Evaluation of Suitable Doses of Hot Chilli Powder as Effective Alternative of Antibiotics on Growth Performance of Broiler

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ABSTRACT

In this study, chicks were treated with different doses of chilli powder to evaluate the physical, biochemical, pathological and economical parameters of broiler. Chilli powder was applied on 480 broiler chicks. A basal diet was supplemented with 1g/L antibiotic (positive control), 0g antibiotic (negative control), 0.5, 1.0, 1.5, 2.0, 2.5 and 3.0% chilli powder. At the age of 28 days, the feed conversion ratio of 2.0% and 2.5% chilli powder was found lower as compared to antibiotic and control. There was no negative impact found on dressing percentage of broilers which was tested by different doses of chilli powder. In this research, significant ($P<0.05$) higher blood glucose level was found in chilli powder as compared with antibiotics. Blood cholesterol was significantly lower ($P<0.05$) in 2.0%, 2.5%, 3.0% chilli powder as compared with antibiotics. SP ratio for Gumboro and Newcastle disease of 2.0%, 2.5%, 3.0% chilli powder were significantly ($P<0.05$) higher as compared to the antibiotics. *E. coli* population of all treatments were significantly ($P<0.05$) lower as compared to control. In economic point of view, 2.0% chilli powder was found more profitable as compared to antibiotics. Considering all the results of the present experiments, it may be concluded that poultry farmers may use 2.0% chilli powder with broiler feed as safe alternative of the traditional antibiotics and they may get more profit rather than antibiotics. Moreover, the 2.0% dietary supplementation of chilli powder may lead to the development of low-cholesterol chicken meat and may fulfill the demanded of meat for health-conscious consumers.

Key words: Chilli, Antibiotics, Profitable, Broiler

INTRODUCTION

Antibiotics are widely used as therapeutic agents and also as growth promoters in poultry production all over the world. In Bangladesh, alongside only few big poultry farms, there are many small farms. There are reports that these poultry farmers are using antibiotics indiscriminately without following any recommendations of recognized organization. Recently, there has been a growing concern about the public health risks resulting from the antibiotic resistance, carcinogenic responses and many other side effects of the residues in poultry products.

Now a day, people are demanding organic or antibiotics free poultry products. That is why, researchers are trying hard to find out effective alternatives of the antibiotics. Many resent researches have indicated that the antibiotic growth promoters can be replaced by alternatives such as probiotics, organic acids, enzymes and the natural medicinal products, such as herbs, spices and other related botanicals.

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 (Ma De Cesare, *et al.,* 2002). 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 (Langlois, *et al.,* 1986). 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).

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). 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). Chilli, the spicy fruit of plants in the genus *Capsicum*, scientific name is *Capsicum annuum*, chillies come in scores of varieties and colours (from green through to yellow, orange and red) and are one of the most popular spices in the world. Chillies can be used fresh, dried or powdered, and the level of heat varies from type to type, from as a general rule- the smaller the chilli, the hotter the taste. The substance that generates the heat is called capsaicin, which is found mainly in the pith and the seeds. There are antibacterial (Milind and Kaura, 2012) and antibody producing character (Whfoods, 2013) present in chilli powder, which is already proven in human body. Power (2013) mentioned that scientific studies on experimental mammals suggest that capsaicin has anti-bacterial, anti-carcinogenic, analgesic and anti-diabetic properties. Chicken has no test buds in tongue, so hot chilli powder supplement can be used in broiler died.

Antibiotics have residue effect. Therefore, 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 different doses of chilli powder as antibiotics alternatives on physical, biochemical, pathological and economical parameters of broiler.

MATERIALS AND METHODS

The study was conducted at Sher-e-Bangla Agricultural University Poultry farm, Dhaka, Bangladesh. About 480 “Cobb-500” strain day old broiler chicks were collected and divided into treatment groups 1 to 8. The chicks of each treatment group were further divided in the form of 4 replications each having 15 birds. The chicks of treatment group 1 to 6 were respectively treated with 0.5, 1.0, 1.5, 2.0, 2.5 and 3.0% of chilli powder (*Capsicum annuum)*. The chicks of treatment group 7 were given antibiotics (1g/L ampicillin and 1g/L oxitatracycline) and group 8 were maintained an untreated control i.e. no herbs and spices or antibiotics were utilized in control diet. 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 for Gumboro and Newcastle diseases (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 per g of caecal contents (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 (Russel, 2004). Duncan Multiple Range Tests (DMRT) was done at 5% level of significance.

