*Pakistan J. Zool., vol. 51(1), pp 173-176, 2019.* **DOI**: http://dx.doi.org/10.17582/journal.pjz/2019.51.1.173.176

# Mannanoligosaccharide (MOS) in Broiler Ration during the Starter Phase: 1. Growth Performance and Intestinal Histomorpholgy

**Naila Chand[1], Shamsullah[1], Rafiullah[1], Rifat Ullah Khan[2], Muhammad Mobashar[3], Shabana Naz[4,*], Ebrahim Rowghani[5] and Murad Ali Khan[2]**

[1]*Department of Poultry Science, The University of Agriculture, Peshawar, Pakistan*
[2]*Department of Animal Health, The University of Agriculture, Peshawar, Pakistan*
[3]*Department of Animal Nutrition, The University of Agriculture, Peshawar, Pakistan*
[4]*Department of Zoology, GC University, Faisalabad, Pakistan*
[5]*Department of Animal Sciences, College of Agriculture, Darab Branch, Islamic Azad University, Darab, Iran*

**Article Information**
**Received 01 November 2016**
**Revised 23 June 2017**
**Accepted 06 July 2018**
**Available online 05 December 2018**

**Authors' Contribution**
**NC designed the study. Shamsullah and Rafiullah conducted the study. MM and SN edited the paper. ER and MAK analyzed the data. RUK proof-read the paper.**

**Key words**
**Antibiotic growth promoter, Broiler starter phase, Mannanoligosaccharide, Prebiotic, Lymphoid organs and histomorphology.**

## ABSTRACT

The study was designed to elucidate the impact of mannanoligosaccharide (MOS) on the growth performance, weight of lymphoid organs and intestinal histomorphology of broilers during starter phase. A total of 180 day-old broiler chicks were distributed into 3 treatments, designated as MOS-0, MOS-50 and MOS-100 having MOS at the rate of 0, 50 and 100 g/kg respectively. Each treatment was further replicated 3 times having 10 chicks per replicate. Treatment MOS-0 was kept as control and the birds in this treatment were fed on basal ration without alteration in feed contents while the other treatments MOS-50 and MOS-100 represented 50 and 100 g MOS/kg feed, respectively during starter phase. Feed intake, weight gain and feed conversion ratio (FCR) were significantly ($P<0.05$) high in Treatment MOS-100 compared to the control. Similar trend was also observed in the weight of bursa,thymus and spleen. Significantly higher villus height, crypt depth and goblet cell count was recorded with MOS-100 while values lower with MOS-0 treatment. It was concluded that improvement in growth performance, intestinal histomorphology and relative weight of lymphoid organs in broiler chicks during starter phase was attributed to the supplementation of MOS.

## INTRODUCTION

Antibiotics as growth promoters keep healthy the intestines in broiler chicks by maintaining the balance of microbes and produce better performance and nutrient availability (Khan *et al*., 2012a, b). The effectiveness of these antibiotics has been decreased in humans (Khan *et al*., 2012c). Due to this reason, some countries banned the use of antibiotics as growth promoters (AGP) and there is possibility that using AGP can face such type of legislation in other areas of the world (Khan and Naz, 2013; Abudabos *et al*., 2016; Zia ur Rehman *et al*., 2017). Therefore, demand for using natural alternatives to sub-therapeutic antimicrobials is rising every day to develop farm performance and safety of broiler products (Khan *et al*., 2016; Abudabos *et al*., 2018; Rahman *et al*., 2017).

Among prebiotics, mannanoligosaccharides (MOS) has been well known as non-digestible feed ingredient and has been found beneficial for the host by motivating the growth or metabolic activity of intestinal microorganisms (Chand *et al*., 2016). MOS is the derivative of cell wall of yeast *Saccharomyces cerevisiae* and it can act as a substitute to antibiotic growth promoters. This is usually true in the early age when response to MOS appears to be more prominent in broiler chicks (Yang *et al*., 2007). The present study was planned to evaluate the effects of MOS on the growth performance, weight of lymphoid organs and intestinal histomorphology of broilers during the starter phase.

