

International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2026): 5.29
IJABR 2026; SP-10(8): 460-465
www.biochemjournal.com
Received: 22-05-2026
Accepted: 26-06-2026

Dr. Shubhnish Bisla
Ph.D., Technical Manager,
Carus Laboratories Pvt. Ltd.,
Karnal, Haryana, India

Dr. Sumit Chauhan
Carus Laboratories Pvt. Ltd.,
Karnal, Haryana, India

Dr. Vinod
Carus Laboratories Pvt. Ltd.,
Karnal, Haryana, India

Dr. Dhruval Bhatt
Carus Laboratories Pvt. Ltd.,
Karnal, Haryana, India

The immunity-growth Link: How bacteria-derived beta-glucans shape broiler development

Shubhnish Bisla, Sumit Chauhan, Vinod and Dhruval Bhatt

DOI: <https://www.doi.org/10.33545/26174693.2026.v10.i8Sf.9467>

Abstract

The present study was conducted for 42 days period on 195 cobb-500 broiler birds to assess the effect of bacteria derived β -1,3-glucans (*Beta-spike*, Carus laboratories Pvt. Ltd., Karnal, Haryana, India) supplementation on growth and immunity parameters. The birds were randomly assigned to 5 treatment groups (3 replicates/group; 13 birds/replicate) on a common basal diet. All groups followed a standard vaccination schedule: NDV (Day 1), LPAI (Day 5), IBD (Day 12) and NDV Booster (Day 21). Treatments included T₁ (Vaccinated control); T₂ and T₃ (supplemented with 10 ml and 20 ml betaspikes/100 birds, respectively, during days 8-12 and 22-26); T₄ (continuous supplementation of 20 ml betaspikes/100 birds throughout the experiment period) and T₅ (10 ml competitor product/100 birds during days 8-12 and 22-26). The continuous supplementation of betaspikes in group T₄ showed numerically highest feed intake, body weight and lowest FCR than control and other groups. However, these improvements were not statistically significant ($p > 0.05$) from the other groups. Similarly, hemoglobin mean levels remained comparable across all the groups without any significant variation ($p > 0.05$). Humoral immunity parameters revealed that beta-spike numerically increased ND antibody titres at day 28, while at day 42, the control group had the highest values. All beta-spike groups (T₂, T₃ and T₄) showed improved LPAI titres over control (T₁) at day 28 while at day 42, the T₃ and T₅ both peaked at 8.35 log₂ value. The T₂ group showed highest IBD titres at day 42 while competitor (T₅) showed lowest. Overall, continuous supplementation of beta-spike (β -1,3-glucan) improved broiler growth performance and positively modulated humoral immune response against key vaccination protocols. These findings suggest that beta-spike can be a viable candidate as a new age immunomodulator in poultry production.

Keywords: Beta-spike (β -1,3-glucan), vaccination, humoral immunity and antibiotic alternative

Introduction

Modern poultry farmers are heavily shifting towards a sustainable, clean and antibiotic free production. Due to rising demands of poultry producers and suggestions of policy makers, various immunomodulator natural feeds additives are in spotlight to be used as an alternative to antibiotics for their growth promoting and immunity enhancing properties. One such feed additive is β -glucan, a natural polysaccharide consisting of glucose molecules bound with β -1,3-linkages. Various forms of β -glucan have been identified and extracted from different sources, such as bacterial β -glucan consisting of linear β -1,3-linkages, yeast and fungal derived consisting β -1,3 backbone with 1,6 side chains and cereal derived β -glucan have β -1,3 backbone with 1,4 side chains (Murphy *et al.*, 2010) [1]. These differences in branching, shape and molecular weight determine their biological function in the body. The cereal based β -glucans are primarily recognised for their ability to lower serum cholesterol, modulate gut microbiota and scavenge reactive oxygen species (Nakashima *et al.*, 2018) [2]. These properties are largely attributed to their high viscosity and gel formation capability, which delays the gastric emptying, form a protective layer on the gut mucosa and slows down the cholesterol and carbohydrate absorption through enterocytes. This leads to low sugar spikes after a meal and controlled insulin levels thus helping in diabetes, blood sugar management, and cardiovascular functions. Additionally, they increase the bile secretion which helps in lipid metabolism (Henrion *et al.*, 2019) [3]. On the other side, fungi, yeast and bacteria based β -glucans mainly work on immune function by enhancing the gut health, promoting immune cells (e.g. macrophage) activity, increasing the antibody titres following vaccination, and through anti-inflammatory and immune-modulatory effects (Singh *et al.*, 2024; Amer *et al.*, 2022; Van Steenwijk *et al.*, 2019a; 2021b; Zhang *et al.*, 2020) [4, 5, 6, 7, 8].

