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# Effect of dietary supplementation of salts of organic acids on growth performance, carcass traits and meat composition of broilers

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**Abstract**
300 commercial broiler chicks were randomly distributed into five treatments to find out the efficacy of sodium butyrate and calcium propionate on the growth performance, carcass traits and meat composition. Control group ($T_1$ ) was fed with a maize-soyabean based diet and treatment groups $T_2$ , $T_3$ were supplemented with sodium butyrate @ 0.5%, 1% and $T_4$ , $T_5$ with calcium propionate @ 0.5%, 1% respectively. A metabolisim trial was conducted at the end of the experiment to evaluate the nutrient utilization. Results revealed that body weight gain (g/bird) during whole growth period (0-6 weeks) was highest in the $T_3$ (2338.78) group and difference was significant in comparision to control group (1967.04). Supplementation of sodium butyrate and calcium propionate @ 1% produced significantly ($P$<0.05) higher dressing percentage (78.74%, 77.93% respectively) as compared to unsupplemented group (76.74%). Drawn percentage and giblet percentage also improved in treatment groups. Drawn percentage was highest in $T_3$ (70.25%) which was significantly ($P$<0.05) differ with the control group (68.56%). Dietary treatment $T_3$ and $T_5$ produced significantly ($P$<0.05) higher giblet percentage (4.99% and 4.82% respectively) than the control group (4.45%). Thigh meat protein (22.52%, 22.55%) was significantly increased in $T_3$ and $T_5$ than control group.

**Keywords:** Sodium butyrate, calcium propionate, growth, carcass characteristics, meat composition, broilers

## Introduction
Broilers are special type of poultry birds reared for meat production due to their high growth rate. India's per capita consumption of poultry meat is estimated at around 3.6 kg per annum in 2017 and total poultry meat consumption is about 4.49 million metric tons (USDA, 2016) [19]. A most arising challenge in the poultry production is to exploit the use of specific dietary supplements to boost their intrinsic potential for optimal performance. Organic acids are routinely included in diets for monogastric animals in Europe as a preservative and acidifier, in order to replace antibiotics as growth promoters and to control pathogens (Papatsiros *et al.*, 2012 and Sugiharto, 2016) [13, 18]. They are either simple mono-carboxylic acids such as formic, acetic, propionic and butyric acids or carboxylic acids with the hydroxyl group such as lactic, malic, tartaric and citric acids or short-chain carboxylic acids containing double bonds like fumaric and sorbic acids (Shahidi *et al.*, 2014) [15]. Dietary organic acids and their salts are able to inhibit microbial growth in the feed, and consequently preserving the microbial balance in the gastrointestinal tract. In addition to modifying intestinal microflora, organic acids also improve the solubility, digestion and absorption of nutrients. By reducing the GIT pH organic acids and their salts increased gastric proteolysis and improved digestibility of protein and amino acids. It was observed that supplementing acetic acid @ 1% and 2 % in the broiler's ration significantly ($P$<0.05) increased the body weight gain (Gupta, 2013) [8].

## Materials and Methods
**Experimental birds and dietary treatments:** Three hundred, day old commercial broiler chicks were randomly distributed into 30 subgroups means 5 dietary treatments with six replicates and each replicate had 10 birds. The first group was kept as a control ($T_1$) and given the basal diet with antibiotics while second ($T_2$) and third ($T_3$) groups were supplemented with sodium butyrate at 0.5% and 1% level and $T_4$ , $T_5$ with calcium propionate @ 0.5%, 1% respectively. Birds were vaccinated against F1 strain of Ranikhet disease on 0, 7$^{th}$ day and Gumboro disease on 14$^{th}$ day. Basal ration was formulated as per BIS (2007) [2] to fulfill the

metabolizable energy (ME), crude protein and limiting amino acids (methionine and lysine) requirements of birds. Level of crude protein in starter (0-4weeks) and finisher (4-6weeks) ration was 22 and 20 percent respectively and respective ME content was 3100 and 3200 KCal/kg. The experimental chicks were reared under deep litter system. The birds were weighed individually at biweekly interval and the body weights were recorded to calculate body weight gain. For carcass evaluations, one bird from each replicate was selected randomly, at the end of 6th week and slaughtered. Samples of breast and thigh muscles were taken from each of the slaughtered birds and stored in deep-freeze separately for further analysis. These samples were analyzed for moisture, protein and ether extract as per AOAC (2013) [1]. Chemical composition of the feed ingredients has been given in Table 1, Ingredient & chemical composition of experimental diets in Table 2. Data was analysed statistically as described by Snedecor and Cochran (1994) [17]. Analysis of variance was used to study the differences among treatment means and they were compared by using Duncan.s Multiple Range Test (DMRT, 1995) as modified by Kramer (1956) [11].

