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# EFFECT OF DIETARY SUPPLEMENTATION OF POSTBIOTICS FROM *LACTIPLANTIBACILLUS PLANTARUM* ON CARCASS CHARACTERISTICS OF BROILER CHICKEN CHALLENGED WITH *ESCHERICHIA COLI*

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## ABSTRACT

This study investigated the effect of dietary supplementation of postbiotics derived from *Lactiplantibacillus plantarum* on carcass characteristics of broiler chicken challenged with *Escherichia coli*. A total of 240, day-old male Cobb 430Y chicks were assigned to six treatment groups in a 2×3 factorial design (infection status: challenged vs. non-challenged; postbiotic supplementation: 0 %, 0.5 %, 0.8 %). Birds were orally challenged with *E. coli* ($3\times10^8$ CFU/mL) at 10-12 days of age. Carcass traits were evaluated at 14 days post-challenge (26 days of age). Results indicated that dietary supplementation of postbiotics from *L. plantarum* did not significantly ($p < 0.05$) alter carcass traits under non-challenged conditions but provided partial benefits under pathogenic stress. Supplementation at 0.5 % improved drumstick yield and neck/back yield, while *E. coli* challenge significantly reduced dressing percentage and ready-to-cook yield. These findings suggest that dietary postbiotics may partially mitigate the negative impact of pathogenic stress on carcass quality.

**Keywords:** Postbiotics, carcass traits, challenge, colibacillosis, interaction effects

## INTRODUCTION

Carcass yield and composition are critical determinants of broiler production efficiency and economic returns. Pathogenic infections such as *Escherichia coli* compromise carcass quality through

systemic stress, inflammation, and impaired nutrient partitioning. Postbiotics are metabolites generated by probiotic organisms which are beneficial to improve the health of the host. Postbiotics refer to deactivated microbial cell fragments, cell segments (exopolysaccharides, cell-surface proteins, teichoic acids and peptidoglycan-derived muropeptides) and/or cell metabolites (enzymes, vitamins, hydrogen peroxide, organic acids, plasmalogens, functional peptides, bacteriocins and short-chain fatty acids) that are produced by a probiotic organism. In 2019, a panel of experts in a workshop convened by the International Scientific Association for Probiotics and Prebiotics (ISAPP) defined the postbiotic as a "preparation of inanimate microorganisms and or their components that confers a health benefit on the host". Postbiotics contain inactivated microbial cells and cell components and/or their metabolites (Salminen *et al*., 2021). Additionally, postbiotics might be a better option than probiotics in regions lacking consistent cold chain facility. Unlike probiotics, metabolites are unlikely to transfer antimicrobial resistance factors to other bacteria. The other desirable qualities of postbiotics are longer shelf life, safe dose ranges, defined chemical composition, ease of use, stability in a wide range of pH and temperature, and broad-spectrum antimicrobial activity (Rad *et al*., 2021).

Postbiotics derived from *Lactiplantibacillus plantarum* are known to modulate gut health, enhance immune responses, and potentially improve carcass traits. As the research reports on effects of postbiotics in challenged clinical conditions are scarce, the current study was designed to evaluate the effect of dietary supplementation of postbiotic metabolites from *L. plantarum* on carcass traits in broiler chicken challenged with *Escherichia coli*.

## MATERIALS AND METHODS

The experiment was conducted at the Department of Poultry Science, College of Veterinary and Animal Sciences, Mannuthy from 27$^{th}$ November 2024 to 8$^{th}$ January 2025. The postbiotics from the culture of *L. plantarum* was harvested as per the procedure explained by Kareem et al. (2016). The stock culture of *L. plantarum* was revived twice using de-Mann Rogosa Sharpe (MRS) broth. Following this, steak plating was done on MRS agar plate to isolate individual colony. A single colony was carefully selected, introduced into 10 mL of MRS broth and incubated at 37 °C for 24 h. This prepared culture was used as an inoculum for preparing the broth culture for production of postbiotics in larger quantity for *in-vivo* trial. The fresh inoculum was added at one per cent level to MRS broth and incubated at 37 °C for 18 h. To isolate the bacterial cells, the culture

was centrifuged at 10,000 rpm for 15 min. The supernatant with a colour ranging from brown to brownish yellow, was collected and filtered using a syringe filter of 0.22 µm pore size, and the same was used as the postbiotic preparation for the study.

