Effect of lycopene and vitamin E on hematological parameters, performance, bacterial count and histopathological alterations in *E. coli* infected broilers

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**ABSTRACT**

The present study was conducted to evaluate the effects of lycopene and vitamin E on hematological parameters, performance, bacterial count and histopathological changes in broiler chicks experimentally infected with *E. coli* O78. A total of 120 twenty-one-day old chicks were divided into 6 groups. Group (1): was fed on commercial basal diet without any additives. Group (2): was fed on commercial basal diet plus lycopene (200 mg/kg of diet). Group (3): was fed on commercial basal diet plus vitamin E (200 mg/kg of diet). Group (4): was fed the commercial basal diet and challenged with *E. coli* O78 at 3 weeks old. Group (5): was fed on commercial basal diet plus lycopene and challenged with *E. coli* O78 at 3 weeks. Group (6): was fed on commercial basal diet plus vitamin E and challenged with *E. coli* at 3 weeks. Blood samples were taken for assessing hematological changes. Performance parameters were calculated. Samples from lung and intestine were taken under aseptic conditions for *E. coli* count and other parts of these organs were taken on 10% formalin for histopathological examination. Results revealed macrocytic hypochromic anemia, leukocytosis, heterophilia, lymphocytosis and monocytosis in infected non-treated birds. It had poor performance, high liver and intestinal *E. coli* count and sever histopathological changes in lung and intestine. Treatment with lycopene or vitamin E modulated all of the above-mentioned parameters with more improvement in case of lycopene treatment therefore, they partially protect against the destructive effect of *E. coli* infection.

1. INTRODUCTION

Avian colibacillosis is an infectious disease of birds caused by *E. coli*, which is considered as one of the major causes of morbidity, mortality and heavy economic losses in the poultry industry by its association with various disease conditions, either as primary or as secondary pathogen. Although *E. coli* is a normal inhabitant in the intestinal tract of birds, it is capable of producing disease under effect of predisposing factors like overcrowding, inadequate ventilation, thirst and higher temperature (Kabir, 2010). The infection of chickens with a pathogenic strain of *E. coli* is associated with poor performance in terms of body weight (BWT), body weight gain (BWG) (El-Kilany et al., 2018) and feed conversion ratio (FCR) (Teo and Tan, 2006). Considering the fact that, *E. coli* infections rise the uninvited economic costs in poultry industry and due to the high resistance of bacteria to the antibiotics and other chemical agents, it is rationale to survey the alternative approaches including natural and safe materials to limit these adverse complications (Tabatabaei et al., 2015).

Lycopene (LYC) is a bright red carotenoid pigment present in red fruits and vegetables like tomato and watermelon. It has potent antioxidant, anti-inflammatory, immune-stimulant and anticancer properties (Bayramoglu et al., 2015). LYC exhibits higher singlet oxygen quenching ability compared to β-carotene or α-tocopherol and to act as a potent antioxidant, preventing the oxidative damage of critical biomolecules including lipids, proteins and DNA. This could be attributed to its high number of conjugated double bonds (Palozza et al., 2010).

Vitamin E (VE) is a fat-soluble vitamin with immune-stimulant effects as well as antioxidant properties (Khan et al., 2012). Studies have shown that broiler feed supplemented with VE can prevent losses due to infections by *E. coli* (Konjufca et al., 2004). Consequently, the aim of the present work was to study the modulatory effects of LYC and VE on hematological parameters, performance, bacterial count and histopathological changes in *E. coli* experimentally infected broilers.

2. MATERIAL AND METHODS

2.1. Experimental chicks and treatment:

100 broiler chicks, aged 21 days old and weighted 40-45 gm were used in this study. Chicks were housed in disinfected rooms and were divided into six groups of 20 birds as the following:

Group (1) was fed on commercial basal diet without additives (control negative).

Group (2): was fed on commercial basal diet plus LYC (50 mg LYCOPENE tablets, Purclinica. England) from the first
day at a dose of 200 mg/kg diet (Sahin et al., 2008) till the end of experiment (35 days).

Group (3): was fed on commercial basal diet plus VE (400 mg synthetic VITAMIN E capsules, Pharco Pharmaceuticals. Egypt) daily from the first day till the end of experiment at a dose rate of 200 mg/kg diet (Niu et al., 2009).

