

*Original Research***Effect of Butyric Acid on Carcass Characteristics and Serum Biochemical Parameters in Broiler Chicken****D. Nataraja^{1*}, V. Malathi², Jayanaik¹ and J. N. Sreedhara¹**

Veterinary College, Hebbal, Bengaluru- 560024, KVAFSU, Karnataka, INDIA

¹Department of Poultry Science²Department of Livestock Production and Management***Corresponding author:** nataraj.deepika2016@gmail.com

Rec. Date:	Oct 25, 2019 17:42
Accept Date:	Feb 03, 2020 08:14
DOI	10.5455/ijlr.20191025054221

Abstract

A biological experiment was conducted to evaluate the effect of butyric acid on carcass characteristics and serum biochemical parameters in broiler chicken. The experiment consisted of 4 experimental diets. 600-day-old broiler chicks were randomly assigned to one of the four dietary treatments containing 150 chicks each: T1 (basal diet), T2 (basal diet + 0.1 % butyric acid), T3 (basal diet + 0.2 % butyric acid) and T4 (basal diet + 0.4 % butyric acid). Dressing per cent, abdominal fat per cent, relative weights of liver and spleen were found to be unaffected by butyric acid supplementation. Whereas, increase in the relative weights of heart at 0.1 per cent and reduced weight of gizzard at 0.1 and 0.2 per cent levels of butyric acid supplementation was recorded at the end of the trail. Significantly higher levels of albumin and uric acid on day 42 and glucose on day 21 was recorded in butyric acid supplemented groups. Decreased levels of globulin on day 42, cholesterol and creatinine levels during both 21 and 42nd days was noted. Serum levels of ALT and ALP was lower at the end of trail in butyric acid supplemented groups.

Key words: Abdominal Fat, Butyric Acid, Broilers, Cholesterol, Carcass

How to cite: Nataraja, D., Venkataramaiah, M., Naik, J., & Sreedhara, J. (2020). Effect of Butyric acid on Carcass Characteristics and Serum Biochemical Parameters in Broiler Chicken. International Journal of Livestock Research, 10(3), 74-80. doi: 10.5455/ijlr.20191025054221

Introduction

Antibiotics have been used as common feed additives in poultry rations as growth promoters to improve performance by reducing the burden of pathogens. The use of antibiotics for growth promotion had arisen with the commercialization of poultry farming. Currently, there is a controversy regarding the use of antibiotic growth promoters (AGPs) for animals intended for meat production, as indiscriminate and irrational use of antibiotics over a period of time may lead to resistance of bacterial populations to the antibiotics used. This affects human health directly through residues of antibiotics in meat and other animal

byproducts and indirectly through the selection of antibiotic resistance microorganisms that may transfer these genes to human pathogen. Antibiotic growth promoters and antibiotic resistance are clearly interconnected and increased concern about the potential for antibiotic resistant strains of bacteria has compelled the researchers to use other nontherapeutic alternatives like organic acids, enzymes, probiotics, prebiotics, herbs extracts, essential oils, immune stimulants as feed additives in poultry production. Among these alternatives, organic acids have shown to be potential in broiler chicken production and constitute an important component of modern feeding practices. Butyric acid is one of the important organic acids that can be used as alternative to antibiotics to improve growth performance and gut health.

Butyrate also carries multiple benefits for gut integrity and health by stimulating intestinal blood flow, mucin secretion (Canani *et al.*, 2011), electrolyte and water absorption. Much attention has been devoted to a broad range of biological functions of this molecule, including its ability to inhibit pathogenic bacteria, modify immune and inflammatory responses and alter antioxidant capacities (Chamba *et al.*, 2014). Because of the unpleasant odor and potentially labile volatility of butyric acid, sodium butyrate (SB) has been typically applied in poultry production and is readily transformed into the effective component within the gastrointestinal tract of birds. It is proposed that butyric acid improve bird performance because of their antimicrobial activity, which enhances protein and energy digestibility by reducing microbial competition with the host for nutrients and endogenous nitrogen losses and by lowering the incidence of subclinical infections and the secretion of immune mediators (Dibner and Buttin, 2002).

Materials and Methods

A total of 600-day old straight run broiler chicks were wing banded, weighed and randomly assigned to 4 groups with 6 replicates in each group and having 25 chicks in each replicate. Birds were fed with either basal diet or 0.1, 0.2 or 0.4 % butyric acid. All standard management practices and vaccination schedule was practiced till 6 weeks of age. Birds were fed with broiler Pre starter (1 to 7 days), Starter (8 to 21 days) and Finisher (22 to 42 days) diets as per the NRC (1994) specifications.