Corresponding Author:
Shubhnish Bisla
Technical Manager, Carus
Laboratories Pvt. Ltd.,
Karnal, Haryana, India

Upon uptake via Peyer's patches in the GALT they subsequently move around the body and attach to specific receptors such as CR3 and Dectin 1 present on the surface of immune cells (e.g. macrophages). This interaction initiates intracellular signalling at DNA level which shifts the cells metabolic activity towards enhanced glycolysis, resulting in increased phagocytic activity, faster deployment rate and releasing more cytokines, antibodies and natural killer cells. Thus, by priming of cells, β -1,3-glucan stimulate both innate and adaptive immunity without any cell proliferation or auto immune complications, helping in combating any negative effects of pathogens, enteric infections or immune suppression by various stress factors in poultry rearing. (Jacobs *et al.*, 2017; Schwartz *et al.*, 2021) ^[9, 10].

Yeast or fungal based β -1,3-glucan have long been used in the poultry sector but the bacterial derived glucans are new in the industry and has an edge above yeast/fungal or plant derived glucans in terms of yield, purity, bioavailability, cost, and efficiency (Kim, MK *et al.*, 2003) ^[11].

By keeping the above benefits of linear β -1,3-glucan of bacterial origin in background knowledge, this study was conducted to evaluate the following objectives by supplementing betaspikes (β -1,3-glucan) in broilers:

1. Growth performance parameters: Feed intake, body weight, body weight gain and feed conversion ratio
2. Hematological and serological parameters: Hemoglobin count and antibody titres against new castle disease

(ND), low pathogenicity avian influenza (LPAI) and infectious bursal disease (IBD) vaccination protocols.

Materials and Methods

A trial was conducted on 195 broiler birds from day one to 42 days age at poultry farm of *Carus Laboratories Private Limited* located in village Kunjpura, Karnal, Haryana, India. Birds were counted, weighed, tagged and randomly distributed into 5 treatment groups having 3 replicates per group and consisting 13 birds in each replicate. All the birds were given same basal diet and the vaccination protocol of new castle disease vaccine (NDV), low pathogenicity avian influenza (LPAI), infectious bursal disease (IBD) and booster doses of both ND and LPAI were followed on day 1, 5, 12 and 21, respectively. The supplementation product was Beta-spike (β -1,3-glucan), manufactured by *Carus Lab. Pvt. Ltd, Karnal, Haryana*. The treatment groups were assigned as Control T₁ (without supplementation of beta-spike, only vaccination); T₂ and T₃ supplemented with low (10 ml/100birds) and high (20 ml/100 birds) dose respectively, during days 8 to 12 and 22 to 26 period; T₄ supplemented on high dose (20 ml/100birds) continuously for the entire period and T₅ supplemented with a competitor product at low (10 ml/100birds) dose from 8 to 12 and 22 to 26 days period. The basal diet was formulated as per BIS standards 2007 ^[12]. The feed ingredients used and their nutrient composition as per AOAC 2013 ^[13] are presented in Table 1.

Table 1: Ingredients and nutrient composition of pre-starter, starter and finisher feed

