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The Use of Some Feed Additives as Growth Promoter in Broilers Nutrition

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Abstract: This study was undertaken to investigate the effects of some feed additives on the performance and blood parameters of broilers. In a completely randomized design, 320 1-d-old chicks were divided into four replicate groups. A control diet was prepared, based on NRC recommendations. For preparing other diets, control diet supplemented with propionic acid, protexin and nettle extract at the levels of 2, 0.1 and 1 g/kg of diet, respectively. Diet contained propionic acid resulted in significant increase in BWG during the starter and from 0-42 periods. The birds fed control diet had more FI and PI during the finisher period than those fed propionic acid. When diet supplemented with propionic acid and protexin, a significant improvement in FCR and PER was observed among this diets and other diets. Propionic acid also significantly increased HDL and decreased LDL compared to other feed additives. In conclusion, based on the results of this experiment, propionic acid and protexin can be used as a suitable alternative to antibiotic growth promoters whereas nettle extract can not.

Key words: Broilers, performance, blood parameters, growth promoters

INTRODUCTION

Prior to birth, the Gastrointestinal tract (GI) of birds is free of any strains of microbial populations (Mead and Adams, 1975; Kelly and King, 2001) and bacteria from the diet, water, excreta and the environment begin to colonize in the GI almost shortly (Dibner and Richards, 2005). The GI of young birds is far more susceptible to pathogenic bacteria compared to other birds (Koopman *et al*., 1984) therefore, balance of this population using feed additive can play a key role for immune system development and increase birds' performance (Patterson and Burkholder, 2003).

In order to balance this population by damaging the pathogenic bacteria, antibiotic feed additives have been used since 50 years ago. Because many of these antibiotics are useful for treating bacterial infections in humans, use of these in animal husbandry can led to a worldwide increase in antibiotic resistance strains of bacteria and hereby damaging the balance of humans' microflora. Therefore, nowadays the use of these feed additives in birds' diet is removing in many countries. Removal of antibiotics from the food cycle of animals can cause increase acute pathogenesis (e.g., *Escherichia coli*, *Campylobacter* and *Salmonella*) in GI. These pathogens can produce many chronic gut disorders (e.g., gastritis, peptic ulcer, irritable bowel syndrome, bowel cancer, ulcerative colitis, Crohn's disease, pseudomembranous colitis) and finally lead to serious damage to animal husbandry. Therefore, animal researchers and animal feed manufacturers are looking for a suitable alternative to antibiotics in order to prevent these damages and to improve breeding performance. Thus, alternatives to antibiotics are of great interest to the animal industry.

Reviewing of scientific reports indicates positive effects of organic acids, probiotics and plant extracts in poultry diets (Vogt *et al*., 1981; Runho *et al*., 1997; Jin *et al*., 1998). Several studies indicated that acidifiers could, as antibiotics, improve poultry performance by reducing colonization of pathogenic microorganisms, increase digestibility of 1) proteins and mineral and reduce toxic components of bacteria (Kishi, 1999; Chaveerach *et al*., 2004).

The modes of action of probiotics in the chickens, it is not completely known, but it seems that the mode of action of those is mainly due to low redox potential, reductions in the population of *Escherichia coli* competition for adhesion receptors in the intestine and reduction of toxin release (Montes and Pugh, 1993; Martins *et al*., 2005).

Plant extracts have recently been used in poultry diets as feed additive. Several studies indicated that these feed additives could be used in poultry diets as an antifungal, antibacterial, antioxidant and or antimutagenic compounds (Osawa *et al*., 1995; Nielsen *et al*., 1999; Wuthi-udomler *et al*., 2000; Hernandez *et al*., 2004). It seems that plant extracts are other suitable alternatives to antibiotic growth promoters. However, due to inconsistent results about the effects of organic acids, probotics and plant extracts on poultry performance therefore, a decisive assessment about the use of these feed additives as suitable alternative to antibiotics; needs more research to be done. Therefore, this study was conducted to evaluate the effects of dietary propionic acid, protexin and nettle extract as growth promoter on the performance and on some blood parameters of broiler chicks.

