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Effect of prebiotics supplementation on carcass quality traits in commercial broiler

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Abstract
A study was conducted to evaluate the effect of prebiotics supplementation on carcass quality traits in the commercial broiler. One hundred and sixty day-old broiler chicks (Cobb 400) were randomly assigned to four dietary treatments. Each treatment was replicated four times with 10 birds/replicate. The different levels of MOS (Prebiotics) supplementation on carcass characteristic of broiler chickens as Control (T_1), 1.0 g/kg mannan oligosaccharide supplemented group (T_2), 2.5 g/kg mannan oligosaccharide supplemented group (T_3) and 5.0 g/kg mannan oligosaccharide supplemented group (T_4). The Carcass parameters are pre fasting & post fasting weight, dressing yield, ready to cook yield, Cut of parts & giblet percentage and developments of digestive organs. The results indicated that Pre fasting weight, post fasting weight, dressing yield and ready to cook yield were found to be (P<0.05) significantly different across all the treatment groups. Cut of parts percentage and giblet percentage were found variable among the groups. The following digestive organs, proventicular weight (%), cecal length (%), average cecal length (cm/100gm) and spleen weight (%) of the treatment groups were found to be (P<0.05) significantly different from each other but as for the small intestine weight, small intestine weight (%), the large intestine weight as well as the large intestine weight (%) it was found out that they are not (P<0.01) significantly different across the treatment groups. It was concluded that Supplementation of prebiotic (MOS) up to the level of 5g/kg improves the carcass quality traits without having any adverse effect on growth in commercial broiler.

Keywords: Commercial broiler, carcass traits, prebiotic

Introduction
Poultry meat is today the major source of meat in India. Poultry serves as one of the means of satisfying the increased demand for animal protein. Presently, chicken meat is on demand as a cheap source of protein with low cholesterol value. Antibiotics have long been used as growth promoters. To promote growth, protect the well-being and maximize the genetic prospective of modern broiler (Dhama *et al*, 2011) [8] and layer hybrids (Youssef *et al*, 2013) [23] growth promoter feed additives have been included in poultry diets. There are different types of growth promoters that are used to exploit the broiler industry like antibiotics, probiotics (bio growth promoters), prebiotics, exogenous enzymes, antioxidants, coccidiostats etc. (Allen, 1999; Walker and Duffy, 1998; Dhama *et al*, 2007, 2011; Angelakis *et al*, 2013) [2, 20, 7, 8, 3]. The use of prebiotics is a promising approach for enhancing the role of endogenous beneficial microbiota in the gut. In India the use of growth promoters has been accepted in the broiler industry and they are usually included in the feed in very small quantities.
One of the most promising prebiotic is Mannan-oligosaccharides (MOS). The benefits of MOS are based on specific properties, including modification of the intestinal micro-flora, reduction in the turnover rate of the intestinal mucosa, and modulation of the immune system in the intestinal lumen. These properties have the potential to enhance growth rate, feed efficiency, and livability in poultry species (Parks *et al*., 2001) [14]. Iji *et al*. (2001) [9] examined the effects of MOS (0, 1, 3 and 5 g MOS/kg diet) on the intestinal structure and function of birds during a 21-day feeding period. Improvements in the intestinal structure and function were noticed in birds supplemented with medium or high levels of MOS but the effects of MOS on the growth performance were minimal. In considering the possibility of total antibiotic restrictions in the future and potential benefits of MOS in poultry feeding, the effects of MOS on the growth as well as gut development and function of birds need to be explored. Antibiotic resistance has led poultry nutritionists to find alternatives for antibacterial growth promoters in broilers.

Among these substitutes, one is mannan oligosaccharides (MOS), a yeast cell wall derived prebiotic. MOS decreases the load of pathogenic bacteria through binding bacterial type-1 fimbriae, increasing goblet cells which produce bactericidal mucin and providing favourable environment for the growth of beneficial bacteria leading to competitive exclusion. Though these combined mechanisms, MOS improves growth rate and performance of broilers.

Materials and Methods

Experimental animal: One hundred and sixty day-old broiler chicks (Cobb 400) strain were procured were randomly distributed into 4 treatments with 4 replications. Each replicate contained 10 chicks.

Experimental design and site: This experiment was conducted at Poultry Research and Training Center, Sardar Vallabhbhai Patel University of Agriculture & Technology, Modipuram, Meerut-250110 (U.P.). Geographically Meerut is situated between $29^{0}01$" latitude in the north and $77^{0}45$" longitudes in the East. The carcass quality traits parameters were analysed at the end of 6 weeks of age. The chicks were kept on a deep litter system.

Feeding rate and formulation: Fresh and clean water was provided *ad libitum* every day to the chicks in each treatment group throughout the period of the study (42 days). Standard broiler feeds for the starter (0-3 weeks) and finisher (4-6 weeks) periods as per BIS specifications (1992) were procured from the market. In treatment group, the measured amount of mannan oligosaccharide (MOS) was supplemented at different levels in the basal diets at the rate of 1.0g/kg, 2.5g/kg, and 5g/kg was purchased from local market.