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 AND DISCUSSION

Physical Parameters

The different physical parameters are feed intake (FI), body weight (BW), feed conversion ratio (FCR) and dressing percentage (DP). The data of FI, BW and DP are presented in table 1.

FI: There was no significantly difference (P>0.05) of FI among the treatments. Higher or lower FI or BW doesn't indicate the good or bad performance but FCR indicates the actual growth performance of broiler. There is no evidence or literature found about chilli powder

effects on FI for broiler production. However, literature related with human was found by Westerterp-Plantenga *et al.* (2004) who stated both oral and gastrointestinal exposure to capsaicin increases satiety and reduces energy as well as fat intake. This leads to a decrease in appetite as well as a decrease in food intake (Lejeune *et al.*, 2003).

BW: Significantly higher (P<0.05) BW was found at 2.0% (1774.17±08.21g), 2.5% (1750.00±23.09g), 3.0% (1753.33±43.72g) doses of chilli powder and antibiotics (1779.17±05.07g) as compared with the control (1666.67±14.53g). Atapattu and Belpagodagamage (2010) found that the birds fed 5% chilli powder gave higher (P<0.05) live weight on day 49 and weight gain from day 30-49, compared to control group. However, literature related with human was found by Diepvens *et al.* (2006), who observed that oral exposure proves to yield stronger reduction suggesting that capsaicin has sensory effects. Short-term studies suggested that capsaicin aids in the decrease of weight regain. However, long-term studies were limited because of the pungency of capsaicin. Lejeune *et al.* (2003) found that there is no evidence showing that weight loss was directly correlated with ingesting capsaicin, but there was a positive correlation between ingesting capsaicin and a decrease in weight regain.

Table 1: Effect of different doses of chilli powder on physical aspects of poultry management practices

Doses	**Physical Parameters**		
	Feed Intake (g) ±SE	**Body Wt. (g) ±SE**	**Dressing% ±SE**
0.5%	2670.00±06.51^{a}	1666.67±46.67^{b}	73.62±0.43^{a}
1.0%	2670.67±01.56^{a}	1713.33±35.28^{ab}	73.06±0.41^{a}
1.5%	2650.73±22.20^{a}	1705.00±22.91^{ab}	73.02±0.52^{a}
2.0%	2659.07±18.09^{a}	1774.17±08.21^{a}	72.82±0.23^{a}
2.5%	2592.07±86.21^{a}	1750.00±23.09^{a}	72.92±1.04^{a}
3.0%	2670.60±06.43^{a}	1753.33±43.72^{a}	72.95±0.80^{a}
Antibiotics	2679.40±09.02^{a}	1779.17±05.07^{a}	72.96±0.55^{a}
Control	2674.20±19.61^{a}	1666.67±14.53^{b}	72.34±0.78^{a}
CV%	**2.14**	**2.23**	**1.45**
LSD (0.05)	**99.55**	**67.45**	**1.852**

- ✓ Mean with different superscripts are significantly different (P<0.05)
- ✓ Mean within same superscripts don't differ (P>0.05) significantly
- ✓ SE= Standard Error, CV= Coefficient of Variation, LSD= Least Significant Difference
- ✓ Each data represents average of 30 birds
- ✓ Antibiotic was used as 1g/L ampicillin and 1g/L oxitetracycline

FCR: Lower FCR means higher the performance. Lower FCR, which indicates that taking lower feed intake and their body weight gain is higher. Better FCR was found in treatment 2.0% and 2.5% doses of chilli powder which were significantly lower (P<0.05) than control (Figure-1). There was no significantly difference (P>0.05) at 0.5%, 1.0%, 1.5%, 3.0% doses of chilli powder and antibiotics from the control. The result was similar with Atapattu and Belpagodagamage (2010) who showed that FCR of the broilers fed 5% chilli powder (2.14) was 6% better than that of the control birds.

