

The effect of selected prebiotics on performance and ileal microbiota of broiler chickens.

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Abstract

The objective of the experiment was to study the influence of lactose, inulin and modified β -glucan, as additives to maize-based diets, on the performance of broiler chickens as well as the pH in the crop, gizzard, ileum, caeca and populations of ileal microflora. Over the entire experimental period (day 1 - day 42), the animals (384 male broilers, 4 treatments, 12 replicates each) were offered maize-based diets. The control group did not contain any additive, the second group (G) contained 0.025% modified β -glucan (Biolex Beta S) third group (I) contained 0.3% inuline (Fructafit HD), fourth group (L) contained 0.02% purified lactose. Taking into consideration the entire experiment, the highest BWG values ($P < 0.05$) and the lowest FCR ($P > 0.05$) were observed in the control without additives. Lactic acid bacteria were lower ($P < 0.05$) in the L group. No effect was observed between all treatments in the population of coliform bacteria.

Introduction

Apart from many doubts concerning antibiotic growth promoters (AGP), it is also well documented that their presence in poultry diets enhances broiler growth and improves feed conversion ratio. In recent years, we have seen a growing interest in feed additives, which may act as alternatives for AGPs. This includes mixtures of organic acids, prebiotics, probiotics, symbiotics and feed enzymes. The mode of their action differs from one another but they are all considered as bacteriostatic agents. Prebiotics are generally classified as indigestible food agents that are potentially beneficial to the health of the host, due to their fermentable properties which may stimulate the growth and/or activity of one or limited number of bacteria in the colon or caecum (Gibson and Roberfroid, 1995). According to this definition, prebiotics might include a very variable and wide range of chemical substances. However, most authors are in agreement that these are carbohydrates which are not hydrolysed by the host endogenous enzymes, thus available for the microbiological fermentation in lower parts of non-ruminant gastrointestinal tract. The objective of the experiment was to study the influence of lactose, inulin and modified β -glucan as additives to maize-based diets, on the performance of broiler chickens as well as the pH in the crop, gizzard, ileum, caeca and populations of ileal microflora.

Materials and Methods

The total of 384 male broiler chickens (Cobb 500) was included in a feeding experiment. The study design consisted of four dietary treatments (12 replicates). Over the entire experimental period (day 1 - day 42), the birds were offered maize-based diets, in the starter period (days 1 - 14) and the grower period (days 15 - 42). The added additives contained the same amounts of maize in diets, no feed antibiotics were used and to prevent coccidiosis, chemical antibiotic (Lasalocid) was used. The control group did not contain any additives, the second group (G) contained 0.025% modified β -glucan (Biolex Beta S) third group (I) contained 0.3% inuline (Fructafit HD), fourth group (L) contained 0.02% purified lactose. The feed intake and body weights were registered at weekly intervals, and the feed conversion ratios (FCR) and body weight gains (BWG) were calculated. The pH in the contents of all gastrointestinal segments was measured with a combined glass/reference electrode. The dietary concentration of dry matter, crude protein and crude fat, ash and

mineral content was determined using the AOAC procedure (1990). Diluted caecal digesta for enumeration of microflora suspension was further homogenized for 2 minutes in CO₂-flushed plastic bags using stomacher homogenizer (Interscience, France). Subsequently, the samples were serially diluted in 10-fold steps using pre-reduced salt medium according to the technique of Miller and Wolin (1974). The total number of lactic acid bacteria were counted on de Man Rogosa and Sharp agar (Merck 1.10660, Darmstad, Germany), and incubated in anaerobic conditions at 37⁰C for two days, whereas the total number of coli form bacteria - on MacConkey agar (Merck 1.05465), and incubated in aerobic conditions at 37⁰C for one day, respectively. The obtained results were elaborated statistically using the statistical computer program package SAS (1996), SAS®/STAT.

Results and Discussion

The performance results of the broiler chickens are shown in Table 1. Taking into consideration the entire experiment, the highest BWG values were observed in the control group followed by G, L and I groups ($P < 0.05$). However, in starter period all experimental groups had higher BWG in comparison with the control. The highest BWG in the starter period was observed in group L ($P > 0.05$). Taking into account the entire experiment, birds receiving potential alternatives for AGPs, had the worst FCR value and, in the case of the I group - it was statistically significant ($P < 0.05$). Irrespective of the diet, there were no changes in pH value in the crop and ileal chyme. However, there was a tendency found in lower pH of gizzard chyme in group G and, in comparison with group C, a significantly lower ($P < 0.05$) in I and L groups (Table 1). Only supplementation of inulin and lactose lowered pH in caeca of broiler chickens. It is well documented that caeca in broiler chickens are the main fermentative chamber (Józefiak et al., 2004), thus the observed pH changes after the addition of fermentable sugars as inulin and lactose were not surprising. However, other authors, who observed lower pH in the caeca, used much higher amounts of lactose in the diet. Corrier et al. (1990) provided 2.5% lactose in drinking water or 10% lactose in feed to broiler chickens. Tellez et al. (1990) administrated 10% of lactose in feed. In comparison with the present experiments, both authors used 50 fold higher amounts of this prebiotic, but the pH value in the caeca was similar. Results of the present experiment suggest that lower pH (6.58 vs 6.38) in this segment of the gastrointestinal tract has minor effect on performance results.