Group (4): was fed on commercial basal diet and intramuscularly challenged with 0.3 ml of broth culture containing 3.6x10^8 CFU E. coli O78 for one time (obtained from Bacteriology Department, Animal Health Research Institute) at 3 weeks old (Madian et al., 2008).

Group 5: was fed on commercial basal diet plus LYC and were challenged with 0.3 ml of broth culture for one time at 3 weeks old.

Group 6: was fed on commercial basal diet plus VE and were challenged with 0.3 ml of broth culture for one time at 3 weeks old.

2. Sampling:
Blood samples were collected from wing vein of 5 chicks in each group 4 days and 2 weeks post infection (PI) on EDTA tube for hematological investigations. 5 gm samples from liver and intestine were taken for E. coli count and samples from lung and intestine were taken on 10% formalin for histopathological examination.

3. Hematological studies:
RBCs count, Hb concentration, PCV, Blood indices (MCV, MCH and MCHC), total and differential leukocytic count were determined using Automatic Vet Hematology Analyzer (Sysmex XT 2000 IV Corporation, KOBE, Japan)

4. Estimation of performance parameters:
The live BWT was determined by weighting 5 chicks in each group. The BWG was obtained by subtracting the initial weight from final weight. The feed intake (FI) was record then FCR was calculated (FI/BWG).

5- E. coli count:
Viable cell count was done by plate count method described by Cruickshank et al. (1975).

6- Histopathological examination:
Samples from lung and intestine were immediately taken after scariification of birds (2 weeks PI) and were fixed in 10% neutral buffered formalin to be examined microscopically (Bancroft and Stevens, 1996).

7: Statistical analysis:
Statistical analyses were performed by SPSS 19.0. Chicago. USA. Differences among the control and exposed groups were tested by one-way analysis of variance (ANOVA) followed by Tukey post-hoc test for multiple comparison. All the values were expressed as mean± S.E.

3. RESULTS

3.1. Hematological results:
3.1. Erythrogram:
As shown in table (1) infected non-treated group (group 4) showed a significant decrease in Hb concentration and RBCs count 4 days and 2 weeks PI beside significantly decreased PCV 4 days PI. MCV and MCH revealed significant increases while MCHC revealed a significant decrease 2 weeks PI comparing to control birds reflecting a picture of macrocytic hypochromic anemia. LYC treated E.coli infected group (group 5) showed non-significant changes in all erythrogram parameters except a significant decrease in MCV 4 days and 2 weeks PI when compared to infected non-treated group. All values also not statistically differ from control values. Comparing VE treated E.coli infected group (group 6) to infected non-treated group (group 4) there were non-significant changes in erythrogram except MCV was significantly decreased and MCHC was significantly increased 2 weeks PI (All values not significantly differ from control values except PCV was significantly decreased).

3.1.2. Leukogram
As shown in table (2) LYC treated group (2) displayed a significant increase in leukocytic and lymphocytic count 4 days PI while VE treated group (3) revealed non-significant changes in leukogram comparing to control negative group. On the other hand, E. coli infected non-treated group (group 4) comparing to control group showed a significant increase in TLC and heterophils count 4 days PI while at 2 weeks PI there were a significant monocytosis. LYC treated E.coli infected group (group 5) when compared to infected non-treated group showed a significant decrease in heterophils count 4 days PI but at 2 weeks PI revealed a significant increase in lymphocytic count and a significant decrease in monocytic count. Comparing VE treated E.coli infected group to infected non-treated one there were a significant decrease in heterophils count 4 days PI and a significant decrease in monocytic count 2 weeks PI (all leukogram parameters not significantly differ from control).

2. Performance parameters:
As shown in table (3) LYC treated group revealed a significant increase in BWT, BWG and FCR while VE treated group had non-significant changes in these parameters except slight decrease in FCR comparing to control group. On the other hand, infected non-treated group (group 4) comparing to negative control group had significantly decreased BWT and BWG and significantly increased FCR. LYC and VE treated E. coli infected groups (group 5 and 6) showed significant increases in BWT and BWG as well as significant decreases in FCR when compared to infected non-treated group. LYC treated groups had more improvement in performance than VE treated ones.