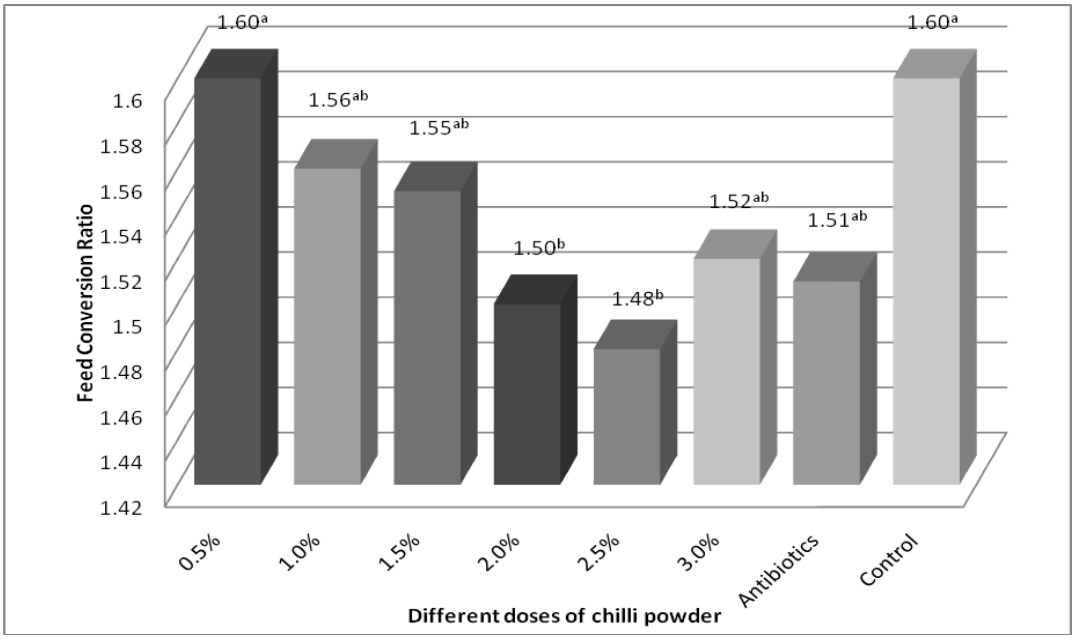

Figure 1: Feed conversion ratio of different treatment groups
(Different superscripts are significantly different; P<0.05; CV%= 3.46; LSD value= 0.09

DP: No significantly difference (P>0.05) of DP was found among the treatments. This finding was related with Atapattu and Belpagodagamage (2010), who stated that DP were not affected by the dietary chilli powder in broiler ration.

Biochemical Parameters

The different biochemical parameters are blood glucose level (BGL) and blood cholesterol level (BCL) of broiler. The degree of BGL and BCL are given in table 2.

BGL: The degree of BGL was reduced at the marketing age of broiler varied with different treatment groups. The dose at 1.5% (17.03±0.68 mmol/L) chilli powder and antibiotics (14.43±0.29 mmol/L) were significantly more reduction (P<0.05) of BGL as compared with the control (18.37±0.39 mmol/L). Power (2013) mentioned that scientific studies on experimental mammals suggest that capsaicin has anti-bacterial, anti-carcinogenic, analgesic and anti-diabetic properties.

BCL: BCL was significantly lower (P<0.05) at 0.5% (164.33±1.76 mg/dl), 1.0% (156.67±0.88 mg/dl), 1.5% (145.67±1.45 mg/dl), 2.0% (134.00±1.53 mg/dl), 2.5% (135.00±0.58 mg/dl), 3.0% doses (135.67±1.20 mg/dl) doses of chilli powder and antibiotics (169.33±4.10 mg/dl) as compared with control (188.00±1.16 mg/dl). Atapattu and Belpagodagamage (2010) showed that serum cholesterol levels of the broilers fed 1% chilli powder were significantly lower than those of the birds fed either 0 or 5% dietary chilli powder. Similar findings were reported by Power (2013) who showed that chilli also found to reduce LDL cholesterol levels in obese persons.

Table 2: Effect of different doses of chilli powder on biochemical aspects of poultry management practices

Doses	Biochemical Parameters	
	Blood Glucose Level mmol/L±SE	Blood Cholesterol Level mg/dl ±SE
0.5%	17.83±0.18^{ab}	164.33±1.76^{b}
1.0%	18.13±0.15^{ab}	156.67±0.88^{c}
1.5%	17.03±0.68^{b}	145.67±1.45^{d}
2.0%	18.63±0.55^{a}	134.00±1.53^{e}
2.5%	17.90±0.35^{ab}	135.00±0.58^{e}
3.0%	18.00±0.64^{ab}	135.67±1.20^{e}
Antibiotics	14.43±0.29^{c}	169.33±4.10^{b}
Control	18.37±0.39^{a}	188.00±1.16^{a}
CV%	**3.27**	**2.18**
LSD (0.05)	**1.003**	**5.860**

- ✓ Mean with different superscripts are significantly different (P<0.05)
- ✓ Mean within same superscripts don't differ (P>0.05) significantly
- ✓ SE= Standard Error, CV= Coefficient of Variation, LSD= Least Significant Difference
- ✓ Each data represents average of 30 birds
- ✓ Antibiotic was used as 1g/L ampicillin and 1g/L oxitetracycline

Pathological Parameters

The different pathological parameters are sp ratio of Gumboro disease (SPG), sp ratio of Newcastle disease (SPN) and *E. coli* populations in cecum (EPC) contents of broiler. The data fo SPG, SPN and EPC are presented in table 3.

