



**International Journal of Biology, Pharmacy
and Allied Sciences (IJBPAS)**

'A Bridge Between Laboratory and Reader'

www.jibpas.com

EFFECTS OF DIETARY PROBIOTICS ON DUODENUM, JEJUNUM, ILEUM AND COLON CHARACTERISTICS OF BROILERS

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ABSTRACT

The effects of dietary probiotics on duodenum, jejunum, ileum and colon characteristics of broilers were studied. Two hundred one-day-old male chickens of the Ross 308 strain were allocated to one of the following treatments: control (basal diet with no added probiotics), and the same basal diet supplemented with 0.005%, 0.01% (recommended level by producer), 0.015% and 0.02% of probiotics. Based on obtained results, probiotics as much as 0.015% in feed improved duodenum length, jejunum weight and jejunum length significantly ($P \leq 0.05$), while probiotics as much as 0.005 and 0.01% in feed improved duodenum width, jejunum width, ileum width and colon width significantly ($P \leq 0.05$).

Key words: Chick, Feed Additive, Gastrointestinal Organ, Intestine

INTRODUCTION

Nowdays probiotics, prebiotics and symbiotics as feed additives uses by farmers for broiler nutrition. There are some reports about positive effects of these additive on broiler productivity [1, 2, 3, 4] and other birds such as ostrich [5, 6] from our findings. While producers suggest a recommended level of

probiotics for broiler feeding, there are reports shows other (more/less) levels in special conditions (management type, diet type, diet physical form, stress, etc) can improve broiler intestine characteristics largely. On the other hand, there are little reports about probiotics effects on intestine characteristics in broiler. Hence,

the aim of the present work was to investigate the effects of increasing levels of probiotic supplementation on duodenum, jejunum, ileum and colon characteristics of broiler chickens.

MATERIALS AND METHODS

Two hundred one-day-old male chickens of the Ross 308 strain (Aviagen, Newbridge, UK) purchased from a commercial hatchery and were placed in 1.5 × 1.0 m cages, which floor was covered with shredded paper. Each cage was equipped with a pan feeder and a manual drinker. The research facility was an open sided poultry barn having thermostatically controlled curtains and equipped with thermostatically controlled gasoline rocket heaters, overhead sprinklers, wall-mounted fans in both ends of the barn, and fluorescent tubes in ceiling fixtures. Ambient temperature was set at 32°C at placement and then decreased gradually to achieve 24°C from week 3 onwards. Lighting was constant at day 1. From day 2 to the finish of the study, light regime was 21L: 3D. Feed (mash form) and water were provided *ad libitum* throughout the whole trial. The experiment lasted 42 days. The feeding programme was a commercial one and consisted of a starter diet until the chicks were 14 days old, followed by a grower diet up to 28 days of age, and then a

finisher diet until the end of the experiment. All feeds were maize-soybean meal based and did not contain any antibiotic feed additives (**Table 1**). Chicks were assigned into one of the following treatments: control (basal diet without added probiotics), and the same basal diet supplemented with 0.005%, 0.01%, 0.015% and 0.02% of Protexin probiotics (P1, P2, P3 and P4 treatments, respectively). Protexin (Probiotics International Ltd, Somerset, UK) is a multi-strain commercial preparation in powder form (2×10^9 CFU/g). It consists of (*Lactobacillus plantarum*), (*Lactobacillus bulgaricus*), (*Lactobacillus acidophilus*), (*Lactobacillus rhamnosus*), (*Bifidobacterium bifidum*), (*Streptococcus thermophilus*), (*Enterococcus faecium*), (*Aspergillus oryzae*) and (*Candida pintolopesii*). The manufacturer's recommended level of Protexin supplementation is 0.01% (1 g/kg feed). Each treatment had four replicates, thus there was a total of 20 groups of 10 birds. At the age of 42 days, after 4 hours of fasting for complete evacuation of the gut, four chickens per treatment (one from each replicate) that had weights closest to the mean weight for the cage were selected and euthanized to determine intestinal traits.