3. E. coli count:
Table (4) demonstrated that, LYC treated E. coli infected group (group 5) had significantly decreased liver and intestinal E. coli count as comparing with infected non-treated group (group 4) either at 4 days or 2 weeks PI. On the other hand, VE treated E. coli infected group (group 6) comparing with infected non-treated group showed a significant decrease in liver E. coli count 4 days and 2 weeks PI beside a significant decrease in intestinal count only at 4 days PI. Higher improvement was noticed in LYC treated birds than VE treated ones.
### Table 1 Erythrogram in all groups 4 days and 2 weeks PI

<table>
<thead>
<tr>
<th>Group</th>
<th>Hb (g/dl)</th>
<th>TLC (x10^6/µl)</th>
<th>Heterophil (x10^6/µl)</th>
<th>Lymphocyte (x10^3/µl)</th>
<th>Monoocyte (x10^3/µl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 days PI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>10.4±0.26</td>
<td>3.6±0.14</td>
<td>5.3±0.23</td>
<td>9.3±0.12</td>
<td>18.6±1.14</td>
</tr>
<tr>
<td>LYC treated</td>
<td>10.8±0.32</td>
<td>3.9±0.13</td>
<td>5.8±0.24</td>
<td>10.3±0.12</td>
<td>16.5±0.02</td>
</tr>
<tr>
<td>VE treated</td>
<td>9.4±0.13</td>
<td>3.3±0.12</td>
<td>5.1±0.21</td>
<td>8.1±0.12</td>
<td>14.2±0.01</td>
</tr>
<tr>
<td>Infected</td>
<td>8.2±0.09</td>
<td>2.9±0.08</td>
<td>4.7±0.20</td>
<td>6.7±0.12</td>
<td>12.2±0.00</td>
</tr>
<tr>
<td>LYC + infect</td>
<td>9.6±0.19</td>
<td>2.5±0.08</td>
<td>4.9±0.21</td>
<td>8.2±0.12</td>
<td>15.7±0.00</td>
</tr>
<tr>
<td>VE+ infect</td>
<td>10.5±0.25</td>
<td>3.4±0.13</td>
<td>6.1±0.21</td>
<td>11.3±0.12</td>
<td>21.6±0.01</td>
</tr>
</tbody>
</table>

Means (S.E.) carrying different alphabetic superscripts in the same column are statistically at p≤ 0.05 level.

### Table 2 Leukogram in all groups 4 days and 2 weeks PI (Mean ± SE):

<table>
<thead>
<tr>
<th>Group</th>
<th>Hb (g/dl)</th>
<th>RBCs (x10^12/µl)</th>
<th>PCV %</th>
<th>MCV (FL)</th>
<th>MCH (pg)</th>
<th>MCHC (g/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 days PI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>10.4±0.26</td>
<td>5.8±0.14</td>
<td>3.6±0.23</td>
<td>9.3±0.12</td>
<td>18.6±1.14</td>
<td></td>
</tr>
<tr>
<td>LYC treated</td>
<td>10.8±0.32</td>
<td>3.9±0.13</td>
<td>5.8±0.24</td>
<td>10.3±0.12</td>
<td>16.5±0.02</td>
<td></td>
</tr>
<tr>
<td>VE treated</td>
<td>9.4±0.13</td>
<td>3.3±0.12</td>
<td>5.1±0.21</td>
<td>8.1±0.12</td>
<td>14.2±0.01</td>
<td></td>
</tr>
<tr>
<td>Infected</td>
<td>8.2±0.09</td>
<td>2.9±0.08</td>
<td>4.7±0.20</td>
<td>6.7±0.12</td>
<td>12.2±0.00</td>
<td></td>
</tr>
<tr>
<td>LYC + infect</td>
<td>9.6±0.19</td>
<td>2.5±0.08</td>
<td>4.9±0.21</td>
<td>8.2±0.12</td>
<td>15.7±0.00</td>
<td></td>
</tr>
<tr>
<td>VE+ infect</td>
<td>10.5±0.25</td>
<td>3.4±0.13</td>
<td>6.1±0.21</td>
<td>11.3±0.12</td>
<td>21.6±0.01</td>
<td></td>
</tr>
</tbody>
</table>

Means (S.E.) carrying different alphabetic superscripts in the same column are statistically at p≤ 0.05 level.

