10.22059/IJVM.2020.303786.1005095

Iranian Journal of Veterinary Medicine
Volume 15- Issue 03

Original Article
Online ISSN: 2252-0554

Appraisal of Dietary Prebiotic Supplementation on Meat Properties and Carcass Characteristics of Broiler Chickens After Experimental Infection with *Eimeria* Species

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Abstract

BACKGROUND: Prebiotics are non-digestible feed ingredients that improve the immune system.

OBJECTIVES: The present study was designed to assess the changes caused by the addition of prebiotics to the feed on carcass characteristics and also chemical composition, physical characteristics, color, texture, and fatty acid profile of chicken pectoral muscles containing *Eimeria* species.

METHODS: Forty-one-day-old male Ross 308 broiler chickens were assigned to four treatments, including negative control (NC), positive control (PC), positive medicated with coxidine (COX), and positive medicated with prebiotics (PRE). After 42 days, carcass characteristics of the chickens were recorded, and also physical characteristics, chemical composition, color, texture, and fatty acid analysis of breast meat were determined.

RESULTS: Infection with *Eimeria* species diminished carcass characteristics. PRE had higher final body weight, hot carcass weight, and breast and thigh muscle weights. Drip loss, pH, cooking loss, fat, ash, dry matter, and texture properties of broilers' breast meat did not show any significant differences among the experimental groups. Dietary supplementation with prebiotics increased the crude protein content of breast meat. Infection with *Eimeria* species decreased the a-value of breast meat. Dietary supplementation with prebiotics decreased the amount of fatty acids 16:1 and 18:1 and monounsaturated fatty acids (MUFAs) compared to NC.

CONCLUSIONS: Dietary supplementation with prebiotics is a promising strategy with the potential to compensate for the negative effects of infection with *Eimeria* spp. on carcass characteristics, protein content, and color of breast meat of broiler chickens.

KEYWORDS: Dietary fiber, *Eimeria* species, Feed, Meat analysis, Poultry products

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Received: 2020-12-30

Accepted: 2021-03-13

How to Cite This Article

Partovi, P ., Seifi, S., Alian Samakkhah, SH., Nikpay, A. (2021). Appraisal of Dietary Prebiotic Supplementation on Meat Properties and Carcass Characteristics of Broiler Chickens After Experimental Infection With *Eimeria* Species. *Iranian Journal of Veterinary Medicine, 15*(3), 346-357.

Introduction

Due to the drastic increase of the world population, the poultry industry is considered as one of the most important yet inexpensive sources of animal protein with low cholesterol value in the human diet (Teng & Kim, 2018). On the other hand, because of the increasing trend in cardiovascular diseases, lots of researchers have paid attention to test the effectiveness of growth promoters on altering lipid metabolism (Teng & Kim, 2018). Fat metabolism in an organism under the influence of animal nutrition strategies can affect the lipid profile of muscles in monogastric animals (Grela *et al*., 2014). Therefore, improvement in poultry meat production quantitatively and qualitatively is crucial.

Coccidiosis is a parasitic disease caused by host-specific *Eimeria* species (Wondimu *et al*., 2019). Seven species of *Eimeria* (*E. tenella*, *E. acervulina*, *E. maxima*, *E. necatrix*, *E. brunetti*, *E. mitis*, and *E. praecox*) are found in domestic chickens. Coccidiosis brings about mortality, morbidity, diarrhea, hematochezia, poor weight gain, and dwindled feed conversion rate leading to economic losses (Elmusharaf *et al*., 2007; Pop *et al*., 2019; Sultan *et al*., 2019). Feed supplementation with anticoccidial drugs has been used to control the disease; however, increasing drug resistance and consumers' tendency not to use products with drug residue and their concern about environmental contamination persuade researchers to find new and natural anticoccidial agents (Elmusharaf *et al*., 2007; Kadykalo *et al*., 2017; Noack *et al*., 2019). Accordingly, the use of medicinal plants, probiotics, and prebiotics are of the best considered ways to prevent, control, or cure coccidiosis (Wondimu *et al*., 2019).

