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Effect of Prebiotic (Fermacto) in Low Protein Diet on Performance and Carcass Characteristics of Broiler Chicks

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Abstract: This study was conducted to evaluate the effects of prebiotic (Fermacto) in low protein diet on performance and carcass characteristics of broiler chicks. One hundred and fifty six 1-day old Ross 308 broiler chicks of both sexes were used for 42-days. The chicks were randomly allocated to 12 pens containing 13 chicks each with 3 replicates and assigned to receive one of the 4 dietary treatments of 2 levels of protein (low and high) and 2 levels of prebiotic (0 and 0.2%) in a completely randomized design with factorial arrangement. There was not significant difference in feed conversation ratio, Feed intake and tights weight among treatments. Significant differences were observed in carcass weight and abdominal fat percentage between high protein diet without prebiotic and low protein diet containing prebiotic ($p<0.05$). The results of the present experiment showed that addition of prebiotic to broiler diets containing 90% of NRC protein recommendation had same effect with control diet on performance of broiler chicks.

Key words: Prebiotic, low protein diet, performance, broiler chicks

Introduction

Starting in 2006 the prophylactic use of antibiotics or so called Antimicrobial Growth Promoters (AGP'S) in animal feeds will be banned in the EU. These AGP'S are use to improve the feed efficiency by altering the microflora in the Gastro Intestinal Tract (GIT). The main reason for this ban is the increasing resistance of pathogenic bacteria against antibiotics.

Use of prebiotics or fermentable sugars instead of antibiotics is going to be popular in birds in order to improve the useful microbial population of GIT (Kermanshahi and Rostami, 2006). Prebiotics have been defined by Gibson and Roberfroid (1995) as indigestible food ingredients which stimulate the growth and/or activity of a select number of bacteria in the GIT and improve the host's health. Prebiotics have been shown to alter gastrointestinal 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). The population of useful bacteria likes lactobacillus and bifidobacteria (Ziggers, 2000) increases and the pH of the GIT, due to increasing production of volatile fatty acids, decreases. Therefore the environment of GIT becomes unsuitable for the activity and proliferation of pathogens like Salmonella. Based on Nurmi concept of competitive exclusion (Nurmi and Rantala, 1973), pathogens will be expelled out of the gut by useful bacteria if it already occupied the gut sites.

Colonization of useful micro flora in the gut of young birds that is related to gut conditions can inhibit further colonization of pathogens (Nurmi and Rantala, 1973). High protein prices and environmental concerns have pressured the industry to reduce dietary protein levels (Firman, 1997). Thus, low protein diets are of interest and important for feed additive evaluation and animal performance. The commercially available fermentation product of Aspergillus orizae, Fermacto (PET-AG, 2006), referred to as Aspergillus meal (AM), has no live cells or spores (PET-AG, 2006) and is proven to enhance the digestive efficiency of the gut (Harms and Miles, 1988). Aspergillus meal might offer better results when the level of protein and amino acids is lower than those recommended by NRC (1994) or applied in commercial flocks. Lower levels of protein and amino acids as compared with those recommended by NRC (1994) or applied in commercial flocks are also a potential environmental benefit (Torres-Rodriguez *et al*., 2005). Because of reports on the use of AM and low dietary protein and amino acids on performance are lacking, Therefore, the objective of the present study was to evaluate the effect of prebiotic (Fermacto) in low protein diet on performance and carcass characteristics of broiler chicks.

Materials and Methods

Birds and experimental diets: 156 day-old mixed Ross broiler chicks were randomly allocated to 12 groups of 13 birds each and reared for 42 days. There were four treatments (treatment 1: high protein diet without prebiotic, treatment 2: high protein diet containing

Table 1: Composition of experimental diets in different periods of the experiment