### Table 3 Growth performance in all groups at the end of experiment (Mean ± SE):

<table>
<thead>
<tr>
<th>Group</th>
<th>Hb (g/dl)</th>
<th>TLC (x10^6/µl)</th>
<th>Heterophil (x10^6/µl)</th>
<th>Lymphocyte (x10^3/µl)</th>
<th>Monoocyte (x10^3/µl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 days PI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>2.0±0.14</td>
<td>0.2±0.11</td>
<td>1.5±0.11</td>
<td>2.7±0.11</td>
<td>4.2±0.11</td>
</tr>
<tr>
<td>LYC treated</td>
<td>2.9±0.11</td>
<td>0.2±0.06</td>
<td>1.7±0.11</td>
<td>3.1±0.11</td>
<td>5.1±0.11</td>
</tr>
<tr>
<td>VE treated</td>
<td>2.5±0.13</td>
<td>0.2±0.06</td>
<td>1.6±0.11</td>
<td>2.8±0.11</td>
<td>4.2±0.11</td>
</tr>
<tr>
<td>Infected</td>
<td>2.3±0.11</td>
<td>0.2±0.06</td>
<td>1.5±0.11</td>
<td>3.0±0.11</td>
<td>4.2±0.11</td>
</tr>
<tr>
<td>LYC + infect</td>
<td>2.4±0.12</td>
<td>0.2±0.06</td>
<td>1.5±0.11</td>
<td>2.8±0.11</td>
<td>4.2±0.11</td>
</tr>
<tr>
<td>VE+ infect</td>
<td>2.8±0.14</td>
<td>0.2±0.06</td>
<td>1.6±0.11</td>
<td>3.1±0.11</td>
<td>5.1±0.11</td>
</tr>
</tbody>
</table>

Means (S.E.) carrying different alphabetic superscripts in the same column are statistically at p≤ 0.05 level.

### Table 4 Liver and intestinal E. coli count in infected groups 4 days and 2 weeks PI (Mean ± SE):

<table>
<thead>
<tr>
<th>Group</th>
<th>Liver count</th>
<th>Intestinal count</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 days PI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infected</td>
<td>1.04±0.47</td>
<td>3.45±0.04</td>
</tr>
<tr>
<td>LYC + Infect.</td>
<td>5.67±0.04</td>
<td>6.37±0.05</td>
</tr>
<tr>
<td>VE+ Infect</td>
<td>3.38±0.03</td>
<td>3.98±0.02</td>
</tr>
<tr>
<td>2 weeks PI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infected</td>
<td>2.43±0.03</td>
<td>3.55±0.02</td>
</tr>
<tr>
<td>LYC + Infect.</td>
<td>3.11±0.04</td>
<td>3.31±0.02</td>
</tr>
<tr>
<td>VE+ Infect</td>
<td>3.87±0.03</td>
<td>3.98±0.02</td>
</tr>
</tbody>
</table>

Means (S.E.) carrying different alphabetic superscripts in the same column are statistically at p≤ 0.05 level. *E0 means the number multiplied by 10^7.

### Table 5 Growth performance in all groups (Mean ± SE):

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Control</th>
<th>LYC treated</th>
<th>VE treated</th>
<th>Infected</th>
<th>LYC + Infect</th>
<th>VE + Infect</th>
</tr>
</thead>
<tbody>
<tr>
<td>BWG (g)</td>
<td>2080.0±3.01</td>
<td>2448.0±3.17</td>
<td>2200.0±3.15</td>
<td>1600.0±3.75</td>
<td>2100.0±3.96</td>
<td>2040.0±4.00</td>
</tr>
<tr>
<td>BWT (g)</td>
<td>2080.6±2.93</td>
<td>2408.6±4.99</td>
<td>2158.4±8.77</td>
<td>1558.5±10.64</td>
<td>2058.6±7.49</td>
<td>1998.4±9.78</td>
</tr>
<tr>
<td>PI (g)</td>
<td>3463.0±3.17</td>
<td>3465.0±3.14</td>
<td>3465.0±3.14</td>
<td>3090.0±16.56</td>
<td>3110.0±17.08</td>
<td>3145.0±16.87</td>
</tr>
<tr>
<td>PCR (g)</td>
<td>1.64±0.10</td>
<td>1.44±0.12</td>
<td>1.61±0.18</td>
<td>1.97±0.28</td>
<td>1.51±0.21</td>
<td>1.57±0.19</td>
</tr>
</tbody>
</table>

Means (S.E.) carrying different alphabetic superscripts in the same column are statistically at p≤ 0.05 level.
4. Histopathological results:
Control, LYC treated and VE treated groups revealed normal histological structure of lungs (Fig 1; A, B and C respectively). Group (4) showed pulmonary emphysema and cellular exudate composed of RBCs admixed with leukocytes inside the alveolar lumen as represented in Fig (1D). On the other hand, LYC treated E. coli infected group (group 5) had improved picture when compared to infected non-treated birds as they had nearly normal lung except few leukocytes appeared in the pleura as seen in Fig 1E. Meanwhile, VE treated E. coli infected group (group 6) showed pulmonary emphysema and few leukocytic cells were seen inside the alveolar lumen as seen in Fig 1F.

