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Live Performance and Processing Yields of Broilers Fed Diets With Tiamulin and Salinomycin Combinations

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ABSTRACT

A study was conducted with the objective of evaluating the combined application of tiamulin (TIA) and salinomycin (SAL) in broiler diets fed from 1 to 42 d of age. One thousand and two hundred Cobb x Cobb 500 male broilers were housed in 48 floor pens and fed corn-soybean meal diets containing 66 ppm of SAL combined or not with TIA at 30 or 20 and 20 or 15 ppm, respectively, in the starter (1-21 d) and grower feeds (22-42 d); however, TIA was withdrawn from the feeds 7 days before slaughter. The experimental design was completely randomized with 3 treatments and 16 replicates of 25 birds each. Broilers were weekly evaluated for live performance whereas carcass yield, abdominal fat and commercial cuts were assessed at 42 d using 6 birds randomly taken from each pen. Results obtained at the end of the study demonstrated that body weight gain was not affected ($P > 0.05$) by the treatments, whereas feed intake was reduced ($P < 0.05$) and feed conversion was improved ($P < 0.05$) for birds on diets containing TIA at 30/20 and 20/15 ppm, respectively. Carcass yield, abdominal fat, and commercial parts were not affected ($P > 0.05$) by the treatments. Live performance and post-slaughter yields data obtained in this study did not indicate that combinations of TIA with SAL could be detrimental. In fact, an improvement in feed conversion was observed at the lowest dose of TIA.

INTRODUCTION

Ionophores have been added to broiler feeds with the objective of preventing coccidiosis for a long time. These compounds are divided into two general groups based on the mode of ion transfer across the cell membrane; channel formers or ion carriers (Kart & Bilgili, 2008). Commercially grown animals generally use ion-carrier ionophores, which move ions across the membrane releasing them afterwards inside de cell. The protective effect of these drugs against coccidia is associated with their ability to change its ionic balance (Augustine *et al*., 1992). Ionophores are generally safe and effective if used at recommended levels; however, ionophore toxicity might occur due to accidental overdoses, misuse, feed mixing errors as well as when combined factors lead to liver incapacity to fully metabolize them (Chapman, 2001; Nebbia *et al*. 1999).

Tiamulin (TIA) is a semi-synthetic antibiotic derived from pleuromutilin, which is recommended for the treatment of mycoplasmosis of poultry (Chapman & Johnson, 2002). It has been used for animals for a long time, but its use in broilers has been frequently avoided due to reported incompatibilities with ionophores (Witkamp *et al*. 1995; Schuhmacher *et al*. 2006). Ataxia, leg weakness, and myopathy have been found in chickens and turkeys following the simultaneous administration of

monensin and TIA (Horrox, 1980; Uchimura *et al*. 1978; Umemura *et al*. 1984). Inhibition of P450 3A enzyme isoform by TIA, which is responsible for the oxidation metabolism of monensin, was demonstrated, leading to accumulation of monensin in animal tissues (Chapman, 2001; Nebbia *et al*. 1999). It has been observed that toxic symptoms due to TIA and monensin combinations are identical to those produced by single overdoses of monensin (Hanrahan, 1981; Van Vleet *et al*. 1987).

Apparently, other ionophores may cause negative responses when used in combination with TIA for broilers, but the resulting effects depend on the type of ionophore and also on TIA levels (Meingassner *et al*., 1979). This has been the case of salinomycin and narasin; however, lasalocide has shown no negative effects when combined with TIA and fed to turkeys (Lodge *et al*., 1988). Semduramycin also seems not to interact with TIA probably due to a detoxification mechanism different from that of monensin (Schuhmacher *et al*., 2006).

Recently, TIA at 20 ppm has been reported to be safe when used along with SAL (Islam *et al*., 2008a), the interest in field applications of TIA in broilers. The objective of this study was to evaluate the effects of the combined supplementation of SAL with TIA on broiler live performance and carcass and commercial cuts yields. (Islam et al., 2008a) which has renewed the interest for field applications of TIA in broilers.

MATERIAL AND METHODS

One thousand and two hundred one-day-old Cobb X Cobb 500 (Cobb-Vantress Brasil Ltda) male broilers vaccinated for Marek's disease, were housed in 1,65 x 1,70 floor-pen boxes, 25 birds in each. Chicks originated from broiler breeders previously tested and confirmed as free of *Mycoplasmosis*. Although placement was done only three days after removal of the previous flock, management was performed to maintain temperature within the comfort range. Live performance was weekly determined by pen group evaluations of body weight, feed intake, and feed conversion. Mortality was daily recorded, and the weight of dead birds was used to correct the feed conversion and evaluated via *post mortem* examination for the cause of death. Females eventually found were removed at 21 d of age. Broiler carcass evaluation was performed at 42 days of age on 6 birds randomly taken from each pen. Birds were individually weighed, and slaughtered using electrical stunning at 45V. Eviscerated carcasses without feet and heads were chilled in slush ice for 2 h, allowed to drip for 2 min, and were then weighed. Carcasses were cut into commercial parts by trained processing plant personnel and the following cuts were produced: breast fillets, tenders, thighs, drumsticks, wings, and abdominal fat. All cuts were individually weighed and their yields were expressed as percentage of the carcass.

