

Influence of β -glucan, Mannan- oligosaccharides and their Combination on Performance of Broiler Chicken

Kushal Taye¹, M. G. Nikam^{2*}, M. V. Dhumal³, K. K. Khose⁴ and V. K. Munde⁵

¹Post-graduate scholar, Department of Poultry Science, College of Veterinary and Animal Sciences, Parbhani- 431402, Maharashtra Animal and Fishery Sciences University, Nagpur, Maharashtra, INDIA

²Assistant Professor, Department of Poultry Science, College of Veterinary and Animal Sciences, Parbhani- 431402, Maharashtra Animal and Fishery Sciences University, Nagpur, Maharashtra, INDIA

³Professor (Retd.), Department of Poultry Science, College of Veterinary and Animal Sciences, Parbhani- 431402, Maharashtra Animal and Fishery Sciences University, Nagpur, Maharashtra, INDIA

⁴Assistant Professor, Department of Poultry Science, College of Veterinary and Animal Sciences, Parbhani- 431402, Maharashtra Animal and Fishery Sciences University, Nagpur, Maharashtra, INDIA

⁵Assistant Professor, Department of Poultry Science, College of Veterinary and Animal Sciences, Parbhani- 431402, Maharashtra Animal and Fishery Sciences University, Nagpur, Maharashtra, INDIA

*Corresponding Author: mgnikam@gmail.com

How to cite this paper: Taye, K., Nikam, M. G., Dhumal, M. V., Khose, K. K. & Munde, V. K. (2021). Influence of beta-glucan, Mannan oligosaccharides and their Combination on Performance of Broiler Chicken. *International Journal of Livestock Research*, 11(11), 26-32. <https://dx.doi.org/10.5455/ijlr.20210820020138>

Received : Aug 21, 2021
Accepted : Oct 06, 2021
Published : Nov 30, 2021

Copyright © Taye *et al.*, 2021

This work is licensed under the Creative Commons Attribution International License (CC BY 4.0). <http://creativecommons.org/licenses/by/4.0/>



Abstract

An experiment was conducted to evaluate the performance and profitability of broiler by supplementation of Mannan oligosaccharides (MOS), β -glucan and their combination. 320 Vencobb400day old straight run chicks were weighed and distributed randomly into four treatment groups viz, A, B, C and D with four replicates of 20 chicks each. Treatment group A was serving as control. Supplementation of β -glucans @5g/100kg and MOS @ 50g/100kg of feed and their combination at the same dose rate were in treatment group B, C and D respectively. The weight gain and cumulative feed conversion ratio were significantly affected ($P < 0.01$) by supplementation of MOS, β -glucans and their combination in hot climatic condition. The net profit per bird was higher in combination of MOS and β -glucans supplemented group. It concludes that β -glucans @ 5g/100kg, MOS @ 50g/100kg of feed alone or in combination through feed was beneficial by considering overall performance.

Keywords: Broiler Performance, β -glucan, Mannan oligosaccharides (MOS), Profitability

Introduction

Mannan-oligosaccharides (MOS) and β -glucans are the two main components of yeast cell wall (YCW) that have been thought to contribute to its beneficial effects on host health and performance Shao *et al.* (2013). Studies have demonstrated a quadratic response to Yeast cell wall incorporation in broiler diet Fowler *et al.* (2015). Mannan oligosaccharide (MOS) obtained from *Saccharomyces spp.* of yeast outer cell wall maintains gut health by adsorption of pathogenic bacteria containing type-I fimbriae or by agglutinating different bacterial strains and increasing villi length, uniformity and integrity, immuno modulatory effect Bonos *et al.* (2011), modify microflora fermentation to favor nutrient availability, enhance the brush border i.e., mucin barrier Pourabedin *et al.* (2016). The β -1,3-glucans is a functional polymer consisting of glucose with β -1,3 linkage and that can be isolated from various sources, including grains, mushrooms and bacteria. Their main action is to enhance phagocytosis and proliferation of monocytes and macrophages. Thus β -1,3-glucan can enhance the resistance against infectious bacteria and viruses by improving non-specific immunity. Scanty literature is available on single and combined effects of dietary mannan- oligosaccharides (MOS) and β -glucan on performance and profitability in chicken during hot climatic condition. Therefore, the present study was planned to evaluate the effects of dietary oligosaccharides (MOS), β -glucans and their combination on growth performance and profitability in broiler during hot climatic condition.