Prebiotics are non-digestible feed ingredients that convert to short-chain fatty acids (propionic, lactic, etc.) in the large intestine, invigorate the growth and/or the activity of some particular intestinal bacteria (bifidobacteria and lactobacilli), and modulate the immune system in the intestinal lumen (Nazhand *et al*., 2020; Sánchez-Hernández *et al*., 2019; Silva *et al*., 2020). Mannan-oligosaccharide (MOS), a compound extracted from the cell wall of the yeast *Saccharomyces cerevisiae,* is of the most well-known prebiotics in the food industry (Carlson *et al*., 2018; Elmusharaf *et al*., 2007; Froebel *et al*., 2019). MOS may prevent the adhesion of pathogenic bacteria to the intestinal mucosa and induce better utilization of diet ingredients, leading to better performance (Adhikari & Kim, 2017; Ricke *et al*., 2020). Prebiotics are known to extend the length of the intestinal mucosa villi, hence increasing absorption surface areas (Teng & Kim, 2018). Dietary supplementation with MOS induced a decline in oocyst production; thus, the severity of coccidiosis (which is probably due to the increase in the length of the intestinal villi) enhanced the integrity of the intestines. (Elmusharaf *et al*., 2007).

Regarding the global spread and high economic losses caused by coccidiosis and resistance to anticoccidial drugs, there is a crucial need to find new approaches to make up for the losses of this disease. The present study was designed to assess the changes caused by the addition of prebiotics to the feed on carcass characteristics and also chemical composition, physical characteristics, color, texture, and fatty acid profile of chicken pectoral muscles containing *Eimeria* species.

Materials and Methods

Birds

A total of 40 male Ross 308 broiler chicks aged one day (Amol Joojeh, Iran) were acquired from a local hatchery. Wire-floored cages were used to rear the birds from day one to six weeks. The temperature of pens was adjusted according to Partovi *et al*. (2019). The groups had access to water and fed *ad libitum*. The rations were designed according to Ross 308 nutrient recommendations provided in Table 1.

Experimental Design

The broiler chicks were randomly assigned to four groups as follows: (1) negative control (NC) fed with basal diet without coccidia challenge, (2) positive control (PC) received basal diet with coccidia challenge, (3) antibiotic group (COX) challenged and fed with coxidine, (4) prebiotic group (PRE) challenged and fed with supplemented diet by prebiotics. Infection with *Eimeria* species was caused with *E. acervulina* (2×10^5), *E. maxima* (1×10^5), and *E. tenella* (2×10^5) oocysts on the 18th day (Conway & McKenzie, 2007). The oocysts were obtained from the Department of Veterinary Parasitology at the

University of Tehran and confirmed according to morphological and morphometric properties in a parasitology lab at Amol University of Special Modern Technologies. On day 18, chickens were challenged with 1 mL of the *Eimeria* species mixture by oral gavage using a 24-gauge stainless steel animal feeding tube attached to a 3-mL syringe. Coxidine (Rooyan Darou, Iran) was used in this study as an antibiotic. Coxidine (sulfaquinoxaline + diaveridine) was administered in COX at 18 days of age. The procedure of adding the drug to drinking water was carried out according to Partovi *et al*. (2019). Chickens from PRE received basal diet supplemented with 0.05% Celmanax prebiotic (mannan-oligosaccharide and beta-glucan) at one day of age (Arm & Hammer Animal Nutrition, USA).