## MATERIALS AND METHODS

This study was approved by the Committee of Ethics of Faculty of Animal Husbandry and Veterinary Sciences, The University of Agriculture, Peshawar.

*Experimental animals, design and management*

In the study, 180 day old broiler chicks were used and distributed randomly among 3 treatments; MOS-0, MOS-50 and MOS-100, each treatment with 30 birds

* Corresponding author: drshabananaz@gcuf.edu.pk
0030-9923/2019/0001-0173 $ 9.00/0

with 3 replicates. The three treatments are represented as 0, 50 and 100 g/kg of feed. MOS-0 is represented as a control group without addition of MOS in feed. Basal diet was composed of yellow corn, 63.04%; soyabean meal, 33.00%; di calcium phosphate, 2.00%; sodium chloride, 0.3%; lime stone, 0.9%; vitamins and minerals, 0.3%; vegetable oil, 0.3%; methionine, 0.1% and lysine, 0.06%. The calculated values are: ME, 2900 Kcal/kg; Ca, 0.90%; P, 0.44%; methionine, 0.43%; methionine and cysteine, 0.75% and lysine, 1.10%.

*Growth parameters*

Daily feed intake was calculated by feed provided on the particular day minus feed leftover in feeder. Gain in body weight was calculated on weekly basis by recording weight at the end of trial minus weight at the beginning of trial. Feed conversion ratio (FCR) was calculated on completion of trial by total feed consumed by experimental birds divided by total weight gain in birds.

*Measurement of lymphoid organs*

At the end of starter phase, 2 broiler birds were selected per replicate and were slaughtered. Lymphoid organs (thymus, spleen and bursa of fabricius) were removed and weighed separately. Relative weight (%) of all these lymphoid organs was calculated by dividing organ weight to body weight of particular bird.

*Lower ileum histomorphology*

At the end of starter phase, 1 cm piece of the lower ileum from 2 broiler birds from all replicates was removed and fixed in 10% formalin. The intestinal parts/sections were sliced into 5 mm parts and fixed in paraffin. The goblet cells counts were obtained per villus and the villus area was taken from 4 villi/3 tissues per slide. From 20 readings of goblet cell count, mean number of goblet cells per bird was obtained. Villus height was calculated from the top of lam*i*na propria to the top of villus. Crypt depth was considered from the base up to the area of conversion between villus and crypt.

*Statistical analysis*

The statistical analysis was performed in SAS 9.2 (SAS, 2003) using a completely randomized design and least significant difference (LSD) was used for statistical difference among various experimental treatments. The individual broiler bird was the experimental unit for all analysis. Data were analyzed by one-way ANOVA. Duncan multiple range tests were used to compare means. Significance was declared at P<0.05.

## RESULTS

Effect of various levels of dietary MOS on total feed intake, body weight gain and FCR is presented in Table I. These growth indicators were significantly (P<0.05) affected by different dietary MOS. Increased feed intake and body weight gain at higher level of MOS (MOS-100 g/kg of feed) was observed. The highest overall FCR was observed in MOS-0 and the least (good) FCR was recorded for group MOS-100. Lowest values of feed intake and body weight gain were found with MOS-0 followed by MOS-50 and MOS-100 g/kg of feed, which indicated that an increase in dietary MOS resulted in improved growth performance of the broiler birds.

Mean relative weight of lymphoid organs (bursa of fabrics, thymus and spleen) is presented in Table I. Weight of studied lymphoid organs is significantly (P<0.05) different at all levels of MOS. It was noticed that MOS at the rate of 100 g/kg produced a significant increase in the relative weight of lymphoid organs. The heavier weight was noticed for bursa, thymus and spleen, respectively in MOS-100, followed by MOS-50 and MOS-0 (control treatment).

