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Evaluation of Bio-Mos® Mannan Oligosaccharide as a Replacement For Growth Promoting Antibiotics in Diets for Turkeys[1]

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Abstract: A study was conducted to evaluate the use of Bio-Mos®, a mannan oligosaccharide derived from the cell wall of yeast, as a potential replacement for growth promoting antibiotics in the diet of growing turkeys. Bio-Mos® was added to nutritionally complete turkey diets at the rate of 0.05 and 0.10%. The growth-promoting antibiotics bambermycins and bacitracin methylene disalicylate (BMD) were added at 2.2 and 55 mg/kg, respectively. One group was fed the diet with no supplements and served as the negative control. Male turkeys of a commercial Large White strain were fed the test diets from day old to 20 wk of age. Birds were weighed at intervals through the trial and samples of birds processed at 20 wk for parts yield and determination of intestinal breaking strength. Body weight, mortality, breast meat yield, and intestinal breaking strength were not significantly ($P < 0.05$) influenced by dietary treatments. Feed conversion from 0 to 20 wk of age was significantly improved by both BMD and 0.10% Bio-Mos®. The addition of BMD significantly reduced the percentage of abdominal fat in the carcass. These results suggest that Bio-Mos® might be considered as a part of an overall feeding and management program to aid in overcoming potential loss of growth-promoting antibiotics.

Key words: Mannan oligosaccharide, Bio-Mos®, antibiotics, turkeys

Introduction

The use of antibiotics for growth promotion in poultry species has been banned in many countries and there is a strong possibility that they may face similar legislation in other areas of the world. Therefore, nutritionists and production managers are interested in compounds that may serve as possible replacements. Bio-Mos®, a mannan oligosaccharide derived from the cell wall of the yeast *Saccharomyces cerevisiae*, has shown promise in suppressing enteric pathogens, modulating the immune response, and improving the integrity of the intestinal mucosa in studies with chickens and turkeys (Spring, 1999a, 1999b; Iji *et al.*, 2001; Sonmez and Eren, 1999; Spring *et al.*, 2000; Savage and Zakrzewska, 1997). The following study was conducted to evaluate the use of Bio-Mos® in diets for growing turkeys in comparison to commonly used growth-promoting antibiotics.

Materials and Methods

One-day old male poults of a commercial strain of Large White turkeys[2] were obtained from a local hatchery. Fifteen poults were randomly assigned to each of 48 litter-floor pens (5.6 m^2) in a house of commercial design. Previously used softwood shavings with a top dressing of new shavings served as bedding over concrete floors. Each pen was equipped with two tube feeders and an automatic water font. Supplemental feeders and water founts were used for the first 7 d. At 8 wk a small range-type feeder replaced the tube feeders. Automatic brooder stoves, ventilation fans, and sidewall curtains controlled temperature and airflow rates. Bird management and care followed approved guidelines (FASS, 1999).

Diets were formulated to meet or exceed 105 % of the amino acid recommendations of the National Research Council (1994). Corn and soybean meal served as the primary ingredients. A blended animal protein product[3] was added to all diets at the rate of 5 %, as most turkey diets in the United States contain animal protein. The metabolizable energy content of the diet was adjusted so as to require approximately 2 % supplemental poultry oil, an amount deemed satisfactory to allow the production of a firm pellet. Diets were adequately fortified with vitamins and trace minerals using supplements obtained from commercial turkey producers. Composition and nutrient content of the diets is shown in Table 1.

Within each age period, a large batch of the basal diet was mixed. The dietary treatments were prepared using aliquots of the basal diet. Five treatments were compared

[1]Published with approval of the Director, Arkansas Agricultural Experiment Station. Mention of a trade name, proprietary product, or specific equipment does not constitute a guarantee or warranty by the University of Arkansas and does not imply its approval to the exclusion of other products that may be suitable.
[2]Nicholas Turkey Breeder Farms, Sonoma CA 95476.
[3]Pro-Pak, H. J. Baker & Bro., 595 Summer Street, Stamford, CT 06901-1407.