The GLM procedure of [7] was used in the statistical analyses. The statistical design was: $Y_{ij} = \mu + T_i + e_{ij}$; where Y_{ij} is the observation, μ is the overall mean, T_i is the fixed effect of the treatment, ($i = 5$), and e_{ij} is the residual error. Tukey's test was used to compare least squares means.

The responses to probiotic supplementation were investigated through preplanned contrasts both orthogonal (control vs. probiotic supplemented diets) and polynomial (linear and quadratic effects of supplementation levels). Statistical significance was declared at $P < 0.05$.

RESULTS AND DISCUSSION

The effects of diet supplementation with increasing levels of probiotics on intestinal parameters are presented in **Tables 2-5**. From obtained results, it is showed that probiotics level had not significant effect on duodenum weight ($P > 0.05$), although probiotics level as much as 0.015% had the highest duodenum weight numerically (23.550 g). Also, probiotics level had not significant effect on relative weight of duodenum ($P > 0.05$), although probiotics level as much as 0.015% had the highest relative weight of duodenum numerically (0.929%).

Probiotics level had significant effect on duodenum length ($P \leq 0.05$), and probiotics

level as much as 0.015% had the highest duodenum length significantly (39.100 mm). From obtained results, it is showed that probiotics level had significant effect on duodenum width ($P \leq 0.05$), and probiotics level as much as 0.01% had the highest duodenum width significantly (7.598 mm). Meanwhile, probiotics level had significant effect on duodenum diameter ($P \leq 0.05$), and no probiotics usage had the highest duodenum diameter significantly (1.197 mm).

From obtained results, it is showed that probiotics level had significant effect on jejunum weight ($P \leq 0.05$), so probiotics level as much as 0.015% had the highest jejunum weight significantly (154.975 g). Also, probiotics level had significant effect on relative weight of jejunum ($P \leq 0.05$), and probiotics level as much as 0.015% had the highest relative weight of jejunum significantly (6.107%). Probiotics level had significant effect on jejunum length ($P \leq 0.05$), and probiotics level as much as 0.015% had the highest jejunum length significantly (171.575 mm). From obtained results, it is showed that probiotics level had significant effect on jejunum width ($P \leq 0.05$), and probiotics level as much as 0.02% had the highest jejunum width significantly (8.470 mm). Meanwhile,

probiotics level had significant effect on jejunum diameter ($P \leq 0.05$), and no probiotics usage had the highest jejunum diameter significantly (1.178 mm).

Probiotics level had significant effect on ileum weight ($P \leq 0.05$), so probiotics level as much as 0.01% had the highest ileum weight significantly (5.525 g). Also, probiotics level had significant effect on relative weight of ileum ($P \leq 0.05$), and no probiotics usage had the highest relative weight of ileum significantly (0.215%). Probiotics level had not significant effect on ileum length ($P > 0.05$), although no probiotics usage had the highest ileum length significantly (14.725 mm). From obtained results, it is showed that probiotics level had significant effect on ileum width ($P \leq 0.05$), and probiotics level as much as 0.01% had the highest ileum width significantly (7.252 mm). Meanwhile, probiotics level had significant effect on ileum diameter ($P \leq 0.05$), and no probiotics usage had the highest ileum diameter significantly (1.330 mm).

Probiotics level had not significant effect on colon weight ($P > 0.05$), although probiotics level as much as 0.02% had the highest colon weight numerically (2.490 g).

Also, probiotics level had not significant effect on relative weight of colon ($P > 0.05$),

although probiotics level as much as 0.02% had the highest relative weight of colon numerically (0.093%). Probiotics level had not significant effect on colon length ($P > 0.05$), however probiotics level as much as 0.02% had the highest colon length numerically (4.050 mm).

