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The Effects of Fermacto, Bactocell and Biostrong in Antibiotic-free Diets on the Performance of Broilers

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ABSTRACT

The aim of this study was to compare the effects of three antibiotic alternatives with a control (Antibiotic-free) and an antibiotic diet on performance and gut morphology of broilers reared on litter. 600 day-old ROSS-308 chicks were assigned to 48 pens in a CRD design with 6 × 2 factorial arrangements, in which 2 levels of chick density (5 and 7.5 chicks/m2) and 6 experimental diets (control, virginiamycin, fermacto, bactocell, biostrong and biostrong matrix-value formulated or biostrong-MV) were used. Higher chick density increased starter feed intake and decreased grower feed conversion ratio (FCR) significantly ($p<0.05$). Average daily gains (ADG) were not different among experimental diets except biostrong-MV that was the least. FCR of different diets were equal, both in starter and grower period. Performance traits didn't influenced by Diet × density interaction. Relative weight of digestive organs, especially jejunum, in antibiotic diets were lesser than other diets ($P<0.05$). The length per gram of jejunum resulted from experimental diets were similar, and so for ileum except that of fermacto that was significantly lesser than biostrong ($p<0.05$). The result of current experiment (winter and corn-soybean based diets) had shown that antibiotic alternatives not only didn’t have an effect similar to antibiotic but also to control diet. Furthermore matrix-value method of diet formulation with biostrong lessened chick performance.

Keywords: Bactocell, Biostrong, Broiler, Fermacto, Virginiamycin.

INTRODUCTION

Appling essential improvements in some scientific domains to maximizing the efficiency and growth performance and meat yield of chickens blossomed to modern broiler industries. Concurrently, modern chick strains and intensive rearing techniques fruited to an impressive condition due to immuno-suppression and colonization of pathogenic gut bacteria so that it necessitated to sub-therapeutic insertion of some antibiotics in broiler diets for a while. Over the last decades of 20th century, antibiotic growth promoters vastly used in animal agriculture to protect them from the adverse effects of enteric bacteria (Ferket, 2003). With increasing concern about antibiotics resistances, this restricted administration of

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them was also banned in some EU countries (Dibner et al., 2004; Ferket, 2003). Increasing interest in finding alternatives to antibiotics in poultry production conducted to emerging different additives such as probiotics, prebiotics, essential oils,… that improve gut health and growth performance (Ferket, 2003, Khan et al., 2000). Fermacto is a commercial brand for a fermentative product of microorganisms especially aspergillus fungi and Lactobacillus. It is reported that fermacto improved nutrients digestibility and adsorption and enhanced broiler growth at a level of 7.02 percent via providing nutrients and mycelial fibers necessary for growth of beneficial intestinal bacteria (Tangendjaja, 1993, Griggs et al., 2005). Essential oils especially in presence of organic acids had a beneficial effect on intestinal bacteria and had a growth promoting effects in comparison with antibiotic-contained control diet (Dibner et al., 2004; Faruga et al., 2002; Ferket, 2003). Biostrong as a plant-based product contain essential oils, encapsulated plant materials, saponin and some organic acids. It increased feed palatability and nutrient retention and decreased ammonia in growing turkeys resulted to better growth and feed consumption comparable with antibiotic feeds (Habibi et al., 2013, Faruga et al., 2002). Bactocell, as another feed additive, improved immune response of birds against salmonella infection and increased body weight and feed efficiency and reduced mortality (Abd-El-Rahman et al., 2012, Patterson et al., 2003). In this experiment the effects of dietary administration of 3 feed additives, namely Bactocell (a probiotic), Fermacto (a prebiotic) and Biostrong (a plant product) were evaluated in broilers reared in two chick densities and compared with antibiotic and antibiotic-free diets.

MATERIALS AND METHODS

600 day-old ROSS-308 chicks were assigned to 48 pens (2 × 1 meter including a pan-tube feeder and a bell-shaped drinker in each), in an experiment with completely randomized design and 6 × 2 factorial arrangements, in which 2 levels of chick density (5 ad 7.5 chicks/m2 or 10 and 15 chicks per pen irrespective to feeder and drinker) and 6 experimental diets were compared (Table 1). Experimental diets were included: 1) Control diet, a batch of basal corn-soybean diet containing 2900 Kcal AME/kg, 2-5) four diets prepared with adding separately four additive to basal diet in an over the top manner: 0.015 % Virginiamycin (a commercial 10 % product from Arasbazar co), 0.010% Bactocell (Live Pediococcus acidilactici in a concentration of 109 CFU/g, Patent EU94/40), 0.20 % Fermacto (a Pet-ag product) and 0.10 % Biostrong-510 (A Mixed product of essential oils, saponin and some organic acids). 6) A diet formulated based on matrix value of biostrong according to an Iranian representative of Delacon Biotechnik GmbH Co i.e. it used as an ordinary feed item with some value for energy, protein and other nutrients in feed formulation. Chick's body weight and feed intake (FI) of each pen determined distinctively for starter and grower period (21 and 42 days of age). Average daily weight gain (AWG), average feed intake feed conversion ratio (FCR) were compared for starter and grower period. The weight and length of intestine segments and liver and spleen weight were measured at the age of 42 days. Mortality rates of first week and thereafter were compared. All of the chicks had ad-libitum access to feed and water and the light regimen was alternate 23:1 light and dark periods other than first 48 hours that was continuum light.