Corn-soybean meal mash feeds were formulated using a two-phase feeding program: starter from 1 to 21 d and grower from 22 to 42 d (Table 1). Energy and nutrients were similar to those used in Brazilian integrations. Group 1 comprised the negative control birds, which were fed a diet containing 66 ppm SAL (Coxistac® 12%, Phibro Animal Health) only, whereas Groups 2 and 3 were given SAL at 66 ppm and also TIA (Denegard® 10%, Novartis Animal Health) at 30 and 20 ppm or 20 and 15 ppm from 1 to 21 d and 21 - 42 d, respectively. All drugs were continuously administered via their respective feeds and diet. All feeds were assayed for TIA and all were found to contain the appropriate level of drug. Mean drug concentration of SEM-containing feeds was 66 ppm. No other antibiotic was used in the feeds and TIA was removed from the feeds 7 days before slaughter.

Table 1 - Composition of basal diets for broilers from 1 to 21 and 21 to 42 days of age.

Ingredients, %	1-21	22-42
Corn	55.55	61.17
Soybean meal 45,6% CP	37.65	31.00
Dicalcium phosphate	1.83	1.57
Limestone	0.59	0.48
L-Lysine HCl	0.17	0.19
Salt	0.31	0.34
Choline chloride	0.09	0.06
DL - Methionine	0.26	0.23
Sodium bicarbonate	0.32	0.01
Soybean oil	3.00	4.72
L-Threonine	0.06	0.06
Vitamin and mineral premix[1]	0.17	0.17
Energy and Nutrients, % or as indicated		
ME, kcal/kg	3,025	3,240
CP	22.00	19.42
Ca	0.95	0.80
Av. P	0.46	0.40
K	0.92	0.81
Na	0.23	0.16
Cl	0.28	0.30
Choline, mg/kg	1,800	1,500
Digestible aminoacids, %		
Lysine	1.20	1.06
Methionine + Cysteine	0.85	0.76
Threonine	0.78	0.69
Tryptophan	0.24	0.20
Valine	0.90	0.82
Isoleucine	0.78	0.71

1Composition per kg of diet: A - 5,000 IU; D3 - 1,000 IU; E - 20 IU; K3 - 0.9 mg; B1 - 0.6 mg; B2 - 3 mg; B6 - 1 mg; B12 - 6 mcg; Niacin - 15 mg; Pantothenic acid - 7 mg; Biotin - 0.04 mg ; Folic acid - 0.5 mg; Zn - 51 mg; Mn - 67.5 mg; Cu - 8 mg; Fe - 64 mg; I - 0.72 mg; Se - 0.28 mg.

The study was conducted according to a completely randomized design with 3 treatments of 16 replicates each. Resulting data was submitted to ANOVA and Tukey's (SAS Institute, 2001) test was used to separate the means when treatment differences were significant ($P < 0.05$).

RESULTS AND DISCUSSION

Live performance data are presented on Table 2. Analyzed feeds contained SAL and TIA levels that corresponded to expected inclusions. Broilers fed diets with SAL + TIA (30/20 ppm) showed lower feed intake and body weight gain ($P < 0.05$) from 14 to 21 d as compared to the diet without TIA. During the overall period, reduced feed intake was observed in birds fed TIA (30/20 ppm); however, no effect was observed on body weight ($P > 0.05$). Feed conversion significantly improved in birds fed TIA (20/15 ppm) during weeks corresponding to 14-21 and 35-42 d, as well as during the overall period. The use of TIA (30/20 ppm) promoted better results than the control treatment from 21 to 28 d ($P < 0.05$). Overall bird mortality was low (grand mean = 2.36%), and was not affected by the treatments ($P > 0.05$).

Carcass data resulting from processing (Table 3) did not show statistical significant differences among treatments ($P > 0.05$). The present study evaluated the animal responses that are usually measured in commercial environments. Therefore, discussions and conclusions from this study cannot provide further explanations regarding mode of action of SAL, TIA or their combination.

Results of the present investigation demonstrate that the continuous use of TIA (30 - 20ppm) in feeds containing SAL (66 ppm) were safe. No clinical signs of toxicity, such as high mortality, leg weakness, myophathy or any other muscle lesions were observed in live animals or carcasses. Reports that found incompatibilities between TIA and ionophores generally applied TIA at 150 ppm and 250 ppm in feed and water, respectively (Schuhmacher *et al*. 2006; Stipkovits *et al*. 1999) with the medicated feeds and water supplied for periods of 7 and 5 d, respectively. In those cases, some birds showed mild signs of incompatibilities characterized by reduced feed intake and body weight, but no mortality.

