EXPERIMENTAL EVALUATION OF USING SOME ORGANIC ACIDS AGAINST SALMONELLA INFECTION IN BROILER CHICKENS

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ABSTRACT

A total 110 one-day-old chicks were used in this study to investigate antibacterial effects of organic acid (formic and propionic acid) either alone or together against *Salmonella pullorum* (*Sal. pullorum*). 10 chicks were slaughtered and examined bacteriologically to prove that chicks free from salmonella, the remainder 100 broiler chicks were divided into 5 groups (20 chicks/each), 1st group healthy chicks (negative control). At 14th day of age broilers in group 2nd, 3rd, 4th and 5th experimentally infected with *Sal. pullorum*, 2nd group infected chicks (positive control), 3rd group chicks received 0.1 ml formic acid/liter drinking water from 1st to 35th day of age and infected with *Sal. pullorum*, 4th group chicks received 0.1 ml propionic acid/liter drinking water from 1st to 35th day of age and infected with *Sal. pullorum*, 5th group received formic acid and propionic by same dose, period and route of infection with *Sal. pullorum*. At 1st day post supplementation 5 chicks from each group were slaughtered and two blood samples were taken for estimation of hematobiochemical parameters. Cloacal swabs were collected for salmonella reisolation. Infected broilers showed clinical signs represented by anorexia, closed eyes diarrhea, dehydration, mortality rate 30% and reduction in body weight gain, RBCs, Hb, PCV%, MCHC, lymphocytes total protein, albumin, CAT and SOD beside significant increase in FCR, MCV, MCH, WBCs, heterophil, monocyte globulin, ALT, AST, ALP, uric acid creatinine and MDA, associated with insignificant decrease in eosinophil and basophil. Broilers received formic acid or propionic acid either alone or together for 35 days and infected with *Sal. pullorum* showed no clinical signs, insignificant decrease in RBCs, Hb, PCV%, MCHC, lymphocyte eosinophil, T. protein, albumin, A/G ratio, CAT, SOD and insignificant increase in weight gain, MCV, MCH, WBCs, heterophil, basophil, monocyte globulin, ALT AST, ALP, uric acid, creatinine and MDA, improved FCR, reduced mortality rate to 5% but both acids together induced zero mortality beside reduction in re-isolation of *Sal. pullorum*. It could be concluded that, formic and propionic acid play an important role in control of salmonellosis in broiler and act as growth promoters beside improved hematobiochemical parameters so we recommend using formic acid and propionic acid allover fattening period.

Keyword: *Sal. Pullorum*-formic - propionic-hematobiochemical – broiler chickens

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**INTRODUCTION**
Chicken meat is considered one of the most desirable meats all over the world (Karine, 2002). Control of broilers diseases leading to increase poultry production (Hassan et al., 2010). *Salmonella* in poultry inducing many diseases (pullorum, typhoid & paratyphoid) (Tatiane et al., 2013). *Salmonella* is a bacterial pathogen caused enteritis and high mortality (Kee et al., 2015). Salmonella is transmittal by vertical and horizontal (Eriksson et al., 2018). Pullorum disease is septicaemic disease in poultry mostly infects young chicks (Marwa et al., 2021).

Antibiotic growth promoters induce antibiotic resistant strains of bacteria has compelled the researchers to use other non-therapeutic alternatives like organic acids as feed additives in poultry production (Gunal et al., 2006). Organic acids are used as growth promoters and stimulate growth performance in poultry (Dibner, 2004). Organic acids have antimicrobial benefits (Hajati, 2018). Organic acids to date has focused on food safety aspects due to lowering incidence of foodborne pathogens in poultry and other livestock (Oakley et al., 2014). Organic acids continue to receive considerable attention as feed additives for animal and poultry production and poultry because organic acids inhibit growth of bacteria (Pande and Akoh 2010). It has an antimicrobial action in gastrointestinal tract of animal (Nour et al., 2011) and lowering pathogenic bacteria in intestine (Artur et al., 2020). Formic acid induce reduction in *Sal* spp. in feed and potentially in gastrointestinal tract (Ricke et al., 2020).

The present study was carried out to evaluate the efficacy of formic and propionic acid either alone or together for control Salmonellosis in broiler chickens, with regard to its effects in some blood constituents in broiler chickens.