RESULTS AND DISCUSSION

Higher chick density increased starter feed intake and improved FCR of grower period. However chick densities had no effects on other performance and intestinal traits (Table 2). With respect to performance parameters in starter and grower period, diets with antibiotic and antibiotic alternatives had no significant different in comparison with the control diet ($P>0.05$). In addition, biostrong-MV decreased significantly AWG and feed intake as compared to other diets.

Higher stocking density during grow-out period would increase ammonia production, footpad lesion, and locomotion difficulties and adversely affect growth performance, carcass yield and skin scratches. Accordingly there is a subtle balance between performance and welfare in view of the optimum density (Dozier et al., 2005). In current study, higher chick density was not at a level that can affect performance especially that it was done at winter season. In above-mentioned experiment density had a prominent relation with feed intake and competition on the existing feeders. This wasn't a limiting factor in current experiment especially in starter period. In this study, virginiamycin as an antibiotic didn’t improve AWG and FCR significantly. There are some pros and cons in papers referred it (Ferket, 2003, Khan et al., 2000), although the types and levels of antibiotics and rearing conditions experienced in different experiments had been very variable. The real effects of antibiotics depend strictly on herd health status and healthy, well-nourished chicks housed under clean conditions and moderate stocking density rarely respond positively to growth promoters including antibiotics (Ferket, 2003). In current study, fermacto had no a prominent effect on performance improvement, although it is reported that fermacto enhances weight gain and FCR (Tangendjaja, 1993). Also bactocell had no any privilege on control and also antibiotic diets in spite of Habibi et al (2013) that noticed an outstanding performance resulted from feeding bactocell and Abd-El-Rahman et al (2012) that mentioned the use of bactocell had no positive effects on performances in 2 first weeks of the chicks but it increased weight gain and feed efficiency thereafter. European Commission (EU) approved pediococus acidilactisi for all kind of farm animals and recently in laying hens but it supposed that it have a health effect on animals. In this experiment, biostrong as over the top was comparable with control but biostrong-MV had the lowest weight gain and FI ($p<0.05$). So it can be neglected the idea that it increases nutritive value of poultry diets. Biostrong-510 has had a performance yield comparable to antibiotic diets (Faruga et al., 2002) although Buchanan et al (2008) in an experiment to evaluate the possibility and comparing feed formulation based on least cost and maximizing yield methods, stated that biostrong 510 improved feed conversion when used in diets containing antibiotics. Research with plant essential oils had contradicting results and the most cases are performed in vitro and their beneficial effects must be thoroughly tested in live birds (Gunal et al., 2006). However, in current study biostrong and fermacto added diets had the least weight gain ($p<0.05$). Any observed changes of weight gain was affected by feed intake especially in starter period, by virtue of this fact that FCR of experimental diets in both starter and grower periods were equal. Apparently, improving production traits and immunity of the chicks with consuming dietary antibiotic alternatives had a prominent relevance on especial external oligosaccharides and enzymes. These chemicals facilitate the colonizing and growth of beneficial microbiota to the expense of pathogenic ones. The basal corn-soybean diet of current experiment was a similar medium across all the treatments probably deficient in nutritives required for optimum growth of beneficial gut bacteria. Using different feed items, various NSPs, external enzymes and proper prebiotic in chicken diets have an enormous effect on bacterial population and ecology of animal intestines (Buchanan et al., 2008). Antibiotic decreased intestine to body weight ratio (especially Jejunum) significantly ($p<0.05$) as compared to other alternatives but not control. This decreasing effect on intestinal weight is in agreement with other experiment, although they stressed on significant difference between antibiotic and antibiotic-free diets. Subtherapeutic levels of antibiotics in the diets reduce weight and length of the intestine. The resulted thinner intestinal epithelium is a major factor in increasing nutrient absorption (Ferket, 2003). Another index of intestine anatomy is gram per cm of length or length per gram. Length per gram of jejunum didn’t differ between the treatments but length per gram ileum in fermacto diets was the least and was different from on top biostrong ($p<0.05$). Thus they had thickest and thinnest intestinal wall respectively. The results of this study indicated that virginiamycin didn’t decrease intestinal thickness in comparison with control diet. Furthermore additives not only didn’t have an effect similar to antibiotic but also to control diet. Thus any

beneficial effect of them must be related to other functions, although the qualities of some of these biological materials practically have an instant effect on intestinal thickness and chick performance.
Chick mortality didn't differ at two levels of chick densities. Also experimental diets had no effect on mortality. Bactocell had numerically the least mortality, especially in 2-7 week period (0.8 against up to 7.1 percent in biostrong-MV). This is an evidence of positive effect of bactocell on health and immune conditions of the chicks. There isn't an independent experiment that had been studied the combined effects of density and antibiotic alternatives. Dozier et al (2005) founded that different densities of male broilers had no effects on their performance until 32 days of age, but thereafter with increasing the density above 9 chicks per square meter, performance were reduced by increasing density (Dozier et al., 2005). In present experiment, chick density at 42 days of age was lesser than that can induce any stress, in particular that it was conducted in winter season.

