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Pharmacology

Effect of Sodium Butyrate and *Origanium Vulgare* on Growth Performance, Biochemical Profile, Immune Status and Carcass Traits of Broiler Chickens

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ABSTRACT

The principal goal of this research was to examine how the addition of sodium butyrate (SB) and *Origanium vulgare* (OV) to basal diet affects various aspects of broiler chicken production, including growth rate, biochemical markers, immune system function, and carcass traits. Five hundred one-day-old chicks of Cobb breed (males and females) were distributed at random way into five dietary treatment groups on floor pens, each group have 4 replicates (25 birds/replicate) and reared at a private farm. Group (G1) received basal diet without any addition (negative control). Birds of groups 2, 3, 4 and 5 received basal diet enriched with 500 g/ton sodium butyrate (SB), 500 g/ton *Origanium vulgare* (OV), 250 g/ton SB+OV and 500 g/ton SB+OV, respectively. At day 35 of rearing, the growth performance, biochemical profile, immunity parameters and carcass traits were evaluated. Our study demonstrated that supplementing basal diet with SB and OV, alone and in combination, resulted in improvements in body weight gain and feed conversion ratio and decreased levels of alanine aminotransferase (ALT), aspartate aminotransferase (AST), total cholesterol (TC), triglycerides (TG) and malondialdehyde (MDA) but increased total protein (TP), albumin, globulin, albumin/globulin ratio, superoxide dismutase (SOD) and catalase (CAT). It also increased levels of IgG and IgM and enhanced immunity as it elevated phagocytic activity, phagocytic index, lysozyme activity, and hemagglutination inhibition (HI) antibody titer against NDV. It improved carcass traits of broilers as it increased live weight and carcass weight and dressing percent (72.5%). It could be concluded that supplementation of basal diet with SB and OV, alone and in combination, improved growth performance, biochemical parameters, immune status, and carcass traits of broilers. Therefore, the utilization of sodium butyrate and *Origanium vulgare* as feed additives can be used as an effective and beneficial approach in broiler chicken production. Both have hepatoprotective, antioxidant, and immunostimulant effects. The mechanisms of action underlying these effects require further study in broiler chickens.

Keywords: Biochemical parameters, Carcass traits, Growth performance, Immune status, *Origanium vulgare* and Sodium butyrate.

INTRODUCTION

Egypt is suffering from severe shortage of poultry meat, which is a popular food for most Egyptians. It is estimated that Egypt's chicken meat production will be approximately 1.59 million tons in the year

2023 (Abdelli *et al*., 2021). The cost of feed ingredients as cereal grains (maize, sorghum, and barley), tends to increase because of fluctuations in prices and the difficulties of importation. Efforts to enhance the health benefits of chickens remain an ongoing concern in the poultry production sector. Antibiotics have been used as a traditional tool for promoting health and growth performance in poultry. Nevertheless, the risk of bacterial resistance development and the incidence of drug residue have increased over time, leading to concerns about their indiscriminate use. As a result, prophylactic and therapeutic uses of antibiotics in poultry nutrition have been restricted (Ricke *et al*., 2020). Feed additives are utilized in poultry nutrition to serve a variety of purposes ranging from enhancing the quality and safety of feed, as well as enhancing the quality of animal-derived food byproducts. The most widely-used feed additives for poultry diets comprise antimicrobial (Alagawany *et al.*, 2021), acidifiers (Ricke *et al*., 2020), antioxidants (Hashemi and Davoodi, 2011), antimycotoxin (Olivera *et al*., 2015 and Adhikari, 2018), prebiotics, probiotics, and phytogenic additives (Abd El-Hack *et al.*, 2017;AL-Khalaifah, 2018; Debnath *et al*., 2019 and Fathi *et al*., 2023).