**Results and Discussion**

Table 3: showed that average body weight gain (g/bird) was significantly increased in the $T_3$ group (2338.78g.) as compared to the control group (1967.04g.) during overall growth period (0-6 weeks). In case of feed intake during overall growth period (0-6weeks) all the supplemented groups showed significant difference in comparision to control group. Data obtained on body weight gain show conformity with those who reported that dietary supplementation of organic acids significantly increased the BWG in broilers (Mohammadagheri *et al.*, 2016; Ragga *et al.*, 2016 and Fathi *et al.*, 2016) [12, 14, 6]. Improvement in the body weight gain could be attributed to the antimicrobial effect of organic acids. Organic acids also improve the digestibility of proteins and absorption of amino acids (Hernandez *et al.*, 2006) [10]. Organic acids reduce microbial competition with the host for nutrients and endogenous nitrogen losses, by lowering the incidence of sub-clinical infections and secretion of immune mediators, by reducing the production of ammonia and other growth depressing microbial metabolites.

The results with respect to feed consumption agree with the findings that showed higher total feed intake with organic acids fed chicks as compared to the control (Chowdhury *et al.*, 2009 and Haque *et al.*, 2009) [4]. Higher feed intake may be due to improved palatability which ultimately increased feed intake but higher level also reduced feed intake.

Table 4 depicted that dietary supplementation of sodium butyrate ($T_3$) produced significantly ($P<0.05$) higher dressing percentage than control and other dietary treatments. Drawn percentage and giblet percentage were significantly ($P<0.05$) improved in all the dietary treatments as compared to control group. Abdominal fat and eviscerated percentage didn't show any significant difference. Higher carcass and dressing yield obtained are in agreement with the results in which carcass yield and dressing percentage was increased on organic acids supplementation (Brzoska *et al.*, 2013 and Ragga *et al.*, 2016) [3, 14]. It is probably due to beneficial effect of organic acids on the gut flora (Ragga *et al.*, 2016) [14]. The higher dressing yield might be due to increased live weight.

In Table 5 it is shown that in case of breast meat all organic acids supplemented groups except 0.5% sodium butyrate resulted in significantly lower moisture percentage than the control group. Dietary supplementation of sodium butyrate ($T_2$, $T_3$) and calcium propionate ($T_4$, $T_5$) increased the crude protein percentage and reduced the fat percentage non-significantly in breast muscles while significantly in case of thigh muscles. Improvement in the meat composition in terms of increased protein and reduced fat may be due to increased gastric proteolysis and improved digestibility of protein and amino acids on organic acid salts supplementation. Additionally, these acids have been shown to inhibit the growth of intestinal bacteria which compete with the host animal for availability of nutrients (Gedek *et al.*, 2006) [7].

**Table 1:** Chemical composition of feed ingredients (% DM basis)

| Ingredient | CP (%) | EE (%) | CF (%) | TA (%) | Lysine* (%) | Methionine* (%) | ME* (kcal/kg) | Cost (Rs./Qtls.) |
|---|---|---|---|---|---|---|---|---|
| Maize | 9.1 | 3.44 | 2.44 | 2.25 | 0.18 | 0.15 | 3300 | 1719 |
| Soyabean meal | 45.2 | 3.16 | 3.93 | 8.47 | 2.57 | 0.76 | 2230 | 3643 |
| Groundnut cake | 40 | 1.52 | 7.23 | 6.62 | 1.82 | 0.49 | 1180 | 2959 |
| Fish meal | 50 | 13.5 | 1.79 | 39.62 | 1.42 | 1.42 | 2600 | 5373 |

*calculated values[11] (*Singh and panda 1998)*

**Table 2:** Ingredient composition and chemical composition of experimental diets

| Name of Ingredient (kg/100kg feed) | 0-4 weeks | 4-6 weeks |
|---|---|---|
| Maize | 55 | 60 |
| Soyabean meal | 24 | 20 |
| Groundnut cake | 10 | 10 |
| Fish meal | 5 | 3 |
| Vegetable oil | 4 | 5 |
| Mineral mixture | 2 | 2 |
| **Chemical composition (% DM basis)** | | |
| Moisture | 11.84 | 11.58 |
| DM | 88.16 | 88.42 |
| CP | 22.01 | 20.10 |
| EE | 4.81 | 5.02 |
| CF | 4.47 | 5.05 |
| Ash | 9.10 | 9.20 |
| NFE | 47.77 | 49.05 |

Spectromix: 10g/100Kg of feed, Spectromix BE: 20g/100kg feed, Veldot: 50g/100kg feed, Choline chloride: 50g/100kg feed, Lysine: 50g/100kg feed, DL-methionine: 150g/100kg of feed.