Sr. No.	Ingredients (%)	Pre-starter (1 st week)	Starter (2 nd to 3 rd week)	Finisher (4 th to 6 th week)
1	Maize	53.00	54.00	58.22
2	Soybean meal	40.20	37.80	32.60
3	Vegetable oil	2.77	4.15	5.10
4	Dicalcium phosphate (DCP)	1.80	1.80	1.90
5	Limestone powder (LSP)	1.20	1.20	1.20
6	Salt (NaCl)	0.25	0.25	0.25
7	Trace mineral premix	0.10	0.10	0.10
8	Vitamin premix	0.05	0.05	0.05
9	DL-Methionine	0.16	0.19	0.15
10	L-Lysine	0.07	0.06	0.03
11	Choline chloride 60%	0.10	0.10	0.10
12	Toxin binder	0.10	0.10	0.10
13	Coccidiostat	0.05	0.05	0.05
14	Sodium bicarbonate	0.15	0.15	0.15
	Total	100.00	100.00	100.00
Nutrient Composition (Calculated basis)				
Sr. No.		Pre-starter	Starter	Finisher
1	ME (Kcal/kg)	3000.33	3101.54	3200.44
2	Crude Protein (%)	23.019	22.04	20.03
3	Ether Extract (%)	5.18	6.57	7.64
4	Crude Fiber (%)	4.20	4.08	3.87
5	Calcium (%)	1.01	1.00	1.01
6	Total Phosphorus (%)	0.70	0.69	0.68
7	Available Phosphorus (%)	0.42	0.42	0.43
8	Total Lysine (%)	1.30	1.23	1.08
9	Total Methionine (%)	0.50	0.52	0.45

* Trace Mineral Mixture: Each 1kg contains: Copper-15 g, Iron-80 g, Manganese-100 g, Zinc-80 g, Iodine-2 g, Cobalt-0.5 g, Selenium-0.5 g, Chromium 10 mg and Molybdenum 50 mg.

** Vitamin Premix: Each 500 g contains: Vit. A-12.50 mIU, Vit. D3-2.50 MIU, Vit. E-12 g, Vit. K-1.50 g, Thiamine (B1)-1.50 g, Riboflavin (B2)-5 g, Pyridoxine (B6)-2 g, Cyanocobalamin (B12)-0.015 g, Niacin-15 g, Cal D Pantothenate-10 g and Folic acid-0.50 g.

The birds were housed in deep litter system and were fed pre-starter, starter and finisher diets for 1-7, 8-21 and 22-42 days of age, respectively. Feed and water were provided ad-lib. The feed intake and body weight were recorded weekly for the calculation of feed conversion efficiency of birds. At

the end of trial, 2 ml blood samples were collected from brachial wing vein per bird from 3 birds per replicate in EDTA vacutainer tubes for studying hematological and serological parameters which included hemoglobin count and antibody titres development against the different

vaccination protocols, respectively. The antibody titres were analysed at Poultry Diagnostic Centre, Venkys India Ltd, Sector 16, Panchkula, Haryana. The results of the trial were statistically analysed by one way ANOVA using IBM SPSS software. Variability in the means were considered statistically significant at $p < 0.05$.

Results

Growth performance

The weekly and cumulative feed intake data as presented in Table 2 suggests no significant differences among different groups ($p = 0.18$) in overall feed intake during the 42 day period. However, during first week period feed intake values showed a tendency towards variance ($p = 0.052$) with numeric values of feed intake ranging from 167.92 ± 0.67 g in T_2 to 175.46 ± 0.20 g in group T_3 . At week 6 the feed consumption ranged from highest (909.61 ± 38.00 g) in continuous supplemented group (T_4) to lowest (787.38 ± 57.32 g) in low dose supplemented group (T_2). Similarly, the overall feed intake of 42 days period was highest in T_4 and lowest in T_2 group. There was no significant difference among all the treatment groups ($p = 0.18$). However, the results showed that numeric values of continuous supplemented group (T_4) were highest (3999.04 ± 62.56 g) followed by control (3928.87 ± 31.20 g), competitor (3911.20 ± 7.70 g), high dose (3905.33 ± 22.23 g) and low dose (3839.97 ± 55.65 g) groups. Initial body weights across all the treatments were comparable, with no significant differences ($p = 0.725$). The overall body weight of broiler birds ranged from lowest in T_2 (2658.05 ± 67.86) to highest in T_4 (2880.67 ± 61.35). The

statistically analysed data for overall period revealed that the numeric values for continuous supplemented group (T_4) resulted in highest body weight followed by high dose group (T_3), control (T_1), competitor (T_5) and low dose group (T_2). However, throughout the experimental period, either weekly or cumulative body weights showed no significant differences ($p > 0.05$) among all the treatment groups (Table 2).