As a safer alternative to antibiotics, SB has been receiving an increasing interest within the field of poultry industry. Sodium butyrate is a crucial substitute for antibiotics in the poultry industry due to its stable and non-odorous properties. Furthermore, it has been found to possess antimicrobial, anti-inflammatory, and antioxidant characteristics, making it a beneficial feed additive for maintaining optimal animal health (Song *et al.*, 2017). By reducing oxidative stress triggered by heat stress, SB has a potential to enhance meat quality in poultry (Lan *et al.*, 2020). The previous study specified that incorporating SB into poultry feed can be used as a beneficial approach to enhance liver function, broiler growth performance, and meat quality, particularly in hot climatic conditions.

Origanium vulgare Lin., (Oregano), is an aromatic herb with many bioactive chemical compounds (Ri *et al*., 2017). Oregano possesses antibacterial, antioxidant, antiviral, immunomodulatory, and antiparasitic properties (Alagawany *et al*., 2018). Incorporating oregano extracts into chicken diets has been shown to provide several benefits, including increased body weight and feed conversion ratio, improved digestion, decreased disease incidence, improved productive performance, and lowered economical loss (Alagawany *et al.*, 2018). Nevertheless, more researches on oregano as a phytogenic feed additive in poultry is essential to determine its influence on lipid metabolism, meat quality, carcass yield, and blood parameters. The goal of the current research was to assess the impact of both sodium butyrate and *Origanium vulgare* on growth performance, biochemical profile, immune status and carcass traits in broiler chickens.

MATERIAL AND METHODS

Ethical approval:

The current study was accomplished with approval from the Institutional Animal Care and Use Committee (IACUC), Faculty of Veterinary Medicine, Cairo, University, Egypt.

Feed additives:

Sodium butyrate (SB) trade name is CM3000®. It is a commercial 30% spherical granules coated sodium butyrate. It is released at a slow and steady manner throughout the small and large intestines of poultry. The manufacturer of CM3000® is Hangzhou King Techina Feed Co., Ltd, China. It was introduced to the broiler basal diet at a 500 g/ton feed concentration (Sikandar *et al.*, 2017).

Origanium vulgare L., (OV), the trade name Oregano is Ropadiar®, which is a natural and popular herb used in traditional medicine and as a culinary spice, which is beneficial for poultry for boosting immunity. *Origanium vulgare* L is manufactured by Ropapharm International Co., Ltd, the Netherlands. It was introduced to the broiler basal diet at a 500 g/ton feed concentration (Zhang *et al*., 2021).

Experimental chicks:

Five hundred 1-day-old chicks (Cobb breed) of males and females were provided from a local hatchery. After weighting, the chicks were assigned randomly into five groups each of 4 replicates (25 birds/replicate). The experiment was conducted on floor pens at a private farm at Giza, Egypt. The administered vaccination program to all experimental groups of birds included protection against Infectious Bronchitis (IB), Newcastle Disease (ND), and Gumboro (IBD) diseases.

Diets and feeding program:

To meet the nutrient requirements of Cobb broilers, diets comprising corn-soybean meal and basal components were prepared (Cobb manual catalogue 2018). The experimental period was 35 days involved providing access to feed in the form of mash-type diets for three stages - starter, grower, and finisher. Water was provided *ad labium*. The control group, designated as G1, received a broiler basal diet without any additions. Broiler chicks of the group 2 (G2) were consumed the basal broiler diet with addition of 500 g/ton feed of SB. In the group 3 (G3), the broiler chicks were fed on the basal diet to which 500 g/ton feed of OV were added. Group four (G4) was received the basal diets to which half of the concentrations (250 g/ton feed) of both additives were added. Broiler chicks in the group five (G5) received the basal diet that was enriched with 500 g/ton feed of combination of SB and OV feed additives.

Growth performance:

On day 35 of dietary period, the chicks were weighed, and their daily feed intake (FI) was reported through the experiment period. Body weight gain (BWG) was computed**.** The feed conversion ratio (FCR) was calculated as feed intake (g)/ body weight gain (g) using the procedure outlined by Kidane *et al.* (2017).

