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The effect of encapsulated butyric acid and zinc on performance, gut integrity and meat quality in male broiler chickens[1]

Abstract

This study evaluated the impact of encapsulated butyric acid and zinc (ButiPEARL™ Z) on performance parameters, gut integrity and meat quality during heat stress in male broiler chickens reared to 47 days of age. Day old chicks (n=448) were randomly assigned to 2 treatments (16 pens/treatment; 14 birds/pen). From day 29 to day 47, broilers were subjected to cyclic heat stress (HS). On day 28 (before HS) and on day 32 (4 days after HS), intestinal samples were taken from 8 birds/treatment and intestinal permeability was measured. On day 47, birds were processed and breast fillets were scored for woody breast (WB). ButiPEARL Z showed significantly higher feed intake and body weight gain (BWG) than the control at day 47 ($P<0.05$). During the HS period, ButiPEARL Z showed significantly higher BWG compared to the control ($P<0.05$). At day 47, ButiPEARL Z showed a numerical improvement on overall feed conversion ratio (FCR) of 4 points when compared to the control. Additionally, intestinal macromolecule permeability of ButiPEARL Z was numerically lower than the control, which indicates a more intact tight junction in the ButiPEARL Z birds. ButiPEARL Z tended to improve WB by 35% ($P=0.07$). The data provides evidence ButiPEARL Z may alleviate the negative effects of heat stress on growth performance and intestinal integrity and help reduce the severity of woody breast.

Introduction

Butyric acid is a by-product of microbial fermentation of products such as non-starch polysaccharides. It is considered important for normal development of epithelial cells.[2] Butyric acid derived from the fermentation of non-starch polysaccharides, has shown to improve gastrointestinal health and reduce incidence of colon cancer in humans.[3] Butyric acid has a positive effect on intestinal integrity by affecting the tight junctions[4,5] and promoting healing of the intestinal epithelium.[6] Zinc, on the other hand, enhances the expression of the tight junction proteins: occludin, claudin-1, and Zo-1.[7,8] Butyric acid and zinc have complementary modes of action; they both positively affect intestinal health. Previous cell culture work has shown that butyric acid and zinc significantly improved trans epithelial electrical resistance (TER) of pig intestinal epithelial cells (IPEC-J2) subjected to heat stress when compared to control.[10]

ButiPEARL Z has been shown to improve growth performance of broilers in previous trial work.[11,12] However, the effect of ButiPEARL Z on heat stressed broiler chicken performance, gut integrity and meat quality has yet to be evaluated. The present study evaluated the impact of E ButiPEARL Z on performance parameters, gut integrity and meat quality during heat stress in male broiler chickens reared to 47 days of age.

Materials and Methods

Day old, male broiler, Cobb 500 were randomly assigned to one of 2 treatments (16 pens/treatment; 14 birds/pen; Table 1), that included either a control (no butyric acid supplementation) or ButiPEARL Z (1lb/ton). The levels of butyric acid in ButiPEARL Z are ~132 g butyric acid/ton. The treatments were added on top of the basal diet that contained 100 ppm of zinc as zinc sulfate. Broilers were raised until 47 days of age. The building temperature's range was maintained at an appropriate temperature for the age of the birds until day 28. From days 29 to 47, broilers were subjected to cyclic heat stress by exposing them to 28 ± 2 °C from 0800 to 1800 hours and 22 °C from 1800 to 0800 hours.

