Original Research

Dietary Supplementation of Mannan-Oligosaccharide on Carcass Traits and Physico-Chemical Attributes of Meat of Broiler Chickens

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Abstract

An experiment was conducted to evaluate the effect of different levels of Mannan-oligosaccharide (MOS) supplementation in the diets on carcass traits of broiler chickens. One hundred and eighty 7 d old Cobb-400 chicks were assigned to 3 treatment groups with 6 replicates of 10 birds in each treatment and managed uniformly up to 42 d. The basal diets in each group were supplemented with different levels of MOS i.e. M_0 (control, without MOS), $M_{0.5}$ (0.5% MOS of experimental diet), M_1 (1% MOS of experimental diet). Carcass traits (dressing %, primal cuts, weight of organs, giblets, abdominal fat and sensory attributes remained similar among all the groups. Physico-chemical properties and nutritional composition of breast and thigh meat of broiler chickens remained comparable among the groups.

Key words: Cobb-400 Broilers, Meat Quality, Prebiotics, Sensory Attributes

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Introduction

Poultry meat production sector is the fastest growing meat sector in the world Ritchie and Roser (2017). Both, consumption and production of poultry meat is increasing with higher demand Bandara *et al.* (2017). An increase of demand forced farmer to produce broiler in short time with maximum input. So, antibiotics are used in poultry for rapid growth and disease control. The residual amounts of these antibiotics may have the potential to cause human health hazards due to emergence of antibiotic resistance to pathogens Smith *et al.* (2003) and decrease the beneficial bacteria in the gut Sahu *et al.* (2019).

Quality of meat depends on production system, diet feed and genotype Fanatico *et al.* (2007). Focus should be made for good food, better health and living conditions for everyone. People spend more money on food with the increasing level of their economic status. Quality and nutritive chicken meat should be produced

because of balanced diets which contain proteins, fats, minerals and vitamins, which are essential for growth and development of human body and brain. Use of natural alternatives to sub therapeutic antimicrobials is increasing to improve performance and safety of broiler products Abudabos *et al.* (2018). Feed additives are called as natural growth promoters i.e., prebiotics, acidifiers, probiotics, enzymes, phytobiotics, immune stimulants and antioxidants Stainer (2006). It does not have any risk with regard to bacterial resistance or undesired residues in animal. Thus, this experiment was carried out to know the effect of different level of prebiotic mannan oligosaccharide (MOS) on carcass characteristics, physical properties and nutritional composition of meat and its sensory evaluation. The criteria for meat quality depend on physical and nutritional quality of meat and sensory acceptability Barbut (2009).

Materials and Methods

Birds and Diets

A total of 180 unsexed chicks of 7 d old of Cobb-400 strain were randomly distributed to 3 groups with 6 replicates in each and 10 chicks per replicate as per completely randomized design. All the birds were kept under uniform management conditions throughout the experimental period till they reached 42 d. The basal diets in each group were supplemented with different levels of MOS i.e. M_0 (control, without MOS), $M_{0.5}$ (0.5% MOS), M_1 (1% MOS). The ingredient and chemical composition of the reference diets for starter phase (which was used for first 3 weeks of experiment) and finisher phase (used during 4 - 5 weeks of experiment) is presented in Table 1. The reference diet was formulated as per BIS standard for broiler ration.

Carcass Traits

At the end of experiment total 18 birds of similar body weight 6 from each group taking randomly 1 from each treatment were fasted for 10 hours with provision for drinking water before slaughter. Birds were weighed and slaughtered immediately by cutting the jugular vein and carotid artery just behind the ear lobes by *halal* method and were allowed to bleed completely. The feather and skin were removed, head was separated at atlanto-occipital joint and shank was cut from hock joints. Near of the keel bone horizontal cut was made. The breast was slightly upturned and pushed upward exposing the viscera along with the visceral organs and these organs were removed completely by pulling out. Giblet i.e., heart, liver and gizzard were removed carefully form viscera and lung was scrapped off. Gall bladder was removed from the liver carefully with less damage to the liver. Gizzard was cut and opened; the content and epithelial lining was removed. The dressed weight was recorded alone and with giblets. The weights of primal cut (chest, back, thigh, wing, neck, head and shank), gizzard, liver, heart and the abdominal fat were recorded individually. All the weights were expressed as a percentage of live weight of the broilers. Dressing percentage was calculated as:

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$$\text{Dressing}(\%) = \frac{\text{Dressed weight}}{\text{Live weight}} \times 10$$

Table 1: Ingredient and nutrient composition of broilers starter and grower ration

Attributes	Starter Diet	Finisher Diet
Ingredient Composition		
Yellow corn maize	52.87	56.59
Rice polish	5.54	8.07
Soybean meal	30	23.88
Soya oil	2.91	2.88
Fish meal	5.83	5.77
Limestone	1.42	1.47
Dicalcium Phosphate	0.66	0.62
Salt	0.5	0.5
DL-methionine	0.12	0.09
Lysine	0.02	0
Vitamin AB2D3 K mix (Hyblend)[1]	0.01	0.01
Vitamin B-complex (Meriplex)[2]	0.02	0.02
Trace mineral mixture (Ultra-TM)[3]	0.1	0.1
Total	100	100
Chemical Composition		
Dry matter	86.46	87
ME (kcal/kg)	3100	3200
Crude protein	22	20
Crude fiber	3.75	3.67
Ether extract	3.48	4
Calcium	1	1
Phosphorous	0.7	0.7
Lysine	1.2	1.03
Methionine	0.5	0.45

[1]One gram of vitamin A B D K supplement contained 82500 IU of vitamin A, 50 mg of vitamin-B_{12}, 12000 IU of vitamin-D_3 and 10 mg of vitamin-K. [2]One gram of B-complex supplement contained 8 mg of vitamin B_1, 16 mg of vitamin B_6, 80 mg vitamin B_{12}, 80 mg of vitamin E, 120 mg of niacin, 8 mg of folic acid, 80 mg of calcium pantothenate and 86 mg of calcium. [3]One gram of trace mineral contained 54 mg of manganese, 52 mg of zinc, 20 mg of iron, 2 mg of iodine and 1mg of cobalt.

Physico-Chemical Properties of Meat

Proximate Composition

Proximate composition of the breast meat was determined as procedures of AOAC (2016). Moisture percentage was determined by drying 1 g of meat in an oven at 100±1°C until a constant weight was obtained. Crude protein was determined by the Kjeldahl method. The crude protein percent was obtained

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as 6.25 × N%. Crude fat content of the meat was estimated by Soxhlet extraction method using petroleum ether. Ash content of the meat was estimated by igniting the sample in a muffle furnace at 550°C for 3 h.

Water Holding Capacity

Water holding capacity was measured by the centrifugation methods as per Wardlaw *et al. (*1973). Triplicate meat samples of 15 g each from left side of breast and thigh was taken in screw capped 50 ml tube with addition of 22.5 ml of 0.6 N NaCl solutions and stirred for 1 min with glass rod. It was hold for 15 minute at 4ºC and the sample was again stirred for 1 min and centrifuged at 5000 rpm immediately for 15 minute. The volume was recorded by decanting supernatant layer. The amount of solution retained by the meat was reported as the water holding capacity in ml per 100 g of meat.

pH Value

The meat sample from left of thigh and breast i.e., 10 g was homogenized with 100 ml of distilled water to measure the pH value after 24 hours of slaughter. Buffer solution of pH 4 and pH 7 was prepared to check the pH. The pH value was recorded by dipping the glass electrode of digital pH meter manufactured by Systrong µ pH system.

