

Effects of mannanoligosaccharides on composition of the cecal microflora and performance of broiler chickens

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Abstract

A study was conducted to evaluate the effect of mannanoligosaccharides (MOS) on the composition of the cecal microflora and growth performance of broiler chickens. In this study, 300 one-d-old (male + female) broiler chickens (Cobb) were divided into three groups of 100 chickens each. During the starter (0-21d) and grower-finisher (22 to 42d) stages all groups were fed a standard basal starter and finisher diets. The treatments were: 1) Negative control (NC) (no additive); 2) MOS (Bio-Mos[®], Alltech Inc), 2.0 kg/ t (0-21d) and 1.0 kg/t (22-42d) and 3) Positive control (PC) (Avilamycin, 10 ppm/kg). At the end of the trial (42 d) five birds from each group were sacrificed and intestinal sections frozen in glycerin-salt solution. The following bacterial populations were enumerated – Total anaerobes, coliforms, lactobacilli, bifidobacteria, enterococci, salmonella and *Cl. perfringens*. Feeding MOS in the diet resulted in the enhanced growth of beneficial microorganisms, regulated the microbial environment in the cecum, and significantly increased the count of lactobacilli and bifidobacteria. Feeding MOS in the diet depressed *Cl. perfringens* and coliforms in cecal content, in comparison to the NC and PC. MOS significantly affected the live body weight of broiler chickens at 21d and 42d compared to the NC and the PC fed groups ($P < 0.001$). MOS improved FCR (0-42d) compared to NC and PC, 1.768 vs. 1.915, and 1.799 respectively. Supplementing MOS or Avilamycin in the diets improved feed efficiency by 7.68% and 6.06% compared to NC. MOS also decreased broiler mortality by 2% and 4% compared to PC and NC, respectively. These results suggest that MOS can provide an alternative to the growth promoting antibiotic Avilamycin in broiler nutrition. In addition, the results suggest that MOS may be useful in controlling *Cl. perfringens*, an agent implicated in necrotic enteritis in broilers.

Introduction

The ban of antibiotic growth promoters in many countries worldwide has forced the broiler industry to search of natural alternative growth promoters to maintain of broiler performance and to control of diseases without antibiotics.

The objective of the present study was to examine the effect of mannanoligosaccharides (MOS) on the cecal microflora and growth performance of broiler chickens.

Materials and Methods

Chickens, diet, and housing. Three hundred one-d-old (male + female) broiler chickens (Cobb) supplied by a commercial broiler hatchery were used in the current experiment. The chickens were divided into three groups of 100 chickens each. During the starter (0-21d) and growth-finisher (22-42d) periods all groups were fed the standard basal starter and finisher diets. The treatments considered of: 1) Negative control (NC) (no additive); 2) MOS (Bio-Mos[®], Alltech Inc., USA), 2.0 kg per ton of feed for the first three weeks (0-21d) and 1.0 kg/t of feed thereafter (22-42d); 3) Positive control (PC) (Avilamycin (10 ppm/kg of feed). Throughout the growth period, feed and water were provided without restriction (*ad libitum*). The chickens were reared in heated premises on floors covered with fresh pine shavings. The environmental temperature, ventilation and photoperiod (light cycle) were regulated according to standard management practices for bird age and external weather.

Sampling procedures. At the end of the trial (42d) five birds from each group were randomly selected and killed by neck dislocation for collection of cecal contents. By using

aseptic techniques, both cecum with contents were ligated and removed from the dissected body cavity. The samples were placed in Whirl-Pak plastic bags containing 100 ml of glycerin-salt solution, mixing well. Samples were frozen and shipped with dry ice and stored in a freezer at -80 °C until analyzed. The contents of the cecum were collected aseptically, serially diluted in sterile pre-reduced anaerobic dilution solution, according to procedures described by Holdeman and Moore (1977). The serially diluted cecal contents were used for the enumeration of the anaerobic and facultative anaerobic organisms.

Microbiological analyses. The viable numbers of microbes in the cecal contents were enumerated using various media:

Bacterial Group	Medium
Total anaerobic bacteria (TAB)	Reinforced clostridial agar
Lactobacilli	Rogosa SL agar
Bifidobacteria	BS-LV agar
Enterococci	Slanetz and Bartley Medium
Coliforms	MacConkey Agar No 3
<i>Clostridium perfringens</i>	Perfringens selective agar