	Starter		Grower		Finisher	
Ingredient (%)	Low Protein	HighProtein	Low Protein	HighProtein	Low Protein	HighProtein
Corn	66.50	59.10	71.30	64.46	76.09	69.92
Soybean meal	29.10	35.50	24.02	29.64	19.63	24.72
DCP	1.74	1.66	1.62	1.57	1.53	1.48
Calcium carbo.	1.20	1.14	1.08	1.07	1.03	1.02
Premix	0.50	0.50	0.50	0.50	0.50	0.50
Salt	0.30	0.30	0.30	0.30	0.30	0.30
Sunflower oil	-	1.10	0.72	1.97	0.65	1.79
DL-Methionine	0.28	0.34	0.18	0.23	0.10	0.14
L-Lysine	0.38	0.36	0.28	0.26	0.17	0.13
Composition						
Metab. Energy (Kcal/Kg)	2900	2900	3000	3000	3050	3050
Crude Protein (%)	19.00	21.20	17.00	18.90	15.32	17.02
Calcium (%)	0.90	0.90	0.85	0.85	0.80	0.80
Avail. Phos. (%)	0.45	0.45	0.42	0.42	0.40	0.40
Arginine (%)	1.17	1.34	1.02	1.17	0.91	1.04
Lysine (%)	1.24	1.38	1.04	1.16	0.85	0.94
Met+Cys (%)	0.94	1.05	0.80	0.90	0.68	0.76
Sodium (%)	0.13	0.13	0.13	0.13	0.13	0.13

Table 2: Effect of protein levels on feed intake of broiler chicks

	Feed intake (g)			
Treatment	1-10	10-28	28-42	1-42
High protein	267[a]	1595[a]	2675	4537
Low protein	253[b]	1432[b]	2511	4197
SEM	0.003	0.030	0.088	0.107

Means with different superscripts in each column differ significantly ($p<0.05$)

Table 3: Effect of prebiotic levels on feed intake of broiler chicks

	Feed intake (g)			
Treatment	1-10	10-28	28-42	1-42
Diet without prebiotic	260	1540	2621	4420
Diet contain 0.2% prebiotic	261	1488	2565	4314
SEM	0.003	0.030	0.088	0.107

Means with different superscripts in each column differ significantly ($p<0.05$)

Table 4: Effect of protein and prebiotic levels on feed intake of broiler chicks

	Feed intake (g)			
Treatment	1-10	10-28	28-42	1-42
High protein without prebiotic	266[a]	1602[a]	2650	4520
High protein with prebiotic	267[a]	1588[a]	2700	4555
Low protein without prebiotic	252[b]	1476[ab]	2593	4321
Low protein with prebiotic	254[ab]	1389[b]	2429	4073
SEM	0.004	0.043	0.124	0.151

Means with different superscripts in each column differ significantly ($p<0.05$)

prebiotic, treatment 3: low protein diet without prebiotic, treatment 4: low protein diet containing prebiotic) in this experiment. Prebiotic (Fermacto) was supplemented at the rate of 0 and 2.0 kg/ton of diets. Feed and water were provided *ad libitum* during the experiment. Diets were provided in 3 periods of starter (1-10 days), grower (10-28 days) and finisher (28-42 days) of age. Composition of experimental diets is presented in Table 1.

Data and sample collection: Body weight gain, feed intake and feed conversion ratio were recorded weekly. Mortality was recorded throughout of the experiment. At 42 days of age two birds from each replicate with body weight similar to mean replicate body weight were selected, slaughtered and the fat pad, carcass, breast meat and tights weight were measured.

Data analysis: The data from this experiment were subjected to one-way analysis of variance as factorial arrangement 2×2 with 2 levels of protein and 2 levels of prebiotic, thus there was 4 treatments and 3 replicates for each treatment. The obtained data were submitted to analysis of variance, using the General Linear Model procedure (GLM) of SAS software (SAS Institute, 2002). Means were compared by the Duncan's multiple range tests at 5% probability (Duncan, 1955).

Results and Discussion

Effects of different levels of protein and prebiotics on feed intake of broiler chicks in different phases of the experiment are presented in Table 2 and 3. There was significant differences among treatments for feed intake in starter and grower periods of the experiment for protein levels ($p<0.05$). chicks fed with high protein diets consumed more feed in starter and grower phase of the experiment. Effect of prebiotic on feed intake of chicks in all phases of the experiment was not significant. Interaction of protein and prebiotic are shown in Table 4. Interaction of protein and prebiotic on feed intake was significant in starter and grower periods of the experiment ($p<0.05$).