A total of 240, day-old male Cobb 430Y broiler chicks were procured and randomly assigned to six treatment groups in a 2×3 factorial design. Factor I comprised infection status (challenged and non-challenged), and Factor II comprised postbiotics supplementation levels (0 %, 0.5 %, 0.8 %). The treatment groups were as follows: T1: Basal diet (control, no postbiotics, non-challenged), T2: Basal diet + postbiotics @ 0.5 % (non-challenged), T3: Basal diet + postbiotics @ 0.8 % (non-challenged), T4: Basal diet (no postbiotics, challenged), T5: Basal diet + postbiotics @ 0.5 % (challenged) and T6: Basal diet + postbiotics @ 0.8 % (challenged). Each treatment had four replicates of 10 birds each. Birds in challenged groups were orally perfused with actively growing *E. coli* ($3\times10^8$ CFU/mL, 0.5 mL per bird) on days 10-12, while non-challenged birds received sterile Luria-Bertani broth.

The basal diet was formulated according to BIS, (2007) standards. The feed and water were given *ad libitum*. The ingredient composition and chemical

**Table 1.** Ingredient composition of the basal diets (%)

| Ingredients | Pre-starter | Starter | Finisher |
|---|---|---|---|
| Yellow maize | 51.97 | 52.80 | 57.10 |
| Soyabean meal | 41.50 | 39.20 | 33.60 |
| Rice bran oil | 2.65 | 4.06 | 5.10 |
| Dicalcium phosphate | 1.80 | 1.80 | 1.90 |
| Calcite | 1.40 | 1.40 | 1.40 |
| Salt | 0.35 | 0.36 | 0.37 |
| [1]L-Lysine | 0.24 | 0.18 | 0.26 |
| [2]DL -Methionine | 0.17 | 0.20 | 0.27 |
| Total | 100 | 100 | 100 |

Additives (per 100 kg diet): [3]Vitamin AB2D3K mix: 50 g,[4]Toxin binder: 100 g, [5]Coccidiostat: 50 g, [6]Choline chloride: 100 g ,[7]Trace mineral mix: 100 g, [8]Liver tonic: 25 g, [9]Enzyme: 35 g

NOTE:

[1] L-Lysine (HCL): Monohydrochloride 98.5% (L-Lysine Hydrochloride, Meihua)
[2] DL-Methionine: Feed grade 99% (Met Amino. Evonik Methionine Pvt Ltd)
[3]Vitamin premix: (Nicomix Breeder, Piramal Pharma Limited)
[4]Toxin binder: (Alusil Mos Plus, Stallen)
[5]Coccidiostat: 0.5 per cent microgranulate diclozuril (Cozuril, Stallen)
[6]Choline chloride: Choline Chloride 60 %, NB Group C. Ltd
[7]Trace mineral mixture: Mak-Minpremium, Zenmark
[8]Liver tonic: Dutchliv Gold, Aminorich Nutrient BV
[9]Enzyme: composition: Avizyme, Alembic

**Table 2.** Chemical composition of the basal diets (%)

| Parameters | Pre-starter | Starter | Finisher |
|---|---|---|---|
| Dry matter | 88.49 | 88.79 | 88.74 |
| Crude protein | 23.37 | 22.13 | 20.76 |
| Crude fibre | 3.25 | 3.11 | 3.32 |
| Ether extract | 4.65 | 4.40 | 4.59 |
| Total ash | 8.78 | 9.51 | 7.38 |
| Acid insoluble ash | 1.32 | 1.24 | 1.65 |
| Calcium | 1.10 | 1.20 | 1.20 |
| Phosphorous | 0.40 | 0.40 | 0.40 |
| Lysine (%) * | 1.30 | 1.20 | 1.15 |
| Methionine (%) * | 0.52 | 0.54 | 0.57 |
| ME (kcal/kg) * | 3000 | 3100 | 3200 |

*Calculated values

composition of the experimental feeds are presented in Table 1 and 2 respectively.

