Alteration in serum biochemical parameters due to garlic (*Allium sativum*) supplementation in broilers’ diets

Sanjeev Kumar¹*, Ashok Kumar¹ and Astha Chandra²

¹Department of Livestock Production and Management, G. B. Pant University of Agriculture and Technology 263145, Uttarakhand, India.
²Department of Veterinary Pathology, G. B. Pant University of Agriculture and Technology 263145, Uttarakhand, India.

This study was undertaken to evaluate the effect of *Allium sativum* supplementation through drinking water and feed on some serum biochemical parameters of broiler chickens. For this purpose, a 42 day’s feeding trial was conducted in a completely randomized design (CRD) on growing broiler chicks. Garlic (*Allium sativum*) was supplemented at graded levels as juice (2.25 and 3%) through drinking water and as powder (0.75 and 1%) through feed to experimental treatment T2, T3, T4 and T5, respectively with three replicates of 10 broiler chicks each for a period of 42 days starting from one day of age. The serum glucose level, serum total cholesterol, serum glutamate oxaloacetate transaminase (SGOT) concentration, and serum glutamate pyruvate transaminase (SGPT) concentration decreased significantly (P≤0.05) due to *A. sativum* supplementation in different treatment group as compared to control group at 28th and 42nd days. Serum alkaline phosphatase (ALP) levels of the birds of different treatment did not reveal any significant impact of *A. sativum* supplementation on the 28th day but significant reduction was noted as compared to control group on the 42nd day.

Key words: Garlic, serum glutamate oxaloacetate transaminase (SGOT), serum glutamate pyruvate transaminase (SGPT), serum alkaline phosphatase (ALP), serum glucose.

INTRODUCTION

Poultry keeping in India is as old as its civilization. Red jungle fowl found in India and its neighbouring countries is considered to be the progenitor of all domestic breeds of fowl. According to Watt Executive Guide (2009 to 2010), poultry industry has emerged as the most dynamic and fastest expanding segment in animal husbandry sector with 47.4 billion eggs produced by 2.4 billion layers and 3 billion broilers giving 2.25 million metric tons of poultry meat and likely to grow up to 75.6 billion eggs and 5.21 million metric tons of poultry meat by year 2012. Recently, Narayana (2008) reported that India is the 3rd largest country in egg production and 4th in chicken meat production. Andhra Pradesh leads other states in poultry output and together with Tamil Nadu and Maharashtra account for 70% of the country's poultry production. The average per capita poultry meat consumption was also estimated to increase from 0.69 kg in the year 2000 to 1.28 kg during the year 2000 to 2004.

Despite India’s tremendous growth in poultry production, per capita consumption is still low that is, 40 eggs and 1.2 kg of poultry meat than per capita consumption of many development countries. Health conscious person avoid egg consumption because of high level of cholesterol, responsible for heart ailment. This problem can be
solved by reducing the cholesterol level in poultry meat and egg by dietary modulation. There are several cholesterol reducing agents such as copper, garlic, linseed oil, soybean oil, etc. Out of them, garlic is selected for the proposed research because it is easily available and relatively cheaper. Garlic (A. sativum) belongs to the plant family Liliaceae. The main chemical components in the volatile form of isolated garlic seedling are diallyl disulphide (23.33%), 1,3-dithiane (18.34%) and dibutyl phthalate (6.30%) (Jin et al., 2007). Garlic and its preparations have been widely recognized as agents for prevention of various metabolic disorders such as atherosclerosis, hyperlipidemia, thrombosis, hypertension and diabetes. Several clinical reports have shown that garlic has cholesterol-lowering effect in animals due to the presence of sulphur-containing bioactive compounds in its homoenolates (Neil et al., 1996; Chowdhury et al., 2002). When raw garlic bulb is chopped or crushed, the enzyme allinase activates alliin, a non-protein amino acid present in the intact garlic, to produce allicin. Other important sulphur-containing compounds present in garlic homoenolates are allyl methyl thiosulphonate, 1-propenyl allyl thiosulphonate and y-L-glutamyl-s-alkyl-L-cysteine (Banerjee and Maulik, 2002). Garlic products have become more popular in the last decade. Market research conducted in United States (1998) showed that garlic products were the most popular of all dietary supplements (Wyngate, 1998). Dozens of brands on store shelves can be classified into four groups: garlic oil, garlic oil macerate, garlic powder and aged garlic extract (AGE). A. sativum is a species in the onion family alliaceae. Epidemiological and medical studies suggest that individuals regularly consuming garlic have longer blood clotting times and show lower blood lipid levels which means a reduced risk of stroke and cardiovascular disease. In addition, garlic is reputed to have antibacterial, antiviral, antifungal, antioxidant and anti-inflammatory activity. Some other studies show that eating garlic regularly reduces risk of oesophageal, stomach, and colon cancer. Garlic has broad range of biological activity, including immune stimulation and anti-tumor activity (Riggs et al., 1997). In the view of the above observations, the present investigation was done to study the alteration of garlic juice and powder supplementation on certain serum biochemical parameters of broilers.