Methods: At the end of the feeding trial, four representative birds from each experimental group were randomly selected and slaughtered for carcass traits**.** Prior to slaughter the broilers were starved for 12 hours. The broilers were weighed alive just prior to slaughter. They were killed by cutting the carotid artery and jugular vein by single clean cut with a sharp knife and left for bleeding. For bleeding one minute was allowed and the carcass was weighed and the blood loss was recorded. The broilers were dressed by removing the head and the neck was also cut off at the base where it joins the body, the blood on the neck which had clotted was removed. The legs or shanks were cut off and the shanks together with the head were discarded. It was done by making a slit from the tip of the breast bone up to the area around the cloaca. The visceral organs were removed by supporting the bird with one hand through the incised abdomen. The Liver was removed carefully. Gall bladder was removed gently without rupture. Gizzard and heart were also removed carefully. The internal layer of gizzard lining was removed retaining its muscular portion. Small intestine, large intestine and caecum were also removed carefully. After the evisceration, thorough washing and cleaning were done with running tap water. Various measurements viz. dressed yield, cut-up parts i.e. drumstick, thighs, wings, neck, back and breast & visceral organ weights i.e. liver, heart, gizzard and spleen weights were taken. The length and weight of small intestine, large intestine and caeca were also measured. Shrinkage percentage was calculated by subtracting post fasting weight from the pre-fasting weight. Dressing percentage and eviscerated yield (ready to cook yield) was also calculated from post fasting weight. Total ready to cook yield was calculated by adding eviscerated yield and giblet yield. Cut-up parts like drumstick, thighs, wings, neck, back and breast were calculated relative to ready to cook yield. Giblet i.e. liver, heart and gizzard percentage were calculated relative to post fasting weight. Similarly, spleen wt., length and weight of small intestine, large intestine & caeca were calculated relative to post fasting weight.

Statistically analysis: The data obtained were subjected to analysis completely randomized design with the simple analysis of variance technique (Snedecor and Cochran, 1994) [16] using Statistical Package for the Social Sciences (SPSS, 2011) [17]. Differences among treatments were considered to be significant when $P \leq 0.05$. The experiment will be conducted in a complete randomized design (CRD).

Results and Discussion

Carcass Charactersitics

The effect of different levels of MOS supplementation on carcass characteristics of broiler chickens is presented in Table 1. Pre fasting weight, post fasting weight, dressing yield and ready to cook yield were found to be ($P<0.05$) significantly different across all the treatment groups. Owens and McCracken (2007) [13] and Pelicano *et al*. (2004) [15] reported that certain types of prebiotics have been used as feed additives to improve animal performance and enhance carcass criteria.

Cut-up parts

The effect of different levels of MOS supplementation on cut-up parts of broiler chickens has been presented in Table 2. The following parameters e.g. thigh, drum stick, breast, back, neck and wing (%) were observed. The entire cut-up parts % except for breast% were observed to be ($P<0.05$) significantly different across the treatment groups. Mahmud et *al.* (2008) and Konca *et al*. (2009) [10] reported that adding MOS to the dier of broilers had no significant effect on carcass and cut-part yields (breast, thigh, wing, liver, heart, gizzard, intestinal system or abdominal fat). Tang *et al.* (2017) [18] observed no significant differences in the relative weights of the heart, liver, pancreas and spleen of all dietary treatment groups when conducting a study on laying hens fed diets supplemented with prebiotic, probiotic and symbiotic.

Development of giblets and spleen

The effect of different levels of mannan oligosaccharide supplementation on the development of the giblets (heart, liver and gizzard) as well as spleen were observed and recorded in table 3. The giblets and spleen % in the 2.5g/kg MOS supplemented group (T_3) and 5g/kg MOS supplemented group (T_4) were found to be ($P<0.01$) significantly different from each other for the entire period of the trial but they were ($P<0.05$) significantly different to the 1.0g/kg MOS supplemented group (T_2)and the control group (T_1). Mohamed *et al*. (2008) [12] reported no significant effects on dressing percentage, liver, heart, gizzard and immune organ bursa weight caused by the addition of MOS to the diet of boiler chickens. Abdel-Hafeez *et al*. (2017) demonstrated that feeding prebiotic to broilers increased ($P<0.05$) the relative weight of gizzard and proventriculus, spleen, bursa of fabricius, and the two caeca.