Materials and Methods

The experiment was carried out at Broiler unit of Department of Poultry Science, COVAS, Parbhani. The quality feed ingredients were procured from local market and rations were prepared as per BIS (2007), at feed mixing plant COVAS, Parbhani. The experimental design and composition of various treatment diets fed to the experimental birds are given in Table 1 and 2, respectively. The data obtained was statistically analyzed by using Randomized block design (Snedecor and Cochran, 2002). The experiment was approved by Institutional Animal Ethics Committee vide resolution no. IAEC/52/19 dated 2/3/2019

Table 1: Experimental design for housing of broiler with supplementation of β -glucan, MOS and their combination

Treatment group	Treatment group details	No. of birds/pen/	No. of replicates	Total No. of birds
		Replication		
A	Control diet	20	4	80
B	Control diet + β -glucans @ 5g/100kg	20	4	80
C	Control diet + MOS@ 50g/100kg	20	4	80
D	Control diet + β -glucans @ 5g/100kg + MOS @ 50g/100kg	20	4	80
	Total no of birds			320

The pre-starter, starter and finisher diets were offered for first seven days, 8th day to 20thday and 21st to 42nd day of age, respectively. Mannan-oligosaccharide (MOS) and β -1,3-glucan were procured from B.V. BIO-CORP PVT. LTD, Pune-412206.

The standard feeding, watering, floor space and vaccination schedule were followed. The body weight, cumulative weight gain, feed consumption, FCR and economics were recorded replicate-wise. The data collected were subjected to statistical analysis by using Randomized Block Design by Snedecor, and Cochran, (2002). The treatment means were compared by Critical Differences (CD) and Analysis of Variance.

Table 2: Percent ingredient and nutrient composition of (basal diet) pre-starter, starter and finisher rations with supplementation of MOS, β -glucan and their combination

Feed Ingredients	Pre-Starter	Starter	Finisher
Maize	524.48	571.04	623.04
Soybean meal	402.32	372.05	310.51
Oil (veg)	31.32	17.24	28.96
Salt	3.8	3.8	3.8
DL-Methionine	2.04	2.21	1.89
Di-Calcium Phosphate	19.97	17.24	16.17
Shell grit	10.6	11.45	10.89
Trace mineral mixture ¹	1	1	1
AB2D3K ²	0.15	0.15	0.15
B-Complex ³	0.1	0.1	0.1
Choline Chloride, 50%	0.5	0.5	0.5
Toxin Binder	2	2	2
Antibiotic	0.5	0.5	0.5
L-lysine HCL	0.72	0.41	0
Coccidiostat	0.5	0.5	0.5
Total	1000	1000	1000
Nutrient Composition (calculated)			
ME (kcal/kg)	2960	3060	3160
Protein (%)	23	21	19.5
Calcium (%)	0.9	0.85	0.8
Available phosphorus (%)	0.45	0.4	0.38
Lysine (%)	1.36	1.2	1.07
Methionine (%)	0.56	0.55	0.5

Results and Discussion

Weekly Body Weights

ANOVA revealed significant ($P < 0.01$) influence on live weight of broiler for treatment groups B, C and D had compared with control group. The improvement in the body weight was attributed to the phenomena that carbohydrate can bind to the fimbria of bacteria, thus inhibiting the colonization of gastrointestinal tract by pathogenic microorganism and also reduced pathogen colonization, thereby improving broilers performance. Similar findings were recorded by, Shendare *et al.* (2008) they reported that combination of β -glucans and MOS has exhibited higher live body weights compared to control. Attia *et al.* (2014), Fowler *et al.* (2015), Jahanian *et al.* (2016), Khose *et al.* (2018) Saleem *et al.* (2018), Waqas *et al.* (2018) reported similar findings. In contrast, Awaad *et al.* (2011) reported that combination of β -glucans and MOS at higher dose level (2kg/ton) has expressed non-significant differences on body weights. The findings of Eseceli *et al.* (2010), Corrigan *et al.* (2011), are not in agreement with present study. The findings of Keser *et al.* (2011), Moon *et al.* (2016) reported non-significant effect of β -glucan supplementation to the broiler diets.

