The Effect of Dietary Supplementation of Prebiotic, Probiotic and Organic Acid, either Alone or Combined, on Broiler Performance and Carcass Characteristics

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Abstract

A prebiotic, a probiotic and an organic acid were used as performance enhancer feed additives in this study. Two thousand and four hundred, 1-d-old broiler chicken (Ross-308) were weighted and randomly assigned to the six treatment groups, each with eight replicates. The addition of performance enhancer feed additives to the diet significantly increased body weight of broilers in both 21 ($P<0.0001$) and 42 ($P<0.05$) days of age. Feed consumption of birds was affected significantly 0 to 3 week ($P<0.05$) but not at 0 to 6 week period. Dietary treatments had significant effect on feed conversion ratio both at starter and entire experimental period. Supplementation of prebiotic + probiotic combination improved over all feed conversion ratio ($P<0.05$) when compared to control treatment. Growth promoter feed additives of all had no significant effect on livability, and affected significantly the liver weight and small intestine weight of male birds ($P<0.05$). The results show that prebiotic, organic acid and probiotic can be used as alternative performance enhancer feed additives, also dietary combination of prebiotic with probiotic revealed additive beneficial effect on feed efficiency through experimental period when compared to supplementation in diet alone.

Introduction

Feed additive antibiotics have been used more then fifty years in feed industry all over the world as growth promoters. The mode of action of antibiotics was suppressing the detrimental effect of photogenic bacteria in the gut. Since the proposed total ban on sub therapeutic feed antibiotics, prebiotics, organic acid and probiotics are currently receiving considerable attention in animal nutrition because of their association with non-residual and non-resistant properties (Mellor, 2000). Feed organic acids reduce certain species of bacteria, with particular effect against acid-intolerant specie like E. coli, Salmonella spp and Campylobacter ssp. (Dibner, 2004). The improvement effects on protein and energy digestibility and also on immune stimulation of these additives were demonstrated in former studies in detail. Probiotics (Jin et al. 1997) and prebiotics (Shane, 2001) act as growth promoters, feed savers, nutritional bio-regulators, immune stimulators and help in improving performance and health. The objective of this study was to evaluate the ability of principal antibiotic replacer feed additives on the growth performance when used as performance enhancer in broiler diets, either alone or combined.

Materials and methods

Two thousand and two hundred sexed day-old broiler chicks (Ross 308) were divided into 6 treatment groups of 400 birds each and randomly assigned to the six treatment diets, consist of negative control, prebiotic (mannan oligosaccharide), organic acid, probiotic, prebiotic + organic acid mixture and prebiotic + probiotic mixture. The six dietary treatments were as follows: 1. Basal diet (negative control); 2. Basal diet with prebiotic (0.5 g/kg diet); 3. Basal diet with organic acid (1.0 g/kg diet); 4. Basal diet with probiotic (0.5 g/kg diet); 5. Basal diet with prebiotic + organic acid (0.5 g/kg + 0.5 g/kg diet); 6. Basal diet with prebiotic + probiotic (0.5 g/kg + 0.5 g/kg diet). Each treatment group was further sub-divided in to 8 replicates of 50 birds (25 male and 25 female) per replicate. The ingredients and chemical composition of the diets are presented in Table 1. The diets were isocaloric and isonitrogenous. Experimental diet in pellet form and water were provided ad libitum. The experiment lasted for 42 days. A photoperiod of 24 h/d was maintained. The standard

techniques of the proximate analysis were used to determine the nutrient concentrations in the experimental diets (Naumann & Bassler, 1993). The data were analyzed using the General Linear Models procedure of SAS (1985).

Table 1. The ingredient and chemical composition of starter and grower diets

	Starter diet	Grower diet	Composition, % (analysed)		
Ingredient	(g/kg)	(g/kg)		Starter diet	Grower diet
Yellow corn	451.75	496.25	Dry matter	88.79	88.92
Wheat	100.00	100.00	Crude protein	22.13	20.37
Soybean meal (% 48)	241.74	202.14	Crude fat	7.03	8.32
Full-fat soybean	150.00	138.53	Crude fibre	3.45	3.29
Soy oil	19.53	29.67	Crude ash	5.96	5.52
Dicalcium phosphate.	21.09	18.44	Starch	35.32	36.96
Ground limestone	4.15	3.28	Sugar	3.12	3.21
Salt	3.80	3.80	Calcium	0.93	0.86
L-Lysine HCL	0.48	0.00	Total phosphorus	0.69	0.63
DL-methionine	2.45	1.89	Calculated analysis		
Vitamin premix	2.50	2.50	Available phosphorus	0.47	0.42
Mineral premix	1.00	1.00	Lysine	1.25	1.03
Anticoccidial	0.50	0.50	Methionine	0.57	0.49
Antioxidant	1.00	1.00	Methionine + cystin	0.92	0.80
Saw dust	1.00	1.00	Linoleic acid	3.51	3.98
TOTAL	1000.00	1000.00	Met. Energy, kcal/kg	3088	3211

Results and Discussion

The effects of dietary growth promoter feed additive supplementation on live performance are shown in Table 2. All of the performance enhancer feed additives, either alone or combined with, significantly improved 21 d ($P<0.0001$) and 42 d ($P<0.05$) body weight similarly as compared to control treatment. However, combination of prebiotic with organic acid or probiotic had no additive increment at 21 and 42 days of age when compared to supplementation in diet alone. Feed intake of birds was significantly influenced by dietary treatments for 0 to 21 d ($P<0.05$) period but not at 0 to 42 d period of this study.

