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ABSTRACT

This study aimed at evaluating the effect of nucleotides on the performance and carcass yield of broilers fed diets with no antibiotic growth promoters (AGP), anticoccidials, or animal feedstuffs. In the trial, 600 Ross 308 male broilers were distributed in a completely randomized experimental design into six treatments with four replicates of 25 birds each. Treatments consisted of a control diet (CD), CD + AGP, CD + 0.04%, CD + 0.05%, CD + 0.06%, and CD + 0.07% nucleotides. The experimental diets did not contain anticoccidials, and birds were vaccinated against coccidiosis at three days of age. No significant differences were detected among broilers submitted to the different treatments in none of the studied parameters. Under the conditions of this experiment, diets supplemented with nucleotides did not influence broiler performance or carcass yield at 42 days of age, and were not different from the feeds not containing any additive or with AGP.

INTRODUCTION

Antibiotic growth promoters (AGP) in animal diets have been banned in several countries due to the public concern with the emergence of antibiotic-resistant bacteria, which may pose human health risks. This has made meat-exporting countries, such as Brazil, to follow this trend. Moreover, Brazilian consumers are increasingly aware of product quality, and today require healthy foods with no chemical residues.

In order to supply this new market, some poultry companies produce the so-called "alternative chickens", which are broilers reared with diets with no inclusion of AGPs, anticoccidials, and animal feedstuffs (Demattê Filho & Mendes, 2001).

Birds fed AGP-free diets are more susceptible to infections caused by pathogens that cause enteric diseases, which may compromise nutrient absorption, and consequently, live performance.

In order to prevent performance losses in poultry production, several natural alternatives to AGPs have been studied. Nucleotides may be one of these alternatives. The beneficial effect of nucleotides on intestinal cell integrity, development, and turnover, with significant proliferation of crypt cell was already demonstrated (Tsujinaka *et al.*, 1993; Dell'Orto *et al.*, 2002). Nucleotides also increase intestinal villi length, and improve the immune response of broilers, promoting nutrient absorption and increased weight gain (Yu *et al.*, 2002). They have also significant effects on enterocytes during intestinal development, maturation, and repair after damage caused by stress or pathogens (McCauley *et al.*, 1998).

The addition of yeast extract to broiler diets improves weight gain and feed conversion ratio (Rutz *et al.*, 2006). The authors suggested that this performance improvement is a consequence of increase in villi height due to the action of nucleotides present in yeast extract. This



improves nutrient digestion and absorption capacity because the absorptive surface area is increased.

There are few studies in literature using nucleotides as additives in broiler diets. Therefore, the objective of the present study was to evaluate the effect of nucleotide supplementation on the performance and carcass yield of broilers.

MATERIAL AND METHODS

The experiment was carried out at FMVZ-UNESP, in an experimental broiler house divided into 24 pens measuring 2.5m². In this trial, 600 male Ross 308 broilers were distributed in a completely randomized experimental design with six treatments with four replicates of 25 birds each, totaling 100 birds per treatment. Treatments consisted of: control diet (CD), CD + 10ppm AGP (Surmax 100® - Elanco), CD + 0.04% nucleotides, CD + 0.05% nucleotides, CD + 0.06% nucleotides, and CD + 0.07% nucleotides (AccelerAid® - FormilVet). No anticoccidials were added to the diets. Birds were vaccinated against coccidiosis (Paracox 5®-Schering Plough Coopers) at three days of age. Feed and water were supplied *ad libitum* during the entire experimental period.

The rearing period was divided in four phases: pre-starter (1-7 days), starter (8-21 days), grower (22-35 days), and finisher (36-42 days). Feeds were based on corn and soybean meal, and were formulated to contain equal protein and energy levels in all treatments. Bird nutritional requirements were established for each rearing phase according to the tables of Rostagno *et al.* (2005).