**MATERIALS AND METHODS**

**Experimental chicks:**

About 110 one day old chicks, the average body weight 45.22-48.10 gm body weight were used in this study. Ten chicks were slaughtered and examined bacteriological to prove chicks free from *salmonella*. Chicks reared under hygienic condition, fed balanced starter fresh ration free from any medications and given water ad-libitum.

**Salmonella pullorum titration**

At 14th day of age 80 broilers were infected by *Sal pullorum* (1x10^6CFU via crop) (Corrier et al., 1990) (*Sal pullorum* obtained from Fac.of Vet. Med Zag Univ).

**Experimental design:**

At 14 day of age, 100 broilers were divided into 5 groups (20/each), 1st group healthy chicks (negative control), 2nd group infected chicks with *Sal. pullorum*. (positive control), 3rd group chicks received 0.1 ml formic acid/liter drinking water from 1st to 35th day of age and at 14 day of age infected with *Sal. pullorum*, 4th group chicks received 0.1 ml propionic acid / liter drinking water from 1st to 35th day of age and at 14 day of age infected with *Sal. pullorum*, 5th group received formic and propionic acid together by same dose for each type, period and infected with *Sal. pullorum*.

**Body weight** Chicks were individually weighed at 14th day of age and at 36th day of age for determination body performance.

Blood samples two blood samples were collected from 5 chicks from each group at 1st day post supplementation. 1st sample was taken in test tube contain EDTA for estimation blood picture (Jain, 1986), 2nd sample was taken for obtain serum for estimation AST and ALT (Reitman and Frankel 1957), ALP (John 1982), T. protein (Doumas et al., 1981) albumin (Doumas, 1971), uric acid (Trinder, 1969) Creatinine (Bartels 1971) SOD (Nishikimi et al., 1972), CAT (Sinha, 1972), MDA (Nielsen et al., 1997)
Salmonella reisolation
Cloacal swabs were taken from all chicks under aseptic condition, inoculated into Selenite F broth, then incubated at 37°C for 24h. in Mac Conkey's agar media incubated at 37°C for 24-48h. Positive plates give pale colony (Waltman et al., 1991). Suspected colony was identified morphologically and biochemically (Cheesbrough, 1985).

Statistical analysis was performed using analysis of variance (ANOVA). Duncan's Multiple Range (Duncan, 1955)

RESULTS
Infected broilers with Sal. pullorum showed clinical signs represented by anorexia, closed eyes, diarrhea, dehydration, mortality rate 30%, reduction in body weight gain, RBCs, Hb, PCV% MCHC, lymphocytes, total protein, albumin, CAT, SOD and significant increase in FCR, MCV, MCH, WBCs, heterophil monocyte globulin, ALT, AST, ALP, uric acid creatinine, MDA beside insignificant decrease in eosinophil and basophil (Tables 1-5).

healthy broilers received formic acid or propionic acid either alone or together for 35 days and infected with Sal. pullorum showed no clinical signs, insignificant decrease in RBCs, Hb, PCV%, MCHC, lymphocyte eosinophil, T. protein, albumin, A/G ratio, CAT, SOD and insignificant increase in weight gain, MCV, MCH, WBCs, heterophil, basophil, monocyte globulin, ALT AST, ALP, uric acid, creatinine and MDA, improved FCR, reduced mortality rate to 5% but both acids together induced zero mortality beside reduction in reisolation of sal. pullorum (Table 1-5).

Table 1: Effect of salmonellosis on mortality rate and reisolated salmonella of chicks.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>total</th>
<th>Mortality rate</th>
<th>Reisolated Salmonella at 1st day post</th>
<th>supplementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groups</td>
<td>number</td>
<td>No</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Gp (1)</td>
<td>20</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Gp (2)</td>
<td>20</td>
<td>6</td>
<td>30</td>
<td>14/14</td>
</tr>
<tr>
<td>Gp (3)</td>
<td>20</td>
<td>1</td>
<td>5</td>
<td>4/19</td>
</tr>
<tr>
<td>Gp (4)</td>
<td>20</td>
<td>1</td>
<td>5</td>
<td>4/19</td>
</tr>
<tr>
<td>Gp (5)</td>
<td>20</td>
<td>0</td>
<td>0</td>
<td>1/20</td>
</tr>
</tbody>
</table>

Table 2: Effect of organic acid and Sal Pullorum on body performance of broiler (n= 5).