Biochemical parameters:

At the end of the experimental period, the blood was withdrawn from the brachial wing vein and serum samples were used to determine the activities of aspartate aminotransferase (AST) and alanine aminotransferase (ALT) using the procedure outlined by Bergmeyer *et al*., (1978). Measurement of serum total cholesterol (TC) level was carried out using the calorimetric method described by Allain *et al*.,(1974), while triglyceride (TG) level were determined following Wahlefeld (1974). Using a spectrophotometer, the activities of serum superoxide dismutase (SOD) and catalase (CAT) enzymes were estimated following the technique of Nishikimi et al., (1972) and Aebi (1984), respectively. Malondialdehyde (MDA) level were measured following the procedure given by Ohkawa *et al*. (1979), while total protein was quantified using commercially available diagnostic kits and the biuret method as per the protocol outlined by Zheng *et al.*,(2017). In accordance with the protocol described by Tothova *et al.,* (2019), an automated electrophoresis system was employed to separate serum protein fractions by zone electrophoresis on an agarose gel. The Enzyme-linked immunosorbent assay (ELISA) technique, as outlined by Engvall and Perlmann (1971) was used to determine the levels of serum IgG and IgM.

Evaluation of immune status:

The phagocytosis test was accomplished following Bos and de Souza (2000).

Phagocytic activity (PA) is the proportion of phagocytic cells that have engulfed Candida albicans yeast cells, expressed as a percentage. On the other hand, the phagocytic index (PI) is determined by taking the ratio of the number of yeast cells that have been phagocytized to the number of macrophage phagocytic cells. Serum samples were obtained at 1st day after administration and at 1st and 2nd post administration of Newcastle and Gumboro vaccinations and at the end of the experiment. The lytic activity of lysozyme against the cell wall of Micrococcus lysodeikticus was used as a substrate in the lysozyme assay (LA) method. To conduct the assay, an agarose gel plate lyses method was employed, following the protocol outlined by Peeters and Vantrappen (1977).The lysozyme concentration was determined by generating a logarithmic curve with a standard lysozyme solution. Nitric oxide(NO) assay was accomplished in accordance with Sun *et al*., (2003) using Griess reaction assay after removing protein via mixture of $ZnSO_4$ and NaOH. The absorbance at 540 nm exhibits a linear correlation with the concentration of NO present in the sample.

Carcass characteristics:

At the end of the experiment, twenty birds were randomly chosen from each group (with 5 birds per replicate) and prepared for slaughter. The birds were fasted for 12 hours prior to slaughter and were then slaughtered by bleeding the jugular vein. Once slaughtered, the birds were defeathered and eviscerated. Heart, liver, spleen, thymus, bursa, gizzard, and abdominal fat were removed and weighed to the nearest 0.01 g on a digital scale. After the shanks, head, and offal were removed, the remaining carcass was weighed to obtain the weight of the ready-to-cook carcass. Using this weight, the carcass dressing yield percentage (dressing %) was then calculated according to Rosa *et al* (2007) as follows:

Dressing % = Carcass weight/ Live weight X100

Statistical analysis:

To analyze the data, IBM SPSS® version 19 software was utilized on a personal computer (2010). The mean ± SD were compared with a one-way ANOVA test, with a significance level of $P<0.05$, and the Post Hoc Duncan test was applied, following Snedecor and Cochran (1986).

Antibody titres against Newcastle (NDV) using Hemagglutination inhibition (HI) test according on days 21 and 35, six broilers from each treatment (one broiler per pen) were randomly selected for hemagglutination inhibition (HI) antibody titer. Blood samples (2 ml per broilers) were drawn from the brachial vein into non-heparinized vacuum tubes (Becton Dickinson Vacutainer Systems, Franklin Lakes) and allowed to clot at 4°C for 2 hr. The serum was separated by centrifugation at 3,000g for 15 min, and stored at −20°C for HI anti-body assay. Briefly, after the serum was inactivated at 56°C for 30 min, twofold serial dilution were made in a 96-well V-shaped bottom microtitre plate containing 50 µl of CMF-PBS in each well then 50 µl of NDV antigen (4 HA units) was added into all the wells except the last row as the controls. Serum dilutions ranged from 1:21 to 1:212. The plate was incubated at 37°C for 10 min, then 50 µl of 1% rooster erythrocytes suspension was added to each well and incubated for 30 min. A positive serum, a negative serum, erythrocytes and antigens were also included as controls. The last wells which caused complete inhibition was considered as the endpoint. The geometric mean titer was expressed as reciprocal log 2 values of the last dilution that dislead HI.