Table 1: Experimental treatments

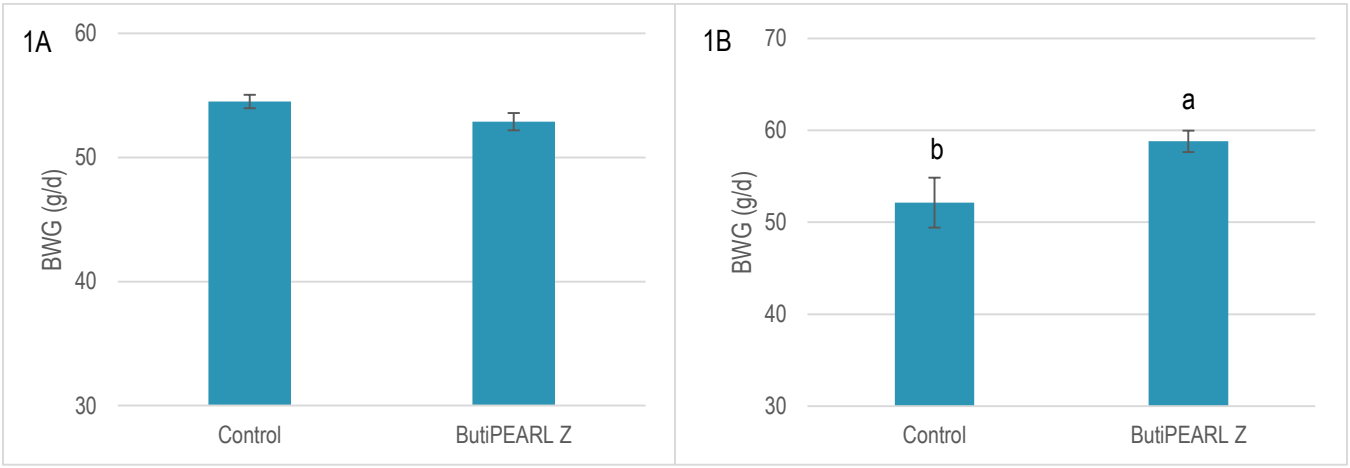
Treatment	Feed additive
1	Control
2	ButiPEARL™ Z 1lb/ton

The corn-soybean based commercial type basal diets contained salinomycin sodium 60 g/ton, BMD® 50 g/ton and phytase. Diets were made for three growth phases: starter (0-14 days), grower (15-28 days) and finisher 1 (29-47 days). The diets and water were provided ad libitum.

Bird weights, feed intake and feed conversion were recorded on days 0, 14, 28, 42 and 47. At day 47, carcass and breast meat weights were collected from 6 birds per pen (96 birds/treatment). Breast fillets were scored for woody breast. The woody breast scoring system used was from 0 to 3, increasing by 1 unit increments, where 0 was no woody breast and 3 was severe woody breast. At day 28, before HS, and at day 32, 4 days after heat stress started, intestinal samples (5 cm distal Meckel's diverticulum) were taken from 8 birds/treatment and cultured in Ussing chambers to determine the permeability.

Results and Discussion

There was no diet effect prior to HS (days 0-28) however, adding ButiPEARL Z to the diet significantly improved BWG during HS (days 29-47), compared to the control (P<0.05; Figure 1). ButiPEARL Z showed a significant improvement on feed intake and BWG at day 47 compared to control (P<0.05; Figure 2).



[a-b]Differing superscripts indicate significant difference P<0.05

Figure 1. Effect of ButiPEARL Z on BWG at 0-28 days (1A) and 29-47 days (1B)