From obtained results, it is showed that probiotics level had significant effect on colon width ($P \leq 0.05$), and probiotics level as much as 0.005% had the highest colon width significantly (7.358 mm). Meanwhile, probiotics level had significant effect on colon diameter ($P \leq 0.05$), and no probiotics usage had the highest colon diameter significantly (1.350 mm). There are some reports about effects of probiotics levels on broiler characteristics [8, 9, 10], however there are few reports about effects of probiotics levels on broiler intestinal characteristics [11, 12]. Although this experiment provide more details about probiotics levels on broiler duodenum, jejunum, ileum and colon characteristics, however more experiments need to clarifying and demonstration of its details.

ACKNOWLEDGMENTS

This manuscript is prepared based on the MSc thesis of the first author at Rasht Branch, Islamic Azad University. We are

grateful to Rasht Branch, Islamic Azad University for support.

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Table 1: Experimental diets fed to broiler chickens

	Starter 1-14 d	Grower 15-28 d	Finisher 29-42 d
Ingredients, %			
Maize	55.60	61.56	64.31
Soybean meal 44	37.00	30.00	27.00
Soybean oil	1.20	2.30	3.60
Dicalcium phosphate	1.70	1.70	1.50
Calcium carbonate	1.50	1.40	1.20
Vitamin and mineral mixture ¹	2.00	2.00	2.00
DL-methionine	0.20	0.26	0.17
Salt	0.23	0.33	0.20
Sodium bicarbonate	0.17	0.17	0.15
L-lysine HCL	0.15	0.15	0.05
Choline chloride	0.10	0.10	0.10
L-treonine	0.03	0.03	0.04
Enzymes ²	0.05	0.05	0.03
Phytase ³	0.01	0.01	0.05
Calculated analysis ⁴			
Metabolizable energy, MJ kg ⁻¹	11.8	12.3	12.9
Crude protein, %	21.3	18.7	17.5
Lysine, %	1.26	1.09	0.93
Methionine + Cysteine, %	0.93	0.80	0.75
Treonine, %	0.83	0.72	0.69
Calcium, %	1.06	1.01	0.90
Phosphorus, %	0.71	0.68	0.63

¹ Supplied per kilogram of feed - Vitamin A: 12500 IU; vitamin D₃: 1250 IU; vitamin E: 18 IU; vitamin K₃: 3.7 mg; thiamine: 1.8 mg; riboflavin: 6.6 mg; calcium pantothenate: 10 mg; niacin: 37.5 mg; pyridoxine: 32.5 mg; vitamin B12: 2.5 mg; Mn: 50 mg; Zn: 37.5 mg; Fe: 25 mg; Cu: 7.5 mg.

² Yiduozyme 9680. GuangDong, VTR Bio-Tech Co. Ltd., China.

³ Phyzyme XP 10000 TPT. Danisco Animal Nutrition, Marlborough, UK.

⁴ According to National Research Council (1994).

Table 2: Mean (\pm SEM) of duodenum characteristics at 42nd days of age in Ross 308 broilers fed the different levels of dietary probiotics from 1st-6th weeks of age*

Trait Treatment	Duodenum weight (gr)	Relative weight of duodenum (%)	Duodenum length (mm)	Duodenum width (mm)	Duodenum diameter (mm)
Control: No additive	14.825 ^a	0.599 ^a	26.925 ^b	6.380 ^b	1.197 ^a
0.005% Ptotexin probiotics	16.950 ^a	0.680 ^a	24.325 ^b	7.525 ^a	1.117 ^{ab}
0.01% Ptotexin probiotics	21.825 ^a	0.782 ^a	23.475 ^b	7.598 ^a	1.110 ^{ab}
0.015% Ptotexin probiotics	23.550 ^a	0.929 ^a	39.100 ^a	4.983 ^c	0.755 ^b
0.02% Ptotexin probiotics	19.750 ^a	0.767 ^a	31.725 ^{ab}	7.205 ^{ab}	1.033 ^{ab}
P	0.624	0.702	0.011	0.000	0.102
SEM (Standard Error of Mean)	4.330	0.167	2.932	0.340	0.112