RESULTS

Effect on growth performance:

Table 1 shows that supplementation of basal diet with SB and OV and in combination, increased BWG and improved feed conversion ratio on day 35 of age of broiler chickens.

Table (1): Effect of Sodium butyrate and/ or *Origanium vulgare* on growth performance:

Parameters	G1	G2	G3	G4	G5
Initial body weight at day 28 (g/bird)	1395.13 0.12^{a}	1411.11 ±0.12^{c}	1408.11 ±0.12^{c}	1419.31 ±0.18^{b}	1418.91 ±0.15^{b}
Final Body weight at day 35 (g/bird)	1999.38 ±0.68^{a}	2079.58 ±0.53^{c}	2063.37 ±0.55^{c}	2186.85 ±0.61^{b}	2111.17 ±0.62^{b}
Weight gain (g/bird)	604.25 ±0.15^{a}	668.47 ±0.18^{c}	665.26 ±0.15^{c}	767.54 ±0.22^{c}	775.26 ±0.21^{b}
Feed intake (FI) (g/bird)	986.80 ±0.45^{a}	1049.50 ±0.60^{d}	1035.31 ±0.60^{d}	1189.69 ±0.55^{c}	1195.77 ±0.58^{b}
Feed conversion ratio (FCR)	1.63	1.57	1.57	1.55	1.54

Means ±SD in each row with different superscript letters are significantly different at P<0.05
G1= Basal diet (BD)
G2= BD supplemented with 500 g/ton of Sodium butyrate (SB)
G3= BD supplemented with 500 g/ton of Origanium vulgare (OV)
G4= BD supplemented with 250 g/ton of SB plus OV
G5= BD supplemented with 250 g/ton of SB plus OV
FCR (feed conversion ratio) =Feed intake (g/bird) / weight gain (g/bird)

Effect on biochemical profile:

Supplementation of basal diet with SB and OV alone and in combination significantly decreased AST, ALT, TC and TG in broiler chickens (Table 2).

Table (2): Impact of sodium butyrate and/or *Origanium vulgare* on serum AST and ALT activities, TC and TG levels:

Parameters Groups	AST (U/L)	ALT (U/L)	TC (mg/dL)	TG (mg/dL)

G1	211.0 ± 3.31[a]	3.43 ± 0.03[a]	128.6 ± 3.02[a]	59.4 ± 1.01[a]
G2	200.0 ± 2.37[b]	2.63 ± 0.06[b]	117.8 ± 3.00[b]	57.0 ± 1.16[b]
G3	189.0 ± 3.17[c]	2.01 ± 0.02[c]	112.0 ± 3.00[c]	53.0 ± 1.15[c]
G4	188.0 ± 2 .11[c]	2.00 ± 0.02[c]	105.0 ± 2.10[d]	52.0 ± 1.14[c]
G5	174.0 ± 1.17[d]	1.80 ± 0.01[d]	100.0 ± 2.10[e]	48.5 ± 1.10[d]

Means ± SD in each column with different superscript letters are significant at P ≤0.05.

G1 = Basal diet (BD)
G2= BD containing 500 g/ton of Sodium butyrate (SB)
G3= BD containing 500 g/ton of *Origanium vulgare* (OV)
G4= BD containing 250 g/ton of SB plus OV
G5= BD containing 500 g/ton of SB plus OV

Our results indicated that addition of sodium butyrate and *Origanium vulgar* alone or in a mixture, to the broilers' basal diet caused significant improvements in serum levels of SOD and CAT antioxidant enzymes (Table 3).