<table>
<thead>
<tr>
<th>Parameters</th>
<th>IW(14th day of age) (gm)</th>
<th>FBW (36th day of age) (gm)</th>
<th>Weight gain (gm)</th>
<th>FC</th>
<th>FCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gp (1)</td>
<td>582.31±1.64a</td>
<td>2190.09±4.27a</td>
<td>1607.78±5.16a</td>
<td>2017.03</td>
<td>1.26</td>
</tr>
<tr>
<td>Gp (2)</td>
<td>577.89±1.84a</td>
<td>1998.58±9.49b</td>
<td>1420.69±6.89b</td>
<td>1899.40</td>
<td>1.34</td>
</tr>
<tr>
<td>Gp (3)</td>
<td>581.44±1.88a</td>
<td>2178.76±9.87a</td>
<td>1597.32±8.63a</td>
<td>2036.64</td>
<td>1.28</td>
</tr>
<tr>
<td>Gp (4)</td>
<td>591.06±1.79a</td>
<td>2178.43±9.48a</td>
<td>1587.37±8.30a</td>
<td>2014.54</td>
<td>1.27</td>
</tr>
<tr>
<td>Gp (5)</td>
<td>584.18±1.63a</td>
<td>2181.55±9.72a</td>
<td>1597.37±8.86a</td>
<td>1969.21</td>
<td>1.23</td>
</tr>
</tbody>
</table>

Initial weight=IW  final body weight=FBW  feed consumption=FC  feed conversion rate=FCR
Means with different superscripts of same column indicate significant difference at P< 0.05
Table 3: Effect of organic acid and *Sal. pullorum* on blood picture of broiler (N=5).

<table>
<thead>
<tr>
<th>Group</th>
<th>Gp(1)</th>
<th>Gp(2)</th>
<th>Gp(3)</th>
<th>Gp(4)</th>
<th>Gp(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RBCs</td>
<td>10^9/mm³</td>
<td>4.17±0.21a</td>
<td>3.12±0.18b</td>
<td>4.05±0.21a</td>
<td>4.18±0.30a</td>
</tr>
<tr>
<td>Hb gm/dl</td>
<td>13.14±0.3a</td>
<td>9.78±0.64b</td>
<td>12.89±0.28a</td>
<td>12.94±0.32a</td>
<td>13.05±0.41a</td>
</tr>
<tr>
<td>PCV (%)</td>
<td>28.21±0.24</td>
<td>25.97±0.6b</td>
<td>27.96±0.42a</td>
<td>27.97±0.36a</td>
<td>28.02±0.27a</td>
</tr>
<tr>
<td>Blood indices</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MCV (fL)</td>
<td>31.14±1.6a</td>
<td>31.35±1.93a</td>
<td>31.82±1.46a</td>
<td>31.82±1.46a</td>
<td>31.91±1.43a</td>
</tr>
<tr>
<td>MCHC (g/L)</td>
<td>67.21±1.43b</td>
<td>83.24±1.42a</td>
<td>69.04±1.54b</td>
<td>68.84±1.55b</td>
<td>68.63±1.9b</td>
</tr>
</tbody>
</table>

Means with different superscripts of the same column indicate significant difference at P < 0.05

Table 4: Effect of organic acid and *Sal. pullorum* on liver function of broiler (N =5).