Table 1. The composition of basal diet

Item	Starter	Grower	Finisher
Ingredients (%)	1-10	11-24	25-42
Corn	55.4	59.2	64.5
Soybean meal	39	34	28
Vegetable oil	1.2	3	3.7
Oyster shell	1.1	1.1	1.05
Dicalcium phosphate	2	1.5	1.55
Common salt	0.3	0.35	0.35
L-Lysine HCL	0.15	0.10	0.10
DL-Methionine	0.25	0.15	0.15
Vitamin E	0.1	0.1	0.1
Vitamin and mineral premix	0.5	0.5	0.5
Calculated contents (%)			
ME (kcal/kg)	2851	3000	3094
Crude protein	21	19.17	17.07
Calcium	0.97	0.93	0.86
Available phosphorus	0.48	0.43	0.35
Sodium	0.16	0.17	0.17
Lysine	1.38	1.15	1.01
Methionine	0.70	0.55	0.48
Methionine+Cystine	1.03	0.86	0.78

Vitamin and mineral premix supplied per kilogram of diet: vitamin A, 10000 IU; vitamin D3, 9800 IU; vitamin E, 121 IU; B12, 20 µg; riboflavin, 4.4 mg; calcium pantothenate, 40 mg; niacin, 22 mg; choline, 840 mg; biotin, 30 µg; thiamin, 4 mg; zinc sulfate, 60 mg; manganese oxide, 60 mg

Ethics

The experimental protocol was in accordance with the Animal Care Committee of Amol University of Special Modern Technologies, Iran. The ethical committee number is ir.ausmt.rec.1397.09.28.

Slaughtering Procedures

Three birds from each group were killed at slaughtering age (42 days). Final body weight, weight of fresh carcass, and pectoral and thigh meat were measured. Carcasses were refrigerated at 0 to 4°C,

for a day before the breast muscles were filleted. Polyethylene bags were used to pack pectoral muscles. Fecal samples were collected from the 6th to the 10th day after infection. The samples were analyzed for the presence of coccidial oocysts using a standard fecal flotation technique (Lee *et al*., 2011).

Physical Characteristics of Breast Meat

A pH meter (Jenway 3505, Staffordshire, UK) was applied to measure the pH value of breast meat. The pH probe was calibrated using pH 4.0 and 7.0, and calibration was repeated between samples. According to a method devised by Pastorelli et al. (2016), the drip and cooking losses were determined in percentage. The drip loss was measured by calculation of the difference between the weight of meat at 4°C before and after 24 h. To measure the cooking loss, meat was cooked at 75°C in a water bath for 60 min and then cooled down for 30 min, followed by drying. The difference between the weight of meat before and after this process is described as cooking loss.

Chemical Composition of the Pectoral Muscle

Dry matter, fat, protein, and ash of pectoral meat were measured based on directions provided by the Association of Official Analytical Chemists (AOAC, 2000a; AOAC, 2000b; AOAC, 2000c; AOAC, 2000d).

Color of the Pectoral Muscle

L (lightness), a (redness), and b (yellowness) of pectoral muscle samples were determined. A Konica Minolta Chroma Meter CR-400 (Minolta Camera Co., Osaka, Japan) was used to measure the L- (lightness), a- (redness), and b- (yellowness) values of the breast meat.

Texture Characteristics of the Pectoral Muscle

The texture characteristics of pectoral muscles were determined using a texture analyzer (Texture Pro CT V1.2 Build 9, Brookfield Engineering Laboratories, Inc., MA, USA) according to Partovi *et al*. (2019).

Analysis of the Fatty Acid Profile of Breast Meat

In order to analyze the fatty acid profile, the crude fat of broiler breast meat was extracted according to Nielsen (2017), and the extracted fat was methylated (IUPAC, 1987). Then, fatty acids were analyzed by gas chromatography according to Cifuni *et al*. (2004).

Statistical Analysis

The obtained data were subjected to the Shapiro–Wilk test for normality and Levene's test for the homogeneity of variances. Data from the carcass characteristics of broiler chickens, physical characteristics and chemical composition, color, texture profile analysis, and fatty acid profile of breast meat in broiler chickens infected with *Eimeria* species were subjected to one-way analysis of variance (ANOVA) in the general linear model, and comparisons between experimental groups were assessed using Tukey's post hoc tests via SPSS 22 (SPSS Inc., Chicago, Ill., USA). All the results were reported as mean ± standard deviations. The comparisons with P-value<0.05 were assumed as statistically significant.