Table (3) Impact of sodium butyrate (SB) and *Origanium vulgare* (OV) alone and in combination on serum superoxide dismutase (SOD) and catalase (CAT) antioxidant enzymes levels on day 35 of age of broiler chickens:

Parameters Groups	SOD (U/mL)	CAT (U/mL)
G1	780 ± 2.6[e]	4.4 ± 0.01[e]
G2	792 ± 3.1[d]	4.7± 0.01[d]
G3	795 ± 1.7[c]	5.6± 0.02[c]
G4	810 ± 2.2[b]	5.9 ± 0.01[b]
G5	830 ± 3.1[a]	6.1± 0.02[a]

Mean ± SD in each column with different superscript letters are significant at P ≤0.05.

G1 = Basal diet (BD)
G2= BD containing 500 g/ton of Sodium butyrate (SB)
G3= BD containing 500 g/ton of *Origanium vulgare* (OV)
G4= BD containing 250 g/ton of SB plus OV
G5= BD containing 500 g/ton of SB plus OV

Supplementation of basal diet with sodium butyrate (500 g/ton feed) and *Origanium vulgare* (500 g/ton feed) alone or in combination significantly decrease serum malondialdehyde (MDA) on day 35 of broiler age as illustrated in Fig. (1).

Supplementation of basal diet with sodium butyrate (500 g/ton feed) and *Origanium*

vulgare (500 g/ton feed) alone or in combination significantly increased albumin (Alb), total proteins (TP), globulin (Glb) and albumin/globulin ratio on day 35 of age of broiler chickens as shown in Table (4).

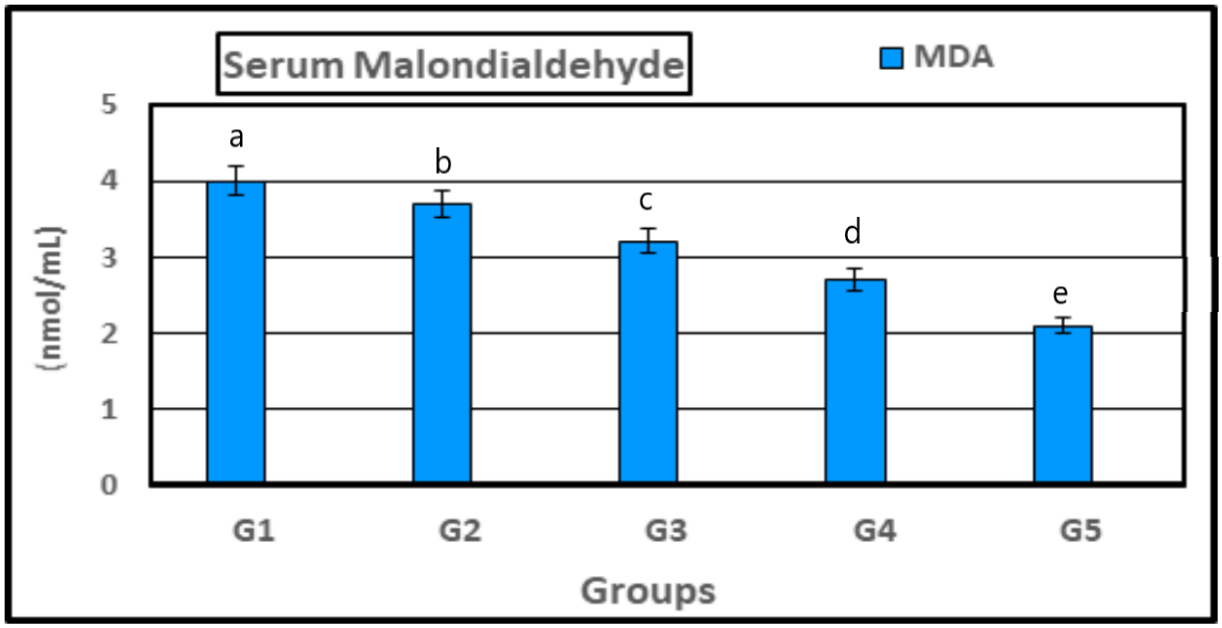

Fig (1): Effect of sodium butyrate (SB) and *Origanium vulgare* (OV) alone and in combination on serum level of malondialdehyde (MDA) in broiler chickens.