MATERIALS AND METHODS

Birds and diets: Three hundreds and twenty unsexed 1-d-old chicks (Cobb 500) were obtained from local commercial hatcheries for determination the effects of dietary propionic acid, protexin and nettle extract on the performance and on some blood parameters of broiler chicks. Newly hatched chickens were divided into four replicate groups, each consisting of 16 chicks and reared on floor pens for 42 day. A control corn-soybean based diet was prepared based on NRC (1994) recommendations. The composition and chemical analysis of the control diet is shown in Table 1. For preparing other treatments, the control diet supplemented with propionic acid, protexin and nettle extract at the levels of 2, 0.1 and 1 g/kg of diet, respectively. No antibiotic and coccidiostat drug were used in any diet of experimental group. Feed and water were provided ad labium during the whole periods of the experiment (0-42 day).

Housing and management: The size of all pens was 1.5×1.5 m; therefore, each bird had about 0.14 m 2 space. The temperature was maintained at 34°C during the 1st week and then was reduced by 3°C per wk until 18°C was reached and this temperature was maintained until the end of the experiment. Relative humidity of the room was about 70-80% and the lighting program was continuous.

Vaccination schedule: To prevention of chickens against Newcastle and bursal infectious disease, all of the chicks were vaccinated at 11 and 14 days of age, respectively.

Experimental procedures

Body weight gain and feed intake: Body Weight Gain (BWG) and feed intake (FI) of chicks were recorded on 21 and 42 day of the experiment. Initial body weights were similar among groups, prior to diet allocation (average = 41 g/bird).

Feed conversion ratio: The chicks were inspected daily and dead birds were removed following registration of date and body weight. Feed Conversion Ratio (FCR) was calculated as the BWG (g) per FI (g). When calculating FCR, the body weights of dead birds were also considered.

Protein intake and protein efficiency ratio: Values of Protein Intake (PI) and Protein Efficiency Ratio (PER) of dietary treatments were measured by using the following formula:

$$\text{PI (g)} = \text{Percentage of protein in diet} \times \text{FI (g)}$$

$$\text{PER (g)} = \frac{\text{BWG(g)}}{\text{PI(g)}}$$

Table 1: Composition of the basal diets

Ingredients (%)	Starter	Finisher
Corn	57.33	57.96
Soybean meal	36.97	33.51
Soybean oil	1.96	5.16
Dicalcium phosphate	1.41	1.09
Limestone	1.26	1.37
Salt	0.42	0.34
Broiler premix*	0.50	0.50
DL-Methionine	0.13	0.05
Vit E	0.02	0.02
Nutrient composition		
ME (kcal/kg)	2900.00	3100.00
Protein (%)	20.84	19.37
Ca (%)	0.90	0.95
Available P (%)	0.41	0.36
Sodium (%)	0.18	0.16
Lysine (%)	1.14	1.10
Methionine (%)	0.46	0.37
Methionine + cyctein (%)	0.82	0.73
Argenin (%)	1.37	1.27

*Broiler premix contained 50% vitamin premix and 50% mineral premix. Each kg of vitamin premix contained: vitamin A, 3,600,000 IU; vitamin D3, 800,000 IU; vitamin E, 7,200 IU; vitamin K3, 800 mg; vitamin B1, 720 mg; vitamin B2, 2,640 mg; vitamin B3, 4,000 mg; vitamin B5, 12,000 mg; vitamin B6, 1,200 mg; vitamin B9, 400 mg; vitamin B12, 6 mg; vitamin H2, 40 mg; choline chloride, 200,000 mg and each kg of mineral premix contained: Mn, 40,000 mg; Fe, 20,000 mg; Zn, 40,000 mg; Cu, 4,000 mg; I, 400 mg, Se, 80 mg

Sampling Procedures for blood parameters assay: At the end of experiment, one male chicken from each experimental unit was randomly selected and 2 ml blood samples were collected from the wing vein. Prior to freezing at -20°C, these blood samples centrifuged at 3000 rpm for 15 min and serum obtained. Then, samples were analyzed for total cholesterol, high-density lipoprotein (HDL), low-density lipoprotein (LDL), total protein, albumin and globulin by enzymatic diagnostic kits. The globulin calculated using difference between total protein and albumin.