Medication programs with high TIA doses often lead to anorexia and live performance losses during the period of concurrent administration of TIA and ionophores. However, when TIA treatment was withdrawn, there were significant compensatory improvements in feed efficiency and differences in body weight could not be detected during the subsequent periods (Schuhmacher *et al*. 2006; Islam *et al*. 2008b).

Table 2 - Performance of broilers fed diets containing salinomycin at 66ppm combined or not with tiamulin from 1 to 42 days of age*.

Body Weight Gain, g							
Treatments, ppm	**1 - 7**	**7 - 14**	**14 - 21**	**21 - 28**	**28 - 35**	**35 - 42**	**1 - 42**
T1 - Negative Control	98	226	442 a	553	652	666	2.637
T2 - Tiamulin (20/15)	88	221	435 ab	572	692	674	2.682
T3 - Tiamulin (30/20)	90	215	422 b	560	658	675	2.620
Mean	92	221	432	562	677	672	2.647
P values	0.18	0.12	0.01	0.30	0.22	0.32	0.41
CV %	9.17	5.07	3.53	4.41	6.32	8.85	4.06
Feed Intake, g							
Treatments, ppm	**1 - 7**	**7 - 14**	**14 - 21**	**21 - 28**	**28 - 35**	**35 - 42**	**1 - 42**
T1 - Negative Control	114	313	559 a	855	1.108	1.357	4.306 a
T2 - Tiamulin (20/15)	103	302	532 ab	838	1.099	1.316	4.190 ab
T3 - Tiamulin (30/20)	106	303	523 b	827	1.061	1.356	4.176 b
Mean	107	306	538	840	1.089	1.343	4.190
P values	0.37	0.35	0.03	0.10	0.25	0.67	0.03
CV %	10.04	4.89	4.47	3.45	4.75	7.40	2.85
Feed Conversion							
Treatments, ppm	**1 - 7**	**7 - 14**	**14 - 21**	**21 - 28**	**28 - 35**	**35 - 42**	**1 - 42**
T1 - Negative Control	1.166	1.384	1.265 b	1.548 b	1.699	2.037 b	1.632 b
T2 - Tiamulin (20/15)	1.172	1.363	1.223 a	1.466 ab	1.588	1.956 a	1.560 a
T3 - Tiamulin (30/20)	1.178	1.415	1.239 ab	1.458 a	1.612	2.008 ab	1.594 ab
Mean	1.172	1.385	1.243	1.491	1.633	2.000	1.595
P values	0.99	0.28	0.01	0.01	0.17	0.01	0.01
CV %	5.66	3.88	2.11	2.97	5.73	7.31	2.95

a,b Means within columns with no common superscript are significantly different ($P < 0.05$).* Values within parentheses adjacent to tiamulin stand for the doses in the starter and grower feeds, ppm.

Table 3 - Processing yields and abdominal fat (%) at 42 days of broilers fed diets containing salinomycin at 66 ppm combined or not with tiamulin*.

Treatments, ppm	Carcass	Fat	Thighs	Drum	Breast	Tender	Wings
T1 - Negative Control	77.14	1.71	14.06	18.72	23.94	4.96	11.24
T2 - Tiamulin (20/15)	77.83	1.43	13.71	18.70	24.98	4.89	11.30
T3 - Tiamulin (30/20)	77.77	1.42	13.72	18.64	24.85	5.02	11.31
Mean	77.58	1.52	13.83	18.69	24.59	4.96	11.28
P values	0.7241	0.0735	0.5659	0.6486	0.1443	0.1188	0.7916
CV %	4.31	17.44	5.21	6.83	5.86	5.21	5.55

($P \leq 0.05$). * Values within parentheses adjacent to tiamulin stand for the doses in the starter and grower feeds, ppm.

Pulse medication of broilers from 1 to 10 and 21 to 27 d with TIA at 0, 20, 30, or 50 ppm did not affect the live performance of broilers fed SAL at 60 ppm (Islam *et al*., 2008b). Actually, some studies showed that TIA at 20 and 30 ppm improved body weight gain and feed conversion (Islam *et al*. 2008a; Islam *et al*. 2008b). Considering production cost, Islam *et al*. (2008a) found that 30 ppm of TIA produced the best economic return per unit of body weight gain.

CONCLUSIONS

Tiamulin included in broiler diets and fed from 1 to 21 and 22 to 42 days at 20 and 15 ppm, respectively, led to improvements in feed conversion.

The administration of 30/20 or 20/15 ppm of TIA in diets from 1 to 21 and 22 to 42 days of age, which also contained 66 ppm SAL, did not impair broiler performance when evaluated using industry standard measurements of live performance and processing yields.

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