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Flavonoids and Mannanoligosaccharides in Broiler Diets

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■ Keywords

Antibiotic, broilers, flavonoids, mannan oligosaccharides, probiotic.

INTRODUCTION

This experiment was carried out at the at the poultry sector of the School of Veterinary Medicine and Animal Science – UNESP, Botucatu campus, and aimed at evaluating the effect of the inclusion of flavonoids along with mannan oligosaccharides (MOS) as compared to other additives on the performance, carcass and parts yields, and meat quality of broilers reared from 1 to 42 days of age. A total number of 1500 Cobb broilers were distributed according to a completely randomized experimental design into five treatments, with six replicates of 50 birds each. Treatments consisted of a control group, probiotic 1, probiotic 2, antibiotic, and flavonoids+MOS. For the period of 1 to 42 days of age, there were no differences among treatments as to daily weight gain, feed intake, mortality, and final body weight, but a significant difference was found for feed conversion ratio for the flavonoids+MOS treatment. Carcass and parts yields were not significantly influenced by the treatments. Tbars number, which indicates meat fat oxidation index, was significantly different in both refrigerated and frozen meat. The lowest oxidation index was obtained with the flavonoids+MOS treatments. Under the conditions of the present study, the supplementation of broiler diets with flavonoids+MOS was effective.

INTRODUCTION

Brazil is presently the world largest exporter of poultry meat. Brazilian poultry meat production chain generates more the US$10 billion annually, and more than one million direct and indirect job positions (Sbrissia, 2005).

One of the consequences of the increase in poultry production was the use of additives in animal nutrition to maximize performance indexes. Poultry production is presently highly dependent on the use of growth promoter to maintain high productivity levels. However, there is an increasing search for alternatives to practices that may pose risks to the consumers' health (Miltenburg, 2000).

The global concern with food safety is based on the possibility of the selection of bacteria resistant to antibiotics, which would be caused by the indiscriminate use of antibiotics used as growth promoters (Palermo Neto, 2002).

In the European Union, the ban of the use of antibiotic growth promoters was effective since January 1st, 2006, and coccidiostats and histomonostats will be banned in January (Comunidade Européia, 2002).

In Brazil, the following growth promoters were banned in 1998: tetracycline, penicillin, sulfonamide, chloramphenicol; in 2002, 3-nitro acid was banned, and in 2003, nitrofurazone and furazolidone (Demattê, Therefore, global market demands include the search for alternatives for antibiotic growth promoters, with no losses in performance. The main focus of the action of these alternative products is the gastrointestinal physiology. Research studies have demonstrated that organic acids, enzymes, symbiotics, prebiotics, probiotics, and phytogenic additives added to feeds may promote similar animal performance as to that achieved by conventional growth promoters (Nonboe, 1999).

Among the investigated alternatives, prebiotics, particularly mannan oligosaccharides, and phytogenic additives, such as flavonoids, are discussed here.

Prebiotics are defined as feed ingredients that are not digested in the gastrointestinal tract of monogastric animals, and that benefit the host by selectively stimulating the growth and/or metabolism of a limited group of bacteria in the gut (Gibson & Roberfroid, 1995). Ferket *et al.* (2002), working with turkeys, reported better performance when the feed was supplemented with mannan oligosaccharides.

Flavonoids are polyphenolic compounds, and their proven antioxidant properties yield several benefits to the body. Sebastián *et al* (2003) reported better carcass quality when flavonoids were added to swine diets.

Therefore, the present study aimed at evaluating the effects of flavonoids, mannan oligosaccharides, probiotics, and antibiotics on the performance, carcass yield, parts yield, and meat quality of 42-day-old broilers.

MATERIAL AND METHODS

This study was carried at the poultry sector of the School of Veterinary Medicine and Animal Science – UNESP, Botucatu campus, from February to April, 2004.

A total number 1500 male Cobb 500 broilers was used. Birds were weighed, and distributed into 5 treatments (control, probiotic 1, probiotic 2, antibiotic, flavonoids+ MOS), as shown in Table 1. A completely randomized experimental designed was applied, consisting of five treatments with 6 replicates of 50 birds each.