At 14 days post-challenge (26 days of age), birds were slaughtered, and carcass traits including preslaughter weight, dressing percentage, ready-to-cook yield, and cut-up part yields (breast, thighs, drumsticks, wings, neck/back, heart, liver, giblets) were recorded. Since broilers have been bred and selected for higher growth rate, compensatory growth mechanism is evident in them. Also, the strain of *E. coli* used in this study was a moderately virulent field strain, the birds may overcome the pathogenic effect by 6$^{th}$ week as they were managed in proper housing and feeding conditions. Hence, the effect of challenge on carcass traits was studied on 14 days of post-challenge rather than the usual market age of broilers.

## RESULTS AND DISCUSSION

The interaction effect between *E. coli* challenge (Factor I) and different levels of postbiotics supplementation (Factor II), the cumulative effect of different levels of supplementation of postbiotics, and the cumulative effect of *E. coli* challenge on carcass traits on 14$^{th}$ day post-challenge was assessed and the result data is given in Table 3.

In non-challenged groups, preslaughter weights ranged from 1259.17 g to 1373.33 g across supplementation levels. Dressing percentage and ready-to-cook yield were relatively stable, with values between 69.85-70.91% and 74.71-76.22%, respectively. The yield of cut-up parts showed numerical variations, with thigh yield increased progressively with supplementation (8.69 %, 9.42 %,

10.16 %). Statistical analysis revealed no significant differences in carcass traits due to supplementation under non-challenged conditions.

In challenged birds, even though the preslaughter weights were numerically higher, dressing percentage and ready to cook yield declined compared to non-challenged groups. The interaction between *E. coli* challenge and postbiotics supplementation did not result in significant differences for most carcass traits, except yield of drumstick. The yield of drumstick showed significant differences ($p < 0.05$), with the 0.5 % group recording the highest value (10.26 %), followed by control (9.99 %) and 0.8 % group (9.39 %). Other cut-up parts and organ yields did not differ significantly.

The interaction between *E. coli* challenge and postbiotics supplementation did not significantly affect most carcass traits. The exception was drumstick yield, where supplementation at 0.5 % under challenged condition resulted in significantly higher values compared to other groups. The reverse interaction between the postbiotic supplementation and *E. coli* challenge showed that the drumstick yield was significantly higher in non-challenged birds compared to challenged birds at 0.8 % supplementation level.

The cumulative effect of different levels of postbiotics supplementation on carcass traits was assessed. Across all three levels of supplementation, preslaughter weights ranged from 1350.00 g to 1396.67 g. Dressing percentage and ready-to-cook yield remained unaffected by postbiotics supplementation. The yield of cut up parts also remained unaffected except the yield of neck and back, which showed a significant difference ($p < 0.05$), with the 0.5 % group recording the highest value (19.41%).

The cumulative effect of pathogenic challenge on carcass traits was assessed. Pathogenic challenge significantly ($p < 0.05$) affected dressing percentage, and ready-to-cook yield. Challenged birds had higher preslaughter weight (1425.83 g vs. 1319.72 g) but lower dressing percentage (67.61 % vs. 70.49 %) and ready-to-cook yield (72.53 % vs. 75.51 %) compared to non-challenged birds. Cut-up part yields were not significantly different, though breast and drumstick yields tended to be lower in challenged birds. The increased preslaughter weight in challenged birds likely reflects pathological changes such as gut oedema and inflammatory fluid accumulation, which did not contribute to carcass yield. The post-mortem examination of dead birds from the challenged groups showed intestinal mucosal thickening.

**Table 3.** Mean (±SE) value of carcass traits of broilers in different dietary treatments at 14 days post-challenge (26 days of age)