Sensory Attributes

A panel of 7 judges were selected and trained to get acquainted with the attributes of cooked meat i.e., acceptability, desirability, flavour, juiciness, tenderness and colour. Piece of meat from the left thigh and breast of birds from each group was cooked without salt in oven for 40 minutes at 200ºC rapping with aluminum foil and piece of meat was made 1×1×1 cm cube for sensory evaluation. Judges were instructed to cleanse their mouth with water at a different interval between samples evaluation. Each panelist was requested to evaluate oven cooked chicken breast and thigh meat samples for acceptability, desirability, flavour, juiciness, tenderness and colour using a 9-point Hedonic Scale, in which 1 = dislike extremely, 5 = neither like nor dislike and 9 = like extremely (Meilgaard *et al.*, 2007).

Statistical Analysis

Data were analysed using one -way ANOVA and the differences among mean were separated by Duncan's tests using standard statistical procedures (Snedecor and Cochran, 1989). A probability value less than 0.05 was declared as statistically significant. Data are presented as a mean and standard error of the mean.

Results and Discussion

Carcass Traits

Effect of feeding MOS supplemented diets on carcass traits on percent basis of body weight of broiler chickens is presented in Table 2. Dressing % was found statistically non-significant among the treated

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group. Similar results were observed by Eseceli *et al.* (2010) who reported that diet added with 0.15% MOS for starter, 0.1% MOS for grower and 0.05% MOS for finisher had similar carcass weight as compared to 1% antibiotic supplemented birds in all the three phases. Similar to current findings, several researchers have reported similar dressing %, or % yield of primal cuts and giblets in quails fed on MOS and organic acid salt supplemented diets (Ghosh *et al.*, 2008; Bonos *et al.*, 2010). Similarly, Khalaji *et al.* (2011) and Galal *et al.* (2016) reported that diet supplemented with MOS had no effect on liver, gizzard, heart breast, thigh and abdominal fat of broiler birds. Konca *et al.* (2009) reported similar slaughter weight, carcass yield, breast meat, thigh, wing, empty gizzard, heart liver and abdominal fat pad (%) in male turkey poults fed on diets supplemented with MOS 0.1%, probiotic 300×10^{10} *Saccharomyces* /Kg feed (equivalent to 0.1% probiotic) and control.

Table 2: Effect of feeding mannan oligosaccharide supplemented diets on carcass characteristics of broiler chickens

Attributes	Dietary Groups			SEM	P-value
	M_0	$M_{0.5}$	M_1		
Dressed weight %	67.44	68.85	70.62	0.62	0.065
Dressed weight with edible giblet %	70.43	71.57	73.68	0.62	0.092
Primal Cuts					
Chest %	25.69	26.81	27.51	0.41	0.195
Back %	11.74	11.94	12.72	0.29	0.389
Thigh %	20.28	19.84	20.36	0.31	0.805
Wing %	6.04	5.95	6.36	0.12	0.353
Neck %	2.25	2.87	2.46	0.18	0.425
Head %	2.75	2.63	2.66	0.08	0.874
Shank %	3.6	3.38	3.33	0.09	0.474
Weight of Giblets					
Gizzard %	1.06	0.89	0.91	0.06	0.553
Liver %	1.62	1.46	1.78	0.08	0.243
Heart %	0.31	0.37	0.37	0.02	0.486
Abdominal fat %	1.44	1.45	1.21	0.05	0.065

M_0, control; $M_{0.5}$, 0.5% MOS; and M_1, 1% MOS supplemented groups, SEM, total standard error of the mean

Physico-Chemical Properties and Nutritional Composition of Meat

Physico-chemical properties i.e., moisture %, pH, and water holding capacity and nutritional composition i.e., CP, fat and ash % of breast and thigh meat of broiler chickens was found similar (P>0.05) among all the groups (Table 3). Similar results were also found by Brzoska *et al.* (2007) reported no significant effects on CP, crude fat and ash on diets supplemented with MOS and probiotics alone or with acidifiers as compared to antibiotic supplemented or control chickens. Similarly, no significant effect in dry matter %, CP and crude fat and total ash was reported by Konca *et al.* (2009) in male turkey poults fed on diets

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supplemented with MOS 0.1%, probiotic 0.1 and control. Contrary to the present findings, Ghosh *et al.* (2008), reported significantly reduced crude fat % with MOS and MOS + organic salt supplemented diets and as increased CP % in MOS + organic salt supplemented Japanese quails as compared to antibiotic and organic salts quails.