* Means (\pm standard error) within each column of dietary treatments with no common superscript differ significantly at P<0.05

Table 3: Mean (\pm SEM) of jejunum characteristics at 42nd days of age in Ross 308 broilers fed the different levels of dietary probiotics from 1st-6th weeks of age*

Trait Treatment	Jejunum weight (gr)	Relative weight of jejunum (%)	Jejunum length (mm)	Jejunum width (mm)	Jejunum diameter (mm)
Control: No additive	71.100 ^b	2.897 ^b	104.975 ^b	6.803 ^{bc}	1.178 ^a
0.005% Ptotexin probiotics	88.150 ^b	3.531 ^b	117.075 ^b	7.018 ^b	1.168 ^a
0.01% Ptotexin probiotics	71.575 ^b	2.572 ^b	107.725 ^b	7.540 ^{ab}	1.145 ^a
0.015% Ptotexin probiotics	154.975 ^a	6.107 ^a	171.575 ^a	5.545 ^c	0.818 ^b
0.02% Ptotexin probiotics	63.625 ^b	2.410 ^b	112.475 ^b	8.470 ^a	1.143 ^a
P	0.007	0.004	0.000	0.003	0.052
SEM (Standard Error of Mean)	16.162	0.614	7.115	0.418	0.088

* Means (\pm standard error) within each column of dietary treatments with no common superscript differ significantly at P<0.05

Table 4: Mean (\pm SEM) of ileum characteristics at 42nd days of age in Ross 308 broilers fed the different levels of dietary probiotics from 1st-6th weeks of age*

Trait Treatment	Ileum weight (gr)	Relative weight of ileum (%)	Ileum length (mm)	Ileum width (mm)	Ileum diameter (mm)
Control: No additive	5.325 ^a	0.215 ^a	14.725 ^a	6.035 ^{ab}	1.330 ^a
0.005% Ptotexin probiotics	3.200 ^b	0.129 ^b	10.375 ^a	7.185 ^a	1.175 ^a
0.01% Ptotexin probiotics	5.525 ^a	0.199 ^{ab}	12.550 ^a	7.252 ^a	1.227 ^a
0.015% Ptotexin probiotics	4.550 ^{ab}	0.180 ^{ab}	12.575 ^a	5.543 ^b	0.887 ^b
0.02% Ptotexin probiotics	4.150 ^{ab}	0.160 ^{ab}	12.400 ^a	6.270 ^{ab}	1.112 ^{ab}
P	0.120	0.205	0.485	0.060	0.012
SEM (Standard Error of Mean)	0.636	0.026	1.617	0.439	0.077

* Means (\pm standard error) within each column of dietary treatments with no common superscript differ significantly at $P < 0.05$

Table 5: Table 5: Mean (\pm SEM) of colon characteristics at 42nd days of age in Ross 308 broilers fed the different levels of dietary probiotics from 1st-6th weeks

Trait Treatment	Colon weight (gr)	Relative weight of colon (%)	Colon length (mm)	Colon width (mm)	Colon diameter (mm)
Control: No additive	2.100 ^a	0.085 ^a	3.975 ^a	6.658 ^{ab}	1.350 ^a
0.005% Ptotexin probiotics	2.250 ^a	0.090 ^a	3.850 ^a	7.358 ^a	1.185 ^a
0.01% Ptotexin probiotics	2.450 ^a	0.088 ^a	3.525 ^a	7.213 ^a	1.225 ^a
0.015% Ptotexin probiotics	2.300 ^a	0.091 ^a	3.350 ^a	5.945 ^b	0.857 ^b
0.02% Ptotexin probiotics	2.490 ^a	0.093 ^a	4.050 ^a	7.303 ^a	1.065 ^{ab}
P	0.954	0.995	0.658	0.092	0.027
SEM (Standard Error of Mean)	0.392	0.014	0.383	0.384	0.096

* Means (\pm standard error) within each column of dietary treatments with no common superscript differ significantly at $P < 0.05$.