Cumulative Weight Gain

The treatment groups B, C and D revealed significant ($P < 0.01$) improvement in cumulative weight gain (g) of broiler as per ANOVA (Table 5). The improvement in weight gain could be attributed to the pathogenic bacteria binding ability described as strongly binding and decoying pathogens away from the intestinal lining Shane, (2001). The cumulative weight gain of birds with MOS was exceeded the control birds by 2.45%. Similarly,

supplementation of β -glucans and combination (β -glucans+MOS) improved the cumulative weight gain by 1.87% and 2.03% respectively. Attia *et al.* (2014), Saleem *et al.* (2018), Hashim *et al.* (2018) and Waqas *et al.* (2018) were in agreement with the results of present study. In contrast, Eseceli *et al.* (2010), Keser *et al.* (2011) Wang *et al.* (2016) did not recorded significant improvement in cumulative weight gain (g) of broilers by supplementation of either β -glucans or MOS.

Cumulative Feed Consumption

The cumulative feed consumption (g) revealed non-significant difference among various treatment groups (Table 5) as per ANOVA. The results in present study are in agreement with the findings of Eseceli *et al.* (2010), Awaad *et al.* (2011), Keser *et al.* (2011), Moon *et al.* (2016) Hashim *et al.* (2018) and Waqas *et al.* (2018). They revealed non-significant effect on cumulative feed consumption by supplementation of β -glucan and MOS. In contrast, Attai *et al.* (2014), Jahanian *et al.* (2016), revealed significantly higher cumulative feed intake by supplementation of either β -glucan or MOS.

Table 3: Weekly body weights (g), Cumulative weight gain (g), feed consumption, FCR and Livability of broiler supplemented with β -glucans, MOS and their combination

	Weekly body weights (g)			
	A (Control diet)	B (β -glucans at 5g/100kg)	C (MOS@ 50g/100kg)	D (β -glucans @ 5g/100kg+ MOS@ 50g/100kg)
I	150.65	152.96	154.31	155.9
II	332	340.08	341.7	348.02
III	592.5	609.16	618.12	619.63
IV	996.3	1033.32	1024.46	1019.78
V	1469.4	1517.63	1505.92	1507.89
VI	1991.22	2040	2029.75	2031.51
Overall Mean	922.01 ^a	948.86 ^b	945.71 ^b	947.12 ^b
Cumulative weights gain (g)				
I	112.65	114.21	114.31	117.4
II	294	301.33	301.7	309.52
III	554.5	570.41	578.12	581.13
IV	958.3	994.57	984.46	981.28
V	1431.4	1478.82	1465.92	1469.39
VI	1953.22	2001.25	1989.75	1993.01
Overall mean	884.01 ^a	910.11 ^b	905.71 ^b	908.62 ^b
Cumulative feed consumption				
I	101.4	102.28	101.26	103.13
II	337.7	341.85	342.07	344.48
III	723.73	735.37	735.65	734.62
IV	1370.6	1404.61	1369.68	1361.59
V	2283.56	2326.36	2285.65	2276.04
VI	3479.53	3505.81	3477.38	3431.76
Overall mean	1382.75	1402.71	1385.28	1375.27
Cumulative feed conversion ratio				
I	0.9	0.89	0.88	0.87
II	1.14	1.13	1.13	1.11
III	1.3	1.28	1.27	1.26
IV	1.43	1.41	1.39	1.38
V	1.59	1.57	1.55	1.54
VI	1.78	1.75	1.74	1.72
Overall mean	1.36 ^a	1.34 ^b	1.33 ^b	1.31 ^{bc}
Mortality %	5	3.75	3.75	3.75
ANOVA				

Cumulative Feed Conversion Ratio

The ANOVA for cumulative FCR of broilers supplemented with β -glucans and MOS revealed significant ($P<0.05$) influence (Table 5). The improvement in FCR with β -glucans & MOS may be due to an improvement of the integrity of the intestinal mucosa and reduction of the stress on the mucosa caused by the presence of mannan oligosaccharides, thereby increasing the absorption and utilization of the dietary nutrients. The results of Shendare *et al.* (2008), Kamran *et al.* (2013), Hashim *et al.* (2018) revealed significant improvement ($P<0.05$) in cumulative FCR with β -glucans and MOS. In contrast, Eseceli *et al.* (2010) and Moon *et al.* (2016) revealed poor FCR with either β -glucans or MOS.