Table 3: Effect of feeding MOS supplemented diets on physical properties and nutritional composition of breast and thigh meat of broiler chickens

Attributes	Dietary Groups			SEM	P -value
	M_0	$M_{0.5}$	M_1		
Breast Meat					
Moisture %	72.1	71.96	71.88	0.31	0.847
pH	5.61	5.58	5.56	0.05	0.927
WHC%	63.8	63.83	63.84	0.02	0.789
CP %	21.31	22.1	21.6	0.19	0.206
Fat %	1.47	1.37	1.42	0.08	0.956
Ash%	0.74	0.73	0.85	0.06	0.651
Thigh Meat					
Moisture %	73.24	73.18	73.16	0.31	0.913
pH	5.75	5.74	5.68	0.05	0.761
WHC%	62.53	62.57	62.39	0.08	0.626
CP %	19	20.78	19.43	0.34	0.073
Fat %	4.02	3.7	3.99	0.13	0.608
Ash%	0.63^b	0.63	0.78	0.05	0.453

Mean bearing different superscript in a row differ significantly ($P<0.05$); M_0, control; $M_{0.5}$, 0.5% MOS; and M_1, 1% MOS supplemented groups SEM, total standard error of the mean.

Sensory Evaluation

Effect of feeding mannan oligosaccharide supplemented diets on sensory attributes of breast and thigh meat without salt is presented in Table 4. Sensory attributes i.e., acceptability, desirability, flavor, juiciness, tenderness and colour of breast and thigh meat without salt was found similar ($P>0.05$) among the groups. Similar to present findings, no significant differences for sensory attributes of meat of poultry fed on combinations of prebiotics and probiotics-based diets (Brzoska *et al.*, 2010; Pelicano *et al.*, 2005).

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Table 4: Effect of feeding mannan oligosaccharide supplemented diets on sensory attributes of oven cooked breast and thigh meat of broiler birds without salt

Attributes	Dietary Groups			SEM	P-value
	M_0	$M_{0.5}$	M_1		
Breast Meat					
Acceptability	8.2	7.6	7.8	0.24	0.608
Desirability	8.2	8	7.8	0.2	0.735
Flavour	8.6	8.6	8.6	0.16	1
Juiciness	8.2	8	8	0.18	0.89
Tenderness	8.4	8.2	8.2	0.15	0.848
Colour	8.4	8.2	8.2	0.21	0.914
Thigh Meat					
Acceptability	8.8	8.6	8.6	0.49	0.783
Desirability	8.6	8.4	8.2	0.63	0.641
Flavour	8.8	8.6	8.6	0.62	0.859
Juiciness	8.4	8.2	8.2	0.7	0.89
Tenderness	8.6	8.2	8.4	0.51	0.493
Colour	8.8	8.6	8.6	0.62	0.859

M_0, control; $M_{0.5}$, 0.5% MOS; and M_1, 1% MOS supplemented groups, SEM, total standard error of the mean

Conclusion

Supplementation of diets with MOS at 0.5 and 1.0% levels of dietary treatments resulted in similar carcass traits *viz*., dressing %, primal cuts, weights of organs, giblets, abdominal fat and sensory attributes and similar physico-chemical properties and nutritional composition of breast and thigh meat of broiler chickens as reported by several authors. Although, the quality of meat depends on production system including the diet and dietary ingredients, but inclusion of MOS which is a polysaccharide based dietary fibre capable of improving gut health and production has not resulted in any adverse effect on carcass traits and meat quality. Thus, MOS can be used safely for improving health and production of poultry without any perceived adverse effect on carcass traits and meat quality.

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