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Influence of mannan-oligosaccharide and *Saccharomyces cerevisiae* on performance, carcass yield and biochemical profile of broiler chickens

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ABSTRACT

Day old Vencobb broiler chicks (150) were randomly allocated to 5 treatment groups with 3 replicates of 10 chicks in each to study the effect of mannan oligosaccharide (MOS) and *Saccharomyces cerevisiae* (SC) on growth performance, nutrient utilization and carcass yield. The trial lasted for 5 weeks. The starter (0-14 day), grower (14-28 days), and finisher (28-35 days) diets contained 23, 21.5 and 20% CP and 2,900, 3,000 and 3,100 kcal ME/kg feed, respectively. The control (C) group in starter, grower and finisher was supplemented with premix while their negative control (NC), mannan oligosaccharides (MOS), *Saccharomyces cerevisiae* (SC) and mannan oligosaccharides+ *Saccharomyces cerevisiae* (MOS+SC) groups were not supplemented with premix. The later 3 groups were supplemented with MOS 500g/tonne, SC 500g/tonne and MOS+SC 500g+500g/tonne feed, respectively. Maximum conversion of feed into gain was recorded in MOS followed by SC and MOS+SC. The chicks attained relatively more body weight in MOS+SC than other groups. It was least in group C. Phosphorus retention was maximum and significant in MOS+SC in spite of their minimum intakes. There was significant improvement in weight of different cuts in MOS+SC group as compared to other groups. Maximum serum cholesterol, LDL cholesterol and triglyceride was recorded in NC group while in the MOS supplemented treatment serum HDL cholesterol and total protein was maximum. The mean serum glucose, Ca and P was recorded highest in MOS+ SC group. It may be concluded that MOS+SC supplementation in the diet improves the overall FCR and blood biochemical profile of broiler chickens.

Key words: Biochemical profile, Carcass yield, Mannan-oligosaccharide, Performance, *Saccharomyces cerevisiae*

The physical status of poultry is widely correlated with gastrointestinal microorganisms, which influence gut morphology, nutrition and immune function of the birds (Lan *et al*. 2005). Antibiotics supplementation in broiler feed is discouraged due to increased bacterial resistance and occurrence of antibiotic residues in meat, making it necessary to find suitable alternative against antibiotic growth promoters. Probiotics, an alternative to the use of antibiotics, served as bio-regulators of the intestinal micro flora and it is found that probiotic supplements based on *Bacillus coagulans* enhanced the growth rate of broilers (Jin *et al*. 1998). In view of above mannan-oligosaccharide (MOS), a prebiotic is used as dietary supplementation. MOS modifies the intestinal micro flora and modulates the immune system in the intestinal lumen. Broiler gut health can be improved by supplementing the mannan oligosaccharide in the diet which can serve as a safe alternative to antibiotic growth promoter (Abudabos and Yehia 2013).

The present study was conducted to study the effect of mannan-oligosaccharide and *Saccharomyces cerevisiae* on growth performance, carcass yield and blood biochemical profile of broiler chickens.

MATERIALS AND METHODS

Birds and diets: The experiment was carried out on day-old Ven Cobb broiler chicks (150). Chicks were allocated to 5 groups (3 replicates/group; 10 chicks/replicate) to study the effect on growth performance and carcass characteristics. The starter diets contained 23% CP and 2,900 kcal ME/kg feed, grower 21.5% CP and 3,000 kcal ME/kg and finisher diet 20% CP and 3,100 kcal ME/kg feed. Ingredient and nutrients composition of diets for chicks at 0 to 35 days old are presented in Table 1. The control (C) group in starter, grower and finisher was supplemented with premix while their negative control (NC), mannan-oligosaccharides (MOS), *Saccharomyces cerevisiae* (SC) and mannan-oligosaccharides+ *Saccharomyces cerevisiae* (MOS+SC) groups were not supplemented with premix. The later 3 groups were supplemented with MOS 500g/tonne, SC 500g/tonne and MOS+SC 500g+500g/tonne feed, respectively. The diets

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Table 1. Ingredients and chemical composition of broilers starter, grower's and finisher's diet