**Table I.- Effect of dietary levels of mannanoligosaccharides (MOS) on feed intake (g), body weight gain (g) and feed conversion ratio, weight of lymphoid organs, villus height, crypt depth and goblet cell count of broiler birds during starter phase.**

| | MOS-0 (n=3) | MOS-50 (n=3) | MOS-100 (n=3) | P value |
|---|---|---|---|---|
| Feed intake | 2216.7± 5.43[c] | 2329.8± 6.05[b] | 2419.3± 5.24[a] | 0.002 |
| Body weight gain | 1212.7± 3.24[c] | 1292.2± 5.10[b] | 1298.4± 3.37[a] | 0.0001 |
| Feed conversion ration | 1.82± 0.11[a] | 1.74± 0.09[b] | 1.63± 0.05[c] | 0.0000 |
| Lymphoid organs | | | | |
| Bursa (g) | 0.26± 0.06[b] | 0.27± 0.05[a] | 0.29± 0.09[a] | 0.049 |
| Thymus (g) | 0.37 ± 0.16[c] | 0.38 ± 0.07[b] | 0.40 ± 0.07[a] | 0.0002 |
| Spleen (g) | 0.073 ± 0.06[c] | 0.077 ± 0.07[b] | 0.083± 0.02[a] | 0.0000 |
| Villus height (µm) | 91.4±1.64[c] | 94.7 ± 2.14[b] | 95.3 ± 2.34[a] | 0.0000 |
| Crypt depth (µm) | 76.3 ± 2.00[c] | 79.2 ± 5.29[b] | 81.5 ± 3.60[a] | 0.0001 |
| Goblet cell count | 112.3 ± 1.00[c] | 115.7 ± 2.64[b] | 119.1 ± 4.08[a] | 0.0002 |

[a,b,c] Value in each column followed by different superscripts are significantly different (P<0.05). MOS, mannanoligosaccharide. MOS-0, MOS-50 and MOS-100 represent 0, 50 and 100 g of MOS/kg feed, respectively.

Mean values of villus height, crypt depth and goblet cell count are given in Table I. Analysis of data indicated the significant effect of MOS on villus height, crypt depth and goblet cells count. It was observed that higher level of treatment resulted in the maximum increase in villus height followed by MOS-50 and control treatment. Similar significant increasing tendency was also observed with crypt depth and goblet cells count by showing higher value at MOS-100.

## DISCUSSION

MOS in the diet in the present study showed enhancement in feed intake of broiler birds. This enhancement may be linked with the proper microbial population in the intestinal tract which has a fundamental role in gut health and overall performance of the chickens (Thongsong *et al*., 2008). Decreasing stress on chickens by Sacchromyces *cerevisiae*, which is a cell wall extract could be suggested as one of the factors resulting in higher feed consumption (Hyginus *et al*., 2003). The repressive effect of MOS on enteric pathogens and improved reliability of the intestinal mucosa of broiler birds may be another possible reason for enhancement of feed intake (Spring *et al*., 2000). These findings are also in line with the findings of other authors (Koc *et al*., 2010; Sultan *et al*., 2015).

Enhancement in body weight of broiler birds might be due to better nutrient consumption (Bardley and Savage, 1994). This might also be correlated to enhanced microbial flora to make broiler birds for better nutrient absorption and decrease nutrient losses. The results of body weight gain revealed that significant improvement in crypt depth, vllii height and goblet cell counts due to MOS could be the possible reasons for better absorption of nutrients and therefore higher gain in body weight.

Improved FCR could be related to positive impact of MOS on digestion and gut health. Due to decrease in pathogen microbes that struggle for nutrients consumption could also be the cause of better FCR (Spring *et al*., 2000). Improved FCR was also reported by Kamran *et al*. (2013) who studied the performance of broiler birds fed MOS during starter phase. Better FCR was also reported by Pelicano *et al*. (2004) and Yang *et al*. (2007) when birds were fed MOS.