**Table 3:** Average body weight gain (g/bird) and Feed intake (g/chick) of overall growth period under different dietary treatments

| Treatment | Average body weight gain (g/bird) | Feed intake (g/chick) | FCR |
|---|---|---|---|
| $T_1$ | $1967.04^{a}\pm22.51$ | $3612.72^{a}\pm31.67$ | $1.87^{a}\pm0.01$ |
| $T_2$ | $2026.22^{a}\pm13.81$ | $3759.43^{b}\pm17.01$ | $1.86^{a}\pm0.01$ |
| $T_3$ | $2338.78^{b}\pm18.53$ | $4160.77^{c}\pm28.93$ | $1.78^{b}\pm0.01$ |
| $T_4$ | $2011.20^{a}\pm20.90$ | $37.51.50^{b}\pm12.89$ | $1.86^{a}\pm0.01$ |
| $T_5$ | $1952.82^{a}\pm17.28$ | $3808.55^{b}\pm35.46$ | $1.83^{ac}\pm0.02$ |

Means bearing different superscripts in a column differ significantly ($P<0.05$)

**Table 4:** Dressed, eviscerated, drawn yield, weight of giblets and abdominal fat (%) of the experimental birds under different dietary treatments

| Treatment | Dressing (%) | Eviscerated (%) | Drawn (%) | Giblet (%) | Abdominal Fat (%) |
|---|---|---|---|---|---|
| $T_1$ | $76.74^{a}+0.32$ | 62.98+0.28 | $68.56^{a}+0.31$ | $4.45^{a}+0.08$ | 1.83±0.01 |
| $T_2$ | $77.72^{b}+0.41$ | 63.36+0.39 | $69.88^{b}+0.17$ | $4.56^{a}+0.08$ | 1.83±0.01 |
| $T_3$ | $78.74^{c}+0.39$ | 63.93+0.30 | $70.25^{b}+0.21$ | $4.99^{b}+0.04$ | 1.82±0.01 |
| $T_4$ | $77.15^{a}+0.12$ | 62.95+0.12 | $69.67^{b}+0.12$ | $4.52^{a}+0.09$ | 1.83±0.01 |
| $T_5$ | $77.93^{b}+0.39$ | 63.55+0.11 | $69.97^{b}+0.23$ | $4.82^{b}+0.07$ | 1.82±0.01 |

Means bearing different superscripts in a column differ significantly ($P<0.05$)

**Table 5:** Composition of Breast and Thigh meat of the experimental birds under different dietary treatments

| | Breast | meat | | Thigh | Meat | |
|---|---|---|---|---|---|---|
| Treatment | %Moisture | %CP | %E.E | %Moisture | %CP | %E.E |
| $T_1$ | $72.21^{a}\pm0.18$ | 24.18±0.52 | 5.07±0.12 | $72.04^{a}\pm0.13$ | $21.03^{a}\pm0.45$ | 7.50±0.07 |
| $T_2$ | $72.47^{a}\pm0.36$ | 24.22±0.34 | 4.89±0.20 | $72.39^{a}\pm0.17$ | $21.23^{a}\pm0.42$ | 7.27±0.09 |
| $T_3$ | $70.64^{b}\pm0.17$ | 24.68±0.33 | 4.77±0.16 | $70.64^{b}\pm0.17$ | $22.52^{b}\pm0.17$ | 7.22±0.11 |
| $T_4$ | $71.01^{b}\pm0.31$ | 24.43±0.47 | 4.83±0.20 | $71.34^{c}\pm0.30$ | $21.37^{a}\pm0.47$ | 7.35±0.14 |
| $T_5$ | $71.07^{b}\pm0.20$ | 24.60±0.32 | 4.78±0.20 | $71.16^{bc}\pm0.22$ | $22.55^{b}\pm0.30$ | 7.28±0.13 |

Means bearing different superscripts in a column differ significantly ($P<0.05$)

## Conclusion

It is concluded that sodium butyrate and calcium propionate at 1% level had significantly improved the carcass traits and meat composition. So these can be incorporated in the broiler's diet without any harmful effect.

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