Effect of Sophy β-Glucan on Immunity and Growth Performance in Broiler Chicken

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ABSTRACT. This study was carried out to determine the effect of Sophy β-glucan on immunity and growth performance in broilers. One group was treated with 1% β-glucan ad libitum with water and the other group was kept as the control. Vaccination for Infectious Bursal Disease was carried out on days 16 and 21. Blood samples were collected from birds, and antibody titres against IBD were measured. The mean body weight of the β-glucan treated group was significantly (P<0.05) higher than that of the control group. The mean antibody titres measured on days 25, 36 and 42 were significantly (P<0.05) higher in 1% β-glucan treated group than that of the control group, suggesting the presence of immune stimulating effect of β-glucan.

KEY WORDS: β-glucan, broiler chicken, growth performance, immunomodulation.

β-glucan is a group of glucose polymers that consist of β-1,3 and β-1,6 glycosidic linkages. It is a main cell wall structural component of fungi, plants and some bacteria [8]. It can bind to various types of cell surface receptors including lectins, scavenger receptors and intergrins on monocytes, macrophages, neutral killer cells, neutrophils and lymphocyte populations, resulting in activation of lymphocyte, production of inflammatory cytokines and chemokines and microbial killing. These lead to development of adaptive immunity [1, 2]. Therefore it has suggested that β-glucan has anti-infective and anti-tumorogenic properties [2]. Enhanced anti-cancer immunity also has been demonstrated in mouse models [7]. The effect of β-glucan on immune system had been determined with regard to diseases of different aetiology. Early studies described the effects of β-glucan on T and B-dependent lymphocytes, lysozyme and complement in viral, bacterial, helminthic and protozoan diseases [6, 12] and found out that β-glucan is able to stimulate the phagocytic activity of granulocytes [5]. β-glucan can stimulate the neutrophil function, leading to disease resistance. This had been reported in different animal species such as mammals, amphibians, fish and crustaceans [10]. It had been found, highly purified β-1,3-1,6-glucons in diets which had extracted from baker’s yeast, stimulate cellular and humoral immune responses and increase disease resistance in a number of fish species [10]. However, β-glucan has not been used so far in Sri Lanka to improve weight gain or to enhance immunity in broiler chicken. Moreover, this project focuses on studying the effect of β-glucan on growth performance and immunity of broiler chicken.

This study was carried out in one of the buy-back farms of which had 1,000 birds’ capacity and the farm was belonged to ‘Cryso group of companies’, Gampola. Experiment was commenced from the day of the new chicks introduced to the farm.

One day old, two hundred Indian River broiler chicks were randomly selected from 1,000 birds housed in the farm. Birds were divided into two groups on the first day and kept separately during brooding period and growing period. Partition between the groups was made using a wire mesh. Group 1 was supplied with 1% β-glucan (Sophy β-glucan extracted from Black Yeast, Aureobasidium pullulans) with water and it was made available ad libitum from day 1 to the day when slaughtered. Second group was used as a control group, providing similar conditions except the β-glucan.

β-glucan was supplied by the Sophy Company, Kochi, Japan. Each pack contained 5 kg sterile colloidal solution which was considered as a 100% β-glucan. The pack was opened under safety cabinet and re-aliquot into 500 ml sterile plastic bottle and kept under 4°C in refrigerator. During the experiment, 500 ml samples were dispersed to 15 ml and 50 ml sterile tubes and again stored in 4°C. On each day, β-glucan was appropriately diluted with potable water at the farm premises to obtain 1% fresh solution and supplied for the treatment group.

All birds were managed under supervision of farm field officers and vaccination program had been carried out for IBD on days 16 and 21 as a routine vaccination procedure. This vaccination schedule was decided by determining the antibody titres against IBD. For this, blood samples were collected from randomly selected 10 one day old chicks by heart puncture and serum were separated as described below. Then the blood samples were collected from wing veins on day 7, 14, 25, 36 and 42 using 5 ml sterile syringes, and were allowed to clot under refrigerated temperature overnight. Then, serum was separated by centrifuging the
sample under 4,000 rpm for 5 min. Serum samples obtained were kept in –20°C for future use. Body weights of the birds were recorded on day 14, 30 and 42. All birds were slaughtered on day 42 in the processing plant, and meat inspection was performed in order to see any lesion and deformities.

Serum samples were checked for antibody levels against IBD using Infectious Bursal Disease Virus Antibody Test Kit supplied by “Flock Check” IDEXX Laboratory, Westbrook, ME, U.S.A. Antibody was detected according to the manufacturer’s instructions. Optical densities and titer values were calculated through computer software supplied by the same company. Mean titer value and mean body weight of the birds of treatment and control groups were compared and interpreted.

The effect of β-glucan on growth performance was determined by comparing the body weights of the treatment with control groups on days 14 and 30, respectively by t-test. Body weights of all the birds were measured on day 42 at the processing time. The effect of β-glucan on immunogenicity was determined comparing the antibody titres against IBD of both groups on days 7, 14, 25, 36 and 42 using t-test.

The body weights of β-glucan treated and control groups on days 14, 30 and 42 are considered to analyze the results. Figure 1 shows the mean body weight of β-glucan fed and control groups on days 14, 30 and 42, respectively. All of the results revealed that β-glucan treated birds have shown significantly higher (P<0.05) mean body weight compared to that of the control group on all of the days examined.