Control, LYC treated and VE treated groups revealed normal histological structure of intestines (elongation of intestinal villi in group 2) (Fig 2; A, B and C). In contrast intestine of infected non-treated birds revealed edema with mononuclear leukocytic cells infiltration in the lamina propria as represented in Fig 2D. Meanwhile intestine of lycopene treated infected birds revealed few leukocytic cells infiltration as represented in Fig 2E. Intestine of VE treated birds in group (6) showed edema and mononuclear leukocytic cells infiltration in the lamina propria as shown in Fig 2F.

4. DISCUSSION
Regarding to hematological results E. coli infected non-treated group (group 4) showed a significant decrease in Hb concentration, RBCs count 4 days and 2 weeks PI beside significantly decreased PCV 4 days PI. MCV and MCH revealed significant increases 2 weeks PI comparing to control birds. Our results are in accordance with results obtained by Suvarna et al. (2017). On the other hand, Godbole et al. (2018) observed non-significant changes in Hb, PCV in E. coli challenged broilers. This difference may be due to the infection dose or breed difference. These
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changes occurred reflecting a picture of macrocytic hypochromic anemia. This Anemia may be due to break down of erythrocytes by hemolytic enzymes produced by E. coli (Justice et al., 2006). Macrocytosis may be due to increase in the reticulocytes count as a result of hemolysis (Nagao and Hirokawa, 2016). LYC treated E. coli infected group (5) revealed non-significant changes in erythrocyrogram except a significant decrease in MCV when compared to infected non-treated group. Although changes didn’t reach to statistical significance (except MCV), they brought the values toward normal control limits (normalization). Our results come in agreement with results of Yonar, (2017) who investigated that simultaneous treatment with LYC (10 mg/kg of fish weight for 28 days) alleviating the toxicity of cypermethrin on hematological parameters in carp. This normalization may be due to the antioxidant effect of LYC preventing lipid peroxidation in the cell membrane and maintaining cells integrity (Palozza et al., 2010). VE treated E. coli infected group (6) showed non-significant changes in erythrocyrogram except a significant decrease in MCV and a significant increase in MCHC 2 weeks PI when compared to infected non-treated group. Although the changes were non-significant, it brought the values toward normal control values. These results agreed with Omonona and Jarikre, (2015) who observed that VE pretreatment (25 mg/kg BW) for 14 days in Carbendazim intoxicated African giant rats enhanced the blood parameters. This normalization may be due to the antioxidant effect of VE protecting cell membrane from oxidation and maintaining cells integrity (Kumari et al., 2013).

Regarding to Leukogram in our study LYC treated group (group 2) revealed significant leukocytosis and lymphocytosis 4 days PI. Similar results were obtained by Fachinello et al. (2018), who observed the immune-activating effect of LYC on finishing pigs. In contrast to our results Pozzo et al. (2013) found that male Hubbard broiler chicks received the basal diet supplemented with 500 mg LYC/kg for 35 days didn’t showed any significant changes in leukogram. This difference may be due to dose difference. Infected non-treated group (group 4) revealed significant leukocytosis and heterophilia 4 days PI and monocytosis 2 weeks PI. Our results come in harmony with Gharieb and Youssef (2014). Indicated leukocytosis due to absolute heterophilia is mainly encountered in localized or generalized infections (Benjamin, 2013). Heterophils also contain a variety of granules that contribute to the first line host defense against bacteria, (Wakenell, 2010). Also, acute or chronic inflammatory disease is the predominant cause of monocytosis and heterophilia in pet birds because they play critical roles in defense and in maintaining homeostasis (Irizarry-Rovira, 2004). LYC treated E. coli infected group (group5) when compared to infected non-treated group showed a significant increase in leukocytic and lymphocytic count 2 weeks PI in addition to a significant decrease in heterophils count and mononuclear count (restoration of their values toward control limits) 4 days and 2 weeks PI respectively. Our results come in agreement with Ibrahim and Banaee (2014), who observed that LYC treatment (10 mg/kg) for 28 days in diazinon exposed fish led to significant elevations in the diazinon induced decreases in WBCs and lymphocytes in addition, it decreased the elevated heterophils and monocytes. Increase TLC and lymphocytic count may be attributed to that LYC stimulates lymphocytes by increasing the production of interleukin-2 and interferon gamma, a potent activator of T lymphocytes (Yuksel et al., 2013). Also, LYC stimulate leukocytic proliferation and synthesis (Fachinello et al., 2018). VE treated E. coli infected group (group 6) when compared to infected non-treated group showed a significant decrease in heterophils and mononuclear count 4 days and 2 weeks PI respectively (restoration of their values toward control limits). Our results come in harmony with Ibrahim and Banaee (2014), who documented that VE supplementation (50 mg/kg BW for 28 days) in the diazinon exposed Nile tilapia led to significant decreases in their monocytes and heterophils near to the control limits.  

