Effect of Dietary Beta-Glucan on the Performance of Broilers

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Summary and Implications

A total of 400, one day-old commercial broiler chicks were divided into five diet groups (negative control, positive control group with 55 ppm Zn-bacitracin, 15 ppm β-glucan, 30 ppm β-glucan, and 60 ppm β-glucan) and fed for six weeks. Ten broilers were allotted to each of 40 floor pens. Eight floor pens were randomly assigned to one of the 5 diets. Each diet was fed to the broilers for 6 weeks with free access to water and diet. The survival rate, growth rate, and feed conversion rate of the broilers were calculated. The high level of dietary β-glucan (60 ppm) showed better feed conversion ratio and survival rate than the negative control. The survival rate of 60 ppm β-glucan-treated group was the same as that of the antibiotic-treated group, which showed the highest survival rate among the treatments. Supplementation of 60 ppm β-glucan to broiler diet improved the survival rate and feed conversion rate of broilers as good as those of the 55 ppm Zn-bacitracin group. The result indicated that use of β-glucan (60 ppm) can be a potential alternative to antibiotics to improve the survival and performance of broilers.

Introduction

β-1,3-Glucan is a functional polymer consisting of glucose with β-1,3 linkage and can be isolated from various sources, including grains, mushrooms and bacteria. β-1,3-Glucan is known to enhance immunity and bioactivity by promoting secretion of cytokines, activating macrophages, natural killer cells and neutrophils, and have antitumor, antibacterial and antiviral effects. β-Glucan also functions as an adjuvant for monoclonal antibody immunotherapy because it can induce cellular cytotoxicity by recruiting tumoricidal granulocytes as killer cells. β-1,3-Glucan is known to increase antibody production by activating the B cells, has a complementing function in mAB-mediated cancer immunology, and activates the secretion of IL-1, IL-2, TNF-α. Therefore, β-glucan can stimulate the cell-mediated immune reactions, which activates the macrophage, NK cell, and cytotoxic T cell. As a result, β-1,3-glucan can enhance the resistance against infection of microorganisms and virus by improving i) non-specific immunity, which may protect animals against infection, ii) host defense mechanism, and iii) growth rate and reduce mortality. Thus, β-glucan may be used as a replacement for dietary antibiotics in animal feeds. Beta Polo, mainly composed of β-1,3-glucan, is a natural feed additive for poultry. Beta-Polo stimulates immune system and improves host defense mechanism, consequently reducing mortality and enhancing growth. The objectives of this study were to determine the effects of dietary β-glucan on the survival rate, growth rate, and feed conversion rate of broilers.

Materials and Methods

Four hundred, one-day-old commercial broiler chicks (Ross x Ross) were divided into five dietary groups (eight replications×10 birds each replication) and fed the following diets for six weeks. NC was the negativecontrol group (basal diet, antibiotics-free); PC, the positive control group (55 ppm Zn-bacitracin, approved for broilers and commonly used); 15 BG, 15 ppm β-glucan; 30 BG, 30 ppm β-glucan; and 60 BG, 60 ppm β-glucan. The β-glucan product containing 25% 1,3-β-glucan was obtained from Naturence Co., Ltd. and used to formulate the BG treatments. All five diets were prepared on corn-soybean basal diet, which met or exceed the NRC requirements for birds during the trial. Crude protein, metabolizable energy, Ca, P, lysine and methionine levels in the four diets were adjusted to the same levels. Ten broilers were allotted to each of 40 floor pens (experimental units), weighed, and wing banded. Eight floor pens were randomly assigned to one of the five experimental diets with different amounts of 1,3-β-glucan. Each of the dietary treatment was fed to the respective broiler groups for six weeks. Broilers had free access to water and diet. The growth and feed consumption of broilers were measured weekly during the feeding trial. At the end of the feeding trial, survival rate, feed consumption, and feed conversion rate were calculated.
Body weight and feed intake per cage were recorded, and feed conversion rate was calculated based on feed intake divided by body weight gain throughout the experiment after adjusting mortality.