Results

The results of coccidial oocyst shedding in different post-challenge sampling days are shown in Table 2. No oocysts were detected in NC. In PC, there was shedding of oocytes on days 6–10 after infection. By contrast, in COX, shedding was observed on days 6, 7, and 8 but not on days 9 and 10. The fecal oocyst counts in COX were lower compared to PC. Oocyte shedding had a decreasing trend in PRE. The chickens fed with prebiotics showed a significant reduction in the number of oocyst shedding compared to PC. The dietary supplementation with prebiotics affected carcass characteristics in broilers infected with *Eimeria* species (Table 3).

Significant differences were detected among all groups regarding carcass characteristics (P=0.001). PC had the least favorable carcass characteristics of broiler chickens compared to all other groups (P=0.001). Dietary supplementation with antibiotics in the infected group improved carcass characteristics significantly compared to PC. PRE had the best carcass characteristics compared to all other groups (P<0.05).

The results of Feed conversion ratio (FCR) in Table 3 reveal that the FCR values of groups NC, COX, and PRE are lower compared to PC (P<0.05). PRE had the lowest FCR, but the difference was not significant (P>0.05). Prebiotics were used from the first

day of age and continued until the end of the experiment. However, the challenge was started at 18 days of age. It might be the cause of better weight gain and lower FCR in PRE.

Dietary supplementation with prebiotics changed the physical characteristics of pectoral muscles in broilers infected with *Eimeria* species (Table 3). Drip loss, pH, and cooking loss did not show any significant differences between experimental groups (P>0.05).

Table 3 depicts the effect of dietary supplementation with prebiotics on the chemical composition of breast meat in broilers infected with *Eimeria* species. No remarkable differences were detected among experimental groups regarding the fat, ash, and dry matter of breast meat in broilers (P>0.05). Dietary supplementation with prebiotics increased the crude protein of breast meat in broilers compared to PC (P=0.01).

Table 2. Number of oocysts per gram of faeces expressed as log $_{10}$ (X+1) in experimental groups from the 6th to the 10th day post-infection

Experimental group	days post infection				
	6	7	8	9	10
NC	0c	0c	0c	0c	0c
PC	5.1±0.01a	5.2±0.02a	4.4±0.02a	3.9±0.01a	3.6±0.02a
COX	3.8±0.10b	3.5±0.17b	2.1±0.21b	0c	0c
PRE	4.8±0.02a	3.9±0.06ab	3.2±0.03ab	2.8±0.06b	1.6±0.05b

Data are reported as mean ± SD; n=3; The different superscripts a,b,c,d in the same column indicate significant differences (P<0.05). NC: negative control; PC: positive control; COX: positive and medicated with antibiotic Coxidine; PRE: positive and medicated with prebiotic.

Table 3. Effect of dietary supplementation with prebiotic on carcass characteristics, physical and chemical properties of breast meat in broilers infected with *Eimeria* species

	Experimental group				*P*-value
	NC	PC	COX	PRE	
Final Body Weight (g)	1919.00±9.53 ^{a}	1430.66±4.50 ^{b}	1636.00±6.55 ^{c}	2670.83±61.69 ^{d}	0.001
Carcass weight (g)	1240.66±4.04 ^{a}	918.66±6.11 ^{b}	1056.66±5.50 ^{c}	1693.03±46.02 ^{d}	0.001
Breast weight (g)	375.33±4.50 ^{a}	290.66±3.51 ^{b}	323.00±7.00 ^{b}	491.96±24.21 ^{c}	0.001
Thigh weight (g)	386.00±6.55 ^{a}	289.33±4.04 ^{b}	334.33±5.13 ^{c}	549.80±13.06 ^{d}	0.001
Feed Conversion Ratio	1.88±0.03^{a}	2.22±0.02^{b}	1.93±0.02^{a}	1.79±0.02^{a}	0.025
Breast meat					
pH	6.01±0.08 ^{a}	6.06±0.06 ^{a}	5.98±0.01 ^{a}	6.07±0.07 ^{a}	0.36
Drip loss (%)	7.61±2.94 ^{a}	6.94±1.40 ^{a}	6.59±0.68 ^{a}	5.57±2.25 ^{a}	0.67
Cooking loss (%)	34.96±0.13 ^{a}	33.04±0.11 ^{a}	34.82±0.23 ^{a}	35.03±0.11 ^{a}	0.10
Fat (%)	1.66±0.57 ^{a}	1.98±0.01 ^{a}	2.29±0.42 ^{a}	1.31±0.56 ^{a}	0.17
Dry matter (%)	22.89±2.83 ^{a}	28.16±7.12 ^{a}	24.31±0.91 ^{a}	25.32±2.92 ^{a}	0.49
Ash (%)	0.77±0.19 ^{a}	1.22±0.38 ^{a}	0.97±0.02 ^{a}	0.99±0.00 ^{a}	0.16
Crude protein (%)	20.33±0.67 ^{ab}	19.30±0.20 ^{a}	20.43±0.34 ^{ab}	20.89±0.52 ^{b}	0.01