<table>
<thead>
<tr>
<th>Group</th>
<th>Gp(1)</th>
<th>Gp(2)</th>
<th>Gp(3)</th>
<th>Gp(4)</th>
<th>Gp(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein profile (gm/dl)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T protein</td>
<td>5.73±0.27a</td>
<td>4.93±0.17b</td>
<td>5.61±0.21a</td>
<td>5.70±0.17a</td>
<td>5.69±0.19a</td>
</tr>
<tr>
<td>Albumin</td>
<td>3.03±0.17a</td>
<td>2.08±0.30b</td>
<td>2.91±0.16a</td>
<td>2.96±0.18a</td>
<td>2.96±0.18a</td>
</tr>
<tr>
<td>Globulin</td>
<td>2.70±0.11a</td>
<td>2.85±0.12b</td>
<td>2.70±0.14a</td>
<td>2.74±0.13a</td>
<td>2.74±0.14a</td>
</tr>
<tr>
<td>A/G ratio</td>
<td>1.12±0.19a</td>
<td>0.73±0.08b</td>
<td>1.12±0.14a</td>
<td>1.09±0.17a</td>
<td>1.08±0.19a</td>
</tr>
<tr>
<td>Liver enzymes (U/L)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AST</td>
<td>47.71±0.48a</td>
<td>49.88±0.28b</td>
<td>48.14±0.21a</td>
<td>48.06±0.16a</td>
<td>47.85±0.4a</td>
</tr>
<tr>
<td>ALT</td>
<td>36.12±0.59a</td>
<td>38.51±0.26b</td>
<td>37.01±0.41a</td>
<td>36.71±0.42a</td>
<td>36.62±0.2a</td>
</tr>
<tr>
<td>ALP</td>
<td>33.42±0.53a</td>
<td>36.31±0.64b</td>
<td>34.36±0.44a</td>
<td>33.71±0.21a</td>
<td>343.7±0.23a</td>
</tr>
</tbody>
</table>

Means with different superscripts of the same column indicate significant difference at P < 0.05

Table 5: Effect of organic acid and *Sal. pullorum* on MDA, SOD & CAT of broiler (N =5).

<table>
<thead>
<tr>
<th>Group</th>
<th>Gp(1)</th>
<th>Gp(2)</th>
<th>Gp(3)</th>
<th>Gp(4)</th>
<th>Gp(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>kidney mog/dL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uric acid</td>
<td>5.57±0.33a</td>
<td>7.02±0.36b</td>
<td>5.76±0.41a</td>
<td>5.79±0.32a</td>
<td>5.66±0.31a</td>
</tr>
<tr>
<td>Creatinin</td>
<td>1.53±0.15a</td>
<td>2.09±0.13b</td>
<td>1.62±0.19a</td>
<td>1.63±0.22a</td>
<td>1.65±0.25a</td>
</tr>
<tr>
<td>MDA (mmol/ml)</td>
<td>20.52±0.89b</td>
<td>29.17±1.12a</td>
<td>23.19±0.68b</td>
<td>23.08±0.89b</td>
<td>21.32±0.76b</td>
</tr>
<tr>
<td>Antioxidant (U/mL)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAT</td>
<td>56.17±1.62a</td>
<td>46.43±1.23b</td>
<td>52.28±1.08a</td>
<td>51.97±1.15a</td>
<td>53.21±1.05a</td>
</tr>
<tr>
<td>SOD</td>
<td>179.17±1.8a</td>
<td>165.38±1.3b</td>
<td>175.05±1.2a</td>
<td>174.32±1.4a</td>
<td>176.19±1.2a</td>
</tr>
</tbody>
</table>

Means with different superscripts of the same column indicate significant difference at P < 0.05

DISCUSSION

In the present study, the main clinical signs appeared on broiler chickens infected with *Sal. pullorum* were ruffled feather, emaciation, droopy wings, anoxia, diarrhea, dehydration, decreased body weight and mortality rate was 30 % beside reduction in body weight gain and increase FCR (table 1 and 2). Reduction in body weight due to deleterious effect of *Sal. pullorum* in intestinal tract (Shivaprasad, 2000). Typical clinical signs and reduction in body performance of Salmonellosis were recorded by Elsam (2000) in broilers and Garcia et al. (2010) in layers infected with *Sal. pullorum*. Broilers suffering from ruffled feathers, dullness, droppings, huddled together, white diarrhea, loss of appetite and mortality rate 24.4% (Gemechu and Abdisa 2021).
Our obtained results revealed that infected broilers received formic acid or propionic acid either alone or together from 1st to 35th day of age showed no clinical signs with significant increase in weight gain, improved FCR and reduced mortality rate to 5% but combination of both acids induced zero mortality beside reduction in reisolation of *Sal pullorum* (table 1 and 2). Similar results were agreed with (Al shawabkeh and Tabbba 2002) reported that broilers received propionic acid improved body performance and reduced intestinal *Salmonella* colonization. Formic acid decreased salmonella in intestinal tract in broilers (Bourassa et al., 2018 and Ricke et al., 2020). Dietary formic acid and propionic acid lowered *Sal. pullorum* in intestine and reduced mortality rate (Al-Tarazi and Alshawabkeh, 2003). Reduced shedding of *salmonella* in poultry received organic acid may be due to penetration of organic acids bacterial cell wall and disrupt the normal physiology of bacteria (Dhawale, 2005). Same results were reported by Cengiz et al. (2012) stated that broilers received formic acid-propionic acid mixture not isolate *Salmonella* from caecal contents. Organic acids reduced pH and dissociation capacity of their carboxyl groups so gut environment is acidic and prevent growth pathogenic bacteria (Ganguly, 2013). Also, Marin et al. (2014) stated that organic acids improve feeding efficiency and reduce mortality due to the reduced toxin excretion by bacteria and colonization of pathogens on intestine. Broilers received organic acids in diets decreased *salmonella* in intestine and improved body performance (Ghazvinian et al., 2019).