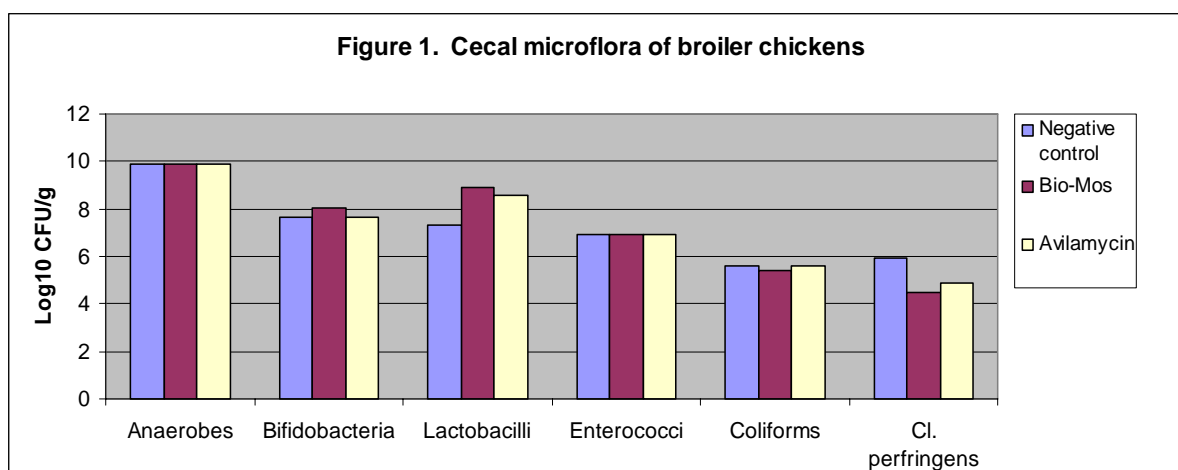
Enumeration method. The diluted cecal contents (0.1 ml) were incorporated into plates of Reinforced clostridial agar, Rogosa SL Agar, BS-LV agar, Slanetz and Bartley Medium, MacConkey's Agar, and Perfringens selective agar to enumerate the TAB, lactobacilli, bifidobacteria, enterococci, coliforms, and *Cl. perfringens* respectively. The plates were incubated anaerobically in Gas Pak jars at 37°C for 5 days (total anaerobic and *Cl. perfringens* count,) and for 48 h (lactobacilli and bifidobacteria) or aerobically at 37°C for 24 h (coliforms), and for 48 h (enterococci) as recommended by the manufacturer of the selective media. Anaerobic conditions were achieved using the Gas Pac system (BBL Microbiology Systems, Cockeysville, MD. U.S.A.). The total colony counts per g of undiluted cecal content from each medium were obtained as the weighed mean from two or three highest duplicate dilutions that showed growth.

Performance data. a) Body weight (BW) was recorded individually before feeding; b) Daily weight gain (DWG) (at 21st and 42nd d); c) Feed conversion ratio (FCR) was calculated at 42d on the basis of kg of feed/kg weight gain.

Statistical analysis. All bacterial populations estimates were calculated and reported on a per g (wet weight) basis of cecal content. The mean and standard deviation of the bacterial counts (CFU/g) were calculated using logarithmic values. Student's *t*-test, conducted using Microsoft® Excel and computer program "STATISTIKA" was used to determine the significance of the differences between the experimental groups.

Results and Discussion

Effects of MOS and Avilamycin on the cecal microflora are summarized in Fig.1. There was no difference in the total count of anaerobes and in the count of enterococci in cecal contents of broiler chickens from the different experimental groups. MOS enhanced growth of beneficial microorganisms, regulated the microbial environment in the cecum, and significantly increased the number of lactobacilli and bifidobacteria (P<0.05). MOS depressed the number of *Cl. perfringens* (P<0.01) and coliforms (P<0.05) in cecal content, in comparison to the NC and Avilamycin fed groups. There was no significant difference in the total number of anaerobes, lactobacilli, bifidobacteria, enterococci, and coliforms present in the cecum of the NC and Avilamycin-fed groups. There was a significant reduction of *Cl. perfringens* in the Avilamycin treated group as compared to the NC (P<0.05).



MOS significantly affected the live BW of broilers at 21st and 42nd d, compared to the NC and the PC groups ($P < 0.001$). BW was significantly increased by Avilamycin in comparison with the NC ($P < 0.001$). DWG of broiler chickens was significantly affected also by the dietary treatments. MOS had significantly improved DWG to 21st and 42nd d, compared to the NC ($P < 0.001$), as well as to PC group (0-21st d) ($P < 0.001$) and has equal effect between 21 and 42 d, compared to the Avilamycin supplemented control. There was significant difference between NC and PC groups too ($P < 0.001$). In the current study (0-42 d). MOS improves FCR - 1.768, v. s. 1.915 and 1.799 (kg/kg), compared to the NC and PC, respectively. The supplementation of MOS and Avilamycin in the diets of broiler chickens improved feed efficiency by 7.68% and 6.06% in comparison with a NC (Table 1.). MOS also decreased mortality of broiler chickens with 2% and 4%, compared to the Avilamycin fed group and NC, respectively.

Table 1. Effects of MOS on broiler performance

	Negative control (NC)	MOS	Avilamycin (PC)
Body Weight (kg)			
21 day	0.759±0.00215 ^a	0.797±0.0022 ^b	0.778±0.0024 ^c
42 day	2.126±0.0174 ^a	2.242±0.0087 ^b	2.205±0.0115 ^c
D W G (kg)			
0 – 21 day	0.0353±0.00069 ^a	0.0359±0.00011 ^b	0.0356±0.00018 ^c
22 – 42 day	0.0649±0.00067 ^a	0.0690±0.00034 ^b	0.0690±0.00032 ^b
F R C (kg/kg)			
0 - 42 day	1.915 (100%)	1.768 (92.32%)	1.799 (93.94%)

* a - c Means within the same row with different superscripts are significantly different ($P < 0.001$)

Conclusions

These results suggest that MOS (Bio-Mos[®], Alltech Inc., USA) provide an alternative to growth promoting antibiotic Avilamycin in broiler nutrition. Since *Cl. perfringens* has been implicated as an agent in necrotic enteritis in broilers, MOS may be useful in maintaining a healthier balance in the cecal microflora, and can reduce or replace antibiotics used for growth promotion in broiler chickens.

References

Holdeman, L.V., and Moore W.E.C. 1977. Anaerobe Laboratory Manual, 4th ed. Virginia Polytechnic Institute and State Univ. Anaerobe Laboratory, Blacksburg, USA