SPG: Gumboro disease is one of the most common threats for poultry industry in Bangladesh. If SP ratio (ratio of sample and positive control) of gumboro disease rises in the blood of bird then bird will be safer from the gumboro disease. SPG of treatments 1.5% (0.442±0.030), 2.0% (2.487±0.038), 2.5% (2.573±0.049), 3.0% (2.594±0.100) doses and antibiotics (0.296±0.009) were significantly higher (P<0.05) as compared with control (0.151±0.006). Power (2013) found that chillis are also good in other antioxidants like vitamin A, and flavonoids like *ß-carotene, α-carotene, lutein, zea-xanthin, and cryptoxanthin*, these antioxidant substances in capsicum help to protect the body from injurious effects of free radicals generated during stress, diseases conditions. Whfoods (2013) cited that chilli peppers' bright red color signals its high content of beta-carotene or pro-vitamin-A. Just two teaspoons of red chilli peppers provide about 6% of the daily value for vitamin C coupled with more than 10% of the daily value for vitamin-A. Often called the anti-infection vitamin, vitamin-A is essential for healthy mucous membranes, which line the nasal passages, lungs, intestinal tract and urinary tract and serve as the body's first line of defense against invading pathogens. Fresh chilli peppers, red and green, are rich source of vitamin-C. 100 g fresh chillies provide about 143.7 µg or about 240% of RDA. Vitamin-C is a potent water-soluble antioxidant. It is required for the collagen synthesis in the body. Collagen is the main structural protein in the body required for maintaining the integrity of blood vessels, skin, organs, and bones. Regular consumption of foods rich in vitamin-C helps

the body protect from scurvy; develop resistance against infectious agents (boosts immunity) and scavenge harmful, pro-inflammatory free radicals from the body (Power, 2013).

Table 3: Effect of different doses of chilli powder on pathological aspects of poultry management practices

Doses	Pathological Parameters		
	SP Ratio for Gumboro (IBD) Disease ±SE	**SP Ratio for Newcastle (ND) Disease ±SE**	***E. coli* per g of Cecum Contents ±SE**
0.5%	0.195 ± 0.005^{cd}	0.015 ± 0.001^{e}	$84X104\pm0.12^{b}$
1.0%	0.193 ± 0.012^{cd}	0.077 ± 0.002^{d}	$85X104\pm1.18^{b}$
1.5%	0.442 ± 0.030^{b}	0.088 ± 0.006^{d}	$48X104\pm1.32^{c}$
2.0%	2.487 ± 0.038^{a}	0.372 ± 0.013^{ab}	$32X104\pm0.92^{d}$
2.5%	2.573 ± 0.049^{a}	0.475 ± 0.026^{a}	$33X104\pm1.28^{d}$
3.0%	2.594 ± 0.100^{a}	0.460 ± 0.021^{a}	$30X104\pm1.74^{d}$
Antibiotics	0.296 ± 0.009^{c}	0.376 ± 0.019^{b}	$27X104\pm1.77^{d}$
Control	0.151 ± 0.006^{d}	0.147 ± 0.002^{c}	$179X104\pm2.01^{a}$
CV%	**6.46**	**10.71**	**129.31**
LSD (0.05)	**0.124**	**0.055**	**78.23**

- ✓ Mean with different superscripts are significantly different (P<0.05)
- ✓ Mean within same superscripts don't differ (P>0.05) significantly
- ✓ SE= Standard Error, CV= Coefficient of Variation, LSD= Least Significant Difference
- ✓ 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
- ✓ Bio-Check IBD and ND antibody detection ELISA kit were used
- ✓ SP means ratio of sample & positive control
- ✓ Each data represents average of 30 birds
- ✓ Antibiotic was used as 1g/L ampicillin and 1g/L oxitetracycline

SPN: Another name of Newcastle disease is "Ranikhat" disease. It is also a harmful disease for poultry industry. SPN of treatments at 2.0% (0.372±0.013), 2.5% (0.475±0.026), 3.0% (0.460±0.021) doses of chilli powder and antibiotics (0.376±0.019) were significantly higher (P<0.05) than control (0.147±0.002). This was not directly similar to the findings of Moreki (2006), however Moreki did research with other disease, who stated that traditional herbs and chilli pepper are used to treat chicken diarrhoea and fowl pox in Uganda.