Table 5: Effect of protein levels on body weight gain of broiler chicks

	Body weight gain (g)			
Treatment	1-10	10-28	28-42	1-42
High protein	198[a]	983[a]	1321	2502
Low protein	183[b]	888[b]	1242	2313
SEM	0.003	0.016	0.030	0.042

Means with different superscripts in each column differ significantly ($p<0.05$)

Table 6: Effect of prebiotic levels on body weight gain of broiler chicks

	Body weight gain (g)			
Treatment	1-10	10-28	28-42	1-42
Diet without prebiotic	189	934	1286	2410
Diet contain 0.2% prebiotic	191	936	1277	2405
SEM	0.003	0.016	0.030	0.042

Means with different superscripts in each column differ significantly ($p<0.05$)

Table 7: Effect of protein and prebiotic levels on body weight gain of broiler chicks

	Body weight gain (g)			
Treatment	1-10	10-28	28-42	1-42
High protein without prebiotic	197[ab]	1005[a]	1323	2525[a]
High protein with prebiotic	199[a]	961[ab]	1319	2479[ab]
Low protein without prebiotic	181[c]	865[c]	1250	2296[b]
Low protein with prebiotic	185[bc]	911[bc]	1235	2331[ab]
SEM	0.004	0.023	0.043	0.060

Means with different superscripts in each column differ significantly ($p<0.05$)

Table 8: Effect of protein levels on feed conversion ratio of broiler chicks

	Feed conversion ratio			
Treatment	1-10	10-28	28-42	1-42
High protein	1.350	1.625	2.027	1.815
Low protein	1.386	1.615	2.018	1.814
SEM	0.017	0.034	0.054	0.040

Means with different superscripts in each column differ significantly ($p<0.05$)

Table 9: Effect of prebiotic levels on feed conversion ratio of broiler chicks

	Feed conversion ratio			
Treatment	1-10	10-28	28-42	1-42
Diet without prebiotic	1.375	1.652	2.039	1.836
Diet contain 0.2% prebiotic	1.361	1.590	2.006	1.793
SEM	0.017	0.034	0.054	0.040

Means with different superscripts in each column differ significantly ($p<0.05$)

Effect of protein and prebiotic levels on body weight gain are presented in Table 5 and 6. Effect of protein levels on body weight gain was significant in starter and grower periods ($p<0.05$). Interaction of above 2 factors was significant in starter, grower and whole phases of the experiment ($P < 0.05$). Results are shown in Table 7. Commercial diets (with and without addition of AM) caused heavier body weights than the 2 low protein diets, however, addition of AM to low protein diet improved body weight in starter, grower and total periods of the experiment. Differences between the commercial and low protein diets were expected because lower protein and amino acids (lysine, methionine and threonine) content affect weight gain and performance. The difference observed between the low protein and low protein supplemented with prebiotic can be attributed to the effect of prebiotic, because these 2 diets were formulated to supply the same amount of protein and amino acids. Effect of protein and prebiotic level on feed conversion ratio are presented in Table 8, 9, 10. Interaction of 2 factors In grower periods, was significant for this trait ($p<0.05$). Treatment 4 (low protein with periodic) had the lowest and treatment 3 had the highest value for this trait.

Table 10: Effect of protein and prebiotic levels on feed conversion ratio of broiler chicks

	Feed conversion ratio			
Treatment	1-10	10-28	28-42	1-42
High protein without prebiotic	1.356	1.595[ab]	2.007	1.792
High protein with prebiotic	1.344	1.654[ab]	2.046	1.838
Low protein without prebiotic	1.394	1.708[a]	2.070	1.880
Low protein with prebiotic	1.379	1.523[b]	1.967	1.747
SEM	0.025	0.048	0.076	0.056

Means with different superscripts in each column differ significantly ($p<0.05$)

Table 11: Effect of protein levels on carcass characteristics of broiler chicks

	Carcass characteristics			
Treatment	Carcass (%)	Breast (%)	Tights (%)	Abdominal fat (%)
High protein	79.235	27.857[a]	22.544	3..521
Low protein	77.875	25.680[b]	23.124	3.430
SEM	0.434	0.431	0.338	0.184

Means with different superscripts in each column differ significantly ($p<0.05$)

Effects of experimental diets on carcass characteristics are presented in Table 11, 12 and 13. Chicks fed with high protein diets had more breast meat percentage ($p<0.05$). There was significant difference among groups for carcass and breast meat percentage ($p<0.05$). Carcass and breast meat percentage in low protein with prebiotic was lower than other groups. Breast meat percentage in treatment 1 was higher than treatment 3. There were not significant differences among treatments for tights and abdominal fat percentage.