Table (4): Effect of sodium butyrate (SB) and *Origanium vulgare* (OV) alone and in combination on serum concentrations of total proteins (TP), albumin (Alb), globulin (Glb) and albumin/globulin ratio in serum of broilers on day 35 of age of broiler chickens.

Parameters Groups	TP (g/mL)	Alb (g/mL)	Glb (g/mL)	Alb/Glb Ratio
G1	32.2± 1.08^{d}	13.0 ± 0.9^{d}	20.2± 0.9^{d}	0.643
G2	34.1 ± 0.53^{c}	15.9 ± 0.3^{c}	23.1± 0.7^{c}	0.688
G3	38.8± 0.23^{b}	19.0 ± 0.4^{b}	27.2± 0.6^{b}	0.698
G4	39.4± 0.23^{b}	20.5 ± 0.2^{b}	28.2± 0.5^{b}	0.726
G5	41.1 ± 1.06^{a}	24.4 ± 0.3^{a}	32.5± 0.3^{a}	0.750

Mean± SD in each column with non-similar superscript letters are significant at $P \leq 0.05$.

G1 = Basal diet (BD)

G2= BD containing 500 g/ton of Sodium butyrate (SB)

G3= BD containing 500 g/ton of *Origanium vulgare* (OV)

G4= BD containing 250g/ton of SB plus OV
G5= BD containing 500 g/ton of SB plus OV

As demonstrated in Fig (2), addition of sodium butyrate (SB) and *Origanium vulgare* (OV) alone and in combination caused an elevation in serum immunoglobulins IgG and IgM concentrations in broiler chickens on day 35 of age.

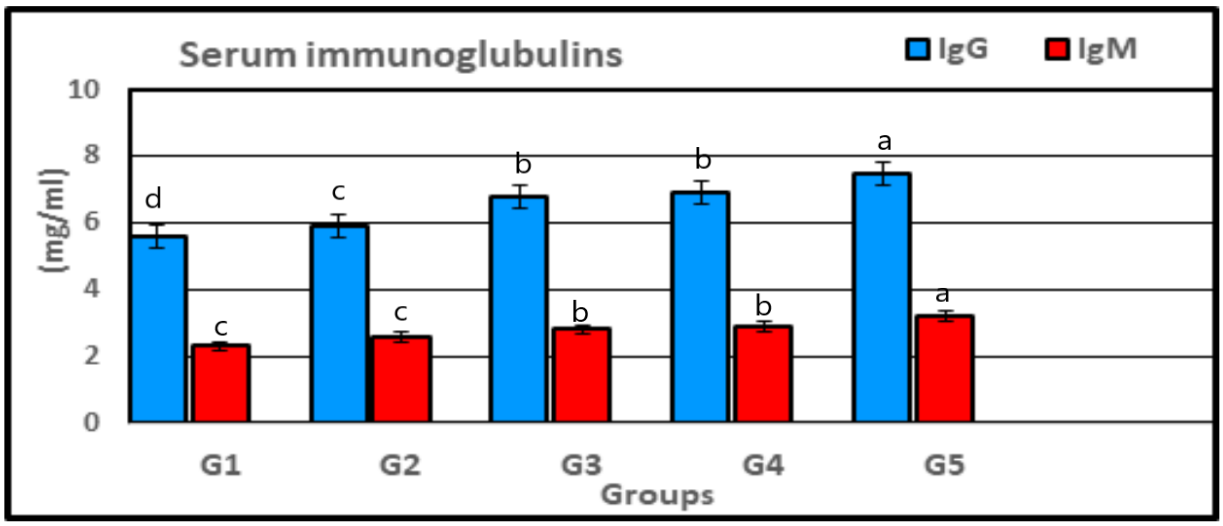

Fig (2): Effect of sodium butyrate (SB) and *Origanium vulgare* (OV) alone and in combination on serum concentration of immunoglobulins IgG and IgM on day 35 of age of broiler chickens.