Data are reported as mean ± SD; n=3; The different superscripts a,b,c,d in the same row indicate significant differences (P<0.05). NC: negative control; PC: positive control; COX: positive and medicated with antibiotic Coxidine; PRE: positive and medicated with prebiotic.

Table 4. Effect of dietary supplementation with prebiotic on color and texture profile analysis of breast meat in broilers infected with *Eimeria* species

	Experimental group				P-value
	NC	PC	COX	PRE	
Color					
L	45.91±3.90 a	45.13±7.35 a	44.96±3.38 a	43.00±2.88 a	0.89
a	4.29±1.88 a	3.14±0.73 a	3.50±1.13 a	3.86±1.46 a	0.76
b	9.68±0.75 ab	11.70±1.15 a	10.48±2.69 ab	8.07±0.13 b	0.04
Texture profile analysis					
Adhesiveness	2.25±0.76 a	1.72±1.76 a	1.43±1.51 a	1.66±1.47 a	0.85
Hardness	6.68±1.91 a	4.42±3.16 a	5.09±0.69 a	5.68±0.71 a	0.55
Springiness	0.98±0.03 a	1.02±0.02 a	1.00±0.00 a	0.98±0.02 a	0.37
Force break	4.52±1.57 a	2.34±0.84 a	3.06±0.40 a	3.32±0.29 a	0.10

Data are reported as mean ± SD; n=3; The different superscripts a,b,c,d in the same row indicate significant differences (P<0.05). NC: negative control; PC: positive control; COX: positive and medicated with antibiotic Coxidine; PRE: positive and medicated with prebiotic.

The consequences of dietary supplementation with prebiotics on the color of the pectoral muscle in broilers infected with *Eimeria* species are shown in Table 4. Infection with *Eimeria* species decreased the a-value that was not significant (P=0.76). Dietary supplementation with prebiotics reduced the b-value of breast meat compared to PC (P=0.04).

Table 4 shows the effect of dietary supplementation with prebiotics on the texture profile analysis of breast meat in broilers infected with *Eimeria* species. No notable differences existed among the experimental groups in the adhesiveness, hardness, springiness, and force break of breast meat (P>0.05).

The consequences of dietary supplementation with prebiotics on the fatty acid profile of breast meat in broilers infected with *Eimeria* species are shown in Table 5. The most abundant fatty acid was oleic acid (C18:1 ranging from 24.90% to 36.10%), followed by palmitic acid (C16:0 ranging from 23.03% to 27.73%) and linoleic acid (C18:2 ranging from 18.50% to 20.43%). Dietary supplementation with prebiotics decreased the amount of fatty acids 16:1 and 18:1 and monounsaturated fatty acids (MUFAs) compared to NC (P<0.05).

Discussion

Infection with *Eimeria* species negatively affected carcass characteristics, which dietary supplementation with prebiotics could compensate for this problem to a considerable extent. PRE had the best carcass characteristics compared to all other groups (P<0.05). Gomez-Verduzco *et al*. (2009) reported that dietary supplementation with 0.05% MOS enhanced local mucosal IgA secretion and cellular and humoral immune responses and decreased parasite excretion in the feces of chickens infected with *Eimeria* species.