Table 1: Composition (g/kg) and nutrient content of experimental diets

Ingredient	Age fed (weeks)				
	0-4	4-8	8-12	12-16	16-20
Yellow corn	424.30	494.65	605.17	690.72	760.13
Soybean meal (48% CP)	459.20	398.72	292.98	213.01	146.96
Pro-Pak[1]	50.00	50.00	50.00	50.00	50.00
Poultry oil	22.50	21.54	21.05	20.54	22.12
Iodized salt	5.23	3.90	3.93	3.90	3.87
Ground limestone	11.76	9.56	8.29	6.98	6.25
Dicalcium phosphate	17.84	12.50	8.95	7.18	4.26
DL-Methionine (98%)	1.88	1.31	0.79	0.13	0.00
L-Lysine HCl (98%)	0.79	1.31	2.25	0.80	0.27
L-Threonine	0.00	0.01	0.09	0.74	0.14
Vitamin premix[2]	5.00	5.00	5.00	5.00	5.00
Trace mineral mix[3]	1.00	1.00	1.00	1.00	1.00
Coban-60[4]	0.50	0.50	0.50	0.00	0.00
Total	1000.00	1000.00	1000.00	1000.00	1000.00
Nutrient content[5]					
ME, kcal/kg	2870.00	2950.00	3060.00	3140.00	3220.00
CP, %	28.70	26.45	22.44	19.25	16.60
Met, %	0.66	0.58	0.48	0.37	0.33
TSAA, %	1.13	1.02	0.86	0.71	0.63
Lys, %	1.72	1.31	1.39	1.06	0.85
Thr, %	1.10	1.01	0.86	0.80	0.63

[1]H. J. Baker & Bro., 595 Summer Street, Stamford, CT 06901-1407.
[2]Provides per kg of diet: vitamin A (from vitamin A acetate16,520 IU; cholecalciferol 7158 IU; vitamin E (from dl-alpha-tocopheryl acetate) 50 IU; vitamin B_{12} 0.022 mg; riboflavin 13.75 mg; niacin 109 mg; pantothenic acid 30 mg; menadione (from menadione dimethylpyrimidinol) 3.8 mg; folic acid 2.2 mg; choline 1040 mg; thiamin (from thiamin mononitrate) 3.3 mg; pyridoxine (from pyridoxine HCl) 5.5 mg; d-biotin 0.181 mg; ethoxyquin 125 mg; Se 0.2 mg.
[3]Provides per kg of diet: Mn (from $MnSO_4 \cdot H_20$) 100 mg; Zn (from $ZnSO_4 \cdot 7H_2O$) 100 mg; Fe (from $FeSO_4 \cdot 7H_2O$) 50 mg; Cu (from $CuSO_4 \cdot 5H_20$) 10 mg; I from $Ca(IO_3)_2 \cdot H_20$), 1 mg. [4]Elanco Animal Health division of Eli Lilly & Co., Indianapolis, IN 46825. [5]Calculated from NRC (1994).

Table 2: Effects of Bio-Mos mannan oligosaccharide, bacitracin methylene disalicylate, and Bambermycins on body weight (kg) of male Large White turkeys

Treatment	Age (weeks)				
	4	8	12	16	20
Negative control	1.094	4.161	8.684	13.044	17.078
Bio-Mos 0.05%	1.053	4.121	8.435	12.802	16.719
Bio-Mos 0.10%	1.115	4.159	8.653	13.299	16.614
Bacitracin methylene disalicylate 55 mg/kg	1.100	4.082	8.602	13.118	17.035
Bambermycins 2.2 mg/kg	1.091	4.154	8.649	13.228	17.422
Probability > F	0.34	0.91	0.61	0.40	0.10
SEM	0.023	0.067	0.12	0.185	0.21

as follows: 1) negative control with no further additives; 2) Bio-Mos®[4] at 0.05% of the diet; 3) Bio-Mos® at 0.1% of the diet; 4) bacitracin methylene disalicylate (BMD)[5] at 55 mg/kg; and 5) bambermycins[6] at 2.2 mg/kg. BMD and bambermycins are the two most widely used antibiotics in turkey diets in the United States. All diets were pelleted with steam; diets fed from 0 to 4 wks of age were crumbled. Ten pens were assigned to each dietary

[4]Alltech, Inc., Nicholasville KY 40356.
[5]BMD-50, Alpharma, Inc., Ft. Lee, NJ 07024.
[6]Flavomycin, Hoechst-Roussel Agri-Vet Company, Somerville NJ 08876.