Conclusion

The experiment has performed in winter with a corn-soybean basal diet. Virginiamycin as a well-known antibiotic had not a prominent effect on chick performance. Also antibiotic alternatives didn't show the potential to substitute antibiotics from the health and performance point of views. It is suitable to pay attention on health effect of bactocell.

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Table 1: Composition and nutrient contents of basal diet and matrix value added diet for biostrong

		Starter (1-21 days)		Grower (22-42)	
		Basal	biostrong-MV	Basal	biostrong-MV
Corn, ground	%	57.48	58.48	64.27	65.1
Soybean meal (45% cp)	%	37.90	36.64	31.66	30.1
Soy oil	%	1.502	1.5	1.505	1.5
Salt, Iodized	%	0.423	0.422	0.311	0.422
CaCO3	%	0.486	0.545	0.727	0.790
Di-calcium phosphate	%	1.397	1.03	0.973	0.605
D L methionine	%	0.152	0.144	0.056	0.048
Vit-Min premix	%	0.500	0.500	0.500	0.500
Biostrong 510-plus	%	0	0.100	0	0.100
Washed grits	%	0	0.739	0	0.635
Calculated Values					
Metabolizable Energy (Kcal/kg)		2900	2900	2985	2985
Crude protein	%	20.88	20.88	18.66	18.66
Ca	%	0.905	0.905	0.839	0.840
Avail. P	%	0.408	0.408	0.327	0.327
Methionine	%	0.476	0.473	0.358	0.354
Lysine	%	1.115	1.114	0.974	0.972

Vitamin premix provided the following per 2.5 kg of diet: vitamin A 15.000 IU, vitamin D_3 1.5 IU, vitamin E 20 mg, vitamin K_3 5 mg, vitamin B_1 3 mg, vitamin B_2 6 mg, niacin 25 mg, Ca-D- pantothenate 12 mg, vitamin B_6 5 mg, vitamin B_{12} 0.03 mg, folic acid 1 mg, D-biotin 0.05 mg, choline cloride 400 mg. Trace mineral premix provided the following per kg of diet: Mn 80 mg, Fe 60 mg, Zn 60 mg, Cu 5 mg, Co 0.2 mg, I 1 mg and Se 0.15 mg.

Table 2: The effects of chick density and antibiotic alternatives on chick performances

	Additives						Densities (Chicks/ m^2)	
				Biostrong				
	Control	Antibiotic	Bactocell	Matrix value	Over the top	Fermacto	5	7.5
Starter								
Daily gain (gr)	33.4 ^{a}	34.3 ^{a}	32.5 ^{ab}	30.9 ^{b}	33.1 ^{a}	32.8 ^{ab}	32.7	32.9
Feed intake(gr)	52.2 ^{a}	52.3 ^{a}	50.7 ^{ab}	49.1 ^{b}	51.6 ^{ab}	51.8 ^{a}	50.6 ^{b}	51.9 ^{a}
FCR **(gr/gr)**	1.57	1.53	1.56	1.59	1.56	1.58	1.55	1.58
Grower								
Daily gain (gr)	80.4	82.4	79.3	76.7	79.3	75.9	78.1	79.9
Feed intake (gr)	168.5	172.9	168.5	168.3	167.9	170.3	170.7	168.1
FCR (gr/gr)	2.1	2.1	2.14	2.2	2.13	2.25	2.2 ^{a}	2.11 ^{b}

Subscripts with different letters in each row of each block of data differs significantly ($p<0.05$)

Table 3: The effects of chick density and antibiotic alternatives on gut properties and mortality of chicks

	Additives						Densities (Chicks/ m^2)	
				Biostrong				
	Control	Antibiotic	Bactocell	Matrix value	Over the top	Fermacto	5	7.5
Liver ratio	2.54	2.43	2.4	2.37	2.26	2.48	2.46	2.37
Spleen ratio	0.288	0.230	0.273	0.235	0.275	0.243	0.250	0.265
Jejunum ratio	1.87^{bc}	1.81^{c}	2.1^{ab}	2.15^{a}	2.17^{a}	2.16^{a}	2.05	2.05
Ileum ratio	1.21^{ab}	1.17^{b}	1.22^{ab}	1.33^{ab}	1.31^{ab}	1.41^{a}	1.29	1.26
Length Per gram								
Jejunum	2.63	2.47	2.65	2.41	2.49	2.47	2.5	2.54
Ileum	3.00^{ab}	2.97^{ab}	3.06^{ab}	2.99^{ab}	3.26^{a}	2.58^{b}	2.86	3.09
Mortality								
First week	4.58	5.42	2.1	4.58	3.75	2.1	3.33	4.16
2-7 week	2.5	4.58	0.8	7.1	4.58	7.5	3.75	5.28

Subscripts with different letters in each row of each block of data differs significantly ($p<0.05$)