MATERIALS AND METHODS

The present investigation was conducted to observe the effect of supplementation of A. sativum on some serum biochemical parameters of broilers. The experiment was conducted on 150 birds, divided into five treatment groups with three replicates of 10 birds each in a six weeks period. Broilers of control treatment (T1) were provided basal feed and water while two different concentration of garlic juice were given viz. 2.25% (T2) and 3% (T3) in drinking water and garlic powder 0.75% (T4) and 1% (T5) in feed, respectively. The biological experiment was conducted during the months of June and July 2008 at Student Practical Poultry Production Unit, College of Veterinary and Animal Sciences, G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand. Geographically, the place is located at altitude of 243.48 m above in humid subtropical zone lying in the foot hills of Himalayas.

Experimental birds and their management

The birds used in this experiment were crossbred broiler chicks. A total of 150, day old broiler chicks were procured from the Venky's Hatchery, Dehradun. Vaccination against Marek's disease was done on the day of hatching through subcutaneous route by hatchery and vaccination against Newcastle disease (RDF strain) was done on 4th day of hatching. All the birds were individually weighed and randomly allocated into five different treatment groups (T1, T2, T3, T4 and T5) with three replicates of 10 birds each. The birds were reared in deep litter system in a gable roofed, open sided house. Paddy husk was used as litter material with a thickness of 4 to 5 cm. Wet litter was replaced with dry and clean litter at weekly interval during experiment and stirring was done on alternate days. All the birds were provided with uniform floor, feederer and waterer space and were reared under standard management conditions throughout the six week period. The birds were fed ad-libitum, and clean drinking water was provided throughout the experiment. The waterers were cleaned twice daily to prevent picking of any infection. Care was taken to minimize spoilage and wastage of feed and water.

Design of experiment

The feeding trial was carried out in a completely randomized design (CRD) in which garlic (A. sativum) in the form of juice was supplemented at graded levels through drinking water and in the form of powder through feed to different groups of broiler chicks for a period of 42 days starting from the 4th day of age.

There were five treatments employed in the experiment. The treatment 1 served as control (T1) in which no supplement was added to the water and feed, in treatment T2, garlic juice at 2.25% concentration was provide, in T3, garlic juice at 3% concentration was provided through drinking water in T4 and T5, garlic powder at 0.75 and 1% concentration, respectively was provided through feed. Garlic (A. sativum) was procured from local market of Pantnagar. Garlic feeding was done in two ways that is juice (1:1 with distilled water) and powder. Garlic powder was mixed with the feed and garlic juice was added to the drinking water. The powder and juice was prepared biweekly; powder was prepared by drying garlic in hot air oven at 65 to 70°C and juice was formed by using grinder. Chemical composition (g/kg) of garlic bulbs and their products are as shown in Table 1.

Blood sampling and serum separation

Blood sampling was done twice during 42 days trial for evaluation of biochemical parameters. First collection was done at 28 days and second collection was done at 42 days of experiment. Blood samples (approximately 3 ml) were collected from three birds of each replicate group aseptically from the wing vein in sterilized disposable syringes (24 gauge needle). Collected blood samples (2 ml) were transferred to clean, dry and sterilized glass tube and kept in slanted position at room temperature for 3 to 4 h for separation of serum. The serum samples were collected in sterile tubes and these were centrifuged at 4000 rpm for 20 min. The top layer was separated and stored at -20°C till further use.

Biochemical parameters

Serum glucose: Estimation of glucose was done by enzymatic glucose oxidase- peroxidase (GOD-POD) method with the help of
Span Diagnostic Kit at 505 nm wavelength against blank reagent (Sacks, 1998). Concentration of serum glucose was expressed in mg/dl.

**Serum cholesterol:** Serum cholesterol concentration was estimated spectrophotometrically using Span Diagnostic Kit with enzymatic CHOD-PAP method at 505 nm wavelength (Tietz, 1998). Concentration of serum cholesterol was expressed in mg/dl.