Dietary supplementation with MOS improved weight gain and feed conversion of chickens infected with *Eimeria* species. This strategy could compensate for weight gain losses induced by coccidiosis (Gomez-Verduzco *et al*., 2009). The positive effect of prebiotics on the incidence of coccidiosis in pheasants was proved by Zabransky *et al*. (2016).

Table 5. Effect of dietary supplementation with prebiotic on fatty acid profile (% of total fatty acid) of breast meat in broilers infected with *Eimeria* species

Fatty acids	Experimental group				
	NC	PC	COX	PRE	P-value
C 4:0	0	0	0	0	-
C 6:0	0	0	0	0	-
C 8:0	0	0	0	0	-
C 10:0	0	0	0	0	-
C 12:0	0.10 a	0.28 a	0.23 a	0.10 a	0.25
C 14:0	0.60 a	0.90 a	0.80 a	0.73 a	0.56
C 14: 1	0	0	0	0	-
C 16:0	23.03 a	25.46 a	25.50 a	27.73 a	0.63
C 16:1	3.46 a	2.63 ab	2.36 ab	1.73 b	0.02
C 18:0	9.26 a	9.93 a	10.76 a	11.10 a	0.31
C 18:1 T	0.50 a	0.83 a	0.56 a	0.22 a	0.37
C 18:1	36.10 a	32.70 ab	31.47 ab	24.90 b	0.014
C 18:2 T	0.23 a	0.35 a	0.27 a	0.17 a	0.17
C 18:2	20.43 a	19.73 a	19.16 a	18.50 a	0.68
C 18:3 T	0	0	0	0	-
C 18: 3	0.67 a	0.60 a	0.67 a	0.57 a	0.80
C 20:0	0.13 a	0.18 a	0.16 a	0.22 a	0.94
Total trans	0.73 a	1.18 a	0.83 a	0.38 a	0.28
Total saturated	33.13 a	36.76 a	37.46 a	39.88 a	0.19
MUFA*	40.10 a	36.16 ab	34.40 ab	26.88 b	0.013
PUFA**	21.33 a	20.68 a	20.10 a	19.23 a	0.63

Data are reported as mean values; n=3; The different superscripts a,b,c,d in the same row indicate significant differences ($P<0.05$). NC: negative control; PC: positive control; COX: positive and medicated with antibiotic Coxidine; PRE: positive and medicated with prebiotic.

Similarly, Angwech *et al*. (2019) reported that *in ovo* delivery of prebiotics improved the body weight, carcass weight, breast weight, and leg weight of Kuroiler chickens infected with *Eimeria* species compared to the antibiotic-treated group and non-medicated group.

Barberis *et al*. (2015) proved the beneficial role of MOS in reducing the replication of *Eimeria* species and, therefore, the economic losses attributable to coccidiosis. MOS increases the villi length, competes with sporozoites for binding sites on intestinal epithelial cells, and so protects it from lesions caused by *Eimeria* species. *Salmonella enteritidis* colonization decreased in chickens given MOS-supplemented feed (Fernandez *et al*., 2002). Fernandez *et al*. (2002) showed that MOS-supplemented diet increased the count of *Bifidobacterium* spp., *Lactobacillus* spp., and *Eubacterium* spp. and also decreased the count of *Enterobacteriaceae* and *Bacteroides* spp. in birds' intestinal microflora.

The production of bactericidal or bacteriostatic substances by *Bifidobacterium* spp. is one of the most important mechanisms to justify the positive effect of MOS (Fernandez *et al*., 2002). Spring *et al*.

(2000) showed that MOS-supplemented diet reduced *Salmonella* Dublin and *Salmonella typhimurium* colonization in chickens because it prevented bacteria from adhering to the gut mucosa. Some have suggested that the mechanism for the antiparasitic effect of MOS-supplemented diet could be the production of acetic acid, lactic acid, and propionic acid due to *Bifidobacterium* spp., pH decrease, MOS fermentation in colon and caecum of birds, removing oxygen and declined redox potential (Fernandez *et al*., 2002).