Hematological parameters in broilers suffering from salmonellosis revealed significant decrease in RBCs, Hb, PCV%, MCHC, lymphocyte and increase in MCV, MCH, WBCs, heterophil, monocyte beside insignificant decrease in eosinophil and basophil (table 3). Change in blood picture may be due to bacterial toxins cause intravascular destruction of RBCs in body leading to haemolysis with breakdown of hemoglobin (Karaivanov, 1984). Leukocytosis in infected broiler may be due to inflammatory response in intestinal tract (Kaneko, 1989). Also, Shand ah et al. (2013) stated that salmonellosis induced reduction in RBCs, Hb, PCV% and increase in WBCs. Our results were in agreement with El Sayed et al. (2014) in broilers suffering from salmonellosis. Salmonellosis induced acute anaemia, leukocytosis, heterophilia, lymphopenia (Ahmed and Mahmoud 2014).

Our results revealed that, infected broilers received formic acid or propionic acid either alone or together from 1st to 35th day of age showed insignificant decrease in RBCs Hb PCV%, MCHC, lymphocyte, eosinophil beside insignificant increase in MCV, MCH, WBCs, heterophil, basophil and monocyte (table 3). Similar result was observed by Talebi et al. (2005) stated that organic acid induced increase in RBCs, Hb, PCV % and WBCs count. Organic acid induced leukocytosis in broilers (Sabry et al., 2016).

Salmonellosis in broilers revealed significant decrease in serum total protein, albumin, A/G ratio beside increase in globulin, ALT, AST, ALP (table 4). Reduction in total protein and albumin in infected chicks with *Sal Pullorum* may be due to a state of anorexia and male absorption of nutrients from inflamed intestine leading to inability of liver to synthesis albumin (Kaneko, 1980). Decrease in serum albumin beside increase AST, ALT and ALP in broiler infected with *Sal pullorum* may be due to destruction liver cells by bacterial toxin (Macpherson, 1986). *Salmonella* toxins induce liver cell damage and liberation of liver enzymes lead to increase in liver enzymes (Doxy, 1983). Elevation in globulin may be due to antigenic stimulation of infectious agent (Azza et al., 2012). Also Ahmed and Mahmoud (2014) stated salmonellosis in broilers induce significant reduction in total protein and albumin beside increase in globulin, ALT, AST and ALP. *Sal pullorum* induced significant decrease in serum total protein, albumin and A/G ratio associated with increase on serum globulin (Belih et al.,
Salmonellosis induces decrease in liver enzyme and increase in globulin, ALT, AST, ALP (Belih et al., 2017).

Broilers received formic acid or propionic acid either alone or together from 1st to 35th day of age and at 14th day of age artificially infected with sal. pullorum showed insignificant decrease in total protein, albumin, A/G ratio and insignificant increase in globulin, AST, ALT, ALP (table 4). Organic acids reduced salmonella colonization in intestine and improved absorption of nutrient beside improvement of protein picture and liver enzymes (Coax et al., 1994). Also, Van Immerseel et al. (2002) stated that organic acids are used in poultry farms to control salmonellosis beside improved protein picture and liver enzymes. Increase in protein profile in broiler fed organic acid may be due to improvement in intestinal environment leads to an improve digestion and absorption of nutrients with increase amino acids and protein (Samanta et al., 2010). Organic acids induced insignificant increase in AST ALT, ALP, albumin and protein of broilers (Adil et al., 2010). Same results were reported by Ezzat et al. (2015) in broilers received formic acid. Broilers suffering from salmonellosis and received organic acids showed insignificant decrease in total protein, albumin and insignificant increase in globulin, AST ALT and ALP (Jing et al., 2019).

