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Full Length Research Paper

Effect of dietary prebiotic and acidifier supplementation on the growth performance, carcass characteristics and serum biochemical parameters of broilers

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This study investigated the effect of dietary supplementation with the fermacto prebiotic and Biotronic® S.E (an acidifier) on the growth performance, carcass characteristics and serum biochemical parameters of broiler chickens. 240 day old Ross 308 broilers were equally distributed into 24 floor pens and reared for 42 days. A basal diet was formulated according to the recommendations of NRC for starter (1 to 21 days) and grower (22 to 42 days) periods and considered as control diet. Four tested diets were formulated as listed control diet (without any additives), fermacto prebiotic, Biotronic® S.E (an acidifier) and mixture of fermacto prebiotic plus Biotronic® S.E. Six replicate were used for each treatment. The results of this study indicate that addition of fermacto prebiotic and Biotronic® S.E increased the final body weight, significantly ($p<0.05$). Furthermore, addition of additives decreased abdominal fat, triglycerides, serum cholesterol and increased carcass weight. Addition of fermacto prebiotic plus Biotronic® S.E had the best performance, carcass characteristics and lowest serum cholesterol on broiler chickens at 42 day of age.

Key words: Fermacto prebiotic, Biotronic® S.E, performance, broiler, carcass characteristics, serum cholesterol.

INTRODUCTION

It is likely that the prophylactic use of antibiotic or so called antimicrobial growth promoters (AGPS) in animal feeds will be banned in the EU shortly. These AGPS are used to improve the feed efficiency by altering the micro flora in the gastro intestinal tract (GIT). The main reason for this ban is the increasing resistance of pathogenic bacteria against antibiotics (Kermanshahi and Rostami, 2006). Different categories of feed additives for farm animals are referred to as natural growth promoters (Stainer, 2006) which include acidifiers, probiotics, prebiotics phytobiotics, feed enzymes, immune stimulants and antioxidants. No report has associated any risk with regard to bacterial resistance or undesired residues in animal products arising from NGP use. Prebiotics have been defined by Gibson and Roberfroid (1995) as indigestible food ingredients which stimulate the growth and/or activity and improve the host's health. Prebiotics have been shown to alter gasterointestinal microflora, alter the immune system, prevent colonic cancer, reduce pathogen invasion including pathogens such as *Salmonella entritidis* and *E.coli* and reduce cholesterol and odor compounds (Cummings and Macfarlane, 2002; Cummings et al., 2001; simmering and Blaut, 2001). Various findings on the health and growth response of broiler chickens were reported (Kabir et al., 2004; Piray et al., 2007). Acidifiers in different forms and combination are included in poultry feed to lower the pH value of the feed, the gut and microbial cytoplasm by inhibiting the growth of intestinal pathogens and preventing microbial contamination of feed. This effect is exhibited also in digestive tract of poultry (Eldelsburger and Kirchaessner, 1994; Freitage et al., 1999). Acidifiers, particularly the short chain fatty acids, acetate, propionate and butyrate have contributed

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Table 1. Ingredient composition (as percent of dry matter) and calculated analysis of basal diet.

Ingredient	Starter (1-21 days)	Grower (22-42 days)
Corn	61	58.7
Soybean meal	29	30
Wheat bran	5	5
Fish meal	-	2
Soybean oil	2	1
Oyster shell meal	1	1.5
DCP	1.07	1
Vitamin and mineral premix[1]	0.5	0.5
Dl-methionine	0.13	0.10
L- lysine	0.15	0.25
Alt	0.25	0.10
Coccidiostate	-	0.05
Total	100	100
Nutrient content		
ME (kcal/kg)	2850	2950
Crude protein (%)	20.48	18.44
Crude fiber (%)	3.89	3.81

1-Vitamin and mineral provided per kilogram of diet: vitamin A, 3600 Iu; vitamin D_3, 800000 Iu; vitamin E, 7200 Iu; vitamin K3, 800 mg; vitamin B1, 720 mg; vitamin B9, 400 mg; vitamin biotin, 40 mg; vitamin B2, 2640mg; vitamin B3, 400 mg; vitamin B5, 12000 mg; vitamin B6, 1200 mg; vitamin B12, 6 mg; choline choloraid, 200000mg; Mn, 40000mg; Fe, 20000 mg; Zn, 40000 mg; Cu, 4000 mg; I, 400 mg, Se, 80 mg.

greatly to the profitability in poultry and also provide people with health and nutritious poultry products (Patten and Waldroup, 1998). Moreover, acidifier improved growth performance through establishment of low gasterointestinal pH condition by supporting endogenous digestive enzymes and reducing undesired gut microorganism (Richards et al., 2005). Acidification of diet with weak organic acids such as formic, fumaric, propionic, lactic and sorbic acids have been reported to decrease colonization of pathogen and production of toxic metabolites, improved digestibility of protein, Ca, P, Mg, Zn and served as substrate in the intermediary metabolism (Veeramani et al., 2003).This study was aimed at determining the effects of supplementing broiler diet with fermacto prebiotic and Biotronic® S.E(an acidifier) on growth performance, carcass characteristics and serum biochemical parameters of broiler chickens.

