



Organ Weights and Intestinal Morphology of Broiler Chickens Fed Diets Containing Different Supplements

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ABSTRACT

The present study was evaluated the effect of dietary inclusion of various feed supplements and their combination on the performance index, glucose and serum cholesterol for 6 weeks. Day-old broiler chicks (n=252) were randomly assigned to seven treatment groups, each with 3 replicates. The first treatment was designated as control (T₀) in which no supplement was added to the feed, while in treatments T₁; organic mineral mixture (Organomin forte), T₂; organic mineral mixture (Vannamin), T₃; probiotics (Microguard), T₄; enzyme (Brozyme -XPR) and probiotics, T₅; emulsifier (Lipigon) were provided through feed. In the T₆ group, 3 percent less energy was given through feed. The weight of vital organs viz. heart, liver, gizzard, and spleen were significantly (P<0.05) increased by the feed supplements of which were in the normal range. The gut morphology was also favorably altered due to feed supplementations. This indicates that the organic mineral mixtures, probiotics, enzymes and emulsifiers, and their combinations can be used as a growth promoter in broiler diets and can improve gut health. These products show promising effects as alternatives for antibiotics as pressure to eliminate growth-promoting antibiotic use increases.

Keywords: Broiler, intestinal morphology, organ weights

Poultry production has garnered significant landmarks in animal production. From a backyard venture five decades ago (Singh *et al.*, 2017), the Indian Poultry industry has evolved as the most vibrant fast-growing and dynamic sub-sector of agriculture with 16.8% growth in poultry population over the previous census (Livestock Census, 2019), has witnessed one of the fastest global share of about 6.3% in egg and 3.3% in meat production over the year 2015-16, India stands 3rd and 5th position, respectively. The industry has not only grown in size but also productivity. With rapidly changing lifestyles, affluent culture, and a conscious need for general wellness, Indian consumers are now opting for a more protein-rich diet (CARI Vision, 2050). The changing trends are a boon for the poultry sector in India. Feed additives or growth promoters have been used to improve growth rate, feed

efficiency, and product quality and to reduce the production cost in poultry Craig *et al.* (2008). Various antibiotics, anthelmintic, anti-coccidial and hepatic-protectants are used for increasing production. They not only increase the cost of production but have adverse effects on long term usage. Due to the prohibition of most of the antimicrobial feed additives in animal feed and their residual effects in animals (Singh *et al.*, 2014), use of different supplements are becoming more popular Chuka (2014). The effects of organic mineral mixtures, probiotics, enzymes and emulsifiers on the intestinal morphology in association with their organs weights of broilers are still unclear.

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Therefore, the present investigation was undertaken to study organ weights and intestinal morphological values.

MATERIALS AND METHODS

Experimental birds and dietary treatments

The present study was undertaken at the Instructional Poultry Farm (IPF), of Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, U.S. Nagar. The place is located between 28° 53' 23" to 30° 27' 50" N and 77° 34' 27" to 81° 02' 22" E at 243.84 m MSL (mean sea level) in the Tarai region of Uttarakhand State (India). The climate is humid subtropical. Winters are very severe and summers are hot and humid. Temperatures may rise to a maximum of 43°C in the summer and fall to a minimum of 2°C in the winter. Relative humidity ranges from 15 to 95% (Singh *et al.*, 2015). The study was conducted on 252 day-olds straight run Ven Cobb⁴⁰⁰ broiler chicks for 6 weeks under standard management conditions. Feed and water were provided *ad libitum*. The present study evaluated the effect of dietary inclusion of various feed supplements and their combination on the performance index, glucose and serum cholesterol for 6 weeks. Day-old broiler chicks (n=252) were randomly assigned to seven treatment groups, each with 3 replicates. The first treatment was designated as control (T₀) in which no supplement was added to the feed, while in treatments T₁; organic mineral mixture (Organomin forte), T₂; organic mineral mixture (Vannamin), T₃; probiotics (Microguard), T₄; enzyme (Brozyme -XPR) and probiotics, T₅; emulsifier (Lipigon) were provided through feed. In the T₆ group, 3 percent less energy was given through feed and at the end of the feeding trial on 42nd day, two birds from each replicate were randomly selected and their organ weights were taken.

Intestinal morphology

After evisceration, the intestine of the birds were carefully separated and the length of the duodenum (from the ventriculus to the pancreo-biliary duct), jejunum (from the pancreo-biliary duct to Meckel's diverticulum), and ileum (from Meckel's diverticulum to the ileocecal junction) were measured using a measuring tape, villus height was measured from the tip of the villus to the bottom of the

villus, crypt depth was measured from the villus bottom to the crypt base and villus height and crypt depth ratio was also calculated.