As demonstrated in Table (5), addition of sodium butyrate (SB) and *Origanium vulgare* (OV) alone and in combination resulted in an increased immunity parameters phagocytic activity (PA), phagocytic index (PI), lysozyme activity (LA) and nitric oxide (NO) concentration in broiler chickens.

Table (5): Effect of sodium butyrate (SB) and *Origanium vulgare* (OV) alone or in a mixture on phagocytic activity (PA), phagocytic index (PI), lysozyme activity (LA) and nitric oxide (NO) concentration on day 35 of age of broiler chickens.

Parameters Groups	PA (%)	PI (%)	LA (µg / ml)	NO (µM)
G1	17.2 ± 0.05^{d}	55.3 ± 1.5^{d}	240.3 ± 4.5^{d}	66.7 ± 1.4^{d}
G2	18.4 ± 0.02^{c}	58.9 ± 1.3^{c}	245.9 ± 33^{c}	69.9 ± 2.3^{c}
G3	19.2 ± 0.04^{b}	60.2 ± 1.4^{b}	258.2 ± 4.4^{b}	$74..2 \pm 1.3^{b}$
G4	20.5 ± 0.06^{b}	61.3 ± 1.6^{b}	259.3 ± 3.6^{b}	75.5 ± 1.6^{b}
G5	22.6 ± 0.09^{a}	62.8 ± 1.4^{a}	262.8 ± 5.4^{a}	78.9 ± 2.4^{a}

Mean ± SD in each column with dissimilar superscript letters are significant at $P \leq 0.05$.

G1 = Basal diet (BD)
G2= BD containing 500 g/ton of Sodium butyrate (SB)
G3= BD containing 500 g/ton of *Origanium vulgare* (OV)
G4= BD containing 250 g/ton of SB plus OV
G5= BD containing 500 g/ton of SB plus OV

As recorded in Table (6) addition of sodium butyrate (SB) and *Origanium vulgare* (OV) alone and in combination resulted in an increase in live weight and carcass weight. The dressing percent (DP %) was 71.5%. There was a significant increase in weights of bursa and a decrease in abdominal fat. Non-significant changes in weights of spleen, thymus, liver, heart, and gizzard were reported.

Carcass traits	G1	G2	G3	G4	G5
Live wt.(g)	1996.21 ±1.20^{a}	2075.24 ±1.70^{c}	2094.51 ±1.80^{c}	2184.21 ±1.10^{b}	2190.68 ±1.85^{b}
Carcass wt. (g)	1427.29 ±1.82^{a}	1483.80 ±1.78^{c}	1497.57 ±1.99^{c}	1561.71 ±1.17^{b}	1577.03 ±1.45^{b}
Dressing (%)	71.5	71.5	71.5	71.5	71.5
Spleen (g)	1.15 ±1.45^{a}	1.20 ±1.35^{a}	1.45 ±1.61^{a}	1.55 ±1.74^{a}	1.55 ±1.52^{a}
Thymus (g)	1.75 ±1.54^{a}	1.82 ±1.14^{a}	1.91 ±1.15^{a}	1.92 ±1.12^{a}	1.94 ±1.13^{a}
Bursa Fabricius (g)	2.55 ±0.12^{d}	2.72 ±0.15^{c}	2.86 ±0.10^{b}	2.88 ±0.10^{b}	2.95 ±0.11^{a}

Table (6): Effect of sodium butyrate (SB) and *Origanium vulgare* (OV) alone and in combination on carcass traits at 35 days of age of broiler chickens. (5 replicates)