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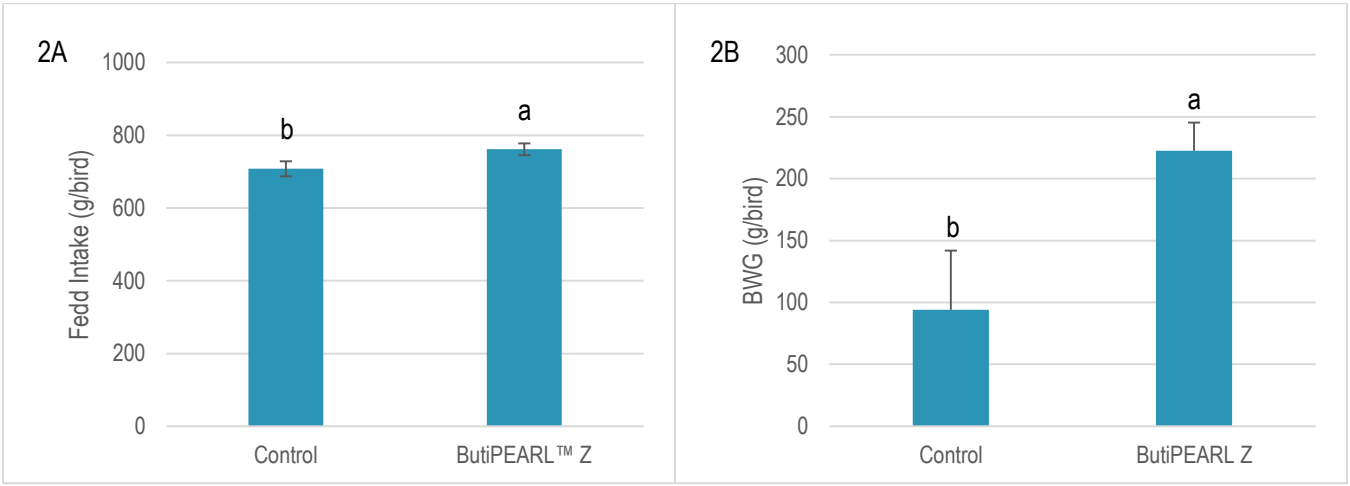


[a-b]Differing superscripts indicate significant difference P<0.05

Figure 2. Effect of ButiPEARL Z on Feed Intake (2A) and BWG (2B) at day 47

ButiPEARL Z showed numerical improvement on FCR of 4 points when compared to the control (Figure 3). These results are in agreement with previous work showing an improvement in growth performance of broilers by ButiPEARL Z.[11,12]

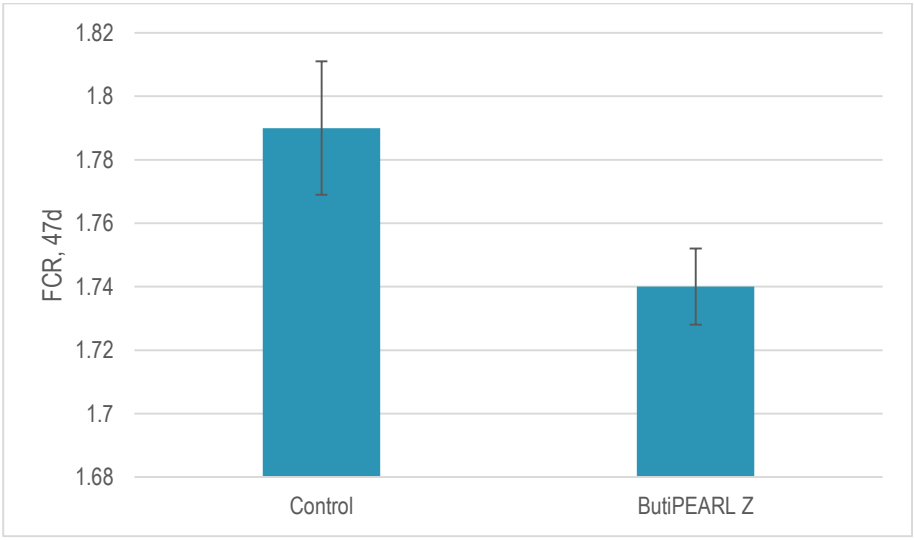
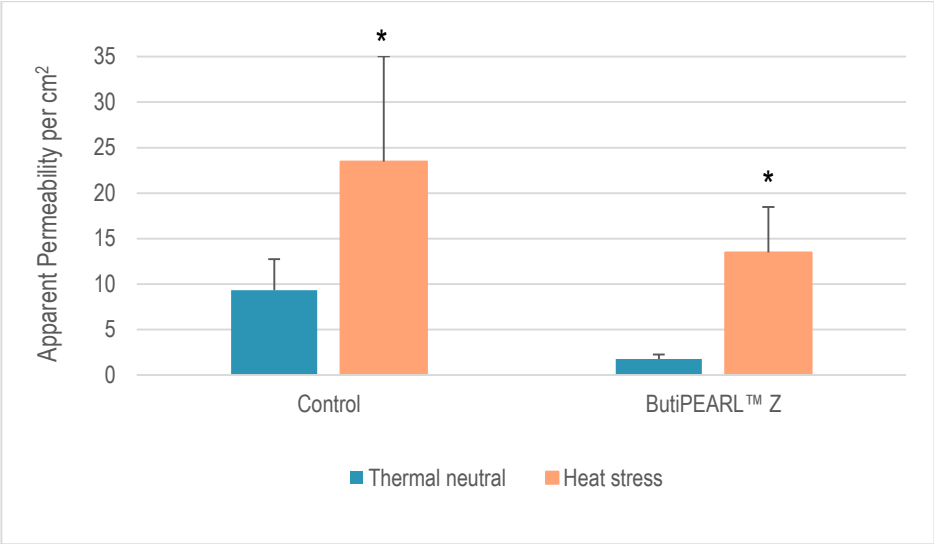