Performance data were collected and analyzed for the accumulated periods of 1 to 7, 1 to 21, and 1 to 42 days of age. The parameters body weight, weight gain, feed conversion ratio, mortality, and production factor were analyzed for these periods. At 42 days of age, data on carcass and parts yield were also collected and analyzed. Five birds per pen, totaling 20 birds per treatment, were randomly collected, fasted for eight hours, electrically stunned, and bled. After evisceration and chilling in a cold storage (the chiller was not used), carcasses were weighed and cut up. All slaughter, evisceration and cut-up procedures followed industry standards. Carcass yield (with feet, head, neck, and fat pad) was calculated relative to live weight. Breast, leg (drum+thigh), and wing yields were calculated relative to eviscerated carcass weight.

Performance and carcass yield data were submitted to analysis of variance at a level of 5% significance,

using the GLM procedure of the software program SPSS 13.0 for Windows.

Table 1 - Composition and calculated nutritional values of the control diets according to rearing phase.

Ingredients	Pre-starter	Starter	Grower	Finisher
Corn	55.843	59.025	61.844	65.920
Soybean meal	37.492	34.520	30.928	27.077
Soybean oil	2.160	2.375	3.343	3.318
NaCl	0.520	0.500	0.480	0.450
Vitamin Suppl. ¹	0.100	0.100	0.100	0.100
Mineral Suppl. ²	0.050	0.050	0.050	0.050
Calcitic limestone	0.910	0.880	0.830	0.785
Dicalcium phosphate	1.950	1.800	1.670	1.520
DL-methionine	0.240	0.175	0.175	0.165
L-lysine	0.375	0.215	0.230	0.275
Choline chloride ³	0.060	0.060	0.050	0.040
AccelerAid ⁴	0.150 (CD+0.04%), 0.200 (CD+0.05%), 0.250 (CD+0.06%), 0.300 (CD+0.07%)			
Growth promoter ⁵	0.001 (CD+AGP) except for the finisher phase			
Kaolin ⁶	Between 0.050 and 0.292 as inert material			
Calculated values				
ME (kcal/kg)	2950	3000	3100	3150
CP (%)	22.0	20.8	19.4	18.0
Calcium (%)	0.94	0.88	0.83	0.76
Available phosphorus (%)	0.47	0.44	0.41	0.38
Dig. methionine (%)	0.54	0.47	0.45	0.43
Dig. Met + Cys (%)	0.84	0.75	0.72	0.68
Dig. lysine (%)	1.37	1.17	1.10	1.05
Potassium (%)	0.84	0.80	0.74	0.68
Sodium (%)	0.23	0.22	0.21	0.20
Chlorine (%)	0.36	0.34	0.33	0.31
Linoleic acid (%)	2.44	2.59	3.14	3.18

1 Vitamin supplement Vaccinar Nutrição e Saúde Animal (per kg feed): vit. A, 15,000 IU; vit. D3, 3,000 IU; vit. E, 30 mg; vit. K3, 4 mg; B1, 3 mg; vit. B2, 6 mg; vit. B6, 6 mg; vit. B12, 30 mcg; niacin, 40 mg; folic acid, 1.5 mg; pantothenic acid, 15 mg; biotin, 120 mcg; vit. C, 50 mg; antioxidant. 2 Mineral supplement Vaccinar Nutrição e Saúde Animal (per kg feed): selenium, 180 mcg; iodine, 700 mcg; iron, 48 mg; copper, 10 mg; manganese, 78 mg; zinc, 55 mg. 3 choline chloride (70%). 4 AccelerAid® - FormilVet containing 22.5% total nucleotides. 5 Surmax 100® Elanco. 6Vehicle used to replace nucleotides and antibiotic growth promoter in the diets.

RESULTS AND DISCUSSION

There was no effect of treatment on the performance parameters analyzed at 7, 21, and 42 days of age (Table 2). Zavarize *et al.* (2007) also did not observe any performance improvement in broilers fed a diet supplemented with 0.05% nucleotides as compared to those fed a non-supplemented diet. On the other hand, Bruno (2009) evaluated the effect of different nucleotides levels (0 to 0.05%) on broiler performance, and observed a linear improvement during the period of 1 to 21 days of age; however, the same benefit of nucleotides was not observed during the subsequent periods. Rutz *et al.* (2006) verified broiler performance improvement when broilers were fed yeast extracts, and attributed the better performance



Table 2 - Body weight (BW), weight gain (WG), feed intake (FI), feed conversion ratio (FCR), mortality (MO), and production factor (PF) of broilers in the periods of 1 to 7, 1 to 21, and 1 to 42 days of age, according to experimental treatment.