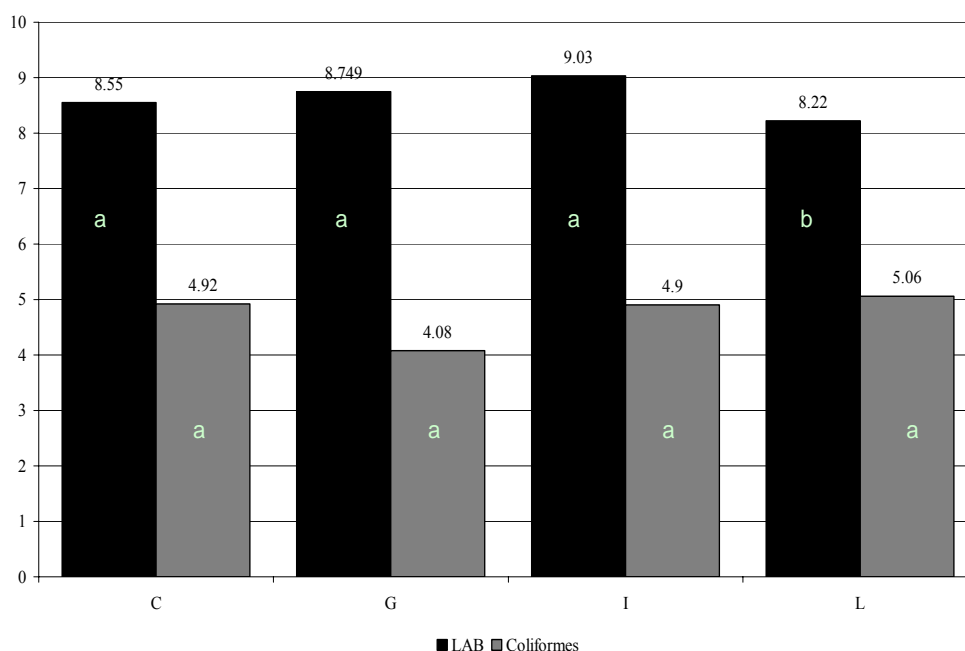
Ileum of broiler chickens is an important site of enzyme secretion and nutrient absorption. Colonization of microbiota populations which interact with one another as well as with the host-bird are closely combined with the growth performance. In the present experiment, the comparison of control group with groups G and I, lactic acid bacteria tended to be at higher level but in group L - significantly ($P < 0.05$) lower (Figure 1). No effect was observed between all treatments in population of coliform bacteria. Probably more pressure on microbiota populations could be observed in lower parts of the GIT (i.e. caeca) where also changes in pH were marked. However, it is suggested that potentially pathogenic bacteria influence absorption processes stronger in the ileum. Thus, even though this region of the GIT is less colonized, the competition of bacteria with the host has important effects on performance. This is why it is suggested that, similarly to AGPs, potential alternatives should affect also this part of the GIT.

The results of the present experiment strongly question the effectiveness of tested additives as potential growth promoting agents in broiler chicken production. Even though in some segments (i.e. caeca) of the gastrointestinal tract lower pH was observed. On the other hand, it is hard to estimate potential effects of those prebiotics in experimental condition, where stress factors are lower and hygiene standards higher than in the field.

Table 1. Performance of the broiler chickens and pH value in gastrointestinal segments

	Treatments			
	C	G	I	L
Body weight gain (g)				
0-14	280.8 ^b	287.4 ^a	286.6 ^a	299.9 ^a
15-42	1948.3 ^a	1858.3 ^b	1835.7 ^b	1834.2 ^{bc}
0-42	2229.1 ^a	2145.8 ^b	2122.3 ^b	2134.2 ^c
Feed conversion ratio (kg feed/kg BWG)				
0-14	1.66 ^b	1.64 ^b	1.76 ^a	1.60 ^b
15-32	1.98 ^b	2.00 ^b	2.29 ^a	2.04 ^b
0-42	1.94 ^b	1.95 ^b	2.22 ^a	1.98 ^b
pH value				
Crop	4.82 ^a	4.90 ^a	4.87 ^a	4.82 ^a
Gizzard	4.10 ^a	3.87 ^{ab}	3.65 ^b	3.69 ^b
Ileum	5.80 ^a	5.93 ^a	5.79 ^a	5.89 ^a
Caeca	6.58 ^a	6.58 ^a	6.12 ^b	6.31 ^b

Figure 2. Lactic acid bacteria (LAB) and coliformes populations (log cfu \times g⁻¹ digesta) in ileal chyme



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