Statistical analysis: Statistical analysis of data was performed using Completely Randomized Design (CRD) with pen as the experimental unit. Univariate analysis of variance using General Linear Model (GLM) procedure was performed using SAS (2001) software. Duncans Multiple Range Test at 0.05 probability level separated differences among treatments.

RESULTS AND DISCUSSION

Body weight gain and Feed intake: The effects of propionic acid, prtexin and nettle extract on the BWG, FI and FCR are shown in Table 2. Propionic acid resulted in significant ($p<0.05$) increase in BWG during the starter and from 0-42 days of age compared to the control and others diets. During the finisher period of the experiment, BWG was not significantly ($p>0.05$) different among the groups. Birds fed control diet had

Table 2: Effect of dietary propionic acid, protexin and nettle extract on performance of the broiler chicks

	Dietary treatments					
	BWG (g)			FI (g)		
Item	0-21 day	22-42 day	0-42 day	0-21 day	22-42 day	0-42 day
Control	612.01±13.47[b]	1659.92±25.21	2273.24 ±39.40[b]	1024.98±6.50	3836.3±158.18[a]	4861.3±163.55
Propionic acid	668.94±15.29[a]	1731.85±46.51	2400.79±45.45[a]	1024.53±22.47	3486.5±70.56[b]	4511.0±85.41
Protexin	638.73±25.94[ab]	1700.44±30.44	2339.16±37.17[ab]	986.00±33.83	3748.9±115.49[ab]	4734.9±108.82
Nettle extract	621.83±1.89[ab]	1662.37±13.96	2284.20±15.45[b]	1025.57±24.50	3659.9±55.86[ab]	4685.5±70.01

	Dietary treatments					
	FCR (g/g)			PI (g)		
Item	0-21 day	22-42 day	0-42 day	0-21 day	22-42 day	0-42 day
Control	1.67830±0.04[a]	2.3568±0.13[a]	2.17502±0.10[a]	209.147±1.32	782.81±32.27[a]	991.95±33.37
Propionic acid	1.53177±0.00[b]	2.0172±0.05[b]	1.88015±0.03[b]	209.056±4.58	711.42±14.39[b]	920.47±17.42
Protexin	1.54669±0.03[b]	2.2116±0.10[ab]	2.02751±0.06[ab]	201.192±6.90	764.96±23.56[ab]	966.16±22.20
Nettle extract	1.64945±0.04[a]	2.2019±0.03[ab]	2.05135±0.02[ab]	209.268±5.00	746.81±11.40[ab]	956.08±14.28

	Dietary treatments		
	PER (g)		
Item	0-21 day	22-42 day	0-42 day
Control	2.92744±0.07[b]	2.0984±0.11[b]	2.26941±0.10[b]
Propionic acid	3.19962±0.01[a]	2.4362±0.06[a]	2.60995±0.04[a]
Protexin	3.17391±0.06[a]	2.2344±0.09[ab]	2.42740±0.07[ab]
Nettle extract	2.97846±0.07[b]	2.2276±0.03[ab]	2.39096±0.03[b]

[a,b]Means (±SEM) in the same row with no common superscript differ significantly (p<0.05)

significantly (p<0.05) higher FI during the finisher period than the birds fed propionic acid diet. Overall, resulted show that the birds fed supplemental growth promoters had numerically higher BWG than control diet.