**Serum glutamate oxaloacetate transaminase (SGOT):** Plasma SGOT concentration was estimated by 2,4-dinitrophenylhydrazine (DNPH) colorimetric method with the help of Span Diagnostic Kit at 505 nm wavelength (Bergmayer and Bernt, 1974). Concentration of SGOT was expressed in IU/L.

**Serum glutamate pyruvate transaminase (SGPT):** Plasma SGPT concentration was estimated by DNPH colorimetric method with the help of Span Diagnostic Kit at 505 nm wavelength (Tietz, 1970). Concentration of SGPT was expressed in IU/L.

**Serum alkaline phosphatase (ALP):** Serum ALP concentration was estimated by Kind and King’s method with the help of Span diagnostic Kit at 510 nm wavelength (Verley, 1975).

**Statistical analysis**

Statistical analysis of the data was done using analysis of variance (ANOVA) technique according to the method described by Snedecor and Cochran (1994). Comparisons among the treated groups were made. Statistically significant difference was considered at 5% level.

### Table 1. Chemical composition (g/kg) of garlic bulbs and their products.

<table>
<thead>
<tr>
<th>Component</th>
<th>GB</th>
<th>LPG</th>
<th>HGP</th>
<th>GP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry matter</td>
<td>312.4</td>
<td>965.8</td>
<td>931.6</td>
<td>934.8</td>
</tr>
<tr>
<td>Crude ash</td>
<td>14.82</td>
<td>41.52</td>
<td>37.83</td>
<td>20.32</td>
</tr>
<tr>
<td>Crude protein</td>
<td>61.43</td>
<td>176.22</td>
<td>158.05</td>
<td>78.38</td>
</tr>
<tr>
<td>Ether extract</td>
<td>6.53</td>
<td>17.31</td>
<td>14.28</td>
<td>2.19</td>
</tr>
<tr>
<td>Crude fiber</td>
<td>8.61</td>
<td>25.92</td>
<td>24.11</td>
<td>ND</td>
</tr>
<tr>
<td>Allin</td>
<td>11.12</td>
<td>21.13</td>
<td>10.2</td>
<td>ND</td>
</tr>
<tr>
<td>Allicin</td>
<td>4.91</td>
<td>9.03</td>
<td>4.31</td>
<td>ND</td>
</tr>
</tbody>
</table>

GB, Garlic bulbs; LPG, lyophilized garlic powder; HGP, heated garlic powder; GP, garlic powder; ND, not detected.

### Table 2. Effect of *A. sativum* supplementation on serum enzymes of broilers at 28 days of study (mean ±S.E).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>T₁</th>
<th>T₂</th>
<th>T₃</th>
<th>T₄</th>
<th>T₅</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cholesterol (mg/dl)</td>
<td>154.31±0.69&lt;sup&gt;a&lt;/sup&gt;</td>
<td>147.80±1.58&lt;sup&gt;b&lt;/sup&gt;</td>
<td>142.59±0.55&lt;sup&gt;c&lt;/sup&gt;</td>
<td>141.43±0.16&lt;sup&gt;d&lt;/sup&gt;</td>
<td>142.18±0.03&lt;sup&gt;e&lt;/sup&gt;</td>
</tr>
<tr>
<td>Glucose (mg/dl)</td>
<td>235.25±2.96&lt;sup&gt;a&lt;/sup&gt;</td>
<td>226.15±3.49&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>225.11±2.45&lt;sup&gt;c&lt;/sup&gt;</td>
<td>215.53±1.94&lt;sup&gt;d&lt;/sup&gt;</td>
<td>211.92±0.19&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>ALP (KA units)</td>
<td>11.75±0.36</td>
<td>11.62±0.29</td>
<td>11.96±0.27</td>
<td>12.33±0.15</td>
<td>11.83±0.05</td>
</tr>
<tr>
<td>SGOT (IU/L)</td>
<td>176.85±1.41&lt;sup&gt;a&lt;/sup&gt;</td>
<td>165.06±0.60&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>165.14±0.33&lt;sup&gt;c&lt;/sup&gt;</td>
<td>165.57±0.15&lt;sup&gt;c&lt;/sup&gt;</td>
<td>164.69±0.23&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>SGPT (IU/L)</td>
<td>28.3±0.49&lt;sup&gt;a&lt;/sup&gt;</td>
<td>23.73±0.29&lt;sup&gt;b&lt;/sup&gt;</td>
<td>23.66±0.46&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>23.13±0.24&lt;sup&gt;d&lt;/sup&gt;</td>
<td>24.53±0.17&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