Feed and water were offered *ad libitum*. All feeds contained the coccidiostat sodium monensin, which was withdrawn when birds were 35 days of age. Diets were formulated to contain the same nutrient levels, and the only change was the additive used. All additives were added to the feeds as powder.

Performance data were measured for the period of 1 to 42 days of age. Body weight was determined per box. Daily weight gain was calculated as average final weight minus average initial weight, and dividing the result by the number of experimental days. Average feed intake was calculated as supplied feed minus feed residue at the end of the experimental period, and dividing the result by the average number of birds. Feed conversion ratio was calculated as the ratio between total feed intake and total weight gain plus weight gain of dead birds. Mortality was daily recorded, and the data, before being submitted to analysis of variance, were transformed into the square root of $(x + 0.5)^{1/2}$, where x is mortality percentage (Steel & Torrie, 1980). All dead birds were weighed to correct feed intake and feed conversion ratio.

At 42 days of age, four birds per box were removed (24 per treatment, 120 birds total), individually identified by leg bands, and after being submitted to 8 hours fasting, they were slaughtered at the experimental slaughter plant of FMVZ/UNESP, Botucatu Campus, SP.

Carcass yield and part yield were calculated on live weight and carcass weight basis. Live weight was measured immediately before slaughter. Carcass weight was considered as carcass weight with no neck, feet, and abdominal fat. The following parts were evaluated: breast, legs (thighs+legs), back, wings, and thigh meat and breast meat. Yields were determined according to the methodology described by Mendes (1990).

To evaluate meat quality, leg samples were collected during slaughter, identified by leg bands, and frozen, if necessary.

Tbars number, which indicated the degree of fat oxidation, was determined by the distillation method recommended by Pikul *et al.* (1989). Legs were analyzed in two periods: refrigerated meat (meat

Table 1 - Experimental treatments.

Treatment	Description
Control	No additive
Probiotic 1	*Bacillus subtillis*: inclusion of 400 ppm during the entire experimental period
Probiotic 2	*Bacillus licheniformis* associated to *Bacillus subtillis* at an inclusion of 1000 ppm from day 1 to 21, and inclusion of 500 ppm from day 22 to 42
Antibiotic	Avilamycin at an inclusion of 10 ppm from 1 to 35 days of age

refrigerated at 4ºC for four days), and frozen meat (meat frozen at -18ºC for six months).

Data were analyzed by analysis of variance, using SISVAR statistical package, as described by Ferreira (1998), and means were compared by the test of Tukey at 5% significance level.

RESULTS AND DISCUSSION

Performance results are presented in Table 2.

Considering the period of 1 to 42 days of age, there was no significant effect (p>0.05) of treatments on average body weight, daily weight gain, feed intake, or mortality. There was a significant effect (p<0,05) of the treatments on feed conversion ratio, with the broilers fed flavonoids + MOS presenting the best feed conversion ratio. Vargas Jr. *et al*. (2001) did not report significant differences in the performance of broiler fed diets supplemented with prebiotics and probiotics; however, as in the present study, flavonoids were also added with the prebiotic, this association may have favored an improvement in feed conversion ratio.

Table 3 presents carcass yield results.

Treatments had no influence (p>0.05) on carcass yield or leg, back, breast, and leg percentages. These results are consistent with those of Sartori *et al*. (2003), Gonçalves *et al*. (2002), and Pelicia (2004). However, Moreira *et al*. (2001) observed higher breast yield in broilers fed antibiotic-supplemented diets.

Leg meat and breast meat yield results are shown in Table 4.

The results obtained in the present study showed that the experimental treatments had no effect (p>0.05) on leg meat and breast meat yields. These results are in agreement with the studies of Maiorka (2001) and Loddi (2000), who did not find significant differences in these parameters when feeding broilers with diets supplemented with prebiotic and probiotic.