In the early stage of broilers life, *Enterobacteriaceae* and *Enterococci* are dominant bacteria in the ceca but start to decrease as the broilers grow older (Vander *et al.*, 2000). These bacteria compete for nutrients with host and decrease efficiency of broilers (Parks *et al.*, 2001). Vander *et al.* (2000) reported significant negative correlations between numbers of *Enterobacteriaceae* and *Enterococci* with amount of volatile fatty acids. Because, during the first weeks of life, young chicks have a low quantity of volatile fatty acids in gut and cecal (Vander *et al.*, 2000), therefore these pathogenic microorganisms can have negative effects on young broilers. In addition, when the birds were fed a diet supplemented with propionic acid had a higher volatile fatty acids and a lower numbers of *Enterobacteriaceae* and *Enterococci* in gut and cecal. So as indicated, significant effect of propionic acid on BWG only during the starter period may be due to this hypothesis. It is noteworthy to indicate that control diet had significantly (p<0.05) higher FI compared to propionic acid during the finisher period. This difference may be due to a decrease in palatability of acidified diets, because acidifiers have a low tendency to free their H+ ions and so tend to have a strong taste associated with them (Cave, 1984). A similar effect was found when broiler chicks were fed a diet supplemented with organic acid (Fuller, 1999; Parks *et al.*, 2001; Abdel-Fattah *et al.*, 2008).

Feed conversion ratio: During the starter period, the birds fed supplemental propionic acid and protexin had significantly (p<0.05) better FCR compared to the control diet, whereas, FCR was improved (p<0.05) during the finisher and from 0-42 periods only in chicks fed diet contained propionic acid but not the other diets. No difference was found during the whole period between the birds fed control diet and those fed supplemented with nettle extract feed additive. The better FCR in these diets may be due to higher body weight gain, lower feed intake and or an improve the conditions in the intestine that leading to improved digestion, absorption and better utilization of nutrients (Parks *et al.*, 2001; Fuller, 1999). The results of FCR obtained in this experiment confirm those reported by Parks *et al.* (2001), Abdel- Fattah *et al.* (2008) and Fuller (2001).

Protein intake and protein efficiency ratio: Results Table 2 indicate that only control group had a higher PI than other groups during the finisher period. The birds fed diets supplemented with growth promoters although had numerically better PER than control birds but not all of these differences were significant. Fuller (1999) reported that probiotics are capable to decrease the break down of proteins by suppress of toxin activity and

Table 3: Effect of dietary propionic acid, protexin and nettle extract on serum lipid and protein concentrations of the broiler chicks

	Dietary treatments					
Item	TC[1] (mg/dl)	HDL (mg/dl)	LDL (mg/dl)	TP[2] (g/dl)	A[3] (g/dl)	G[4] (g/dl)
Control	112.800±5.37	70.600±2.37[ab]	28.600±1.74[a]	2.2400±0.06	1.4800±0.07	0.7600±0.06
Propionic acid	118.800±5.35	78.200±2.37[a]	17.800±1.39[b]	2.6160±0.14	1.6940±0.06	0.9220±0.15
Protexin	100.600±6.86	65.200±2.90[b]	22.000±3.83[ab]	2.3600±0.18	1.4460±0.09	0.9140±0.14
Nettle extract	106.400±6.11	69.000±2.75[b]	21.200±3.65[ab]	2.2960±0.10	1.5600±0.09	0.7360±0.07

[a,b]Means (±SEM) in the same row with no common superscript differ significantly ($p<0.05$). [1]Total cholesterol, [2]Total protein, [3]Albumin, [4]Globulin

hereby can increase PER in broiler chicks. On the other hand, Jin *et al.* (1998) reported that organic acids could prevent the development of harmful bacteria, increase digestibility of protein and prevent of break down of protein to nitrogen. The better PER in the birds fed diets supplemented propionic acid and protexin may be due to these effects and also through lower PI and higher BWG.

Blood parameters: The effects of dietary treatments on the blood parameters are presented in Table 3. The total cholesterol, total protein, albumin and globulin of birds were unaffected by feed additives, whereas HDL and LDL were affected significantly ($p<0.05$) by dietary propionic acid. Young and Foegeding (1993) reported that organic acids could through decreasing the microbial intracellular pH, forces the important microbial enzymes to use energy for release the acid protons and finally increase intracellular accumulation of acid anions. Therefore, increased HDL and decreased LDL in birds fed diet supplemented with propionic acid may be due to this hypothesis.

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