Parameter	Nucleotide inclusion level						C.V. (%)
	CD	CD+ 0.04%	CD+ 0.05%	CD+ 0.06%	CD+ 0.07%	CD+ AGP	
1 to 7 days of age							
IW, g	45.6	45.5	45.4	45.6	45.8	45.6	0.6
BW, g	172	173	180	170	178	175	4.2
WG, g	126	128	135	125	133	129	5.7
FI, g	146	151	151	150	151	151	4.5
FCR	1.16	1.18	1.12	1.20	1.15	1.17	4.7
MO, % ¹	1.06	1.06	0.71	0.71	0.71	0.71	50.8
1 to 21 days of age							
BW, g	844	838	869	877	895	868	5.0
WG, g	799	793	824	831	850	823	5.4
FI, g	1.154	1.166	1.193	1.170	1.225	1.176	4.4
FCR	1.45	1.48	1.45	1.41	1.44	1.44	2.2
MO, % ¹	1.77	1.81	0.71	1.06	0.71	1.77	56.4
1 to 42 days of age							
BW, g	2.810	2.766	2.846	2.819	2.871	2.865	4.5
WG, g	2.764	2.720	2.801	2.774	2.825	2.820	4.6
FI, g	4.852	4.860	4.945	4.897	5.017	4.946	3.5
FCR	1.77	1.82	1.78	1.77	1.79	1.76	1.8
MO, % ¹	2.67	2.50	1.41	1.06	1.06	1.77	62.7
PF ²	344	325	367	369	373	369	8.3

1 - Percentages were submitted to transformation $(x+0.5)^{1/2}$, before the analysis of variance. 2 - Production factor = $((DWG \times \text{Livability})/FCR) \times 100$.

to the beneficial effect of the nucleotides present in the yeast extract.

There was no effect of nucleotides on carcass and parts yields (Table 3). Rutz *et al.* (2006) observed in broilers fed yeast extract (nucleotide source) a numerical improvement in carcass yield, as well as in drum, thigh, wing and breast yields as compared to birds that did not receive yeast extract. However, it must be noted that yeast extract contains other nutrients in addition to nucleotides, such as amino acids, vitamins, and minerals, which may contribute to increase carcass yield.

According to literature, dietary nucleotides may improve the immune response (Yu *et al.*, 2002) and accelerate intestinal epithelium repair after lesions caused by pathogens (Bueno *et al.*, 1994). This would be the expected result in broilers raised under the above-mentioned alternative production system, with

consequent performance improvement.

In the present experiment, broilers were vaccinated against coccidiosis and reared on new litter and under strict health control. Therefore, these birds did not have to face the challenges typically present in the field, which may be one of the possible causes of the absence of differences among treatments.

CONCLUSION

Under the conditions of this experiment, diets supplemented with nucleotides did not influence broiler performance or carcass yield at 42 days of age, and were not different from the feeds not containing any additive or with AGP.

New studies are warranted to evaluate the effect of nucleotides added to broiler diets under the challenges typically found in commercial farms.

Table 3 - Carcass and parts yields of 42-day-old broilers.

Parameter	Nucleotide inclusion level						C.V. (%)
	CD	CD+ 0.04%	CD+ 0.05%	CD+ 0.06%	CD+ 0.07%	CD+ AGP	
Carcass (%) ¹	69.25	70.26	71.33	70.10	70.25	70.80	3.9
Head and neck (%) ¹	5.77	5.65	5.62	5.75	5.87	5.82	8.5
Feet (%) ¹	3.70	3.67	3.71	3.65	3.69	3.72	7.8
Abdominal fat (%) ¹	1.97	1.81	1.75	1.66	1.70	1.93	23.6
Wings (%) ²	11.66	11.56	11.35	11.63	11.42	11.63	4.8
Breast (%) ²	35.89	37.23	37.19	36.69	36.60	34.79	11.5
Legs (%) ²	31.28	31.29	30.84	31.81	31.74	31.49	5.0

1 - Percentage relative to live weight. 2 - Percentage relative to eviscerated carcass.



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