Feed ingredients	Starter (0–14 days)					Grower (14–28 days)					Finisher (28–35 days)				
	Group					Group					Group				
	C	NC	MOS	SC	MOS +SC	C	NC	MOS	SC	MOS +SC	C	NC	MOS	SC	MOS +SC
Yellow maize	53	53	53	53	53	56.40	56.40	56.40	56.40	56.40	59.70	59.70	59.70	59.70	59.70
Deoiled soybean meal	36.40	36.40	36.40	36.40	36.40	33.40	33.40	33.40	33.40	33.40	26.30	26.30	26.30	26.30	26.30
Rice polish	2.50	2.50	2.50	2.50	2.50	-	-	-	-	-	-	-	-	-	-
Fish meal	2	2	2	2	2	2	2	2	2	2	5	5	5	5	5
Soybean oil	2.4	2.4	2.4	2.4	2.4	4.60	4.60	4.60	4.60	4.60	5.50	5.50	5.50	5.50	5.50
Dicalcium phosphate	1.70	1.70	1.70	1.70	1.70	1.60	1.60	1.60	1.60	1.60	1.30	1.30	1.30	1.30	1.30
Limestone powder	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
DL-methionine	0.28	0.28	0.28	0.28	0.28	0.26	0.26	0.26	0.26	0.26	0.22	0.37	0.37	0.37	0.37
Lysine	0.02	0.02	0.02	0.02	0.02	00	0.19	0.19	0.19	0.19	0.17	0.32	0.32	0.32	0.32
Soda	0.17	0.50	0.47	0.47	0.42	0.16	0.35	0.35	0.35	0.35	0.23	0.39	0.39	0.39	0.39
Salt	0.27	0.50	0.48	0.48	0.8	0.30	0.50	0.45	0.45	0.35	0.26	0.42	0.37	0.37	0.32
Premix*	0.56	-	-	-	-	0.58	-	-	-	-	0.62	-	-	-	-
MOS	-	-	0.05	-	0.05	-	-	0.05	-	0.05	-	-	0.05	-	0.05
SC	-	-		0.05	0..05	-	-	-	0.05	0.05	-	-		0.05	0.05
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Chemical composition (%)															
CP	23.01	23.01	23.01	23.01	23.01	22.11	22.11	22.11	22.11	22.11	20.1	22.11	22.11	22.11	22.11
CF	3.80	3.80	3.80	3.80	3.80	3.28	3.28	3.28	3.28	3.28	4.11	3.28	3.28	3.28	3.28
EE	6.10	6.10	6.10	6.10	6.10	6.91	6.91	6.91	6.91	6.91	7.85	6.91	6.91	6.91	6.91
NFE	60.41	60.41	60.41	60.41	60.41	60.6	60.6	60.6	60.6	60.6	61.89	60.6	60.6	60.6	60.6
Ash	6.98	6.98	6.98	6.98	6.98	7.3	7.3	7.3	7.3	7.3	6.45	7.3	7.3	7.3	7.3
AIA	1.75	1.75	1.75	1.75	1.75	2.02	2.02	2.02	2.02	2.02	1.55	2.02	2.02	2.02	2.02
Ca	0.89	0.89	0.89	0.89	0.89	0.78	0.78	0.78	0.78	0.78	0.81	0.78	0.78	0.78	0.78
Total P	0.78	0.78	0.78	0.78	0.78	0.82	0.82	0.82	0.82	0.82	0.83	0.82	0.82	0.82	0.82
Available P	0.45	0.45	0.45	0.45	0.45	0.49	0.49	0.49	0.49	0.49	0.50	0.50	0.50	0.50	0.50
ME (kcal/kg)	2978	2978	2978	2978	2978	3141	3141	3141	3141	3141	3241	3141	3141	3141	3141

*Trace mineral premix (mg/kg diet): Mg 300; Mn 55; Fe 56; Zn 30; Cu 4; vitamin premix (per kg diet): vit. A 8250 i.u.; vit. K 1 mg; vit. E 40 i.u.; vit. B_1 2 mg; vit. B_2 4 mg; vit. B_{12} 100 mg; niacin 60 mg; pantothenic acid 10 mg; choline 500 mg and 30 ppm salinomycin (Coxistac 12%), 55 ppm bacitracin methylene disalicyclate (BMD110)C (control); NC (negative control); MOS (mannan oligosaccharides); SC (*Saccharomyces cerevisiae*) and MOS+SC (mannan-oligosaccharides+*Saccharomyces cerevisiae*).

