Original Research

Comparative Effect of Encapsulated and Nonencapsulated Probiotic Bacteria on Broiler Production Performance

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Abstract

A biological experiment was conducted to study the effects of supplementation of nonencapsulated and encapsulated probiotic bacteria Lactobacillus lactis and Bifidobacter bifidum alone and their combination on broiler performance and blood biochemical parameters. The trial was carried out with 288 numbers of day old straight run broiler (Vencobb) chicks divided into eight treatment groups having six replicates of six birds each. Supplementing the birds with encapsulated bacteria especially in combination significantly ($p<0.05$) increased the body weight gain of the broiler chicken and improved feed conversion ratio from the second to sixth week as compared to nonencapsulated probiotic feeding.

Key words: Broiler, Encapsulation, *Lactobacillus lactis* and *Bifidobacter bifidum*, Probiotic

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Introduction

Poultry is a significant source of animal protein and accounts for 30% of global meat consumption. Various dietary supplements are employed to boost the immune status, gut health, meat quality and growth. The ban of antibiotics as a growth promoters has increased the search for alternative feed additives for poultry production. Probiotics can be defined as live microorganisms which, when administrated in adequate numbers, confer a health benefit on the host by improving its microbial balance. Many research studies have reported that inclusion of probiotic species such as *Lactobacillus, Streptococcus, Bacillus, Bifidobacterium, Enterococcus, Aspergillus, Candida* and *Saccharomyces*, in broiler nutrition have a beneficial effect on growth performance and biochemical characters. However, for the optimal functioning, probiotics must be

metabolically stable and active as they pass through upper digestive tract and colonize the intestine. To improve the survival of probiotics, a variety of attempts were made, encapsulation is a recent technique which is used to protect probiotic. Encapsulation protect cells from unfavourable environmental conditions and provide controlled release in a viable and metabolically active state in the intestine (Nazzaro *et al*., 2012). Among all the materials used for encapsulation, alginate and chitosan are the most widely used and investigated biopolymers for live cell bioencapsulation.

Materials and Methods

Encapsulation

Encapsulation of *Lactobacillus lactis and Bifidobacterium bifidum* was done separately by following modified method of Sharma *et al*. (2012).

Experimental Birds and Design

Day-old straight-run broiler chicks (Vencobb 400) with number of 288 were placed on 8 dietary treatments, (T_1) - Basal diet (with antibiotic supplementation), (T_2) - Basal diet (without antibiotic supplementation - Oxytetracycline 50mg/kg) and the remaining groups were supplemented with nonencapsulated and encapsulated probiotic bacteria alone and in combination along with basal diet (without antibiotic supplementation) viz., (T_3) - nonencapsulated *L. lactis* ($1x10^9$ cfu/kg feed), (T_4) - encapsulated *L. lactis* ($1x10^9$ cfu/kg feed), (T_5) - nonencapsulated *B. bifidum* ($1x10^{12}$ cfu/kg feed), (T_6) - encapsulated *B. bifidum* ($1x10^{12}$ cfu/kg feed), (T_7) - nonencapsulated *L. lactis* ($1x10^4$ cfu/kg feed) and *B. bifidum* ($1x10^6$ cfu/kgfeed), (T_8) - encapsulated *L. lactis* ($1x10^4$ cfu/kg feed) and *B. bifidum* ($1x10^6$ cfu/kg feed). The group not supplemented with neither probiotic nor antibiotic served as control.

Production Performance

At the end of every week, body weight of individual bird was recorded and body weight gain was calculated. At the end of every week, feed intake was recorded and feed conversion ratio of each group was calculated.

Statistical Methods

The completely randomized design was followed for the experiment (Snedecor and Cochran, 2007) and the data collected were analysed using SPSS® 20.0 software package. Post-hoc analysis was done by Duncan`s significance difference test.

Result and Discussion

The effect of supplementation of nonencapsulated and encapsulated probiotic bacteria alone and their combination on the body weight gain of broiler chicken is presented in Table 1. Supplementation of encapsulated probiotics in combination (T_8) significantly ($p<0.05$) increased body weight gain of broiler

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chickens from age of 2nd to 6th week than any other groups. Birds supplemented with basal diet (T_2) showed significantly ($p<0.05$) lowest body weight gain from 2nd week to 6th week of age. Upto 6th week of age there were no significant difference among treatment groups T_3 and T_5 and between T_4 and T_6. In general birds supplemented with antibiotic showed significantly ($p<0.05$) higher weight gain than birds supplemented with basal diet without antibiotic, and birds supplemented with probiotic showed significantly ($p<0.05$) higher weight gain than birds supplemented with antibiotic and birds supplemented with encapsulated probiotic showed higher weight gain than birds supplemented with nonencapsulted probiotic.