Prebiotics have been shown to alter gastrointestinal microflora, alter the immune system, prevent colonic cancer, reduce pathogen invasion including pathogens such as *E.coli* and reduce cholesterol and odor compounds (Cummings and Macfarlane, 2002; Cummings *et al*., 2001; Simmering and Blaut, 2001).

Table 12: Effect of prebiotic levels on carcass characteristics of broiler chicks

	Carcass characteristics			
Treatment	Carcass (%)	Breast (%)	Tights (%)	Abdominal fat (%)
Diet without prebiotic	79.143	26.354	22.606	3.531
Diet contain 0.2% prebiotic	77.966	27.182	23.061	3.425
SEM	0.434	0.431	0.338	0.184

Means with different superscripts in each column differ significantly ($p<0.05$)

Table 13: Effect of protein and prebiotic levels on carcass characteristics of broiler chicks

	Carcass characteristics			
Treatment	Carcass (%)	Breast (%)	Tights (%)	Abdominal fat (%)
High protein without prebiotic	79.338^{a}	27.451^{ab}	22.107	3.570
High protein with prebiotic	79.142^{a}	28.262^{a}	22.980	3.330
Low protein without prebiotic	78.960^{a}	25.258^{c}	23.105	3.337
Low protein with prebiotic	76.790^{b}	26.102^{bc}	23.143	3.521
SEM	0.613	0.610	0.478	0.260

Means with different superscripts in each column differ significantly ($p<0.05$)

Prebiotics are short-chain carbohydrates that are indigestible by human, animal and poultry digestive systems. Prebiotics stimulate the growth and/or activity of a select number of bacteria in the GIT and improve the host's health. (Cummings and Macfarlane, 2002; Cummings *et al*., 2001; Patterson and Burkholder, 2003). The major effects of prebiotics have been reviewed by Cummings and Macfarlane (2002) and include: production of short-chain fatty acids and lactate, selective increases in bifidobacteria and lactobacilli, increase in pathogen resistance and improved calcium and magnesium absorption. The results observed for body weight gain are in accordance with other reports (Meinz, 1993; Tangendjaja, 1993) that supplementation of Fermacto in broiler diet resulted in weight gain than those using diet without supplemented of Fermacto. These findings are also consistent with reports of improved body weight gain when broilers are fed diet supplemented with prebiotics (Ammerman and Twining, 1989; Yusrizal and Chen, 2003). Several studies have shown that addition of prebiotics to the diet of broiler, layer and pig leads to improved performance through improving gut microflora (Pelicano *et al*., 2004; Spring *et al*., 2000; Xu *et al*., 2003). Zhang (2000) reported that 0.2 or 0.4% Isomaltooligosaccharide (IMO) (a prebiotic) could improve broiler performance in the starter period. Recent report suggested that feeding of chicory beta fructans-an oligosaccharide, reduced the abdominal fat of broiler chicken (Yusrizal and Chen, 2003). In recent study, Kalavathy *et al*. (2003) found that supplementation of Lactobacillus culture significantly reduced abdominal fat. Similarly, Yusrizal and chen (2003) reported that supplementation of beta fructans from chicory had significantly produced low level of abdominal fat. Our findings are contrast with the results obtained from mentioned studies. Others have noted a lack of change in the size of the fat pad after a similar period of feeding (Waldroup *et al*., 1993). Xia *et al*. (2001) reported that dietary IMO improved survivability of chicks. These results are same with our results. It is probable that IMO supplementation altered the gastrointestinal microflora and, therefore, affected the immune system (Li *et al*., 2000; Shao *et al*., 2000). The results of the present study indicated that addition of prebiotic to broiler diets containing 90% of NRC protein recommendation (low protein diet) had similar effect on performance like control diet (high protein diet without prebiotic).

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