Carcass Characteristics

On 21st and 42nd day of the experiment, 12 birds from each treatment were sacrificed to record carcass characteristics viz., dressing percentage, abdominal fat and visceral organs weights viz. heart, liver and gizzard. Birds selected for slaughter were fasted for 12 hours with access to *ad-libitum* drinking water. After recording the live weight, birds were slaughtered by humane method and bled for 90 seconds by severing jugular vein and carotid artery, scalded at 60°C for two minutes, defeathered mechanically. Eviscerated carcass weights were recorded and dressing percent was calculated. The weights of visceral organs was recorded and expressed as per cent of live body weight. The weight of fat lining the abdominal cavity, covering the gizzard and bursa was scooped out, weighed and recorded.

Serum Biochemistry

On 21st and 42nd day of the experiment, blood samples were collected from 12 birds from each group and the serum was analysed for total protein, albumin, globulin, creatinine, uric acid, glucose, cholesterol, glutamic pyruvic transaminase (SGPT), glutaminoxaloacetic transaminase (SGOT), lactate dehydrogenase (LDH) and alkaline phosphatase (ALP) using serum biochemical analyser as per the recommendations of the manufacturer of the kit.

Statistical Analysis

The data collected (n=12 in each group) was subjected to One Way Analysis of Variance (ANOVA) and the means were compared by Duncan's multiple range test using SPSS statistical software version 20.0.

Results and Discussion

Carcass Characteristics

The carcass characteristics and visceral organ weights of birds in different experiment groups at day 42 are presented in Table 1. The dressing per cent, liver, spleen and abdominal fat percent was unaffected ($P > 0.05$) by supplementation of butyric acid. Similar findings were recorded by (Adil *et al.*, 2010; Adil *et al.*, 2011 and Azza *et al.*, 2014). However, Panda *et al.* (2009) observed significantly higher ($P \leq 0.05$) dressing percentage at 0.3, 0.4 and 0.6 per cent butyric acid levels. The relative weight of liver was not affected with supplementation of butyric acid and agrees with the results of Mahdavi and Torki (2009). However, Aghazadeh *et al.* (2012) reported increased weight of liver by supplementation of organic acids to broilers. Spleen weight was also unaffected by butyric acid supplementation which is in agreement with Chamba *et al.* (2014), who supplemented 0.07 per cent sodium butyrate and found that spleen weight was unaffected. On contrary, the relative weight of spleen was significantly ($P \leq 0.05$) higher as reported by Sikandar *et al.* (2017) on supplementation of sodium butyrate (0.5 and 1 %) in broilers. Mahdavi and Torki (2009) supplemented butyric acid (0.2 and 0.3 %) in broiler diet and found that abdominal fat per cent was unaffected and similar findings were also reported by Aghazadeh *et al.* (2012). However, significantly lower abdominal fat content in broilers was reported by Panda *et al.* (2009) using graded levels of butyric acid (0.2, 0.4 and 0.6 %) and similar results were also recorded by Bedford *et al.* (2017). The mean gizzard weight of the group fed with basal diet was significantly ($P \leq 0.05$) higher than 0.1 and 0.2 percent butyric acid supplemented groups. Contrary to this result, the gizzard weight was unaffected by butyric acid (2 and 3 %) supplementation in experiment conducted by Adil *et al.* (2011). The heart weight was significantly ($P \leq 0.05$) higher in 0.1 per cent butyric acid supplemented group compared to 0.2 per cent butyric acid supplemented group. However, Adil *et al.* (2011) and Sahir *et al.* (2013) did not find difference in the heart weight with butyric acid supplementation. Supplementation of butyric acid apparently did not affect the carcass parameters.

Table 1: Effect of Butyric acid supplementation on dressing yield, visceral organ weights and abdominal fat (as per cent of body weight) in broiler chicken

Experimental Groups	Dressing %	Liver	Gizzard	Heart	Spleen	Abdominal Fat
Basal diet (Control)	70.90 ± 0.64	2.27 ± 0.07	2.05 ± 0.07 ^a	0.51 ± 0.01 ^{ab}	0.14 ± 0.01	1.19 ± 0.14
Basal diet + 0.1 % butyric acid.	72.39 ± 0.56	2.18 ± 0.08	1.77 ± 0.07 ^b	0.53 ± 0.01 ^a	0.12 ± 0.00	1.11 ± 0.10
Basal diet + 0.2 % butyric acid.	71.48 ± 0.46	2.23 ± 0.06	1.77 ± 0.06 ^b	0.45 ± 0.01 ^b	0.12 ± 0.0	1.28 ± 0.13
Basal diet + 0.4 % butyric acid.	72.21 ± 0.49	2.25 ± 0.08	1.88 ± 0.05 ^{ab}	0.5 ± 0.01 ^{ab}	0.14 ± 0.0	1.24 ± 0.10
P value	0.203	0.855	0.021	0.034	0.103	0.791
Pooled SE	0.277	0.037	0.037	0.009	0.004	0.06