Increased relative weight of lymphoid organs at higher level of MOS in the current study was supported by Teo and Tan *et al*. (2007) who reported positive effect of MOS on nourishing the beneficial bacterial population in the intestines. Furthermore, according to above authors, broiler birds fed MOS at different levels of MOS have increased weight of lymphoid organs in comparison to control treatment which might be due to decreasing effect of MOS population of pathogenic microbes in the gut and therefore better health status of broiler birds. Enhanced villi height in the present study observed with MOS dietary supplementation could be related with improved microbial count of Bifidobacteria and Lactobacilli in the gut. Moreover, decrease in development in pathogenic microbes in intestine and necessary anti-nutritional factors in the feed decreasing inflammatory reaction of mucosa in the intestines could also be the possible reason for increased villi height (Iji and Tivey, 1998). MOS improved goblet cell count in the small intestine in our study that in turns increased mucin secretion that helped in elimination of the pathogenic microbes and presented a decent situation for assimilation of nutrients and digestion. Results on improvement in goblet cells density in broiler birds due to MOS feeding in diet are in agreement with Uni and Smironov (2006).

## CONCLUSION

Based on results of this study, supplementation of MOS up to 100 g/kg of feed can be used to improve growth performance, weight of lymphoid organs and histomorphology in term of villi height, crypt depth and Gobler cells count of broilers birds during starter phase.

*Statement of conflict of interest*

The authors declare that they have no conflict of interests.

## REFERENCES

Abudabos, A.M., Alyemni A.H., Dafallah, Y.M. and Khan, R.U., 2016. The effect of phytogenic feed additives to substitute in-feed antibiotics on growth traits and blood biochemical parameters in broiler chicks challenged with *Salmonella typhimurium*. *Environ. Sci. Poll. Res.,* **23**: 24151-24157. https://doi.org/10.1007/s11356-016-7665-2

Abudabos, A.M., Alyemni, A.H., Dafalla, Y.M. and Khan, R.U., 2018. The effect of phytogenics on growth traits, blood biochemical and intestinal histology in broiler chickens exposed to *Clostridium perfringens* challenge. *J. appl. Anim. Res.,* **46**: 691-695. https://doi.org/10.1080/09712119.2017.1383258

Bradley, G.L. and Savage, T.F., 1994. The effects of supplementing diets with *Saccharomyces cerevisiae* var. *boulardii* on male poult performance and ileal morphology. *Poult. Sci.*, **73**: 1766-1770. https://doi.org/10.3382/ps.0731766

Chand, N., Faheem, H., Khan, R.U., Qureshi, M.S., Alhidary, I.A. and Abudabos, A.M., 2016.

Anticoccidial effect of mananoligosacharide against experimentally induced coccidiosis in broiler. *Environ. Sci. Poll. Res.,* **23**:14414-14421. https://doi.org/10.1007/s11356-016-6600-x

Hyginus, M., Çelik, M. and Okan, F., 2003. Comparative effects of feeding diets containing Flavomycin, Bioteksin-L and dry yeast (*Saccharomyces cerevisiae*) on broiler performance. *J. appl. Anim. Res.,* **23**: 139-144. https://doi.org/10.1080/09712119.2003.9706415

Iji, P.A. and Tivey, D.R., 1998. Natural and synthetic oligosaccharides in broiler chicken diets. *World's Poult. Sci. J.*, **54**: 129-143. https://doi.org/10.1079/WPS19980010

Kamran, Z., Mirzaa, M.A., Ahmad, S., Samad, H.A., Sohail, M.U. and Saadullahb, M., 2013. Performance of broiler chickens fed mannan oligosaccharides as alternatives to antibiotics from one to twenty-two days of age. *J. Anim. Pl. Sci.,* **23**: 1482-1485.

Khan, R.U. and Naz, S., 2013. Application of probiotics in poultry production. *World's Poult. Sci. J.,* **69**: 621-632. https://doi.org/10.1017/S0043933913000627

Khan, R.U., Naz, S., Javadani, M., Nikousefat, Z., Selvaggi, M., Tufarelli, V. and Laudadio, V., 2012. The use of turmeric (*Curcuma longa*) in poultry diets. *World's Poult. Sci. J.,* **68**: 97-103. https://doi.org/10.1017/S0043933912000104