During the first week body weight gain was highest in group T_1 (176.77 ± 2.01) and T_3 (176.39 ± 5.09). As the trial progressed further, the results showed numerically highest body weight gain in continuous supplemented group (T_4) in comparison to control, competitor and rest of the beta-spike supplemented groups. The overall body gain was also highest in group T_4 with the mean value of 2836.36 ± 61.50 g. However, the statistical analysis was not significant ($p > 0.05$) across all the groups during all the individual weeks or overall period (Table 2).

The mean values of weekly and cumulative feed conversion ratios are summarised in Table 2. The results showed that no significant difference in FCR was observed throughout the individual weeks or whole 42 days period among different treatment groups. The cumulative FCR values recorded were as 1.48 ± 0.02 (T_1), 1.47 ± 0.02 (T_2), 1.47 ± 0.05 (T_3), 1.41 ± 0.03 (T_4) and 1.48 ± 0.01 (T_5) with T_1 , T_2 , T_3 and T_5 showing very close and consistent values. Although, continuous supplemented group (T_4) demonstrated a superior (lowest) overall FCR of 1.41 ± 0.03 compared to the control and other treatment groups, these variations were all non-significant with each other ($p > 0.05$).

Table 2: The weekly and cumulative feed intake data as presented

Treatments	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Cummulative
Weekly feed intake (g)							
T_1	169.97 ± 1.33	363.48 ± 2.49	571.74 ± 2.14	886.79 ± 16.90	1082 ± 3.97	854.87 ± 10.10	3928.87 ± 31.20
T_2	167.92 ± 0.67	359.41 ± 1.52	573.48 ± 1.59	864.28 ± 1.31	1087.48 ± 1.93	787.38 ± 57.32	3839.97 ± 55.65
T_3	175.46 ± 0.20	355.25 ± 2.61	573.69 ± 0.47	860.61 ± 2.62	1080.66 ± 9.89	859.64 ± 12.86	3905.33 ± 22.23
T_4	170.59 ± 0.80	363.67 ± 6.16	592.19 ± 19.18	869.26 ± 8.72	1093.71 ± 9.02	909.61 ± 38.00	3999.04 ± 62.56
T_5	173.05 ± 3.08	357.69 ± 1.39	571.51 ± 1.58	862.38 ± 4.88	1084.77 ± 6.20	861.79 ± 4.42	3911.20 ± 7.70
p value	0.052	0.36	0.43	0.29	0.69	0.18	0.18
Weekly body weight (g)							
T_1	43.79 ± 0.67	220.56 ± 2.62	502.82 ± 5.51	995.69 ± 14.61	1568.05 ± 12.82	2187.33 ± 12.80	2703.53 ± 17.71
T_2	44.82 ± 1.18	211.94 ± 5.16	501.64 ± 5.28	964.05 ± 22.91	1548.92 ± 21.48	2153.43 ± 62.44	2658.05 ± 67.86
T_3	44.30 ± 0.53	220.69 ± 4.56	501.84 ± 5.70	998.12 ± 21.35	1583.54 ± 38.68	2205.35 ± 70.97	2712.19 ± 101.85
T_4	44.30 ± 0.61	216.15 ± 3.25	508.01 ± 9.84	1013.61 ± 42.18	1623.16 ± 42.77	2288.79 ± 36.73	2880.67 ± 61.35
T_5	43.21 ± 1.03	215.33 ± 2.38	499.53 ± 7.53	961.31 ± 3.65	1533.95 ± 7.39	2171.43 ± 7.88	2690.69 ± 21.98
p value	0.725	0.461	0.930	0.512	0.279	0.330	0.179
Weekly body weight gain (g)							
T_1	176.77 ± 2.01	282.25 ± 6.61	492.87 ± 9.45	572.36 ± 19.83	619.28 ± 16.59	516.21 ± 15.76	2659.74 ± 18.30
T_2	167.13 ± 6.10	289.69 ± 1.70	462.41 ± 17.88	584.87 ± 17.14	604.51 ± 43.93	504.62 ± 68.30	2613.23 ± 68.88
T_3	176.39 ± 5.09	281.15 ± 5.69	496.28 ± 17.88	585.41 ± 28.45	621.81 ± 37.18	506.84 ± 32.39	2667.88 ± 101.97
T_4	171.85 ± 2.68	291.85 ± 9.79	505.60 ± 32.37	609.56 ± 4.91	665.62 ± 18.65	591.87 ± 35.20	2836.36 ± 61.50
T_5	172.10 ± 1.69	284.21 ± 5.71	461.77 ± 5.13	572.64 ± 10.81	637.49 ± 15.07	519.26 ± 14.11	2647.46 ± 21.76
p value	0.44	0.71	0.38	0.61	0.64	0.50	0.18
Weekly FCR							
T_1	0.96 ± 0.01	1.29 ± 0.03	1.16 ± 0.02	1.55 ± 0.08	1.75 ± 0.05	1.65 ± 0.05	1.48 ± 0.02
T_2	1.00 ± 0.40	1.24 ± 0.005	1.24 ± 0.05	1.48 ± 0.04	1.81 ± 0.13	1.59 ± 0.12	1.47 ± 0.02
T_3	0.99 ± 0.02	1.26 ± 0.01	1.15 ± 0.03	1.47 ± 0.06	1.75 ± 0.10	1.71 ± 0.09	1.47 ± 0.05
T_4	0.99 ± 0.02	1.24 ± 0.02	1.17 ± 0.04	1.42 ± 0.01	1.64 ± 0.03	1.55 ± 0.15	1.41 ± 0.03
T_5	1.00 ± 0.02	1.25 ± 0.02	1.24 ± 0.01	1.50 ± 0.01	1.70 ± 0.04	1.66 ± 0.04	1.48 ± 0.01
p value	0.79	0.60	0.27	0.56	0.70	0.82	0.53