Mortality (%)

The mortality in the present study was within normal range. The patho-physiological changes observed under postmortem examination of dead birds were attributed to heat stroke and not to the dietary treatment. It clearly inferred that β -glucans, MOS and their combination had no detrimental effect on survivability of broilers. Similar findings were observed by Attai *et al.* (2014), Jahanian *et al.* (2016), Waqas *et al.* (2018), However, Shendare *et al.* (2008), Cheraghi *et al.* (2014), Moon *et al.* (2016), Hashim *et al.* (2018) concluded that the supplementation of β -glucans and MOS in broilers diet mortality rate was lower than non-supplemented diet.

Table 4: ANOVA for body weight, cumulative weight gain, FCR, feed consumption of broilers with MOS and β -glucans and their combination

Sources	Df	Weekly body weight			Cumulative weight gain		
		SS	MSS	F	SS	MSS	F
Treatments	3	11567.46	3855.82	11.128**	10725.962	3575.321	10.258**
Replicate	3	2204.34	734.78	2.121	2765.697	921.899	2.645
Week	5	41284000.1	8256799.3	23828.326**	41284007	8256799.3	23689.966
Error	84	29107.003	346.512		29277	348.536	
Sources	Df	Cumulative FCR			Cumulative feed consumption		
		SS	MSS	F	SS	MSS	F
Treatments	3	0.022	0.007	14.00**	9708.449	3236.15	1.818
Replicate	3	0.002	0.001	1.252	4445.197	1481.732	0.832
Week	5	7.588	1.518	2903.811	13356008	26712107	15004.91
Error	84	0.044	0.001		149538.55	1780.221	

** Significant at 1% level

Economics

Table 5: Economics of broiler production supplemented with β -glucan, MOS and their combination

S. No.	Particulars	A	B	C	D
		(Control diet)	(β -glucans @ 5g/100kg)	(MOS@50g/100kg)	(β -glucans @ 5g/100kg+ MOS@ 50g/100kg)
1	Chick cost (Rs)	40	40	40	40
2	Feed cost/bird (Rs.)	103.44	104.52	104.42	103.34
3	Misc. cost (Rs)	8	8	8	8
4	Production cost	151.44	152.52	152.42	151.34
5	Av. Live wt. (g)	1953.22	2001.25	1989.75	1993.01
6	Sale receipt @ 95/kg wt	185.55	190.11	189.02	189.33
7	Net profit/ bird	34.11	37.59	36.6	37.99
8	Net profit /kg (Rs)	17.46	18.78	18.39	19.06

The β -glucans, MOS and their combination improved the profitability per kg body weight of the birds. The combination of β -glucans and MOS recorded highest improvement in profitability (9.16%), followed by MOS alone

(7.56%) and β -glucans alone (5.32%). Reward due to superior FCR or reducing the amount of feed required to produce body weight gain. Similar results were also recorded by Fattah and Fararh (2009). Hooge *et al.* (2003) revealed that highest profitability was recorded with diet supplemented MOS compared with control group. Kamran *et al.* (2013) concluded that the weight gain was improved significantly with the use of MOS as compared to control, the cost per kg live weight gain was greater with MOS group. Cheraghi *et al.* (2014) revealed that highest profitability was recorded with diet supplemented with yeast extracted β -glucans and α -mannans compared with control.

Conclusion

It is concluded that the supplementation of MOS, β -glucans and their combination significantly affected ($P < 0.01$) cumulative weight gain and feed conversion ratio and net profit per bird in hot climatic condition. It concludes that β -glucans @ 5g/100kg, MOS @ 50g/100kg of feed alone or in combination may be beneficial to the broiler farmers by considering overall performance.