Khan, R.U., Naz, S., Tufarelli, V., and Laudadio, V., 2012a. Potential applications of ginger (*Zingiber officinale*) in poultry diet. *World's Poult. Sci. J.,* **68**: 245-252. https://doi.org/10.1017/S004393391200030X

Khan, R.U., Naz, S., Nikousefat, Z., Tufarelli, V. and Laudadio, V., 2012b. *Thymus vlugaris*: Alternative to antibiotics in poultry feed. *World's Poult. Sci. J.*, **68**:401-408. https://doi.org/10.1017/S0043933912000517

Khan, R.U., Nikosefat, Z., Tufarelli, V., Naz, S., Javdani, M. and Laudadio, V., 2012c. Garlic (*Allium sativa*) supplementation in poultry diet: Effect on production and physiology. *World's Poult. Sci. J.*, **68**: 417-424. https://doi.org/10.1017/S0043933912000530

Khan, R.U., Chand, N. and Ali, A., 2016. Effect of organic acids on the performance of Japanese quails. *Pakistan J. Zool.*, **48**: 1799-1803.

Koc, F., Samli, H., Okur, A., Ozduven, M., Akyurek, H. and Senkoylu, N., 2010. Effects of Saccharomyces cerevisiae and/or mannanoligosaccharide on performance, blood parameters and intestinal microbiota of broiler chicks. *Bulg. J. agri. Sci.,* **16**: 643-650.

Pelicano, E.R.L., De Souza, P.A., De Souza, H.B.A., Leonel, F.R., Zeola, N.M.B.L. and Boiago, M.M., 2004. Productive traits of broiler chickens fed diets containing different growth promoters. *Rev. Bres. Cienc. Avic*., **6**: 177-182. https://doi.org/10.1590/S1516-635X2004000300008

Rahman Z, Naz, S., Khan, R.U. and Tahir, M., 2017. An update on the potential application of L-carnitine in poultry. *World's Poult. Sci. J.,* **73**: 823-830. https://doi.org/10.1017/S0043933917000733

SAS, 2003. *SAS User's Guide.* Version 9.1 Edn. SAS Institute Inc., Cary, NC.

Spring, P., Wenk, C., Dawson, K.A. and Newman, K.E., 2000. The effects of dietary mannanoligosaccharides on cecal parameters and the concentrations of enteric bacteria in the ceca of Salmonella-challenged broiler chicks. *Poult. Sci.*, **79**: 205-211. https://doi.org/10.1093/ps/79.2.205

Sultan, A., Uddin, I., Khan, S., Ullah, R., Khan, H., Khan, N.A. and Khan, R.U., 2015. Effect of yeast derived carbohydrate fraction on growth performance, apparent metabolizable energy, mineral retention and gut histomorphology of broilers during starter phase. *Pak. Vet. J.*, **35**: 237-245.

Teo, A.Y.L. and Tan, H.M., 2007. Evaluation of the performance and Intestinal gut microflora of broilers fed on corn-soy diets supplemented with *Bacillus subtilis* PB6 (CloSTAT). *J. appl. Poult. Res.,* **16**: 296-303. https://doi.org/10.1093/japr/16.3.296

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. *Thai J. Vet. Med.*, **38**: 17-26.

Uni, Z. and Smirnov, A.E., 2006. Mucin gene expression and mucin content in the chicken intestinal goblet cells are affected by *in ovo* feeding of carbohydrates. *Poult. Sci.,* **85**: 669-673. https://doi.org/10.1093/ps/85.4.669

Yang, Y., Iji, P., Kocher, A., Mikkelsen, L.L. and Choct, M., 2007. Effects of mannanoligosaccharide on growth performance, the development of gut microflora and gut function of broiler chickens raised on new litter. *J. appl. Poult. Res*., **16**: 280-288. https://doi.org/10.1093/japr/16.2.280

Zia ur Rahman, Chand, N. and Khan, R.U., 2017. The effect of vitamin E, L-carnitine and ginger on production traits, immune response and antioxidant status in two broiler strains exposed to chronic heat stress. *Environ. Sci. Poll. Res.,* **24**: 26851-26857.