were prepared with ground maize, rice polish, deoiled soybean meal, fish meal, dicalcium phosphate, limestone powder, DL methionine, lysine and salt. Mineral and vitamin premix, *Saccharomyces cerevisiae* (a commercial product) and MOS were admixed in the diets in the above mentioned groups. To ensure proper mixing of 500g MOS or SC was first hand mixed with approximately 10 kg of feed prior to mixing into the complete feed. The chicks were raised in well ventilated house with facilities of clean drinking water and artificial light during night hours in order to extend 24 h photoperiod.

Analysis of feed samples: Feed samples were analyzed for proximate principles (AOAC 1990; method 984.13). Nitrogen free extract was calculated by difference. Ca and P contents of these samples were determined by precipitation (Clark and Collip 1925) and colorimetric method (Fiske and Subba Rao 1925), respectively.

Balance study: A metabolic trial of 4 days was conducted between 32 to 35 days. During trial excreta from each group was collected replicate wise. A representative sample of feed offered and feed left over was collected daily for laboratory analysis. One portion of excreta was collected and oven dried at 60°C for the determination of moisture, CP, CF, EE, total ash and the other portion was processed for analysis of nitrogen, calcium and phosphorus.

Measurements: All birds were fed for 35 days. Weekly body weight and daily feed intake of chicks were recorded throughout the experiment. Gain in body weight was calculated to determine the growth pattern and feed conversion ratio (FCR) of birds. On last day of experiment after collection of blood samples, birds were sacrificed immediately to determine the dressing percent, total edible meat, various cuts (neck, thigh, drum stick, wing, back) and giblet yields (heart, liver, spleen and gizzard as % of dressed weight). Prior to sacrifice, the birds were kept off fed for 10 h. For biochemical analysis blood was collected from jugular vein in non-heparinised and clean test tubes from three birds on day 35 of experiment. The serum was

collected after 3 h as per the standard procedure and stored under deep freezing temperature awaiting analysis. These samples were analyzed for total serum protein, cholesterol, HDL-cholesterol, LDL-cholesterol, glucose, serum calcium, serum phosphorus, and triglyceride in semi automated analyzer by using diagnostic kits and methodology recommended by manufacturer.

Statistical analysis: Data were analyzed as a randomized complete block design (Snedecor and Cochran 1994). Statistical significance was determined at a 5% probability level.

RESULTS AND DISCUSSION

The effect of supplementation of dietary MOS and SC individually or in combination on feed intake, body weight gain, FCR and nutrient intake in broiler are given in Table 2. The feed consumption by birds was decreased due to supplementation of MOS in the diet however; it was more when a combined supplement of MOS+SC culture was fed to birds. Similarly change in body weights and daily gain in body weights followed the same trend. The maximum FCR was recorded in C group and the minimum in MOS group indicating better utilization of feed for converting into per kilogram body mass due to supplementation of mannan-oligosaccharide in the diet although the feed consumption was lower than those of C, SC and MOS+SC groups. The changes were significant at the probability level of 5% ($P<0.05$). The result indicated that MOS+SC supplementation in the diet improved feed efficiency and weight gain better than NC. Feed consumption was affected by MOS and SC supplementation. This is in accordance to results reported by Bolduan *et al.* (1997) who stated that MOS could improve performance to a level comparable to that produced by antibiotic growth promoters. The other workers (Lan *et al*. 2003, Waldroup *et al*. (2003) stated that probiotic was the most effective growth promoter. Probiotics fed chickens had more weight than other groups (Lan *et al*. 2003). Recently, it has been reported that poultry growth is promoted with the increasing doses of probiotic (commercial) from 0.5 to 1.5g /10 kg feed. The growth trend of supplemented birds positively influenced, up to 1g/ 10 kg feed but beyond that, the pattern was reversed (Ahmad 2004). On the other hand, the increased growth rate could be also related to the lower microbial population in the gastrointestinal tract (Thongsong *et al*. 2008). In our study too the probiotics promoted the growth.

