcastle disease. Similarly, Toghyani [22] reported that increasing the level of black seed in the diet improved the immune response of chicks. The bacterial effect of herbs as observed in this work was surprising. The difference of bacterial population between control to other groups were very much dintinct. *E. coli* population was significantly ($p<0.05$) lower in all treatments compared to control. Researchers are agree with the findings, they found that some plants and herbs have bactericidal and bacteriostatic aspects [13, 18, 19].

Economical Parameters

Significantly higher ($p<0.05$) PPB was found in the treatment of cinnamon followed by antibiotics, black cumin and chilli powder than control. There is no evidence about cinnamon and chilli as profitable feed suppliment for broiler production but Soliman [21] found that 10% black cumin seed meal inclusion level is economically more profitable than that of the control diet in Tilapia fish. Black cumin and cinnamon were found significantly higher ($p<0.05$) BCR followed by chilli and mushroom than control.

CONCLUSION

The result obtained from this study showed that 1% black cumin, 1% cinnamon and 1% chilli powder is profitable feed supplement and can be used as good alternative of antibiotics in broiler diet. Thus, the use of antibiotics in boilers should be discouraged as they can be replaced by black cumin or cinnamon or chilli powder. Moreover, the dietary supplementation of chilli powder and black cumin may lead to the development of low-cholesterol chicken meat as demanded by health-conscious consumers.

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