Table 3: Effects of Bio-Mos mannan oligosaccharide, bacitracin methylene disalicylate, and Bambermycins on feed conversion (kg feed per kg gain) of male Large White turkeys

Treatment	Age (weeks)				
	0-4	0-8	0-12	0-16	0-20
Negative control	1.411[b]	1.702[b]	1.981	2.677	3.062[a]
Bio-Mos 0.05%	1.488[a]	1.762[a]	2.073	2.594	3.055[a]
Bio-Mos 0.1%	1.512[a]	1.706[ab]	2.060	2.539	2.808[b]
Bacitracin methylene disalicylate 55 mg/kg	1.399[b]	1.720[ab]	2.003	2.554	2.824[b]
Bambermycins 2.2 mg/kg	1.393[b]	1.662[b]	1.979	2.603	2.920[ab]
Probability > F	0.003	0.04	0.19	0.51	0.03
SEM	0.024	0.022	0.03	0.058	0.064

[ab]Means in columns with common superscripts do not differ significantly ($P \leq 0.05$).

Table 4: Effects of Bio-Mos mannan oligosaccharide, bacitracin methylene disalicylate, and Bambermycins on mortality (%) of male Large White turkeys

Treatment	Age (weeks)				
	0-4	0-8	0-12	0-16	0-20
Negative control	2.00	3.33	4.60	8.66	14.00
Bio-Mos 0.05%	1.33	2.67	4.00	6.67	12.00
Bio-Mos 0.1%	1.66	2.50	4.16	6.67	13.33
Bacitracin methylene disalicylate 55 mg/kg	1.33	3.33	8.66	14.00	15.33
Bambermycins 2.2 mg/kg	2.00	3.33	4.00	8.66	12.00
Probability > F	0.27	0.90	0.24	0.25	0.57
SEM	0.33	1.33	3.3	3.3	3.7

Table 5: Effects of Bio-Mos mannan oligosaccharide, bacitracin methylene disalicylate, and Bambermycins on carcass and intestinal traits of male Large White turkeys

Treatment	Breast% of carcass	Abdominal Fat % of carcass	Intestinal Break Force (kg)
Negative control	30.16	1.18[a]	1.106
Bio-Mos 0.05%	30.72	1.11[a]	1.141
Bio-Mos 0.1%	30.39	0.93[ab]	1.086
Bacitracin methylene disalicylate 55 mg/kg	30.41	0.82[b]	1.055
Bambermycins 2.2 mg/kg	30.81	1.02[ab]	1.093
Probability > F	0.54	0.04	0.80
SEM	0.31	0.089	0.05

[ab]Means in columns with common superscripts do not differ significantly ($P \leq 0.05$).

treatment with the exception of treatment 2 (0.05% Bio-Mos®), which was fed to eight replicate pens.

Poults and feed were weighed at 4 wk intervals throughout the study. Any bird that died was weighed with the weight used to adjust feed conversion (feed conversion ratio; kg feed per kg gain). At 20 wk of age, four birds per pen, chosen to be nearest to the pen mean, were fasted for 12 hr with water available before being transported 2 km to the University processing plant where they were processed using manual evisceration. Parts yield and abdominal fat were determined on chilled carcasses. During processing, a 10 cm segment of the jejunum was taken approximately 2 cm posterior to Meckel's diverticulum, cleaned of any residual feed, and subjected to breaking strength as described by Huff *et al.* (1994).

Data were analyzed as a one-way ANOVA using the General Linear Models option of SAS (SAS Institute, 1991). Pen means served as the experimental unit. All percentage data were transformed to arc sine prior to analysis; data are presented as natural numbers. Mortality data were transformed to $\sqrt{n+1}$. Natural numbers are presented in the tables. Statements of statistical significance are based upon a probability of $P < 0.05$.

Results and Discussion

None of the dietary treatments had any significant effect on body weight at any age, as compared to those fed the negative control (Table 2). Body weights were equal or superior to the standard weights suggested by the NRC (1994), indicating that the birds were growing well and perhaps did not need antibiotic supplementation to attain maximum growth rate.

None of the dietary treatments resulted in a significant improvement in feed conversion (grams of feed per gram

of gain) at any age period up to 20 weeks of age (Table 3). However, over the entire 20 wk feeding period the inclusion of either 0.1% Bio-Mos® or 55 mg/kg of BMD resulted in a significant improvement in feed conversion as compared to poults fed the negative control diet. Mortality was not significantly affected by dietary treatment (Table 4).