Liver (g)	48.28 ±1.83[a]	48.50 ±1.71[a]	48.35 ±1.95[a]	48.15 ±1.35[a]	48.28 ±1.45[a]
Heart (g)	2.35 ±1.62[a]	2.50 ±1.15[a]	2.45 ±1.71[a]	2.65 ±1.14[a]	2.55 ±1.31[a]
Gizzard (g)	4.45 ±1.52[a]	4.50 ±1.84[a]	4.45 ±1.61[a]	4.65 ±1.23[a]	4.55 ±1.10[a]
Abdominal fat (g)	2.21±0.92[a]	1.95±0.29[b]	1.90±0.83[b]	1.85±0.74[c]	1.80±0.63[d]

Mean values ±SE with different letter superscript in each raw are significant at $P \leq 0.05$,

G1 = Basal diet (BD)

G2= BD containing 500 g/ton of Sodium butyrate (SB)

G3= BD containing 500 g/ton of *Origanium vulgare* (OV)

G4= BD containing 250g/ton of SB plus OV

G5= BD containing 500 g/ton of SB plus OV

DP= Dressing percent,

Dressing % = Carcass weight /Live weight X 100

DISSCUSION:

In the present study, effects of feed additives sodium butyrate (SB) and *Origanium vulgare* (OV) separately or combined on growth performance, serum biochemical indexes, immune status and carcass traits of broiler chickens were evaluated.

Our findings showed that supplementing basal diet with SB and OV alone and in combination led to significant improvements in BWG and FCR in broiler chickens at 35 days of age. These findings agreed with those of Abd El-Ghaney (2017); Alagawany *et al*. (2018); Lan *et al.* (2020); Alagawany *et al.* (2021) and Fathi *et al*. (2023). The previous studies specified that addition of SB and OV improved the growth performance. Moreover, other phytogenic feed additives, vitamins, and minerals when added to basal diets, produced excellent growth promoting effects in animals and broiler chickens. However, Wang *et al.* (2017) mentioned that nutrition is a crucial factor in preserving the broiler health, ensuring high-quality eggs in laying hens and body growth and immune status of broilers.

The current results indicated that supplementation of basal diet with SB and OV alone and in combination significantly lowered serum liver enzymes AST and ALT activities and TC, TG and MDA levels. It significantly increased serum activities of SOD and CAT of broilers on day 35 of age. These outcomes were partly consistent with the results reported by Sikandar *et al*. (2017); Ri *et al.* (2017); Alagawany *et al.* (2018); Lan *et al*. (2020) and Zhang *et al*. (2021).

The obtained results indicated that supplementation of basal diet SB and OV alone and in combination led to decreased TC and TG levels and mitigated lipid

peroxidation and oxidative stress as it lowered MDA level and increased SOD and CAT activities (Ri *et al.,* 2017 and Lan *et al*., 2020). However, Parvizi *et al*., (2020) and Zaazaa *et al*., (2022) concluded that using thyme and Oregano improved biochemical indexes (AST, ALT, TC and TG) of broilers.

Regarding immunity parameters, this study indicated that supplementation of basal diet SB and OV alone or in combination significantly PA, PI, LA, and NO concentration in broiler chickens. These results agreed with Ri *et al*., (2017); Alagawany *et al*., (2018); Lan *et al*., (2020) and Parvizi *et al*., (2020) who discovered that addition of SB and OV alone or in combination to basal diet enhanced immunity in broiler chickens.

Concerning carcass traits, the present results showed that supplementation of basal diet SB and OV alone or in combination significantly improved carcass characteristics. It increased live weight and carcass weight and the dressing % was 71.5%. Consequently they increased the weight of bursa of Fabricius and decreased abdominal fat Non- significant changes in the weight of other organs and were reported. These results agreed with those of Alagawany *et al*. (2018); Lan *et al*. (2020) and Parvizi *et al*. (2020) who found that SB and OV alone and in combination resulted in a good carcass traits of broiler chickens.

CONCLUSION

It could be concluded that supplementation of basal diet with sodium butyrate (SB) and *Origanium vulgare* (OV) alone and in combination can be used as a useful and effective strategy for enhancing growth performance and biochemical parameters and enhance immune status and improve carcass traits of broiler chickens. It has hepatoprotective, antioxidant and immunostimulant effects. The mechanisms of action underlying these effects require further study in broiler chickens.

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