Infected broilers with Sal. Pullorum showed significant increase in uric acid, creatinine, MDA beside significant decrease in CAT and SOD (table 5). Elevation in uric acid and creatinine in broilers suffering from salmonellosis due to kidney damage by salmonella toxins (Doxy, 1983). Salmonellosis induced increase oxidative stress leading to increase in uric acid, creatinine and MDA beside decrease in CAT and SOD (Mine, 2009). In addition, Ismail et al. (2013) mentioned that oxidation induced increase serum uric acid, creatinine, MDA beside significant decrease in CAT and SOD. Salmonellosis induces increase in uric acid and creatinine in broiler (Rauber et al., 2014).

Salmonellosis in broilers induces marked increase in creatinine and uric acid (Ahmed and Mahmoud, 2014). Our finding agreed with Belih et al. (2017) in broilers suffering from salmonellosis. Salmonella infection leads to a significant increase of serum MDA and decreased SOD and CAT (Sokoudjou et al., 2019).

Broilers received formic and propionic acid either alone or together from 1st to 35th day of age and at 14th day of age infected with Sal. pullorum showed insignificant increase in Uric acid and creatinine, MDA beside insignificant decrease in CAT and SOD (table 5). Organic acids in diet reduced salmonllae in hens intestine leading insignificant increase in uric acid and creatinine (Thompson and Hinton 1997). Our data coincide with results of Abdel-Fattah et al. (2008) stated that organic acid induced insignificant increase in uric acid and creatinine in broilers. Organic acids induced insignificant increase in uric acid and creatinine of broilers (Adil et al., 2010). These results agreed with those stated by Abudabos and Al-Mufarrej (2014) stated that organic acids reduced oxidative stress in broilers infected with Salmonella improving serum uric acid and creatinine, MDA, SOD and CAT. Organic acid had positive influence on Salmonella and reduced oxidation stress beside improve serum antioxidant enzymes and MDA (Alaeldein et al., 2017). Propionic acid induces decrease in MDA and increase in CAT and SOD (Huda et al., 2020).

Finally, it could be concluded that, formic and propionic acid play an important role in control salmonellosis in broilers and act as growth promoter beside improved liver and kidney function so we recommend using formic acid and propionic acid alleviate fattening period due to its low side effect and improved feed conversion rate and boy weight.

REFERENCES


Marwa, F.; Amr, A.; Jan, P. and Josef, K. (2021): mitigating the spread and translocation of Salmonella enteritidis in experimentally Infected broilers under the influence of different flooring housing systems and feed particle sizes. Microorganisms 9(1)87-93


The experiment was to use some of the most common results to measure the health of the salmonella in broilers.

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The aim of this study was to compare the effects of different diets on the health of broilers infected with Salmonella. The study was carried out on 110 broiler chickens and 100 control chickens. The results showed that the broilers on the experimental diets had better liver function and lower levels of oxidative stress compared to the control group.

Canarium schwainfurthii Engl. (Burseraceae) is a plant species that has been used in traditional medicine for its antimicrobial and antioxidant properties. The hydroethanolic extract of the plant was tested for its potential to inhibit the growth of Salmonella enterica serovar Typhimurium, a common pathogen associated with poultry. The results showed that the extract had significant antibacterial activity, particularly against the typhoid strain.

The study also investigated the effects of adding the plant extract to broiler diets on liver function and oxidative stress. The results showed that the addition of the extract to the diet improved liver function and reduced oxidative stress markers in the broilers.

The findings of this study suggest that Canarium schwainfurthii Engl. (Burseraceae) could be a potential source of natural antimicrobial and antioxidant compounds for use in poultry production. Further studies are needed to determine the optimal concentration and formulation of the extract for effective use in broiler diets.