Breast meat yield was not significantly affected by addition of either Bio-Mos® or the antibiotics BMD or bambermycins (Table 5). Abdominal fat, expressed as percentage of the chilled carcass, was significantly reduced by addition of 55 mg/kg BMD. Abdominal fat content of birds fed 0.1% Bio-Mos® or 2.2 mg/kg bambermycins was intermediate between that of poults fed the negative control diet and those fed the BMD. Intestinal breaking force was not significantly influenced by any of the dietary treatments in comparison to the negative control group.

Few published reports deal with the use of Bio-Mos® or other mannan oligosaccharides in the diet of turkeys grown to market weights. The results of the present study are in agreement with the reports of Olsen (1996) and Savage and Zakrzewska (1997) who reported that turkeys fed diets with Bio-Mos® had significantly improved feed conversion in the absence of improved body weight gain. In another study, Savage and Zakrzewska (1996) reported significantly improved body weight gain and feed conversion in turkey poults fed to eight weeks of age. In a study conducted to three weeks of age, Fairchild *et al.* (2001) reported that both Bio-Mos® and bambermycins significantly improved body weight gains of turkey poults. In contrast, Valancony *et al.* (2001) compared the antibiotic avilamycin and Bio-Mos® in diets fed to turkeys grown to slaughter weights and observed no difference in slaughter weight or carcass yield; no mention was made regarding feed conversion.

Results of the present study, in agreement with other published studies, suggests that Bio-Mos® might be considered as a part of an overall feeding and management program to aid in overcoming potential loss of growth-promoting antibiotics.

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References

Fairchild, A. S., J. L. Grimes, F. W. Edens, M. J. Wineland, F. T. Jones and A. E. Sefton, 2001. The effect of hen age, Bio-Mos, and Flavomycin on poult susceptibility to oral Escherichia coli challenge. Zootechnia Int., 24 :46-47.

FASS, 1999. Guide For the Care and Use of Agricultural Animals in Agricultural Research and Teaching. 1st rev. ed. Federation of Animal Science Societies, Savoy IL.

Huff, W. E., J. M. Balog, G. R. Bayyari and N.C. Rath, 1994. The effect of Mycocurb®, propionic acid, and calcium propionate on the intestinal strength of broiler chickens. Poult. Sci., 73:1352-1356.

Iji, P. A., A. A. Saki and D. R. Tivey, 2001. Intestinal structure and function of broiler chickens on diets supplemented with a mannan oligosaccharide. J. Sci. Food Agric., 81: 1186-1192.

National Research Council, 1994. Nutrient Requirements of Poultry. 9th rev. ed. National Academy Press, Washington, DC.

Olsen, R., 1996. Experience with mannan oligosaccharides in commercial turkey production. Zootech. Int., 19 :38-39.

SAS Institute, 1991. SAS® User's Guide: Statistics. Version 6.03 edition. SAS Institute, Inc., Cary, NC.

Savage, T. F. and E. I. Zakrzewska, 1996. The performance of male turkeys fed a starter diet containing a manna-oligosaccharide (Bio-Mos) from day old to eight weeks of age. Pages 47-54 in: Biotechnology in The Feed Industry. Proceedings of Alltech's 12th Annual Symposium. T. P. Lyons and K. A. Jacques, ed. Nottingham University Press, Nottingham, UK.

Savage, T.F. and E. I. Zakrzewska, 1997. The performance of male turkeys fed a starter diet containing a mannan oligosaccharide. Zootech. Int., 20: 30-32.

Sonmez, G. and M. Eren, 1999. Effects of supplementation of zinc bacitracin, mannan oligosaccharide, and probiotic into the broiler feeds on morphology of the small intestine. Vet. Fac. Dergisi Uludag Univ., 18:125-138.

Spring, P., C. Wenk, K. A. Dawson and K. E. Newman, 2000. The effects of dietary mannan oligosaccharides on cecal parameters and the concentrations of enteric bacteria in the ceca of salmonella-challenged broiler chicks. Poult. Sci., 79: 205-211.

Spring, P., 1999a. Mannanoligosaccharides as an alternative to antibiotic use in Europe. Zootech. Int., 22: 38-41.

Spring, P., 1999b. Modes of action of dietary mannan oligosaccharide R as a growth enhancer. Zootech. Int., 22: 34-36.

Valancony, H., F. Humbert, J. Rukelibuga, M. Bougon, L. Balaine and F. Lalande, 2001. Comparison of some substitutes for antibiotic additives in diets for turkey poults. Effects on production and on resistance to salmonella colonization. Sci. Tech. Avicoles, 35:25-34.