No significant differences were found between different treatment groups ($p > 0.05$)

Hemoglobin count

Treatments	T ₁	T ₂	T ₃	T ₄	T ₅	p value
Hb (g/dl)	12.66±0.37	12.54±0.39	12.56±0.23	12.12±0.37	12.02±0.44	0.664

No significant differences were found between different treatment groups ($p > 0.05$)

The statistical analysis for mean hemoglobin count (Table 3) among different treatment groups revealed no significant differences ($p = 0.664$) among birds of control group (T₁), low dose supplementation (T₂), high dose supplementation (T₃), continuous supplementation (T₄) or the competitor product group (T₅). Although, a slight numerically decreasing trend in the values was observed in the supplemented groups relative to control (T₁).

Humoral immune response

The mean serological antibody titres determined across

different vaccination protocols are presented in Table 4. At day 28 post vaccination the new castle disease titres (log₂) ranged from 4.68 (T₂) to 6.25 (T₄). The continuous supplemented group (T₄: 6.25) and competitor group (T₅: 6.0) showed numerically higher values of new castle disease antibody titres than control (T₁: 4.8). The low pathogen avian influenza (LPAI) titres (log₂) at day 28 showed consistency among all groups ranging from 6.82(T₅) to 7.41 (T₃). However, at day 42 LPAI titres numeric values were increased in all the supplemented groups (T₂:8.06; T₃: 8.35; T₄: 8.20 and T₅: 8.35) in comparison to control (T₁: 7.4).

Treatments	ND 28 day	LPAI 28 Day	ND 42 day	LPAI 42 day	IBD 42 day	
	Mean log 2 values				Mean titre	CV%
T ₁	4.8	7	6.3	7.4	1000	46
T ₂	4.68	7.16	4.0	8.06	1281	32
T ₃	5.35	7.41	3.4	8.35	1012	38
T ₄	6.25	7.19	3.7	8.20	1158	39
T ₅	6.0	6.82	2.65	8.35	483	24

No significant differences were found between different treatment groups ($p > 0.05$)

Conversely, the ND titres (log₂) at day 42 decreased in all the supplemented groups in comparison to control (T₁: 6.3) with competitor revealing the lowest numeric value (T₅: 2.65). Evaluation of infectious bursal disease (IBD) antibody titres at day 42 revealed highest values in low dose supplemented group (T₂:1281; CV = 32%) and continuous supplemented group (T₄: 1158; CV = 39%) while lowest in competitor group (T₅: 483; CV = 24%) when compared with the control group (T₁: 1000; CV = 46%).