Study showed that probiotics supplementation in feed of chickens improved the feed conversion ratio (Fig 1). Kumprecht and Zobac (1997) reported that inclusion of Bio-Mos® in broiler finisher diets resulted in a significant improvement in body weight and FCR with a level of 2 g/ kg being most effective whereas, 5 g/kg of Bio-Mos® led to minor improvements in body weight Iji *et al*. (2001). In agreement with our study, Onifade *et al*. (1999) reported that SC improved feed/gain ratio and BW gain. Ghasemi *et al*. (2006) had reported that during starter and grower phase,

Table 2. The effect of supplementation of mannan-oligosaccharide and *Saccharomyces cerevisiae* individually or in combination on DM intake, body weight gain and feed conversion ratio in broiler chicken (0–14, 14–28 and 28–35 days)

Period (days)	Group				
	C	NC	MOS	SC	MOS+SC
DM intake (g/bird)					
0-7	103.69±9.02	107.48±4.89	102.42±2.28	96.86±1.37	109.25±0.80
7-14	415.32^{c}±35.16	446.24^{bc}±33.15	527.50^{abc}±50.08	595.33^{a}±49.84	551.92^{ab}±26.60
14-21	317.54^{b}±36.46	381.22^{ab}±47.46	441.64^{a}±27.21	366.57^{ab}±25.35	335.56^{ab}±24.23
21-28	556.73±116.49	544.99±131.29	459.66±73.33	451.12±39.38	459.09±152.71
28-35	417.96^{ab}±32.88	242.93^{b}±53.55	228.85^{b}±64.34	418.8^{ab}±110.23	574.86^{a}±93.05
Body weight gain (g)					
0-7	83.38^{ab}±3.86	80.74^{b}±2.33	85.39^{ab}±0.88	82.09^{b}±0.32	90.31^{a}±1.03
7-14	278.50^{b}±19.80	268.03^{b}±23.1	351.30^{a}±28.7	373.26^{a}±18.31	358.10^{a}±10.95
14-21	189.26^{b}±16.00	199.90^{b}±25.60	268.93^{a}±12.10	244.53^{ab}±11.80	204.46^{b}±18.89
21-28	257.93±41.5	259.90±60.70	228.33±35.6	220±18.50	219.93±69.34
28-35	181.23^{ab}±6.36	105.50^{b}±18.50	97.90^{b}±28.50	183.76^{ab}±32.73	269.33^{a}±49.52
FCR					
0-7	1.24^{ab}±0.05	1.33^{a}±0.02	1.2^{b}±0.03	1.18^{b}±0.01	1.21^{b}±0.01
7-14	1.49^{b}±0.04	1.67^{a}±0.04	1.5^{b}±0.04	1.59^{ab}±0.05	1.54^{ab}±0.03
14-21	1.67^{b}±0.05	1.91^{a}±0.02	1.64^{b}±0.02	1.63^{b}±0.02	1.65^{b}±0.06
21-28	2.12±0.12	2.09±0.12	2.01±0.01	2.05±0.02	2.01±0.14
28-35	2.30±0.11	2.27±0.10	2.40±0.19	2.20±0.23	2.15±0.06

C, control with premix; NC, negative control without premix; MOS, mannan-oligosaccharides 500g/tonne feed without premix; SC, *Saccharomyces cerevisiae* 500g/tonne feed without premix; and MOS+SC (mannan-oligosaccharides 500g/tonne + *Saccharomyces cerevisiae* 500g/tonne without premix. Different superscripts in row differ significantly ($P< 0.05$).

Table 3. The effect of supplementation of mannan-oligosaccharide and *Saccharomyces cerevisiae* individually or in combination on nitrogen, calcium and phosphorus balance in broiler chicken