Statistical analysis

The data were analysed statistically by using SPSS (Armonk, New York, US) and significant mean differences between the treatments were determined at P<0.05 using Duncan's Multiple Range Test as modified by Kramer (1957). A *p-value* of <0.05 was considered as statistically significant.

RESULTS AND DISCUSSION

Organ weights

The effect of different supplements on organ weights of the broilers has been shown in Table 1. Liver weight was significantly increased in the broilers of feed supplemented groups in comparison to control. Gizzard and heart weights were significantly increased in the broilers of feed supplemented groups in comparison to control except T₆. Pancreas weight was significantly increased in the broilers of feed supplemented groups in comparison to control except T₂ and T₆. Spleen weight was significantly increased in the broilers of feed supplemented groups in comparison to control except T₁ and T₂.

The results of the present study are in agreement with Aguihe *et al.* (2017) and Kaushal *et al.* (2018) who found significantly (P<0.05) higher liver and gizzard weights of broilers fed the diet supplemented with enzymes with probiotics. Awad *et al.* (2009) and Mahmud *et al.* (2014) noted a significant (P<0.05) increase in weights of liver, spleen, gizzard, and heart in broilers fed the diet supplemented with probiotics. Swain *et al.* (2012) observed that weights of liver, heart, spleen were higher in broilers supplemented with probiotics and yeast. Aguilar *et al.* (2013) found an increase in liver weight of broilers fed the diet supplemented with an exogenous emulsifier. Sagar *et al.* (2018) reported a significant (P<0.05) increase in spleen weight of broilers supplemented with zinc. Sharma *et al.* (2018) found a significant (P<0.05) increase in liver, spleen, gizzard, heart and pancreas weights of broilers fed the diet supplemented with enzymes.

Table 1: Effect of feed supplements on organ weights (% of live weight) of broilers

Treatments	Liver	Gizzard	Heart	Pancreas	Spleen
T ₀	2.25 ^a ± 0.02	2.10 ^a ± 0.03	0.47 ^a ± 0.00	0.17 ^a ± 0.00	0.12 ^a ± 0.00
T ₁	2.35 ^b ± 0.02	2.26 ^b ± 0.01	0.50 ^b ± 0.00	0.20 ^b ± 0.00	0.13 ^a ± 0.00
T ₂	2.43 ^c ± 0.01	2.30 ^b ± 0.00	0.52 ^c ± 0.00	0.18 ^a ± 0.00	0.13 ^a ± 0.00
T ₃	2.47 ^{cd} ± 0.01	2.38 ^c ± 0.00	0.54 ^d ± 0.00	0.20 ^b ± 0.00	0.15 ^b ± 0.00
T ₄	2.51 ^d ± 0.01	2.43 ^{ce} ± 0.01	0.55 ^{de} ± 0.00	0.21 ^{bc} ± 0.00	0.16 ^{bc} ± 0.00
T ₅	2.55 ^{de} ± 0.00	2.34 ^c ± 0.01	0.53 ^{cd} ± 0.00	0.19 ^b ± 0.00	0.14 ^b ± 0.00
T ₆	2.59 ^e ± 0.01	2.16 ^{ad} ± 0.00	0.48 ^a ± 0.00	0.18 ^a ± 0.00	0.14 ^b ± 0.00

Means bearing different superscripts in a column differ significantly ($P < 0.05$).

Table 2: Effect of feed supplements on intestinal morphology of broilers

Treatments	Intestinal morphological values						
	cm			µm		—	
	Duodenum length	Jejunum length	Ileum length	Small intestinal length	Duodenum villous height (DVH)	Duodenum crypt depth (DCD)	DVH/DCD
T ₀	30.77 ^a ± 0.16	55.89 ^a ± 0.56	55.19 ^a ± 0.18	141.85 ^a ± 0.64	1436.84 ^a ± 0.64	301.65 ^a ± 0.70	4.76 ^a ± 0.00
T ₁	32.43 ^b ± 0.21	57.56 ^a ± 0.46	56.96 ^b ± 0.14	146.95 ^b ± 0.80	1526.78 ^b ± 0.40	274.83 ^b ± 0.60	5.55 ^b ± 0.13
T ₂	33.40 ^c ± 0.34	58.39 ^b ± 0.68	57.49 ^b ± 0.14	149.28 ^b ± 0.48	1542.74 ^{bc} ± 0.75	287.49 ^c ± 0.53	5.36 ^c ± 0.00
T ₃	33.25 ^b ± 0.05	59.40 ^b ± 0.65	57.93 ^b ± 0.09	150.58 ^b ± 0.54	1570.82 ^c ± 0.61	301.46 ^a ± 0.82	5.21 ^d ± 0.07
T ₄	33.40 ^c ± 0.02	59.72 ^b ± 0.47	58.14 ^b ± 0.02	151.26 ^c ± 0.71	1579.47 ^c ± 0.80	301.61 ^a ± 0.74	5.23 ^d ± 0.00
T ₅	32.95 ^b ± 0.11	58.6 ^b ± 0.63	57.73 ^b ± 0.00	149.28 ^b ± 0.50	1558.72 ^c ± 0.75	297.80 ^a ± 0.64	5.23 ^d ± 0.00
T ₆	31.50 ^a ± 0.23	56.79 ^a ± 0.65	56.79 ^a ± 0.65	145.08 ^a ± 0.70	1457.60 ^a ± 0.39	247.61 ^d ± 0.65	5.88 ^e ± 0.09