Figure 3. Effect of ButiPEARL Z on feed conversion ratio (FCR) at day 47

Additionally, there was a HS effect on intestinal macromolecule permeability (P<0.05) and a numerical diet effect. Intestinal macromolecule permeability of ButiPEARL Z was numerically lower than the control at day 28, which indicates a more intact tight junction in the ButiPEARL Z birds (Figure 4). After 4 days of HS, intestinal macromolecule permeability of ButiPEARL Z was numerically lower than the control (Figure 4). These results are in agreement with previous findings showing that butyric acid and zinc positively affect intestinal health.[4-8,10] Furthermore, ButiPEARL Z showed a trend of improvement on WB of 35% (P=0.07; Figure 5).



* Indicates heat stress effect P<0.05.

Figure 4. Effect of ButiPEARL Z on intestinal permeability during HS and thermal neutral conditions

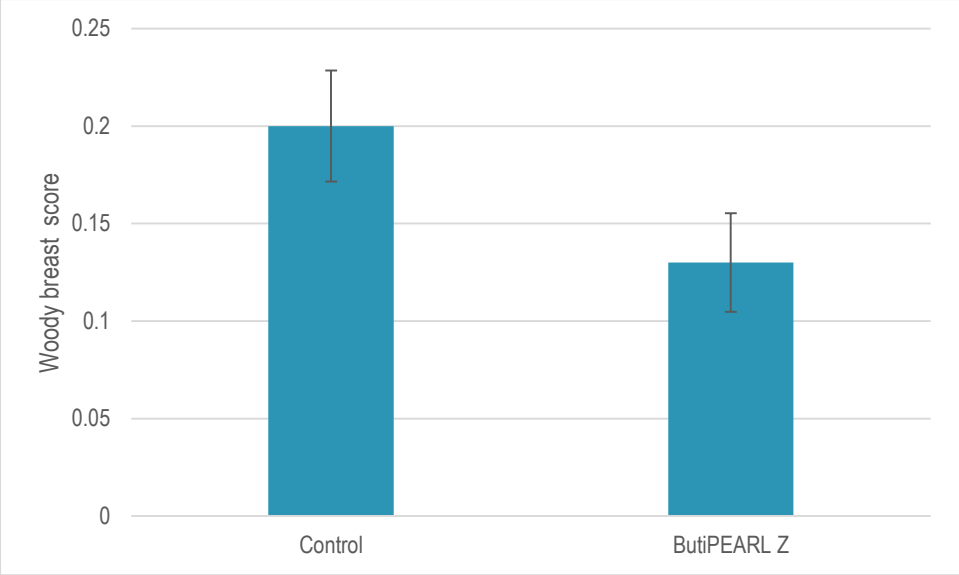


Figure 5. Effect of ButiPEARL Z on WB

Conclusions

Encapsulated butyric acid and zinc showed a synergistic effect by having a significant impact on performance and gut integrity. The data provides evidence ButiPEARL Z may alleviate the negative effects of heat stress on growth performance and intestinal integrity, as well as help reduce the severity of woody breast.

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