Particulars	Group				
	C	NC	MOS	SC	MOS+ SC
Nitrogen (g/day)					
Intake	19.99^{ab}±1.05	22.95^{a}±1.24	19.9^{ab}±1.04	17.45^{b}±0.47	18.55^{b}±0.77
excreted	4.85±0.84	5.22±1.00	4.72±0.77	3.99±0.66	3.98±0.54
retained	15.14^{b}±0.26	17.73^{a}±0.23	15.18^{b}±0.34	13.46^{c}±0.21	14.57^{b}±0.28
retention (%)	76.02±2.90	77.58±3.02	76.53±2.64	77.29±3.14	78.69±2.03
Calcium (g/day)					
Intake	1.08^{a}±0.03	1.01^{a}±0.01	1.07^{a}±0.03	0.79^{b}±0.11	0.90^{ab}±0.05
excreted	0.66±0.06	0.70±0.10	0.67±0.03	0.45±0.07	0.48±0.08
retained	0.42±0.05	0.31±0.10	0.40±0.01	0.34±0.05	0.42±0.04
retention (%)	38.96±5.08	30.78±10.16	37.42±2.02	43.09±3.32	47.23±5.95
Phosphorus (g/day)					
Intake	0.50^{a}±0.01	0.49^{a}±0.03	0.39^{b}±0.01	0.42^{b}±0.01	0.36^{b}±0.02
excreted	0.32^{a}±0.04	0.30^{ab}±0.02	0.23^{bc}±0.01	0.26^{ab}±0.01	0.17^{c}±0.02
retained	0.18±0.03	0.19±0.01	0.16±0.09	0.16±0.01	0.19±0.10
retention (%)	36.25^{b}±20.92	38.87^{b}±0.68	41.04^{b}±0.60	38.11^{b}±1.00	53.33^{a}±3.99

C, control with premix; NC, negative control without premix; MOS, mannan-oligosaccharides 500g/tonne feed without premix; SC, *Saccharomyces cerevisiae* 500g/tonne feed without premix; and MOS+SC (mannan-oligosaccharides 500g/tonne + *Saccharomyces cerevisiae* 500g/tonne without premix. Superscripts are read row wise for comparison of mean. Different superscripts differ significantly (P< 0.05).

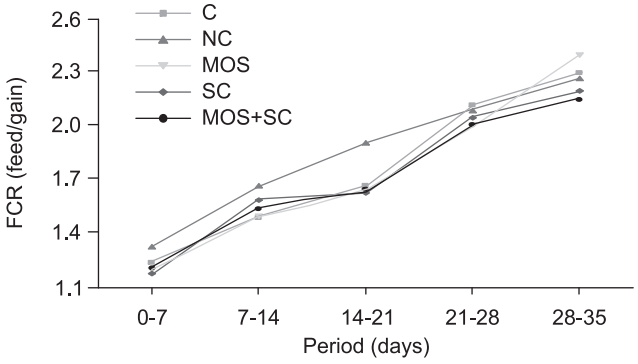

Fig. 1. Effect of mannan-oligosaccharide and *Saccharomyce scerevisiae* on FCR at different period of growth in broiler chickens.

body weight gain and FCR was significantly (P<0.01) improved by SC supplementation. Supplementation of mannan-oligosaccharide in broiler diets improved improves the FCR of birds which was not associated with feed intake but it was associated with a significant reduction in the ileal *Clostridium perfringens* populations in the gut (Abudabos and Yehia 2013).

The data pertaining to balance study has been given in Table 3. The maximum phosphorus was retained by broiler in MOS+SC. It was lowest in C group. The results were significant (P<0.05) amongst groups. No significant change was obtained in the per cent retention of either N or Ca amongst groups in birds. The current findings are consistent with the findings of Ghasemi *et al.* (2006) who reported that supplementation of *Saccharomyces* in diets linearly improved the per cent P retention significantly (P<0.01). Santin *et al*. (2001) reported that mannan -oligosaccharides and fructo-oligosaccharides in the cell wall of yeast assist the balance of minerals. Bradley and Savage (1993) reported that there was increase in mineral retention and better bone mineralization of broilers due to MOS.

C, control with premix; NC, negative control without premix; MOS, mannan-oligosaccharides 500g/tonne feed without premix; SC, *Saccharomyces cerevisiae* 500g/tonne feed without premix; and MOS+SC (mannan-oligosaccharides 500g/tonne + *Saccharomyces cerevisiae* 500g/tonne without premix.