The results of the present study are contrary to the results stated by Abu-Akkada and Awad (2015), who showed that dietary supplementation with prebiotics (ImmunoLin) did not improve the performance of challenged chickens with *E. tenella*. This contradiction could be related to the difference between the *Eimeria* species used in the present study and that of the mentioned study (Lee *et al*., 2007).

The physical characteristics of the pectoral muscle in broilers infected with *Eimeria* species did not show any significant differences among the experimental groups. Similarly, the meat pH of Kuroiler chickens infected with *Eimeria* species was not affected by *in ovo* delivery of prebiotics (Angwech *et al*., 2019). Breast meat cooking loss was not affected by dietary supplementation with probiotics and prebiotics significantly (Takahashi *et al*., 2005).

The chemical composition of the pectoral muscle in broilers infected with *Eimeria* species did not have any significant differences among the experimental groups—except for crude protein that increased in infected chickens fed with dietary supplementation with prebiotics. Breast muscle is the greatest edible part and also the most valuable part of broilers' carcass (Konca *et al*., 2009). Meat composition affects the nutritional value of meat and also the quality of meat products (Konca *et al*., 2009). The result of the present study was supported by Angwech *et al*. (2019), who showed that *in ovo* delivery of prebiotics could not affect the fat content of Kuroiler chickens.

Feed supplementation with inulin did not have any significant influence on the crude fat content of the muscle longissimus dorsi in pigs (Grela *et al*., 2014). Similarly, Konca *et al*. (2009) reported that dietary supplementation with MOS did not affect the dry matter, ether extract, and crude ash of breast meat of turkeys. Some researchers have proved that dietary supplementation with MOS improves the morphology and structure of the intestinal mucosa, activity of digestive enzymes, transportation of amino acids, caecal metabolism, decrease of ammonia concentration, and β-glucuronidase activity in the caeca (Juskiewicz *et al*., 2006).

Infection with *Eimeria* species decreased the a-value, while dietary supplementation with prebiotics reduced the b-value of breast meat compared to PC. Color is an important sensory property affecting consumer selection and acceptability of meat (Konca *et al*., 2009). The findings of the current study are in agreement with those of previous works showing that dietary supplementation with MOS had no influence on the L-value (lightness) of breast meat of broiler chickens and turkeys (Konca *et al*., 2009; Pelicano *et al*., 2005). According to Rajput *et al*. (2014), coccidiosis diminished the a-value of broiler chicken meat. This can be attributed to hemorrhage caused in the broiler intestine due to *Eimeria* species (McDougald & Fitz-Coy, 2008). One of the most important clinical signs of coccidiosis is anemia due to hemorrhages in the intestines and caeca, which causes carcass paleness (Kaboudi *et al*., 2016).

The texture profile analyses of breast meat in broilers infected with *Eimeria* species were not different among the experimental groups. Pelicano *et al*. (2005) claimed that adding prebiotics to feed had no effects on the texture properties of broilers' pectoral muscle. These results were proved by Takahashi *et al*. (2005).

Dietary supplementation with prebiotics decreased the amount of fatty acids 16:1 and 18:1 and MUFA compared to NC. Similar to the results of the present study, MUFA of meat from chickens infected with *Eimeria* species was reduced following *in ovo* delivery of prebiotics (Angwech *et al*., 2019). This can be attributed to changes in gut microflora, hence resulting in metabolic changes caused by prebiotics (Angwech *et al*., 2019). Diet supplementation with water and water-alcohol extract of inulin and also root powder from chicory did not have any effect on the fatty acid composition of muscle in pigs (Grela *et al*., 2014). No scientific paper identical to

our work determining the effects of dietary supplementation with prebiotics on the physical characteristics, chemical composition, texture, and fatty acid profile of broiler meat challenged with *Eimeria* spp. was found in scientific databases.