Acknowledgement

The authors are highly grateful to Dr. N.M. Markandeya, Associate Dean, College of Veterinary and Animal Sciences, MAFSU, Parbhani for providing necessary facilities and for his help at various stages of the experiment. The authors are also thankful to B.V. BIO-CORP PVT. LTD, Pune-412206 for providing Mannan-oligosaccharide (MOS) and β -1,3-glucan products for experimentation.

Conflict of Interests

There is no conflict of interest.

Publisher Disclaimer

IJLR remains neutral concerning jurisdictional claims in published institutional affiliation.

References

1. Attia, Y. A., A.E. Abd Al-Hamid., M. S. Ibrahim., M. A. Al-Harhi., F. Bovera., & A. Sh. Elnaggar. (2014). Productive performance, biochemical and haematological traits of broiler chicken supplemented with propolis, bee pollen and mannan-oligosaccharides continuously or intermittently. *Elsevier Livestock Science*, Volume 164, Pages 87-95.
2. Awaad M. H. H., A. M. Atta., Wafaa A., Abd El-Ghany., M. Elmenawey., K. Ahmed., A. A. Hassan., A. A. Nada., & G. A. Abdelaleem. (2011). Effect of a Specific Combination of Mannan-Oligosaccharides and β -Glucans Extracted from Yeast Cell Wall on the Health Status and Growth Performance of Ochratoxicated Broiler Chickens. *Journal of American Science*, 7 (3), 82-96.
3. BIS (2007). *Indian standards: Poultry feed specification* (fifth revision) 3-5
4. Bonos, E., E. Christaki., A. Abraham., N. Soultos & P. Florou- Paneri. (2011). The influence of mannan oligosaccharides, acidifiers and their combination on cecal microflora of Japanese quail (*Coturnix japonica*). *Anaerobe*, 17, 436–439.
5. Cheraghi, A., H. Khosravinia., S.M. Mousavi & B. Massori. (2014). Effects of dietary levels of yeast extracted β -glucans and α -mannans (Alphamune™) on performance of broiler chicken raised in normal and thermal-stressed conditions. *Europ. Poult. Sci*, 78.
6. Corrigan, A., K. Horgan., N. Clipson., & R. A. Murphy. (2011). Effect of Dietary Supplementation with a *Saccharomyces cerevisiae* Mannan Oligosaccharide on the Bacterial Community Structure of Broiler Cecal Contents. *Journal of Applied and Environmental Microbiology*, 77(18), 6653–6662.
7. Eseceli Huseyin, Ergun Demir, Nurcan Degirmencioglu & Murat Bilgic. (2010). The effect of Bio-Mos (Mannan Oligosaccharide and Antibiotic Growth Promoter Performance of Broilers. *Journal of Animal and Veterinary Advances*, 9(2), 392-395.
8. Fattah Abdel., & Fathy, A. I. Khalid M. Fararh. (2009). Effect of Dietary Supplementation of Probiotic, Prebiotic and Synbiotic on Performance, Carcass Characteristics, Blood Picture and Some Biochemical Parameters in Broiler Chickens. *Benha Vet. Med. J*, 20(2).