Discussion

Growth performance and better immunity status derive the poultry farms productivity and most direct indicators for its economic value. In this study, the evaluation of dietary supplementation of betaspikes (β-1,3-glucan) across various treatment groups (T₂-T₄) and with a competitor product (T₅) demonstrated no significant differences ($p > 0.05$) in overall feed intake, body weight, body weight gain and feed conversion ratio (FCR) compared to the control (T₁) over the 42 days trial period. These findings suggest that inclusion of the supplement across different dietary regimens did not have any profound effects on body growth, feed intake or palatability compared to the control or competitor product. However, the numerical data suggests that product was good enough to bring modulations in the body growth, feed intake and FCR trajectories from a commercial standpoint. The continuous supplementation of betaspikes in group T₄ had numerically the highest body weight gain (2880.67±61.35 g) and better FCR values (1.41±0.03) than control (T₁) or competitor product (T₅). In modern broiler farming where feed only accounts for the approximately 70% of the cost of running, a numerically 177.14 g increase in final body weight and a 7 point reduction (1.48 to 1.41) in FCR than control group still provides a meaningful economic benefit for the commercial scale poultry farmers. The lack of statistical significance may be due to sample size limitations, inherent physiological variations among birds of different groups, baseline conditions or management conditions of the birds

during the trial. Often, the significant effects of these feed additives are demonstrated under the stress, high pathogen load, or disease conditions. Under good sanitary practices and farm management, the baseline physiology or performance of the control group remains high, which can mask the statistical significance. Our body growth results are in line with the findings of Sun Hee Moon *et al.* (2016) [14], who reported that β-1,3-glucan supplementation in broilers did not have any significant effect on feed intake, body weight gain and feed conversion ratio ($p > 0.05$). However, similar to our findings, he stated a numerical increase in mean values of these parameters in the β-1,3-glucan supplemented groups when compared to control. Our data also corroborate with the findings of Zhang *et al.* (2012) [15] who reported that bacterial derived β-1,3-glucan supplementation had no significant ($p > 0.05$) effect on growth of broilers. However, supplementation of β-1,3-glucan have been shown to increase body weight, average daily gain and FCR at significant levels ($p < 0.05$) in comparison to control (Wei Guo *et al.*, 2023 and Zhang *et al.*, 2020) [16, 17] suggesting its use as a potential growth promoting feed additive in broiler production.

Hemoglobin count is a vital factor that indicates physiological status, biological stress or nutritional health status of birds. In the present study, mean hemoglobin count of birds under different treatment groups remained in normal physiological range and had no statistically significant differences ($p > 0.05$). Although, the product did not show any increase in hemoglobin count, but it also had no hemolytic or toxic effects ensuring the safety and biocompatibility of the additive across all the dietary groups.

Evaluation of serum antibody titres revealed notable humoral immunity trends by the supplementation of betaspikes in different groups of broilers. At day 28 (7 days post-booster), the ND titres were numerically highest in continuous supplemented group (T₄: 6.25 log₂) and competitor (T₅: 6.0 log₂) in comparison to control (4.8). However, at day 42, a different trend was followed, with all

the supplemented groups facing a decline relative to the control. The sharpest drop was noticed in competitor group (T_5 ; $\log_2$ 2.65) falling below conventional protective thresholds. While minor decay post-peak due to viral antigen-antibody complex catabolism kinetics is normal or expected but sharp decay in T_5 suggests competitor product failed to sustain long term humoral immunity near the market age of broilers. Conversely, the control group (T_1) exhibited a delayed kinetics characterised by a slow initial antibody titre (4.8 $\log_2$) at day 28 when it was needed most (critical post booster stress phase) and prolonged systemic circulating antibodies (6.3 $\log_2$) due to delayed vaccine antigen clearing. Muthusamy *et al.* (2020)^[18] reported that β -1,3-glucan supplementation enhanced both cellular and humoral immune responses, and reduced mortality in NDV challenged broilers compared to the control group. Consistent with our results, Cao L. *et al.* (2023)^[19] and Horst G. *et al.* (2019)^[20] also reported a remarkable increase in ND antibody titres in the β -1,3-glucan supplemented group compared with the control.