Dietary supplementation with prebiotics is a promising strategy with the potential to compensate for the negative effects of infection with *Eimeria* spp. on carcass characteristics, protein content, and color of breast meat of broiler chickens. This strategy is suitable for large-scale poultry production, especially in countries like Iran, in which coccidiosis is an endemic disease bringing about high economic losses. Further studies involving the use of different kinds of prebiotics at higher concentrations, along with larger infection doses, are necessary to assess their positive effects on other pathogens.

Acknowledgments

This research work was supported by a research grant from Amol University of Special Modern Technologies, Amol, Iran.

Conflict of Interest

The authors declare that they have no conflict of interest.

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10.22059/IJVM.2020.303786.1005095

Iranian Journal of Veterinary Medicine

Abstracts in Persian Language

Online ISSN 2252-0554

مجله طب دامی ایران، ۱۴۰۰، دوره ۱۵، شماره ۳، ۳۴۶-۳۵۷

ارزیابی تأثیر غنی‌سازی جیره با پری‌بیوتیک بر ویژگی‌های گوشت و خصوصیات لاشه جوجه‌های گوشتی پس از عفونت تجربی با گونه‌های *آ یمریا*

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(دریافت مقاله: ۱۰دی ماه ۱۳۹۹، پذیرش نهایی: ۲۳ اسفند ماه ۱۳۹۹)

زمینه مطالعه: پری‌بیوتیک‌ها اجزای غذایی غیر قابل هضمی هستند که موجب تقویت سیستم ایمنی می‌شوند.

هدف: هدف از این مطالعه بررسی تأثیرات غنی‌سازی جیره با پری‌بیوتیک بر خصوصیات لاشه، اجزای سازنده، خصوصیات فیزیکی، رنگ، بافت و پروفایل اسید چرب گوشت سینه جوجه‌های گوشتی آلوده شده با گونه‌های *آ یمریا* است.

روش کار: ۴۰ جوجه گوشتی یک روزه نژاد راس ۳۰۸ به چهار گروه تقسیم شدند: ۱) سالم، درمان‌نشده، ۲) آلوده، درمان‌نشده، ۳) آلوده، درمان‌شده با آنتی‌بیوتیک کوکسیدین و ۴) آلوده و درمان شده با پری‌بیوتیک. پس از ۴۲ روز، خصوصیات لاشه جوجه‌ها ثبت گردید و خصوصیات فیزیکی، اجزای سازنده، رنگ، بافت و پروفایل اسید چرب گوشت سینه مورد ارزیابی قرار گرفت.

نتایج: عفونت با گونه‌های *آ یمریا* موجب افت خصوصیات لاشه شد. گروه ۴ بالاترین میزان وزن نهایی، وزن لاشه و وزن عضلات سینه و ران را نشان داد. pH، افت وزن و افت وزن حاصل از پخت، چربی، خاکستر، ماده خشک و خصوصیات بافتی گوشت سینه جوجه‌های گوشتی در میان گروه‌های مختلف اختلاف معناداری نشان نداد. غنی سازی جیره با پری‌بیوتیک موجب افزایش میزان پروتئین در گوشت سینه شد. عفونت با گونه‌های *آ یمریا* موجب کاهش ارزش a در گوشت سینه شد. غنی‌سازی جیره با پری‌بیوتیک در مقایسه با گروه ۱ موجب کاهش اسیدهای چرب ۱۶:۱ و ۱۸:۱ و اسیدهای چرب تک اشباع‌نشده شد.

نتیجه‌گیری نهایی: غنی‌سازی جیره با پری‌بیوتیک یک روش نویدبخش به‌منظور جبران اثرات منفی عفونت با گونه‌های *آ یمریا* بر خصوصیات لاشه، میزان پروتئین و رنگ گوشت سینه جوجه‌های گوشتی است.

واژه‌های کلیدی: جیره غذایی، گونه‌های *آ یمریا*، فیبر غذایی، آنالیز گوشت، محصولات طیور

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