Means bearing different superscripts in a column differ significantly ($P < 0.05$).

In contrast, Shareef and Al-Dabbagh (2009) and Yadav *et al.* (2018) reported non-significant ($P > 0.05$) differences in liver, gizzard, heart, spleen and pancreas weights of broilers fed the diet supplemented with probiotics *viz.*, *Saccharomyces cerevisiae* and *Bacillus subtilis* respectively. Zakaria *et al.* (2010) found non-significant ($P > 0.05$) differences in liver and gizzard weight of broilers fed diet supplemented with enzymes. Narasimha (2013) observed non-significant ($P > 0.05$) differences in liver, gizzard, pancreas, spleen and heart weights of broilers fed the diet supplemented with enzymes and probiotics.

The weight of vital organs *viz.* heart, pancreas, liver, gizzard, and spleen were significantly ($P < 0.05$) increased by the feed supplements of which were in the normal range. The effect of higher inclusion levels of feed supplements and their combination of vital organs increase was more pronounced as compared to lower levels in general.

Intestinal morphological values

The effect of different feed supplements on the intestinal morphology of the broilers has been shown in Table 2.

Duodenum, ileum and small intestinal length were significantly increased in the broilers of feed supplemented groups in comparison to control except T₆. Jejunum length was significantly ($P < 0.05$) increased in broilers of feed supplemented groups in comparison to control except T₁ and T₆. The results are in agreement with the finding of Wang *et al.* (2016) found a significant ($P < 0.05$) increase in duodenal, jejunal and ileal length of broilers fed the diet supplemented with probiotics. In contrast, Kaushal *et al.* (2018) found non-significant ($P > 0.05$) difference in intestinal length of broilers fed the diet supplemented with multi- enzymes.

Duodenum villous height was significantly increased in the broilers of feed supplemented groups in comparison to



control except T₆. Duodenum crypt depth was significantly decreased in broilers of feed supplemented groups in comparison to control except T₃, T₄, and T₅. Villous height: crypt depth ratio was significantly increased in the broilers of feed supplemented groups in comparison to control. Gao *et al.* (2008) noted a significant (P<0.05) increase in villi height in the duodenum of broilers fed the diet supplemented with probiotics (*Saccharomyces cerevisiae*). Luo *et al.* (2009) found a significant (P<0.05) increase in villus height: crypt depth ratio in broilers fed the diet supplemented with the enzyme (xylanase). Yang *et al.* (2008) observed a significantly (P<0.05) decrease in crypts depth of broilers fed the diet supplemented with the enzyme (xylanase). Zhang *et al.* (2005) found a significant (P<0.05) increase in villus height: crypt depth ratio in broilers supplemented with yeast. Awad *et al.* (2009) found a significant (P<0.05) decrease in crypt depth and increase in villus height: crypt depth ratio of broilers fed the diet supplemented with probiotics (*Lactobacillus species*). Echeverry *et al.* (2016) found significantly (P<0.05) lower crypt depth and higher villi height: crypt depth ratio in broilers fed the diet supplemented with organic trace minerals. Abdel-Latif *et al.* (2018) found a significant (P<0.05) increase in the villi height and villus height: crypt depth ratio in broilers while crypt depth was significantly (P<0.05) decreased in broilers fed the diet supplemented with probiotics. Kaushal *et al.* (2018) found a significant (P<0.05) increase in duodenum villus height and villous height: crypt depth ratio and decrease in duodenum crypt depth of broilers fed the diet supplemented with enzymes and probiotics. Pelicano *et al.* (2005) noted a significant (P<0.05) increase in villus height in the duodenum, jejunum, and ileum of broilers fed the diet supplemented with probiotics and prebiotics.

Thus it may be inferred that supplements had altered the gut morphology by stimulating rapid cell division and elongation and more intercellular space leading to increased surface area for absorption of nutrients.

CONCLUSION

The vital organ weights and gut morphology favourably altered due to feed supplements. These supplements alone or in combination can improve gut health by showing promising effects as alternative to antibiotics.

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