MATERIALS AND METHODS

Birds and housing

In this study, 240 broiler chickens of the commercial Ross 308 strain were used in a randomized design with four treatments (six replicates in each treatment and 10 birds/ replicate) and reared on the floor pens for 42 days. A basal diet was formulated and considered as control according to recommendation of NRC, 1994 for starter (1 to 21 days) and grower (22 to 42 days) diets. Four tested diets were formulated by supplementing the basal control diet without any additives, prebiotic (fermacto, 2 kg/ton of diets), acidifier (Biotronic® S.E, 3 kg/ton of diets) and mixture of prebiotic (2 kg/ton) plus acidifier (3 kg/ton), respectively (Table 1). From day 1 to 42 of the study, water and experimental diets were given to the birds, *ad-libitum.* Broilers and feed intake were weighed weekly. Feed conversion ratio was calculated as feed intake per unit body weight.

Carcass characteristics

At the end of this experiment, three birds from each replicate with body weight close to mean of the group were selected and tagged. The birds were then starved but given ample supply of drinking water 12 h prior to slaughtering (Joseph et al., 1996). Each bird was weighed separately and sacrificed, then propel bled. The slaughtered birds were scalded at 80°C for 2 min and manually defeathered. The carcass was carefully eviscerated and split open to remove the gasterointestinal tract. Carcass weights were recorded respectively. Organ weight such as proventriculus, crop, gizzard, heart, liver, kidneys, abdominal fat and spleen were separated and weighed. Recorded weights of part were expressed as percentage of the respective live body weight.

Biochemical serum data collection and analysis:

At 21 and 42 days of age, 4 ml of blood was collected from wing vein from three birds in each treatment. In order to prevent clotting, blood was collected in heparinized test tubes and centrifuged at 2000 rpm for 10 min and the serum was separated, and hen stored at -20°C until assayed to measure blood parameters (cholesterol, triglycerides and high density lipoprotein (HDL) cholesterol) using

Table 2. Growth performance characteristics of experimental birds at 42 day of age.

Parameter	Control	Fermacto prebiotic	Biotronic® S.E	Fermacto + Biotronic® S.E
Final body weight (g)	2250±118.51[a]	2310±116.56[b]	2320±113.32[b]	2360±115.19[b]
Feed intake	4370±312.26	4460±316.44	4520±318.22	4560±321.85
Feed conversion Ratio (FCR)	1.94±0.03	1.93±0.02	1.94±0.03	1.93±0.01

Composition of Biotronic® S.E (an acidifier): 17.4% formic acid; 14.1% ammonium formate; 12.4% propionic acid; 8.4% ammonium propionate; means on the same row with different superscripts are significantly different (p<0.05).

Table 3. The results of feed additives on broiler carcass characteristics.

Parameter	Control	Fermacto prebiotic	Biotronic® S.E	Fermacto + Biotronic® S.E
Carcass weight (%)	76.5±5.84[a]	77.20±6.12	77.26±6.16	79.31±6.84
Pancreas (%)	0.32±0.04[a]	0.27±0.04[b]	0.33±0.05[a]	0.38±0.05[a]
Crop (%)	0.36±0.13[a]	0.48±0.15[b]	0.51±0.12[c]	0.43±0.16[b]
Proventriculus (%)	0.53±0.07	0.56±0.07	0.58±0.05	0.58±0.06
Full gizzard (%)	3.58±0.23	3.62±0.24	3.78±0.26	3.80±0.28
Heart (%)	0.56±0.05	0.54±0.05	0.58±0.03	0.56±0.03
Liver (%)	1.95±0.08	1.98±0.07	2.08±0.09	2.11±0.09
Kidney (%)	0.76±0.06	0.73±0.05	0.71±0.06	0.72±0.04
Abdominal fat (%)	1.75±0.36	1.71±0.33	1.63±0.31	1.61±0.31
Spleen (%)	0.08±0.02	0.11±0.02	0.13±0.03	0.15±0.03

Means in the same row with different superscripts are significantly different (p < 0.05).

commercial kits (Pars Azmoon) according to the manufacturer's protocols. Very low density lipoprotein (VLDL) cholesterol was calculated from triglycerides by dividing the factor 2.2. The low density lipoprotein (LDL) cholesterol was calculated by using the formula: LDL cholesterol = total cholesterol – HDL cholesterol + VLDL cholesterol.