Development of the digestive organs

The effects of different levels of mannan oligosaccharide

supplementation on the digestive organs of broiler chickens are presented in Table 4. The following parameters i.e. proventicular weight (%), average cecal length (cm/100g), cecal length.(%), spleen weight (%) small intestine weight.(%), small intestine length (cm/100g), large intestine weight (%) and large intestine length (cm/100g) were observed. The following digestive organs, proventicular weight (%), Cecal length (%), average cecal length (cm/100g) and spleen weight (%) of the treatment groups were found to be (P<0.05) significantly different from each other but as for the small intestine weight, small intestine weight%, the large intestine weight as well as the large intestine weight% it was found out that they are not (P<0.01) significantly different across the treatment groups. Awad *et al*. (2009) found out that the spleen weight did not show any significant effect due to feeding a diet supplemented with prebiotics. Yang *et al*. (2007) [22] found out that depending on the dosage level and the age of birds, MOS seemed to reduce the size of the liver and the relative length of the small intestine but did not affect the relative weight of the other visceral organs (proventriculus, gizzard, pancreas, bursa and spleen) and that of the small intestine. Abdel-Hafeez *et al*. (2017) [1] demonstrated that the dietary supplementation with Bio Mos did not influence the carcass yield. However, the relative weights of liver, gizzard and proventriculus, small intestine and bursa of fabricius were found to be increased. Waldroup *et* al. (2003) [19] and Bozkurt *et al*. (2005) [6] reported that supplementation of prebiotic had no significant effect on the abdominal fat of broiler chickens. Likewise, Wang and Zhou (2007) [21] observed that were no significant effect in carcass yield, internal organs and breast yield of birds fed a diet containing a prebiotic.

Table 1: Cut-up parts of broiler chickens at 6 weeks of age

Treatment	Thigh (%)	Drumstick (%)	Breast (%)	Back (%)	Neck (%)	Wing (%)
T_1	19.49^{ab}	17.15^{a}	20.11^{ab}	22.28^{a}	6.64^{a}	11.10^{a}
T_2	19.87^{b}	12.37^{b}	21.44^{b}	19.31^{b}	4.64^{b}	12.07^{c}
T_3	18.86^{a}	16.87^{a}	19.73^{a}	22.42^{a}	5.98^{c}	11.05^{a}
T_4	18.02^{c}	17.02^{a}	19.50^{a}	21.79^{a}	6.23^{ac}	10.26^{b}
SEM	0.17	0.21	0.33	0.30	0.12	0.18
P value	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Means bearing different superscript in a column differ significantly (P<0.05)

Table 2: Development of giblets and spleen of broiler chickens at 6 weeks of age

Treatment	Heart (%)	Liver (%)	Gizzard (%)	Spleen (%)
T_1	0.66^{a}	2.09^{a}	2.20^{a}	0.09^{a}
T_2	0.59^{b}	1.86^{b}	2.18^{a}	0.11^{b}
T_3	0.52^{c}	2.50^{c}	2.07^{b}	0.15^{c}
T_4	0.50^{c}	2.43^{c}	2.08^{b}	0.14^{c}
SEM	0.01	0.05	0.02	0.01
P value	<0.01	<0.01	<0.01	<0.01

Means bearing different superscript in a column differ significantly (P<0.05)

Table 3: Development of the digestive organs of broiler chickens at 6 weeks of age

Treatment	Proventricular wt. (%)	Cecal length (cm/100g)	Cecal length (%)	Spleen wt. (%)	Small intestine wt. (g)	Small intestine wt. (%)	Large intestine wt. (g)	Large intestine wt. (%)
T_1	0.49^{a}	11.96^{a}	0.71^{a}	0.09^{a}	76.19	4.53	3.83	0.23
T_2	0.47^{b}	12.05^{a}	0.67^{b}	0.11^{b}	76.62	4.23	4.53	0.25
T_3	0.43^{c}	12.63^{b}	0.65^{c}	0.15^{c}	82.10	4.21	4.39	0.23
T_4	0.41^{d}	13.04^{b}	0.63^{c}	0.14^{c}	87.43	4.26	5.35	0.26
SEM	0.004	0.135	0.008	0.003	3.833	0.201	0.395	0.021
P value	<0.01	<0.01	<0.01	<0.01	0.18	0.65	0.11	0.58

Means bearing different superscript in a column differ significantly (P<0.05)

Table 4: Carcass quality traits at 6 weeks of age of broiler chickens

Treatment	Pre fasting weight (g)	Post fasting weight (g)	Shrinkage (%)	Dressing yield (g)	Dressing (%)	Eviscerated yield (g)	Eviscerated weight (%)	Ready to cook yield (g)	Readyto cook yield (%)
T_1	1789.00^{a}	1681.75^{a}	6.00	1205.00^{a}	71.63	923.85^{a}	54.93	1006.97^{a}	59.88
T_2	1924.00^{b}	1812.00^{b}	5.82	1296.50^{b}	71.55	1027.35^{b}	56.70	1111.07^{b}	61.32
T_3	2071.00^{c}	1948.50^{c}	5.92	1374.25^{c}	70.53	1107.66^{c}	56.85	1206.64^{c}	61.93
T_4	2184.50^{d}	2056.75^{d}	5.85	1434.00^{d}	69.72	1167.39^{d}	56.77	1270.19^{d}	61.77
SEM	7.73	7.82	0.08	11.66	0.56	9.20	0.53	9.36	0.55
P value	<0.01	<0.01	0.43	<0.01	0.10	<0.01	0.07	<0.01	0.08

Means bearing different superscript in a column differ significantly (P<0.05)

Conclusion

It can be concluded that supplementation of prebiotic (MOS) up to the level of 5g/kg in broiler diet improve the carcass quality traits without the adverse effect of MOS supplementation.

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