EPC: *E. coli* bacteria is one of the major threats for poultry farming. The results of experiments on effect of chilli powder on the *E. coli* was surprising. The difference of bacterial population between control to other groups were very much distinct. This research showed that the *E. coli* population in cecum at 0.5%, 1.0%, 1.5%, 2.0%, 2.5%, 3.0% doses of chilli powder, antibiotics and control were 84X104±0.12/g, 85X104±1.18/g, 48X104±1.32/g, 32X104±0.92/g, 33X104±1.28/g, 30X104±1.74/g, 27X104±1.77/g and 179X104±2.01/g, respectively. *E. coli* population per g in cecum contents of broiler chicken of all treatments were significantly lower (P<0.05) than the control. The results observed in the present research were also more or less similar to that of Milind and Kaura (2012) who observed that chilli juice possesses antibacterial and antifungal activities. Lakner *et al.* (2011) stated that capsaicin possesses antibacterial property particularly against the bacteria *H. pyroli*, which is one of the causative agents of stomach ulcer.

Economical Parameters

The different economical parameters are profit per broiler (PPB) and benefit cost ratio (BCR). The data of PPB and BCR are presented in table 4.

PPB: One of the most important parts of poultry farming is profit. If herbs are not profitable but effective for healthy meat production then nobody uses herbs in there poultry feed. Either consumer or farmer, everybody think about profit. From this point of view, PPB also was carried out in this research. The treatments at 0.5% (47.61±0.43TK), 1.0% (48.35±0.41TK), 1.5% (45.43±0.52TK), 2.0% (48.77±0.23TK), 2.5% doses (43.17±1.04TK) and antibiotics (47.55±0.55TK) were significantly higher (P<0.05) profit than control (40.78±0.78TK). Nath *et al.* (2012) found that dietary inclusion of tulsi, pepper and cloves extract in broiler diet fetched the maximum profit as compared to control group.

Table 4: Effect of different doses of chilli powder on economical aspects of poultry management practices

Doses	**Economical Parameters**	
	Profit / Bird (TK) ± SE	**Benefit Cost Ratio ± SE**
0.5%	47.61 ± 0.43^{a}	1.27 ± 0.01^{a}
1.0%	48.35 ± 0.41^{a}	1.27 ± 0.01^{a}
1.5%	45.43 ± 0.52^{b}	1.26 ± 0.01^{ab}
2.0%	48.77 ± 0.23^{a}	1.28 ± 0.01^{a}
2.5%	43.17 ± 1.04^{c}	1.23 ± 0.02^{b}
3.0%	37.21 ± 0.80^{e}	1.19 ± 0.03^{c}
Antibiotics	47.55 ± 0.55^{a}	1.27 ± 0.03^{a}
Control	40.78 ± 0.78^{d}	1.21 ± 0.02^{c}
CV%	**2.41**	**8.58**
LSD (0.05)	**1.897**	**0.11**

- ✓ Mean with different superscripts are significantly different (P<0.05)
- ✓ Mean within same superscripts don't differ (P>0.05) significantly
- ✓ SE= Standard Error, CV= Coefficient of Variation, LSD= Least Significant Difference
- ✓ Each data represents average of 30 birds
- ✓ Antibiotic was used as 1g/L ampicillin and 1g/L oxitetracycline

BCR: Treatments 0.5% (1.27±0.01), 1.0% (1.27±0.01), 1.5% (1.26±0.01), 2.0% (1.28±0.01), 2.5% (1.23±0.02) and antibiotics (1.27±0.03) were significantly higher (P<0.05) BCR than control (1.21±0.02). The BCR of 2.0% chilli powder was 1.28, it indicates that farmer will get 28TK (1$ = 78.70TK) profit if they invest 100TK in broiler farming with 2.0% dose of chilli powder treatment. The results of the present study are in line with the findings of Ahmad (2005), who reported that dietary inclusion of herbs and spices in the rations was more beneficial in broiler production.

CONCLUSION

The result obtained from this study showed that 2.0% 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 chilli powder. Moreover, the dietary supplementation of chilli powder may lead to the development of low-cholesterol chicken meat as demanded by health-conscious consumers.

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