Statistical analysis

All data were analyzed using the one-way ANOVA procedure of SAS (SAS, 1998) for analysis of variance. Significant differences among treatments were identified at 55 levels by Duncan's multiple range tests.

RESULTS AND DISCUSSION

The results of feed additives on broiler growth performance are presented in Table 2. There was no significant difference among treatment for feed intake (p>0.05). Supplementation of prebiotic and acidifier significantly increased the final body weight as compared to the control groups (p<0.05). Moreover, these indices were highest in broilers fed with fermacto prebiotic plus Biotronic® S.E at 42 day of age. Other results show that adding prebiotic and acidifier supplementation increased feed intake, although there was not a significant difference between the control and other treatment groups. In the present study, the beneficial effect of prebiotic and acidifier additives on broiler performance are in agreement with previous studies (Nayebpor et al., 2007; Falaki et al., 2010) but in contrast with the study of Zhang et al. (2005) and Willis et al. (2007). Samana and Biswas (1995) also reported increased body weight when the diet was supplemented with lactic acid.

The results of feed additives on broiler carcass characteristics are presented in Table 3. Furthermore, the results of this experiment showed that addition reduced abdominal fat, although there were no significant differences between the control and the other treatment groups. Weights of carcass, proventricalus, heart, kidney, spleen, liver and full gizzard were not significantly different (p>0.05).

The results of this investigation show that addition of fermacto prebiotic plus Biotronic® S.E had highest carcass weight, pancreas, proventriculus and spleen weight. The effect of feed additives on broiler's blood constituents is presented in Table 4. At 21 days of age, 180 significant differences were observed in triglycerides, HDL, LDL and VLDL levels between treatments (p>0.05). In 21 days old birds, dietary supplementation with prebiotic and acidifier decreased cholesterol concentration (p<0.05) when compared with the control groups. At 42 day of age, no significant differences were observed in HDL and LDL levels between treatments (p>0.05). In 42 day old, birds under prebiotic and acidifier treatment, the serum VLDL was lower than those under the control treatments (p<0.05).

It was reported that the probiotic supplementation significantly reduces the serum cholesterol level of the chickens (Panda et al., 2001). Kannan et al. (2005) reported that the use of 0.5 g/kg mannanoligosaccharide obtained

Table 4. Serum lipid concentrations of experimental birds (as mmol/L).

Lipid concentration	Control	Fermacto prebiotic	Biotronic® S.E	Fermacto + Biotronic® S.E
21 days of age				
Cholesterol	3.96±0.32[a]	3.43±0.37[b]	3.40±0.38[b]	3.23±0.29[c]
Triglyceride	1.07±0.03	1.04±0.05	1.03±0.06	0.98±0.02
HDL	1.76±0.07	1.63±0.09	1.61±0.09	1.53±0.07
LDL	1.58±0.06	1.55±0.04	1.51±0.04	1.13±0.05
VLDL	0.62±0.009	0.25±0.004	0.28±0.002	0.57±0.007
42 days of age				
Cholesterol	4.36±0.38[a]	4.13±0.32[a]	3.88±0.22[b]	3.61±0.27[b]
Triglyceride	0.95±0.06[a]	0.91±0.04[a]	0.68±0.02[b]	0.63±0.01
HDL	1.84±0.11	1.72±0.09	1.68±0.06	1.64±0.05
LDL	1.63±0.08	1.61±0.07	1.43±0.03	1.36±0.03
VLDL	0.89±0.007[a]	0.80±0.005[a]	0.77±0.006[a]	0.61±0.004[b]

Means in each row different superscripts are significantly different ($p<0.05$).

from yeast in the ration of broiler chickens, significantly reduced the serum cholesterol level on day 35 as compared with the control ($p<0.05$). Several studies have shown that the addition of prebiotics to the diet of broiler, layer and pig leads to improved performance through improving gut microflora (Spring et al., 2000; Pelicano et al., 2004). The other results showed that supplementation of beta fructans from chicory had significantly produced low level of abdominal fat (Yusrizal and Chen, 2003).

Conclusion

The results of the present study indicate that addition of prebiotic and acidifier supplementations to broiler diets, improved growth performance, carcass characteristics and decreased serum cholesterol level of the broiler chickens at 42 days of age.

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