Results and Discussion

The feed consumption and body weight gain of broiler chicks are shown in Table 1. No differences in weekly feed consumption and body weight gain among dietary treatment groups were found during the 6-week feeding trial ($p>0.05$). The feed consumption of birds with PC, 15 BG and 30 BG were not different from that of the control (NC). However, high level of beta glucan (60 ppm, 60 BG) treatment showed numerically lower feed consumption than other treatments. In agreement with our results, other studies observed no effects of β-glucan on growth performance. Table 2 showed the feed conversion rate of chickens fed with diets containing various concentrations of β-glucan. There was no significant difference in feed conversion rate among the five treatment groups. However, the high-level β-glucan treatment (60 ppm, 60 BG) showed better feed conversion rate than the negative control (Table 3). In fact, 60 ppm β-glucan group showed better feed conversion rate than that of 55 ppm bacitracin group (PC), which is encouraging. It was reported that β-glucans from various sources were able to cause divergent responses in relation with their structures and sources. All β-glucan treatment groups (15 BG - 60 BG) showed numerically higher survival rate than the control, and the survival rate of 60 ppm β-glucan-treated group (60 BG) was the same as that of the antibiotic-treated group (PC), which showed the highest survival rate among the treatments (Table 2). Our results suggested that >60 ppm of dietary β-glucan has a possibility of replacing antibiotics to improve survival rate and promoting growth of broilers.

Conclusion

Dietary supplementation with β-glucan improved survival rate and feed conversion rate. In general, these responses indicated that β-glucan can be a potential alternative to antibiotic growth promoter in order to improve growth performance. However, dietary β-glucan showed no effects on the quality parameters of chicken breast meat.

Table 1. Effect of β-glucan on the feed consumption and body weight gain of broiler chickens

Items	1 wk	2 wk	3 wk	4 wk	5 wk	6 wk	Total
Feed consumed (kg/pen/week)							
NC	1.33	3.63	6.517	9.00	10.20	9.67	40.34
PC	1.49	3.80	6.78	8.83	10.00	9.65	40.55
15 BG	1.44	3.81	6.77	9.15	10.01	9.33	40.51
30 BG	1.45	3.83	6.92	9.21	10.17	9.21	40.79
60 BG	1.34	3.63	6.32	8.56	9.66	9.25	38.76
Body weight gain (kg/pen/week)							
NC	1.50	2.58	4.28	5.38	5.11	4.18	23.03
PC	1.58	2.71	4.58	5.40	5.39	4.36	24.04
15 BG	1.49	2.61	4.40	5.38	4.73	4.37	22.98
30 BG	1.52	2.55	4.33	5.36	5.11	4.45	23.36
60 BG	1.53	2.66	4.54	5.60	5.15	4.26	23.74

Values are mean±standard deviation of each treatment group. n = 8.
NC, negative control; PC, positive control (adding Zinc bacitracin); 15 BG, adding 15 ppm β-glucan (6 g/100 kg diet); 30 BG, adding 30 ppm β-glucan (12 g/100 kg diet); 60 BG, adding 60 ppm β-glucan (24 g/100 kg diet).

Table 2. Effect of β-glucan on the feed conversion rate and survival rate of broiler chickens

Group	Feed conversion rate	Survival rate (%)
NC	1.752±0.170	93.75
PC	1.687±0.101	98.75
15 BG	1.763±0.188	96.25
30 BG	1.746±0.096	96.25
60 BG	1.633±0.218	98.75

Values are mean±standard deviation of each treatment group. n = 8.
NC, negative control; PC, positive control (adding Zinc bacitracin); 15 BG; adding 15 ppm β-glucan; 30 BG, adding 30 ppm β-glucan; 60 BG,adding 60 ppm β-glucan.