The antibody titre response to LPAI demonstrated numerically elevated humoral response in betaspikes supplemented groups (T_2 , T_3 and T_4) in comparison to control (T_1) and competitor supplemented group (T_5) both at day 28 and day 42 of the production cycle. While ND titres peaked early (day 28) and subsequently declined due to rapid replication and clearance kinetics of live attenuated vaccines, LPAI on the other hand showed persistent elevation till market age (day 28 to day 42). This is possibly due to the fact that inactivated LPAI vaccines are typically formulated with oil adjuvants which forms a depot in body tissues that releases viral antigens slowly over a long period in the bloodstream. This suggests that betaspikes supplementation worked synergistically with the vaccine protocol and sustained the titres over a long period of time without decay. In agreement with our results, Abd Al-Tawab *et al.* (2019)^[21] and Zhen *et al.* (2020)^[22] reported that broilers supplemented with β -1,3-glucan improved the humoral immunity by increasing AIV and NDV antibody titres.

The IBD titre evaluation at day 42 revealed that low dose (T_2 ; 1281, CV 32%) and continuous supplemented (T_4 ; 1158, CV 39%) groups demonstrated numerically superior antibody titres compared to both control (T_1 ; 1000, CV 46%) and competitor (T_5 ; 483, 24%). The higher titre in T_2 and T_4 were also accompanied by lower coefficient of variation relative to control, indicating both strong humoral immune response and uniformity of immune protection in birds. Aligning with our findings, Van Hamme *et al.* (2019)^[6] reported that β -1,3-glucan increased antibody titre against IBD vaccination and decreased the CV% compared to the control group. Similarly, Ezzat *et al.* (2025)^[23] found that β -1,3-glucan supplemented birds showed significantly increased ($p < 0.05$) IBD and ND antibody titres compared to the control.

Overall, the continuously supplemented T_4 group showed the balanced, broad-spectrum protection across all pathogens, indicating that continuous supplementation of betaspikes (β -1,3-glucan) supports broader and more persistent immune function in broiler production.

Conclusion

This study suggests that bacterial derived β -1,3-glucan (Betaspikes) offers an effective alternative to conventional

yeast or fungal sources, offering superior purity, bioavailability, production efficiency and cost. Although, growth performance parameters were statistically non-significant ($p > 0.05$), continuous supplementation at commercial scale could offer economic benefits. Demonstration of positive immunomodulatory and numerically enhanced growth performance positions Betaspikes (β -1,3-glucan) as a functional feed additive for better immune function and overall production in poultry.

Acknowledgements

All the financial and logistic support to carry out this research trial was provided by Carus Laboratories Pvt. Ltd., Sector 3, Karnal, Haryana

Conflict of Interest

All authors declare that they do not have any conflict of interest

References

- Murphy EA, Davis JM, Carmichael MD. Immune modulating effects of β -glucan. *Current Opinion in Clinical Nutrition and Metabolic Care*. 2010;13(6):656-661.
- Nakashima A, Yamada K, Iwata O, Sugimoto R, Atsugi K, Ogawa T, *et al.* β -Glucan in foods and its physiological functions. *Journal of Nutritional Science and Vitaminology*. 2018;64(1):8-17.
- Henrion M, Francey C, L   KA, Lamothe L. Cereal β -glucans: the impact of processing and how it affects physiological responses. *Nutrients*. 2019;11(8):1729.
- Singh M, Sain A, Venu G, Saravanan R, Chander V, Malik YP, *et al.* Beta-glucan: an immunomodulator and promising trained immunity inducer in human and animals. *Journal of Immunology and Immunopathology*. 2024;26(1):20-35.
- Amer SA, Attia GA, Aljahmany AA, Mohamed AK, Ali AA, Gouda A, *et al.* Effect of 1,3-beta glucans dietary addition on the growth, intestinal histology, blood biochemical parameters, immune response, and immune expression of CD3 and CD20 in broiler chickens. *Animals*. 2022;12(22):3197.
- Van Hamme V, Spaepen R, Smeets N. Algal beta-(1,3)-glucan and its effect on infectious bursal disease vaccination in poultry. *Vlaams Diergeneeskundig Tijdschrift*. 2019;88(6).
- Van Steenwijk HP, Bast A, De Boer A. Immunomodulating effects of fungal beta-glucans: from traditional use to medicine. *Nutrients*. 2021;13(4):1333.
- Zhang S, Ou J, Luo Z, Kim IH. Effect of dietary β -1,3-glucan supplementation and heat stress on growth performance, nutrient digestibility, meat quality, organ weight, ileum microbiota, and immunity in broilers. *Poultry Science*. 2020;99(10):4969-4977.
- Jacob J, Pescatore A. Glucans and the poultry immune system. *American Journal of Immunology*. 2017;13(1):45-49.
- Schwartz B, Vetvicka V. β -Glucans as effective antibiotic alternatives in poultry. *Molecules*. 2021;26(12):3560.
- Kim MK, Ryu KE, Choi WA, Rhee YH, Lee IY. Enhanced production of (1 $\rightarrow$ 3)- β -D-glucan by a mutant strain of *Agrobacterium* species. *Biochemical Engineering Journal*. 2003;16(2):163-168.