| Treatment | Preslaughter (g) | Eviscerated (g) | Dressing (%) | Ready-to-Cook(%) | Breast (%) | Wings (%) | Neck & Back(%) | Thighs (%) | Drumstick (%) | Liver (%) | Heart (%) | Gizzard (%) | Giblet (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Non-challenged** | | | | | | | | | | | | | |
| 0% Postbiotic | 1373.33 ± 44.81 | 974.00 ± 33.28 | 70.91 ± 0.35 | 76.22 ± 0.13 | 24.42 ± 0.73 | 7.64 ± 0.21 | 19.36 ± 0.47 | 8.69 ± 0.07 | 10.41 ± 0.19 | 2.28 ± 0.17 | 0.68 ± 0.03 | 2.35 ± 0.12 | 5.31 ± 0.27 |
| 0.5% Postbiotic | 1259.17 ± 53.87 | 879.67 ± 40.42 | 69.85 ± 0.93 | 74.71 ± 1.03 | 22.15 ± 0.59 | 7.58 ± 0.18 | 19.33 ± 0.53 | 9.42 ± 0.19 | 10.47 ± 0.07 | 1.98 ± 0.06 | 0.64 ± 0.03 | 2.25 ± 0.19 | 4.87 ± 0.15 |
| 0.8% Postbiotic | 1326.67 ± 51.97 | 937.33 ± 43.30 | 70.71 ± 2.30 | 75.59 ± 2.36 | 22.42 ± 1.03 | 7.76 ± 0.24 | 19.50 ± 0.72 | 10.16 ± 0.19 | 10.46$^{A}$ ± 0.44 | 2.11 ± 0.05 | 0.63 ± 0.05 | 2.13 ± 0.14 | 4.88 ± 0.16 |
| **Challenged** | | | | | | | | | | | | | |
| 0% Postbiotic | 1370.00 ± 79.66 | 942.67 ± 50.73 | 68.92 ± 0.64 | 73.63 ± 0.63 | 22.64 ± 0.42 | 7.32 ± 0.15 | 18.84 ± 0.49 | 9.56 ± 0.13 | 9.99$^{a}$ ± 0.09 | 2.02 ± 0.04 | 0.58 ± 0.03 | 2.12 ± 0.11 | 4.71 ± 0.08 |
| 0.5% Postbiotic | 1440.83 ± 36.68 | 991.33 ± 33.13 | 68.74 ± 0.63 | 73.49 ± 0.70 | 21.69 ± 0.32 | 7.31 ± 0.26 | 19.49 ± 0.42 | 9.76 ± 0.21 | 10.26$^{a}$ ± 0.14 | 2.16 ± 0.03 | 0.60 ± 0.03 | 2.00 ± 0.12 | 4.75 ± 0.08 |
| 0.8% Postbiotic | 1466.67 ± 18.29 | 957.33 ± 38.38 | 65.16 ± 1.86 | 70.46 ± 2.05 | 21.49 ± 0.87 | 6.82 ± 0.12 | 18.42 ± 0.66 | 8.72 ± 0.20 | 9.39$^{bB}$ ± 0.25 | 2.36 ± 0.15 | 0.59 ± 0.02 | 2.36 ± 0.08 | 5.31 ± 0.22 |
| **Postbiotic levels** | | | | | | | | | | | | | |
| 0% Postbiotic | 1371.67 ± 43.57 | 958.33 ± 29.31 | 69.92 ± 0.46 | 74.93 ± 0.50 | 21.53 ± 0.48 | 7.48 ± 0.13 | 19.10$^{ab}$ ± 0.33 | 9.13 ± 0.15 | 10.20 ± 0.12 | 2.15 ± 0.09 | 0.63 ± 0.02 | 2.23 ± 0.09 | 5.01 ± 0.16 |
| 0.5% Postbiotic | 1350.00 ± 41.42 | 935.50 ± 30.07 | 69.29 ± 0.56 | 74.10 ± 0.62 | 21.92 ± 0.33 | 7.44 ± 0.16 | 19.41$^{a}$ ± 0.32 | 9.59 ± 0.14 | 10.37 ± 0.08 | 2.07 ± 0.04 | 0.62 ± 0.02 | 2.12 ± 0.11 | 4.81 ± 0.08 |
| 0.8% Postbiotic | 1396.67 ± 33.70 | 947.33 ± 27.75 | 67.93 ± 1.64 | 73.02 ± 1.68 | 21.95 ± 0.66 | 7.29 ± 0.19 | 18.96$^{b}$ ± 0.49 | 9.44 ± 0.26 | 9.93 ± 0.29 | 2.24 ± 0.08 | 0.61 ± 0.03 | 2.25 ± 0.08 | 5.09 ± 0.14 |
| **Challenge status** | | | | | | | | | | | | | |
| Non-challenged | 1319.72$^{b}$ ± 29.59 | 930.33 ± 23.27 | 70.49$^{a}$ ± 0.79 | 75.51$^{a}$ ± 0.82 | 23.00 ± 0.50 | 7.66 ± 0.12 | 19.40 ± 0.32 | 9.43 ± 0.17 | 10.45 ± 0.15 | 2.12 ± 0.07 | 0.65 ± 0.02 | 2.24 ± 0.09 | 5.02 ± 0.12 |
| Challenged | 1425.83$^{a}$ ± 29.75 | 963.78 ± 22.99 | 67.61$^{b}$ ± 0.77 | 72.53$^{b}$ ± 0.79 | 21.94 ± 0.34 | 7.15 ± 0.12 | 18.92 ± 0.31 | 9.35 ± 0.15 | 9.88 ± 0.13 | 2.18 ± 0.06 | 0.59 ± 0.01 | 2.16 ± 0.07 | 4.92 ± 0.10 |
| **p-value** | | | | | | | | | | | | | |
| Interaction | 0.182 | 0.216 | 0.226 | 0.197 | 0.640 | 0.547 | 0.698 | 0.175 | 0.031 | 0.561 | 0.133 | 0.053 | 0.380 |
| Postbiotic levels | 0.662 | 0.853 | 0.325 | 0.602 | 0.056 | 0.715 | 0.035 | 0.174 | 0.253 | 0.844 | 0.588 | 0.265 | 0.406 |
| Challenge status | 0.016 | 0.318 | 0.012 | 0.004 | 0.077 | 0.301 | 0.576 | 0.056 | 0.535 | 0.057 | 0.436 | 0.504 | 0.054 |