There was significant difference in dressing percentage and average weight of edible organs (heart, liver, gizzard and spleen) amongst groups. They were more in MOS+SC group than other groups. The average weights of different cuts of dressed carcass (thigh, breast, wing, back and neck) have been presented in Table 4. There was significant improvement in per cent weight of cuts as compared to the control where there was no supplementation. Moisture, protein and ready to cook yield percentage also recorded highest in MOS+SC group. Kabir *et al*. (2004) found significantly (P<0.01) higher carcass yield in broilers when probiotic is supplemented in the diet. The result is in accordance with many investigators (Mahajan *et al*. 1999, Singh *et al*. 1999). Shoeib and Madian (2002) had demonstrated increased carcass yield in probiotic fed birds.

Table 4**.** The effect of supplementation of mannan-oligosaccharide and *Saccharomyces cerevisiae* individually or in combination on weight of various cuts of carcass weight (g), chemical composition and ready to cook yield in broiler chicken

Particulars	Group				
	C	NC	MOS	SC	MOS+ SC
Live weight	1281.4±44.70	1175.26±25.00	1320.4±32.21	1378.43±14.65	1452.76±8.14
Liver	26.77^{d}±0.89	24.91^{e}±0.52	29.57^{c}±0.72	31.67^{b}±0.32	33.55^{a}±0.18
Gizzard	20.88^{ab}±0.70	17.02^{b}±0.35	21.71^{ab}±1.53	24.37^{a}±3.92	27.16^{a}±0.15
Heart	5.25^{c}±0.17	4.81^{d}±0.10	6.46^{ab}±0.15	6.20^{b}±0.06	6.61^{a}±0.05
Spleen	1.27^{a}±0.04	1.29^{a}±0.02	1.18^{b}±0.02	1.09^{c}±0.01	1.3^{a}±0.01
Wing piece	260.37^{c}±8.73	220.94^{d}±4.70	277.01^{bc}±6.75	281.33^{ab}±2.99	298.1^{a}±1.67
Thigh	242.05^{d}±8.12	213.77^{e}±4.54	265.66^{c}±6.48	289.60^{b}±3.07	307.98^{a}±1.72
Breast	104.68^{d}±3.51	103.55^{e}±2.20	118.96^{c}±2.90	126.53^{b}±1.34	137.86^{a}±0.77
Back and neck	144.79^{c}±4.58	129.86^{d}±2.76	156.33^{b}±3.81	157.55^{b}±1.67	177.23^{a}±0.99
Dressed meat	805.99^{c}±27.04	717.49^{d}±15.26	868.02^{b}±21.17	915.55^{b}±9.72	988.02^{a}±5.53
Giblet yield	52.78^{c}±1.77	48.06^{d}±1.02	59.41^{b}±1.44	59.40^{b}±0.63	66.85^{a}±0.37
Composition and yield of meat					
Moisture (%)	62.77± 1.25	62.95± 1.05	64.46± 0.95	64.58±1.08	69.59± 0.95
Protein (%)	21.68± 2.00	21.55± 1.85	22.07± 0.95	21.82± 1.05	22.25± 1.25
Ready to cook yield (%)	62.90± 1.45	61.05± 2.25	65.74± 1.65	66.42± 1.88	68.01± 1.72

C (control with premix); NC (negative control without premix); MOS (mannan-oligosaccharides @ 500g/tonne feed without premix); SC (*Saccharomyces cerevisiae* @ 500g/tonne feed without premix) and MOS+SC (mannan-oligosaccharides @ 500g/tonne + *Saccharomyces cerevisiae* @ 500g/tonne without premix).Superscripts are read row wise for comparison of mean. Different superscripts differ significantly (P< 0.05).

Table 5**.** The effect of supplementation of mannan-oligosaccharides and *Saccharomyces cerevisiae* individually or in combination on various biochemical parameters in broiler chicken