*means within in column with different superscript differ significantly ($P \leq 0.05$)

Serum Biochemical Parameters

The effect of butyric acid on serum biochemical parameters on day 21 and 42 are presented in Table 2 and 3, respectively. Total protein, albumin and globulin levels were not influenced by butyric acid supplementation on day 21. On day 42, total protein was unaffected but, albumin levels were significantly higher and globulin levels were significantly lower in butyric acid supplemented groups compared to the unsupplemented group. These findings are in agreement with Mahdavi and Torki (2009) who supplemented butyric acid (0.2 and 0.3 %) in broilers diet and found no change in serum total protein levels. The increasing trend in albumin levels by BA supplementation indicates the mediating function of butyrate in protein synthesis. Butyrate can be used as a substrate for energy production or has the potential to act as an effector in several intestinal and liver cells (Beauvieux *et al.*, 2001). Similar results were recorded by Zhang *et al.* (2011) who noticed lower globulin levels in 0.1 per cent sodium butyrate supplemented chicken. In the present study, the lower globulin levels might be due to good health and low microbial assault. Serum glucose level on day 21 was significantly higher in 0.2 % butyric acid supplemented group, whereas, glucose level was not influenced by butyric acid on day 42 of the trail. Adil *et al.* (2010) supplemented butyric acid (2 and 3 %) to boilers and observed that serum glucose level was unaffected. Tappenden and McBurney (1998) reported the butyric acid increased expressions of plasma glucagon-like peptide-2 (GLP-2), ileal proglucagon mRNA and glucose transporter (GLUT2), all of which are the signals which can potentially mediate gut epithelial cell proliferation.

Serum cholesterol and creatinine levels were significantly lower in butyric acid supplemented groups than the control group and agree with the results of Taherpour *et al.* (2009). Mansoub (2011) reported lower serum cholesterol level in 0.2 per cent butyric acid supplemented group. The lower creatinine levels indicate lower muscle protein breakdown and proper functioning of kidneys. Contrary to these results, serum creatinine levels was unaffected by butyric acid in the trial conducted by Deepa *et al.*, 2017. Serum uric acid levels on day 21 were unaffected whereas, it was significantly higher on day 42 in 0.2 and 0.4 % butyric acid supplemented groups. Higher uric acid levels may be due to increase in length of intestinal villi

and thus higher absorption capacity of small intestine resulting in more intensive protein and purine metabolism (Qaisrani *et al.*, 2015).

Table 2: Effect of Butyric acid supplementation on serum biochemical parameters on 21st day in broiler chicken

Treatment Groups	Total Protein (g/dl)	Albumin (g/dl)	Globulin (g/dl)	Glucose (mg/dl)	Cholesterol (mg/dl)	Creatinine (mg/dl)	Uric acid (mg/dl)
Basal diet (Control)	1.98±0.13	0.89±0.05	1.08±0.12	238.38±14.0 ^b	101.52±6.08 ^a	0.91±0.02 ^a	8.48 ± 0.56
Basal diet + 0.1 % butyric acid	2.26±0.09	0.96±0.03	1.29±0.10	249.40±6.07 ^{ab}	88.67±3.63 ^{ab}	0.73±0.0 ^b	8.41 ± 0.33
Basal diet + 0.2 % butyric acid	2.14±0.09	0.89±0.03	1.24±0.09	272.73±11.67 ^a	78.98±4.90 ^{bc}	0.67±0.0 ^b	8.87 ± 0.54
Basal diet + 0.4 % butyric acid	2.16±0.07	0.93±0.06	1.23± 0.06	268.50±10.8 ^{ab}	71.56±4.08 ^c	0.71±0.0 ^b	7.94 ± 0.40
P value	0.306	0.71	0.476	0.109	0	0	0.587
Pooled SE	0.052	0.024	0.048	5.728	2.828	0.018	0.233

*means within in column with different superscript differ significantly ($P \leq 0.05$)

Table 3: Effect of Butyric acid supplementation on serum biochemical parameters on 42nd day in broiler chicken

Treatment Groups	Total Protein (g/dl)	Albumin (g/dl)	Globulin (g/dl)	Glucose (mg/dl)	Cholesterol (mg/dl)	Creatinine (mg/dl)	Uric acid (mg/dl)
Basal diet (Control)	3.23±0.11	1.62±0.0 ^b	1.61±0.11 ^a	233.91±11.30	83.45±4.96 ^a	0.77±0.02 ^a	3.76±0.47 ^{ab}
Basal diet + 0.1 % butyric acid	3.08±0.07	1.72±0.02 ^{ab}	1.36±0.0 ^b	217.26±4.42	72.39±2.96 ^b	0.64±0.01 ^b	2.31±0.55 ^b
Basal diet + 0.2 % butyric acid	3.05±0.11	1.72±0.06 ^{ab}	1.33±0.0 ^b	218.61±4.47	80.42±3.09 ^{ab}	0.61±0.01 ^b	4.62±0.53 ^a
Basal diet + 0.4 % butyric acid	3.32±0.08	1.8 ±0.07 ^a	1.46±0.05 ^{ab}	223.70±7.49	60.39±2.41 ^c	0.61±0.01 ^b	5.10±0.58 ^a
P value	0.187	0.112	0.073	0.392	0	0	0.004
Pooled SE	0.05	0.035	0.041	3.739	2.133	0.013	0.304