Regarding to performance parameters LYC supplemented group (group 2) had a significant increase in BWT and BWG beside decreased FCR comparing to control. Similarly, Mezbani et al. (2019) found that LYC supplementation in broiler diet (100 mg/kg diet) significantly improved BWT, BWG comparing with control. Dietary LYC could improve growth performance due to its positive effect on gut physiology (increase in villus height and villus height: crypt depth ratio) (Sun et al., 2015). Our histopathological results confirmed this theory. VE supplemented group showed only decreased FCR comparing with control group. Our results harmonized with Pompeu et al. (2018), who found non-significant differences in BWT and BWG by VE supplementation in broilers. On the other hand, Abou-Kassem et al. (2016) mentioned that dietary supplementation of VE (250 mg/kg diet) to growing Japanese quails improved live BWT and BWG at 6 weeks of age. Difference may be due to species. Infected non-treated birds (group 4) showed a significant decrease in BWT and BWG as well as significantly increased FCR comparing to control birds. LYC treated infected group (group 5) had significantly improved BWT, BWG and FCR comparing with non-supplemented group. Our results matched with Lee et al. (2016), who investigated that dietary LYC 10 and 20 mg/kg could mitigate the toxic effect of copper-mediated oxidation of low-density lipoprotein in broiler chicken and improve its growth performance. VE treated infected group (group 6) showed significant increases in BWT and BWG and significant decrease in FCR when compared to infected non-supplemented group. Our results come in agreement with Bou et al., (2004), who recorded that inclusion of VE at higher levels in broiler feed has resulted in positive effects on growth performance during heat stress. This effect may be due to that VE may reduce stress by suppressing the catabolic response of the body resulted in improvement of production effects (Rymer and Givens, 2005). Regarding to results of bacterial cell count, LYC and VE supplemented infected group had significantly reduced E. coli count in liver and intestine comparing with infected non-supplemented group. Our results come in the same direction with Lee and Lee, (2014), who demonstrated the bactericidal effect of lycopen存在的 E. coli in vitro. It was found that lycopen存在的 induced reactive oxygen species (ROS)-mediated DNA damage in E. coli. Also, Al-Salih et al., (2013) proved the antibacterial effect of VE (400IU) against E. coli in vitro. Decreased count may be due to the positive effect of VE in protecting chickens from lethal E. coli infection by inhibiting the biosynthesis of prostaglandins, thereby activating humoral immunity and phagocytosis (Likoff et al., 1981). Histopathological pictures of lung and intestine of birds in E. coli infected non-treated group came in same direction with those of El-Sheikh et al., (2007) and Tonu et al., (2011),
respectively. On the other hand, LYC treated E. coli infected groups had an improved histopathological picture comparing with infected non-treated group. This in agreement with Bas and Pandur, (2016), who demonstrated the protective effect of LYC against lung histopathological alterations caused by furan treatment in diabetic rats.

5. CONCLUSIONS

It could be concluded that the presence of Lycopene and vitamin E might be helpful in reducing the harmful effect of E. coli infection by maintaining optimum hematological values. LYC supplementation enhanced the performance, decreased liver and intestinal E. coli count and improved histopathological changes resulted from E. coli infection than VE supplementation. Consequently, we advise using lycopene as a supplement in chicken ration.

6. REFERENCES

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