Particulars	Group				
	C	NC	MOS	SC	MOS+ SC
Glucose (mg/dl)	243.33^{b}±1.76	235.67^{c}±2.02	248.33^{ab}±1.02	250.33^{a}±2.84	252^{a}±2.08
Cholesterol (mg/dl)	166^{c}± 1.52	186.33^{a} ±1.45	146.67^{d}±0.88	169^{bc}±2.88	172.67^{b}±1.45
HDL cholesterol (mg/dl)	95.67^{a}±0.88	62.67^{c}±1.20	96.33^{a}±1.45	82.33^{b}±1.85	93.67^{a}±1.45
LDL cholesterol (mg/dl)	37.93^{c}±1.84	87.06^{a}±0.96	18.26^{d}±1.63	54.4^{b}±4.52	45.46^{c}±2.7
Triglyceride (mg/dl)	162^{b}±3.78	183^{a}±3.21	160.33^{c}±2.33	161.33^{b}±1.45	167.67^{b}±1.2
Total protein (g/dl)	4.35^{a}±0.27	3.40^{b}±0.10	4.74^{a}±0.11	4.39^{a}±0.01	4.40^{a}±0.01
Calcium (mg/dl)	10.65^{b}±0.04	10.66^{b}±0.03	10.68^{b}±0.06	10.68^{b}±0.09	11.00^{a}±0.1
Phosphorus (mg/dl)	6.67^{b}±0.11	6.28^{c}±0.09	6.93^{ab}±0.03	6.79^{ab}±0.12	7.04^{a}±0.03

C (control with premix); NC (negative control without premix); MOS (mannan-oligosaccharides @ 500g/tonne feed without premix); SC (*Saccharomyces cerevisiae* @ 500g/tonne feed without premix) and MOS+SC (mannan-oligosaccharides @ 500g/tonne + *Saccharomyces cerevisiae* @ 500g/tonne without premix). Superscripts are read row wise for comparison of mean. Different superscripts differ significantly (P< 0.05).

The result revealed significant (P<0.05) difference amongst treatments for different biochemical parameters (Table 5). Maximum serum cholesterol, LDL cholesterol and triglyceride were recorded in NC however it was minimum in MOS supplemented group. The serum HDL cholesterol and total protein was recorded highest in MOS supplemented group whereas the lowest in NC group. The mean serum glucose being highest in MOS+SC group however, the lowest value was recorded in NC group. Similar trend is observed by (Makarski and Polonis 2001) who reported that turkeys given a commercial probiotic product, in the drinking water had higher blood hematocrit and glucose content. The highest serum calcium and phosphorus was recorded in MOS+SC supplemented group where as the lowest was recorded in NC group. These findings were in accordance to Ghasemi *et al*. (2006). Kalavathy *et al*. (2003), reported that dietary probiotic (*Lactobacillus* spp.) increase serum HDL cholesterol, but simultaneously LDL cholesterol decreases which might be due to ability of *Lactobacillus* to synthesize bile salt hydrolase, which deconjugates bile salts and the more cholesterol is taken out of blood. Yalcinkaya *et al.* (2008) reported that serum triglyceride level was not influenced by dietary treatment but mean total cholesterol was significantly lower in the birds fed 0.05% MOS when compared to the other treatment groups.

Based on different parameters studied, it was concluded that the addition of MOS and SC can improve the FCR,

yield of different carcass cut and blood biochemical profile of broilers. Supplementation also improves the mineral retention which might enhance the bone mineralization.

REFERENCES

Abudabos A M and Yehia M. 2013. Effect of dietary mannan oligosaccharide from Saccharomyces cerevisiae on live performance of broilers under Clostridium perfringens *challenge. Italian Journal of Animal Science* **12** (2): e 38.

Ahmad I. 2004. 'Effect of probiotic (Protexin) on the growth of broilers with special reference to the small intestinal crypt cells proliferation.' M. Phil thesis. Centre of Biotechnology, University of Peshawar.

AOAC, 1990. *Official Methods of Analysis* 14th edn. Association of official Analytical Chemists, Washington, D.C.

Bolduan G, Shuldt A and Hackl W. 1997. Diet feeding in weaner piglets. *Animal Breeding* **40**: 95-100.

Bradley J L and Savage T F. 1993. Effect of preincubation egg storage time and genotype on hatchability of eggs from turkey breeder hens fed a diet containing a yeast culture. *Poultry Science* **72**: 44.

Clark E P and Collip J B. 1925. Determination of serum calcium. *Journal of Biological Chemistry* **63**: 641-46.

Fiske C H and Subba Rao Y. 1925. Oser, B.L. 1965. *Hawk's Physiological Chemistry*. 14th Edn. McGraw-Hill Co, London.