Mean values bearing different superscripts a, b within a column differs significantly ($p<0.05$) for interaction between challenge status and postbiotic levels of supplementation, cumulative effect of different postbiotics levels and for cumulative effect of challenge status.

Mean values bearing different superscripts A, B within a column differs significantly ($p<0.05$) for interaction between same level of postbiotic supplementation and challenge status

Postbiotics supplementation did not markedly alter carcass traits under non-challenged conditions, suggesting limited direct influence on carcass composition in healthy birds. The result was in accordance with the findings of previous researchers, in which, they did not observe any significant difference in carcass traits in broiler chicken supplemented with postbiotics derived from different lactic acid bacteria (Mohammed and Kareem, 2022 and Tradhnesh *et al*.,2023). Study carried out by Danladi *et al*. (2022) also showed no significant difference ($p > 0.05$) in the carcass weight,

carcass yield, weight of breast, drumstick, thigh, wing, back, shank, gizzard, liver, intestine and heart across the postbiotic supplemented and control groups.

In contrast, Humam *et al.* (2019) have documented higher carcass weight in broilers when they were supplemented with postbiotics RI11 and UL4 prepared from *L. plantarum.* But the yield of breast, leg, wing, back, gizzard, abdominal fat and heart of the broiler chicken did not get affected by supplementing diet with postbiotics from different strains of *L. plantarum*.

Postbiotic levels did not significantly affect most traits, though neck and back yield showed a significant ($p < 0.05$) difference. The birds supplemented with 0.5 per cent postbiotics showed the higher yield than other groups. Doski *et al*. (2023) found a significant increase ($p > 0.05$) in the percentage of breast weight with postbiotics supplementation compared to basal diet fed groups. Kareem *et al*. (2015) observed significantly ($p < 0.05$) higher yield of leg in broiler birds fed with 0.3 per cent *L. plantarum* RI11 derived postbiotics.

The present study demonstrated that *E. coli* challenge significantly compromised carcass efficiency in broilers, despite higher preslaughter weights. The reduction in dressing percentage and ready-to-cook yield in challenged birds highlights the impact of systemic stress and inflammation on nutrient partitioning and muscle accretion. These findings are consistent with Tugiyanti *et al*. (2025), who reported significant reductions in breast, thigh, and wing weights in *E. coli*-infected birds compared to probiotic-fed groups. The present study extends this evidence by demonstrating that postbiotics, while not dramatically altering carcass traits, may provide targeted improvements in specific muscle groups under infection pressure.

## SUMMARY

Dietary supplementation of postbiotics from *L. plantarum* did not markedly alter carcass traits under non-challenged conditions but provided partial benefits under pathogenic stress. Supplementation at 0.5% improved drumstick yield and neck/back yield, while *E. coli* challenge significantly reduced dressing percentage, ready-to-cook yield, and thigh yield. These results suggest that postbiotics may serve as supportive nutritional interventions to mitigate carcass losses under bacterial challenge.

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