Table 1: Mean (± SE) body weight (g) of broiler chicken supplemented with nonencapsulated and encapsulated probiotic bacteria

Treatment	Age in Weeks					
Groups	**I**	II	III	**IV**	**V**	**VI**
T1	115.1±1.3	185.8^{b}±4.3	440.2^{b}±8.31	703.4^{b}±11.3	1004.7^{b}±12.2	1454.9^{b}±15.2
T2	114.8±2.2	175.1^{a}±5.3	435.9^{a}±8.22	695.2^{a}±12.3	984.3^{a}±14.3	1432.4^{a}±34.2
T3	116.0±1.3	198.9^{c}±5.2	468.1^{c}±9.32	719.9^{c}±11.5	1035.3^{c}±16.5	1521.4^{c}±27.4
T4	118.2±1.4	228.1^{e}±6.6	510.1^{e}±10.1	767.1^{d}±11.3	1070.5^{e}±20.6	1579.9^{e}±17.2
T5	117.5±1.3	191.8^{c}±4.2	459.2^{c}±9.31	727.2^{c}±10.5	1029.3^{c}±22.5	1514.3^{c}±19.4
T6	119.2±2.5	221.9^{e}±4.6	518.9^{e}±12.3	759.3^{d}±12.5	1065.9^{e}±19.8	1569.3^{e}±21.7
T7	118.4±1.4	205.4^{d}±5.5	475.7^{d}±9.71	732.5^{c}±13.9	1041.1^{d}±21.8	1532.4^{d}±19.4
T8	120.2±2.4	234.1^{f}±5.4	525.6^{f}±9.61	774.4^{e}±12.8	1080.2^{f}±34.4	1604.4^{f}±18.9

Means within the same column bearing different superscripts differ significantly ($p<0.05$)

Results of the present study concurs with that of Kabir *et al*. (2004), Khaksefidi and Rahimi (2005), Savkoic *et al*. (2005), Khaksefidi and Ghoorchi (2006), Panda *et al*. (2006), Mountzouris *et al*. (2007), Awad *et al*. (2009), Torshizi *et al*. (2010), Alkhalf *et al*. (2010), Ghavidel *et al*. (2011), Gang *et al*. (2014) and Li *et al*. (2014) observed increased weight gain and growth rate in broiler chicken on probiotic supplementation. However results of present study were contrary with findings of Olnood *et al*. (2015), who did not find any significant difference in weight gain and FCR of broilers supplemented with probiotics.

The mean FCR of birds in the T_4 and T_6 was similar but was significantly ($p<0.05$) higher than the T_8 group. The mean FCR was significantly ($p<0.05$) lowest in the T_8 group as compared to all the other treatment groups. T_1 and T_2 group had significantly ($p<0.05$) higher FCR than any other group of birds. Birds belong to T_3, T_5 and T_7 showed significantly ($p<0.05$) higher FCR than birds supplemented with encapsulated probiotic. The results of the feed conversion ratio are in accordance with that of Savkoic *et al*. (2005), Zhu *et al*. (2009), Fritts *et al*. (2000), Khaksefidi and Rahimi (2005), Panda *et al*. (2006) Khaksefidi and Ghoorchi (2006), Awad *et al*. (2009), Alkhalf *et al*. (2010), Ghavidel *et al*. (2011), Hosseini *et al*. (2013) and Li *et al*. (2014) who observed better feed conversion ratio due to probiotic supplementation in broilers. The enhancement in the body weight, daily weight gain and feed conversion ratio observed in the probiotic supplemented groups of broiler chicken of the present study might be due to the increased digestion and

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nutrient absorption enhanced by the probiotic bacteria. Further, the increased jejunal and ileal villi height observed in the encapsulated probiotic supplemented broiler chicken of the present study would have enhanced nutrient absorption and thereby improved growth performance and feed efficiency. *Clostridium perfringens* and *Coliform* bacteria in the intestine compete with the host for nutrients (Brzoska *et al*., 2005) and cause thickening of gut wall, thereby reduce nutrient absorption and depress growth of bird (Khaksefidi and Ghoorchi, 2006). Reduction of the undesirable microbial population in the intestine which was observed in the encapsulated probiotic supplemented groups of broiler chicken in this study would have contributed to the enhanced nutrient utilization and increased body weight. Moreover, the enhanced immune response as observed in the encapsulated probiotic supplemented groups of broiler chicken of the present study might have contributed to the higher body weight and better FCR.

Thus, it could be concluded that supplementation of broiler chicken with the combination of probiotic bacteria in encapsulated form improved mean FCR and body weight gain from the second week to sixth week as compared to nonencapsulated probiotic feeding.

Conclusion

Conclusively, supplementation of the probiotic (*Lactobacillus lactis* and *Bifidobacterium bifidum*) in a encapsulated form to broilers improves production performance, especially supplementing them in combinations have more effect on production performance.

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