Ghasemi H A, Tahmasbi A M, Moghaddam G H, Mehri M, Alijani S, Kashefi E and Fasihi A. 2006. The effect of phytase and *Saccharomyces cervisiae* (Sc47) supplementation on performance, serum parameters, phosphorus and calcium retention of broiler chickens. *Poultry Science* **5**:162-68.

Iji P A, Saki A A and Tivey D R. 2001. Intestinal structure and function of broiler chickens on diet supplemented with a mannanoligosaccharide. *Journal of Animal Science* **81**: 1186-92.

Jin L Y W Ho, Abdullah N and Jallaludin S. 1998. Growth performance, intestinal microbial populations and serum cholesterol of broilers fed diets containing *Lactobacillus* cultures. *Poultry Science* **77**: 1259-63.

Kabir S L M, Rahman M M, Rahman M B, Rahman M M and Ahmad S U. 2004. The Dynamics of probiotics on growth performance and immune response in broilers. *International Journal* of *Poultry Science* **3** (5): 361-64.

Kalavathy R, Abdullah N, Jalaludin S and Ho Y W. 2003. Effect of *Lactobacillus* cultures on growth performance, abdominal fat deposition, serum lipids and weight of organs of brother chickens. *British Poultry Science* **44**: 139-44.

Kumprecht I and Zobac F. 1997. The effect of manna oligosaccharides in feed mixtures on the performance of broilers. *Zivocisna Vyroba* **42**: 117-24.

Lan P T, Binh T L and Benno Y. 2003.Impact of two probiotics *Lactobacillus* strains feeding on fecal Lactobacilli and weight gains in chickens. *Journal of Genetical Applied Microbiology* **49**:29-26.

Lan Y, Verstegen M W A, Tamminga S and Williams B A. 2005. The role of the commensal gut microbial community in broiler chickens. *Journal of World Poultry Science* **61**:95-104.

Mahajan P, Sahoo J and Panda P C. 1999. Effect of probiotic feeding and seasons on the growth performance and carcass quality of broilers. *Indian Journal* of *Poultry Science* **34:** 167-76.

Makarski B and Polonis A. 2001. Effect of Bioplex-Cu on the level of biochemical indices of turkey blood. *Polish Journal of Food and Nutrition Science* **10**: 49-51.

Onifade A A, Odunsi A A, Babatunde G M , Olorede B R and Muma E. 1999. Comparison of the supplemental effects of *Saccharomyces cerevisiae* and antibiotics in low-protein and high-fiber diets fed to broiler chicken. *Archiv Animal Nutrition* **52:** 29–39.

Santin E, Maiorka A, Macari M, Grecco M, Sanchezi J C, Okada T M. and Myasaka A M. 2001. Performance and intestinal mucosa development of broiler chickens fed diets containing Saccharomyces cerevisiae cell wall. *Journal of Applied Poultry Research* **10**: 236-44.

Shoeib H K and Madian A H. 2002. A study on the effect of feeding diets containing probiotics (Pronifer and biogen) on growth performance, intestinal flora and hematological picture of broiler chicks. *Asian Veterinary Medical Journal* **47:** 112-25.

Singh S, Sharma V P and Singh S. 1999. Performance of broiler chicks under different energy and probiotic levels during summer season. *Indian Journal* of *Poultry Science* **34**: 34-37.

Snedecor G W and Cochran W G. 1994. *Statistical Methods*. 8th edn. Iowa State University Press, Ames, Iowa.

Thongsong B, Kalandakanond-Thongsong S and Chavananikul V. 2008. Effects of the addition of probiotic containing both bacteria and yeast or an antibiotic on performance parameters, mortality rate and antibiotic residue in broilers. *Thailand Journal of Veterinary Medicine*. **38**:1726.

Waldroup P W, Oviedo-Randon E O and Fitts C A. 2003. Comparison of Bio-Mos and antibiotic feeding programs in broiler diets containing copper sulfate. *Indian Journal* of *Poultry Science* **2** (1): 28-31.

Yalcinkaya I, Gungor T, Bafialan M and Erdem E. 2008. Mannan oligosaccharides from *Saccharomyces cerevisiae* in broilers: Effects on performance and blood biochemistry. *Turkish Journal of Veterinary and Animal Science* **32** (1): 43-48.