*means within in column with different superscript differ significantly ($P \leq 0.05$)

Serum Enzymes

The effect of butyric acid on serum enzymes on both day 21 and 42 is presented in Table 4 and 5. Serum glutamic oxaloacetic transaminase (SGOT) levels were not affected on day 21 while, it was significantly higher in 0.2 % butyric acid supplemented group at the end of the trail. Bedford *et al.* (2017) recorded higher SGOT levels in birds supplemented with mono butyrins (0.05 and 0.2 %) and tri butyrins (0.05 %). Serum glutamic pyruvic transaminase (SGPT) levels were significantly higher in 0.2 % butyric acid supplemented group on day 21 but, significantly lower in 0.2 and 0.4 % butyric acid supplemented groups on day 42 of the trail. Serum alkaline phosphatase (ALP) level was not influenced by butyric acid supplementation on day 21 and was significantly lower in butyric acid supplemented groups at the end of the trail. The findings are in agreement with Azza *et al.* (2014) who reported significantly lower ALP levels

with 3 per cent butyric acid supplementation. This could be due to better integrity of liver in butyric acid supplemented groups. Serum lactate dehydrogenase (LDH) level was significantly higher in 0.4 % butyric acid supplemented group in both phases of the study. However, the observed level of LDH enzyme was in normal physiological range and is in agreement with the findings of Malheiros *et al.* (2003).

Table 4: Effect of Butyric acid supplementation on serum enzymes on 21st day in broiler chicken

Treatment Groups	SGOT (IU/L)	SGPT (IU/L)	ALP (IU/L)	LDH (IU/L)
Basal diet (Control)	99.17 ± 9.44	6.41 ± 0.38 ^b	1455.03 ± 117.25	2298.00 ± 192.64 ^{ab}
Basal diet + 0.1 % butyric acid	108.39 ± 5.18	4.93 ± 0.29 ^b	1377.44 ± 108.00	2250.91 ± 181.34 ^{ab}
Basal diet + 0.2 % butyric acid	106.58 ± 6.40	12.68 ± 1.82 ^a	1312.92 ± 114.82	1828.50 ± 201.51 ^b
Basal diet + 0.4 % butyric acid	113.71 ± 9.14	6.41 ± 0.56 ^b	1394.91 ± 102.40	2595.50 ± 116.69 ^a
P value	0.618	0	0.841	0.032
Pooled SE	3.829	0.646	54.097	94.126

*means within in column with different superscript differ significantly ($P \leq 0.05$)

Table 5: Effect of Butyric acid supplementation on serum enzymes on 42nd day in broiler chicken

Treatment Groups	SGOT (IU/L)	SGPT (IU/L)	ALP (IU/L)	LDH (IU/L)
Basal diet (Control)	82.83 ± 2.93 ^b	15.98 ± 3.58 ^a	1605.78 ± 56.48 ^a	2434.66 ± 78.49 ^b
Basal diet + 0.1 % butyric acid	77.67 ± 3.66 ^b	18.89 ± 3.30 ^a	1371.94 ± 85.74 ^b	2667.75 ± 122.06 ^{ab}
Basal diet + 0.2 % butyric acid	104.94 ± 9.72 ^a	8.40 ± 1.14 ^b	1305.59 ± 67.45 ^b	2426.50 ± 117.30 ^b
Basal diet + 0.4 % butyric acid	89.17 ± 4.59 ^{ab}	7.21 ± 1.12 ^b	1431.59 ± 93.87 ^{ab}	2872.83 ± 66.78 ^a
P value	0.012	0.005	0.052	0.007
Pooled SE	3.208	1.435	40.782	54.993

*means within in column with different superscript differ significantly ($P \leq 0.05$)

Conclusion

Carcass yields viz. dressing per cent, abdominal fat per cent and the relative organ weights of liver and spleen was not affected with butyric acid supplementation. Serum levels of albumin and uric acid levels increased, probably due to higher protein metabolism and decreased levels of creatinine was best indicator of improved renal function. Reduced levels of cholesterol levels with butyric acid in the diet could aid in the lean meat production. Butyric acid supplementation could improve the health of broilers with improved protein metabolism, renal and liver functions in broilers.

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