Table 4 - Breast meat yield and leg (legs + thighs) meat yield of broilers.

Treatment	Breast* (%)	Leg* (%)
Control	28.51	33.93
Probiotic 1	30.51	36.80
Probiotic 2	27.82	38.24
Antibiotic	26.42	36.87
Flavonoids + MOS	29.51	37.24
General mean	26.58	36.61
C.V. (%)	38.97	21.10

= Not significant (p>0.05).

The results observed in the present experiment for carcass, parts, leg meat, and breast meat yields were expected, as several literature studies reported that prebiotics, probiotics, and antibiotics present similar effects on the control of the intestinal microflora and on the transformation of ingested feed into meat (Pelicia, 2004).

The results for Tbars number in thigh meat are presented in Table 5.

Tbars number results were significantly different among experimental treatments, both in refrigerated and frozen meat. Tbars number scale ranges from 0 to 1, with lower number indicating lower meat oxidation. Thigh meat was used to analyze Tbars number as it presents higher fat

Table 2 - Performance of 1-42-day-old broilers.

Treatment	Average body weight (42 d) (g)*	Daily weight gain (g)*	Mortal. (%)*	Feed intake (g)*	Feed conversion ratio
Control	2660	62.33	1.75	4682	1.79 [ab]
Probiotic 1	2643	61.90	1.75	4663	1.79 [ab]
Probiotic 2	2637	61.80	1.52	4769	1.84 [b]
Antibiotic	2643	61.91	1.60	4662	1.79 [ab]
Flavonoids + MOS	2680	62.80	1.32	4658	1.76 [a]
General mean	2653	62.15	1.59	4687	1.80
C.V. (%)	2.52	2.56	32.78	1.97	2.52

[a,b] = Means followed by different letters in the same column are significantly different by the test of Tukey (p<0.05). * = Not significant (p>0.05).

Table 3 - Rendimento de carcaça e de partes de frangos de corte.

Control	Carcass *(%)	Wings* (%)	Back* (%)	Breast* (%)	Legs* (%)
Probiotic 1	72.08	11.15	20.53	36.13	31.24
Probiotic 2	69.88	11.46	20.79	35.73	32.44
Antibiotic	72.04	11.09	21.08	35.07	33.26
Flavonoids + MOS	70.34	11.16	20.11	36.23	32.60
General mean	71.37	11.12	20.51	35.60	32.40
Control	72.52	10.75	20.01	34.85	31.87
C.V. (%)	12.81	8.69	11.05	9.47	9.63

content as compared to breast muscle, and therefore, it can be subject to a higher degree of oxidation.

Table 5 - Tbars number of broiler thigh meat. Period 1: 4 days of refrigeration at 4° C; Period 2: 6 months of freezing at -18° C.

Treatment	Period 1	Period 2
Control	0.12[ab]	0.27[ab]
Probiotic 1	0.11[ab]	0.40[b]
Probiotic 2	0.12[ab]	0.32[ab]
Antibiotic	0.16[b]	0.26[ab]
Flavonoids + MOS	0.08[a]	0.19[a]
General mean	0.12	0.29
C.V. (%)	46.97	50.84

[a,b] = Means followed by different letters in the same column are significantly different by the test of Tukey ($p<0.05$).

It is possible to observe that, under refrigeration (period 1), results showed that thigh meat as already experiencing fat oxidation, and that the flavonoid +MOS treatment presented the lowest oxidation index, whereas the antibiotic treatments, the highest. After freezing (period 2), results showed that thigh meat presented higher oxidation index that after refrigeration. The flavonoids +MOS treatment promoted lower oxidation index than the treatment probiotic 1.

There was lower meat fat oxidation both after refrigeration and freezing when birds were fed flavonoids + MOS, which may be attributed to the antioxidant effect of flavonoids, which was already described by Sebastián *et al*. (2003) in pork.

CONCLUSIONS

Under the conditions of the present experiment, the use of flavonoids, together with mannan oligosaccharide (MOS) was effective as compared to other additives used for the supplementation of broiler diets.

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