12. Bureau of Indian Standards. Nutrient requirements for poultry. IS:9883. New Delhi: Bureau of Indian Standards; 2007.
13. AOAC International. Official methods of analysis. 18th ed. Gaithersburg (MD): AOAC International; 2013.
14. Moon SH, Lee I, Feng X, Lee HY, Kim J, Ahn DU. Effect of dietary beta-glucan on the performance of broilers and the quality of broiler breast meat. *Asian-Australasian Journal of Animal Sciences*. 2016;29(3):384-389.
15. Zhang ZF, Zhou TX, Ao X, Kim IH. Effects of β -glucan and *Bacillus subtilis* on growth performance, blood profiles, relative organ weight and meat quality in broilers fed maize-soybean meal based diets. *Livestock Science*. 2012;150(1-3):419-424.
16. Guo W, Han D, Zhang F, Zhan Q, Liu Y, Peng Q, *et al*. Effects of dietary β -1,3-glucan addition on the growth performance, mRNA expression in jejunal barrier, and cecal microflora of broilers challenged with *Clostridium perfringens*. *Poultry Science*. 2023;102(2):102349.
17. Zhang S, Ou J, Luo Z, Kim IH. Effect of dietary β -1,3-glucan supplementation and heat stress on growth performance, nutrient digestibility, meat quality, organ weight, ileum microbiota, and immunity in broilers. *Poultry Science*. 2020;99(10):4969-4977.
18. Muthusamy G, Joardar SN, Samanta I, Isore DP, Roy B, Maiti TK. Dietary administered purified β -glucan of edible mushroom (*Pleurotus florida*) provides immunostimulation and protection in broiler experimentally challenged with virulent Newcastle disease virus. *Journal of Basic and Applied Zoology*. 2020;81(1):55.
19. Cao L, Li J, Zhang J, Huang H, Gui F, Xu W, *et al*. Beta-glucan enhanced immune response to Newcastle disease vaccine and changed mRNA expression of spleen in chickens. *Poultry Science*. 2023;102(2):102414.
20. Horst G, Levine R, Chick R, Hofacre C. Effects of beta-1,3-glucan (Aleta™) on vaccination response in broiler chickens. *Poultry Science*. 2019;98(4):1643-1647.
21. LTawab AE, Awad A, Elnaggar OM, Elsissi AF. The impact of β -glucan on the immune response of broiler chickens vaccinated with NDV and AI H9V vaccines. *Benha Veterinary Medical Journal*. 2019;36(2):100-108.
22. Zhen W, Shao Y, Wu Y, Li L, Pham VH, Abbas W, *et al*. Dietary yeast β -glucan supplementation improves eggshell color and fertile eggs hatchability as well as enhances immune functions in breeder laying hens. *International Journal of Biological Macromolecules*. 2020;159:607-621.
23. Ezzat W, Rizk AM, Ouda MM, Mohamed HS, Fathey IA, El-Sharkawy IM, *et al*. Effect of β -glucan dietary supplementation on performance, nutrient digestibility, immune response and heat shock proteins in broiler chickens under heat stress by early heat acclimation. *Brazilian Journal of Poultry Science*. 2025;27(2):eRBCA-2024.