Supplementation of performance enhancer feed additives positively influenced the feed efficiency throughout the experiment. Combination of prebiotic + probiotic improved feed conversion both at 0 to 21 d and 0 to 42 d periods at significant level ($P<0.05$) when compared to control treatment. Bird mortality was significantly different between the treatments ($P<0.05$) at 21 d and 42 d. Although any of the carcass traits of female birds was not affected by the dietary treatments ($P<0.05$), weight and percentage of liver and small intestines of male birds were significantly affected by dietary treatments ($P<0.06$). Prebiotic and probiotic supplementation to diets caused a significant decrease on the liver weight and percentage of male broilers as compared to control treatment. On the other hand, the small intestines weight and percentage of birds fed the diet containing prebiotic + organic acid mixture was lower ($P<0.05$) than those of other dietary treatments (Table 3).

The results of this experiment showed that supplementation of performance enhancer feed additives, used in this trial significantly increased body weight of birds both at 21 d and 42 d ($P<0.01$) and improved feed efficiency compared with controls. Our findings are in agreement with those of (Sims and Sefton, 1999) who supplemented to diet 1.0 g/kg mannan oligosaccharide, those of (Patten and Waldroup, 1988) investigated dietary addition of fumaric acid, those of (Abdulrahim et al. 1999) examined the use of probiotics containing L. acidophilus, who found that prebiotic, organic acid and probiotic addition in diet improved growth performance of broiler.

The results obtained from this study indicated that the supplementation of prebiotic, organic acid and probiotic to the diet significantly increased the body weight gain, slightly improved feed efficiency when compared to control treatment. Any of the treatments had no negative effect on carcass characteristics of broilers examined in this study also.

Table 2. Effects of prebiotic, organic acid, probiotic, prebiotic + organic acid, prebiotic + probiotic inclusion in broiler diets on growth performance of broilers

Groups	0 to 21 d				0 to 42 d			
	Body weight (g)	Feed intake	Feed convers.	Mortality (%)	Body weight (g)	Feed intake (g)	Feed convers.	Mortality (%)
Control	721b	1050b	1.544a	0.25b	2207b	3943	1.818a	0.75b
Prebiotic	764a	1095a	1.512ab	0.50ab	2256a	4001	1.804ab	1.25ab
Organic acid	758a	1060b	1.478b	0.75a	2251a	3928	1.775ab	2.75a
Probiotic	751a	1080ab	1.520ab	0.50ab	2258a	3940	1.791ab	0.75b
Prebiotic + organic acid	754a	1078ab	1.513ab	0.00b	2248a	3958	1.774ab	2.75a
Prebiotic + probiotic	755a	1061b	1.484b	0.25b	2263a	3899	1.755b	1.75ab
SEM	4.42	9.98	0.016	0.38	13.75	36.28	0.017	0.56
P	0.0001	0.0301	0.0576	0.0325	0.0462	0.4982	0.0504	0.0325

a, b: Means with different superscripts in the same column differ (P<0.06)

Table-3 Effects of prebiotic, organic acid, probiotic, prebiotic + organic acid, prebiotic +probiotic inclusion in broiler diets on carcass characteristics of broilers

Group	Sex	Live weight (g)	Carcass weight (g)	Carcass yield (%)	Liver weight		Small intestines weight		Pancreas weight		Abdominal fat weight	
					(g)	(%)	(g)	(%)	(g)	(%)	(g)	(%)
Control	E	2407	1757	72,98	47,25a	1,96a	69,40a	2,88a	5,92	0,24	28,83	1,19
	D	2099	1565	74,57	44,35	2,11	54,34	2,58	6,03	0,28	37,60	1,79
Prebiotic	E	2409	1779	73,83	42,41b	1,76b	66,94ab	2,77a	6,17	0,25	34,02	1,40
	D	2104	1582	75,16	46,90	2,23	57,36	2,72	5,82	0,27	35,71	1,69
Organic acid	E	2403	1762	73,31	44,88ab	1,86ab	68,73a	2,86a	6,54	0,27	31,73	1,31
	D	2105	1582	75,15	42,99	2,04	58,42	2,77	6,54	0,31	36,01	1,70
Probiotic	E	2406	1752	72,82	41,89b	1,74b	63,30ab	2,63ab	6,02	0,25	33,1	1,37
	D	2092	1560	74,61	45,60	2,18	57,54	2,75	5,75	0,27	34,85	1,66
Prebiotic + Organic acid	E	2427	1797	74,03	44,30ab	1,82ab	60,35b	2,48b	6,05	0,24	33,70	1,38
	D	2101	1589	75,64	45,65	2,17	61,26	2,91	5,67	0,27	39,25	1,86
Prebiotic + Probiotic	E	2426	1796	74,02	43,83ab	1,80ab	68,92a	2,83a	6,46	0,26	31,34	1,28
	D	2126	1599	75,24	43,92	2,06	59,75	2,80	5,94	0,28	39,3	1,84
SEM	E	17.35	19.83	0.47	1.25	0.05	2.28	0.08	0.30	0.01	2.64	0.10
	D	12.69	11.60	0.39	1.53	0.07	2.37	0.11	0.21	0.01	2.58	0.12
P	E	0.862	0.429	0.301	0.053	0.038	0.034	0.014	0.647	0.655	0.751	0.72
	D	0.538	0.180	0.382	0.522	0.454	0.433	0.479	0.089	0.113	0.747	0.78

a, b: Means with different superscripts in the same column differ (P<0.06)

Consequently, the combination of prebiotic with organic acid or probiotic did not exert any additive improvement on the growth performance of broilers as compared to supplementation in diet alone. Because of slightly improvements of prebiotic and probiotic combination on the feed efficiency of broilers as compared to added in diet alone, further experiments are needed to elucidate the underlying synergistic mode of action.

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