9. Fowler, J., R. Kakani., A. Haq., J. A. Byrd., & C. A. Bailey. (2015). Growth promoting effects of prebiotic yeast cell wall products in starter broilers under an immune stress and *Clostridium perfringens* challenge. *J. Appl. Poult. Res.*, 24,66–72.
10. Hashim, M.M., Ryan J. Arsenault., James A. Byrd., Michael H. Kogut., Morouj Al-Ajeeli., & Christopher A. Bailey. (2018). Influence of different yeast cell wall preparations and their components on performance and immune and metabolic pathways in *Clostridium perfringens*-challenged broiler chicks. *Poultry Science*, 97,203–210.
11. Hooge,D. M., M. D. Sims., A. E. Sefton., A. Connolly., & P. Spring. (2003). Effect of Dietary Mannan Oligosaccharide, With or Without Bacitracin or Virginiamycin, on Live Performance of Broiler Chickens at Relatively High Stocking Density on New Litter. *J. Appl. Poult*, 12,461–467.
12. Jahanian, E., A.H. Mahdavi., S. Asgary., R. Jahanian (2016). Effect of dietary supplementation of mannanoligosaccharides on growth performance, ileal microbial counts, and jejunal morphology in broiler chicks exposed to aflatoxins. *Livestock Science*, (16) 301-302.
13. Kamran, Z., M. A. Mirzaa., S. Ahmad., H. A. Samad, M. U. Sohail and M. Saadullahb. (2013). Performance of Broiler Chickens Fed Mannan Oligosaccharides as Alternative to Antibiotics from One to Twenty-Two Days of Age. *The Journal of Animal & Plant Sciences*, 23(5): 1482-1485.
14. Keser, Onur., Tanay Bilal., Halil, Can Kutay., Ismail Abas., Huseyin Eseceli. (2011). Effects of Chitosan Oligosaccharide and/or Beta-Glucan Supplementation to Diets Containing Organic Zinc on Performance and Some Blood Indices in Broilers. *Pakistan Veterinary Journal*, 32(1),15-19.
15. Khose, K. K., M.V. Dhumal., M. G. Nikam., and S. N. Rindhe. (2018). Effect of Amino Acid, Vitamin E, Selenium, MOS and Biotin Nutritional Formula Supplementation Through Feed at Different Dose Levels on Performance of Broiler Chicken. *International Journal of Livestock Research*, 8 (3), 70-79.
16. Moon, S.H., Lee, I.Y.,Feng, X., Lee Y.H. Kim J., and Dong, U.K. (2016). Effect of Dietary Beta-glucans on the Performance of Broilers and the Quality of Broiler Breast Meat. *Asian Australian Journal of Animal Science*,29 (03), 384-389.
17. Pourabedin, M., Q. Chen., M. Yang., and X. Zhao. (2016). Mannan-and xylooligosaccharides modulate cecal microbiota and expression of inflammatory-related cytokines and reduce cecal *Salmonella* Enteritidis colonisation in young chickens. *FEMS. Microbiol. Ecol*, 93,226.
18. Saleem,Muhammad Usman., S.Masood., Hafsa Zaneb., Aneela Zameer Durrani.,Asim Aslam.,Kamran Ashraf., Habib-ur-Rehman., Muti-ur-Rehman., and Muhammad Shabir Shaheen.(2018). Histophysiological Changes in Broilers Fed on Diet Supplemented with Mannanoligosaccharide and Organic Acid Blend. *Pakistan J. Zool*, vol. 50(2), pp 473-480.
19. Shane, S., (2001). Antibiotic alternatives in turkey production. *World Poult.*, 19: 14-15.
20. Shao, Y., Guo, Y., Wang, Z., (2013). beta-1,3/1,6-Glucan alleviated intestinal mucosal barrier impairment of broiler chickens challenged with *Salmonella* enterica serovar Typhimurium. *Poult. Sci.* 92, 1764–1773.
21. Shendare,R.C., M.A. Gongle, A.B. Rajput, B.V.Wanjari, S.M. Mandlekar (2008). Effect of supplementation of Manno-Oligosaccharide and b-glucans on maize-based meal on commercial broilers. *Veterinary World* Vol 1(1) 13-15.
22. Snedecor, G. W. and W. G. Cochran (2002) *Statistical Methods*, 8th Edition, Oxford and IBH publishing company Calcutta, Bombay and New Delhi.
23. Wang,X., Y. Z. Farnell., E. D. Peebles., A. S. Kiess., K. G. S. Wamsley., and W. Zhai. (2016). Effects of prebiotics, probiotics, and their combination on growth performance, small intestine morphology, and resident *Lactobacillus* of male broilers. *Poult. Sci.*, 95,1332–1340.
24. Waqas, M., S. Mehmood., A. Mahmud., Saima, J. Hussain., S. Ahmad., M. Tahir Khan., A. Rehman., M.W. Zia &M.S. Shaheen. (2018). Effect of yeast based mannan oligosaccharide (Actigen™) supplementation on growth, carcass characteristics and physiological response in broiler chickens. *Indian J. Anim. Res.*, <https://arccjournals.com/journal/indian-journal-of-animal-research/B-923>