On day 7, mean antibody titer of the β-glucan treated group is 5,877 and lowest and highest titers are 3,154 and 7,598, respectively. The mean antibody titer of the control group is 5,749 and lowest and highest are 3,647 and 8,367, respectively. The two way t-test showed no significant difference (P>0.05) between the two groups. Further, there was no significant difference (P>0.05) detected in the mean antibody titer of the β-glucan treated group and control group on day 14. However, on day 25 after the first vaccination against IBD, the mean antibody titre of the β-glucan fed group has raised up to a higher level compared to that of the control group. The mean antibody titer of the β-glucan fed group is 6,858 and lowest and highest titres are 5,725 and 7,985, respectively. The mean value of control group is 4,801. On day 36, mean antibody titer of the β-glucan fed group is 6,775 and lowest and highest titers are 5,875 and 7,896, respectively. In the control group the mean antibody titre is 5,610. According to the two sample t-test, there is a significant difference (P<0.05) between the two groups. On day 42, mean antibody titer of the β-glucan fed group is 6,711. The lowest and highest antibody titer of the group is 5,921 and 7,899, respectively. The mean antibody titer of the control group is 5,906 and lowest and highest are 4,722 and 6,961, respectively. According to the results of t-test, there is a significant difference (P<0.05) between the two groups on day 42. Mean antibody titres against IBD of the birds in control and treatment groups on days 7, 14, 25, 36 and 42 are illustrated in the Fig. 2. In conclusion, mean antibody titres against IBD of control and the β-glucan treated-group increased with increasing age except during the first two weeks. In both groups, although the antibody titres have shown drastic reduction on day 14, the antibody titres of birds in the β-glucan treated-group has shown signifi-

![Graph of Mean Body Weight](image)

**Fig. 1.** Comparison of mean body weights in broiler chicken at days 14 (a), 30 (b) and 42 (c) after glucan administration between glucan group and control group.
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Fig. 2. Dispersion of antibody titres of control and β-glucan treated groups with age. C, Control groups; G, β-glucan treated group; D, Day.

cantly higher titres \((P<0.05)\) than the birds of the control group on days 25, 36 and 42.

Another significant finding is reduction of mortality in β-glucan treated group (Data not shown). The development of antimicrobial resistance by pathogenic micro-organisms has led to a worldwide consideration of limiting the usage of antibiotics and related supplements in livestock industry. Recent international legislations and domestic consumer pressures have led to withdrawal of growth-promoting antibiotics from general usage in a number of poultry companies and these legislations have limited some antibiotics available for treating bacterial infections. Also usage of vaccines against various diseases does not always become a success due to vaccine failure. It is therefore essential to develop alternative ways of dealing with pathogenic microbial challenges in commercial poultry production. Therefore, numbers of potential immunomodulators are being tested to find out whether they can serve as alternatives to antibiotics which result in both disease resistance and growth promotion in poultry. As mentioned earlier, β-glucan is one of such substance that has been tested in many researches without showing side effects. According to Trnovec \textit{et al.} [12], it is highly effective and biologically well tolerated immunomodulative agent which degrades into glucose. Our main objective of this study was to determine the effect of supplementation of 1% β-glucan on growth performance and immunity in broiler chicken. Body weights of the birds were compared to assess its effect on growth performance. Antibody titres against IBD vaccine were used to determine the effect of β-glucan on immunity. The antibody titers were measured against the Infectious Bursal Disease vaccine, since it is a common vaccine used for controlling the particular disease in Sri Lankan poultry industry. In this study, broiler chicken supplemented with 1% β-glucan with drinking water have shown significantly \((P<0.05)\) a higher level of weight, enhanced immunity and reduced mortality, compared with those of the control group. Similar studies carried out in other countries have shown positive effects of β-glucan on the growth performances of chicken. However, the percentage β-glucan used in those studies was different from the present study. A study carried out by Chae \textit{et al.} [3] investigated the effect of 0.02 and 0.04% of β-glucan on the weight gain and immunity of broilers. The β-glucan supplemented-birds showed higher weight gain than the non-supplemented group and when the birds were supplemented with β-glucan above the level of 0.02%, the weight gain was significantly higher \((P<0.05)\). Further, their study revealed that there was no effect of β-glucan on growth performance in the starter phase but greater effect on weight gain and immunity was confirmed in the finisher phase. They also reported that the effect was more prominent in litter-reared broilers than in caged birds. However, in our study, we only focused on the litter reared-broilers. The present study reveals antibody titers against IBD vaccination is significantly higher \((P<0.05)\) than antibody titres of control group. Before IBD vaccination commenced, there was no significant difference \((P>0.05)\) in the maternal antibody titre between the two groups, indicating that mean maternal antibody titres of both groups on days 7 and 14 were almost similar. These maternal antibodies have reduced in both groups during the first two weeks. After particular vaccination, the vaccine antibody titres of both groups have increased with age and have shown a significant difference \((P<0.05)\) on days 25, 36 and 42. Therefore it can be suggested that soluble β-glucan supplied by Sophy β-glucan Company showed high immunomodulatory property in 1% concentration. Suzuki \textit{et al.} [11] showed that there is a higher proliferative response of spleen cells to T-cell and B-cell mitogens in β-glucan administered mice when compared to the normal mice. Activities of nat-
ural killer cells and peritoneal macrophages had also enhanced for oral administration of β-glucan. Apart from that, Cross et al. [4] had found out that β-glucan is able to stimulate the cytotoxic T-lymphocytes, B cell, and macrophages in mice. Although we did not evaluate the stimulation of cell proliferation and activity of natural killer cells and macrophages, it may be assumed that feeding of β-glucan can lead to immunostimulatory action when fed continuously with drinking water. The immuno-modulatory role of β-glucan in partitioning nutrients towards growth could be a possible reason for the improved growth. Certain types of oligosaccharides could serve as a growth promoter in broiler production by modulating the concentrations of intestinal microbial flora [9]. We should, however, conduct more studies on the exact mechanism of action of β-glucan in broilers.

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