T₁, 0%; T₂, 2.25%; T₃, 3%; T₄, 0.75%; T₅, 1%

RESULT AND DISCUSSION

### Biochemical parameters

#### Glucose

The data comprising of mean serum glucose concentration (mg/dl) in different treatment groups recorded at the end of the 28th and 42nd days study are summarized in Tables 2 and 3. The serum glucose concentration in control, T₂, T₃, T₄ and T₅ groups of broilers were 235.25 ± 2.96, 226.15 ± 3.49, 225.11 ± 2.45, 215.53 ± 1.94 and 211.92±0.19 mg/dl, respectively at the end of 28 days (Figure 2). In the present investigation, serum glucose concentration in T₅ group was significantly (P<0.05) lower than the serum glucose level in T₁, T₂ and T₃ groups but not significant with T₄ group. However, T₂ and T₃ groups showed significant decrease in serum glucose levels and T₄ group showed no significant decrease in serum glucose levels. Maximum and mini-mum glucose concentrations were observed in T₁ and T₅ groups, respectively. The result obtained at the 42nd day of study revealed that garlic supplemented groups T₃, T₄, T₅ showed significantly (P < 0.05) lower serum glucose concentration compared to the control, the broilers of groups T₄ showed lowest glucose concentration (206.90 ± 0.59 mg/dl) followed by T₅ (209.02 ± 0.35), T₃ (211.77 ± 4.99), T₂ (219.11 ± 1.29) and T₁ (223.87 ± 1.70) groups. However, there was no significant difference among T₃, T₄ and T₅ groups. The present study reports that there was reduction in the serum glucose concentration in garlic supple-
Table 3. Effect of *A. sativum* supplementation on serum enzymes of broilers at 42 days study (mean ±S.E.).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
<th>T5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cholesterol (mg/dl)</td>
<td>148.78±1.22a</td>
<td>137.73±0.85bc</td>
<td>134.51±0.09c</td>
<td>130.14±1.17d</td>
<td>131.55±1.83cd</td>
</tr>
<tr>
<td>Glucose (mg/dl)</td>
<td>223.87±1.70a</td>
<td>219.11±1.29ab</td>
<td>211.77±4.99bc</td>
<td>206.90±0.59c</td>
<td>209.02±0.35c</td>
</tr>
<tr>
<td>AKP (KA units)</td>
<td>12.25±0.13ab</td>
<td>11.34±0.11bc</td>
<td>11.18±0.02b</td>
<td>11.7±0.23c</td>
<td>11.44±0.12c</td>
</tr>
<tr>
<td>SGOT (IU/L)</td>
<td>176.5±1.85a</td>
<td>161.16±0.40b</td>
<td>161.44±0.48b</td>
<td>161.01±0.15b</td>
<td>161.40±0.28b</td>
</tr>
<tr>
<td>SGPT (IU/L)</td>
<td>28.53±0.52a</td>
<td>23.33±0.24bc</td>
<td>22.93±0.29c</td>
<td>22.13±0.17cd</td>
<td>21.4±0.11d</td>
</tr>
</tbody>
</table>

Figure 1. Effect of *A. sativum* supplementation on serum cholesterol (mg/dl) of broilers at 28th and 42nd day of study

**Cholesterol**

Mean serum cholesterol concentration (mg/dl) in different treatment groups at 28th day of experiment is illustrated in Table 2. Total serum cholesterol concentrations in T4, T5, T3 and T2 groups were 141.43 ± 0.16, 142.18 ± 0.03, 142.59 ± 0.5503 and 147.80 ± 1.58 mg/dl, respectively which were significantly (P<0.05) lower compared to the control group (154.31± 0.69 mg/dl) (Figure 1). Further, there was a significant (P <0.05) decrease noticed in T4, T5, T3 and T2 groups with value 130.14± 1.17, 131.55 ± 1.83, 134.51±0.09 and 137.73±0.85 mg/dl, respectively when compared with T1 at the 42nd day. Highest and lowest values of cholesterol were observed in T1 and T4 group of broilers. Lower cholesterol concentrations were significantly (P < 0.05) obtained among garlic supplemented groups compared to the control. Further, cholesterol concentration recorded at 28th day was found to be significantly reduced in the 42nd day for all treatment groups. In this study, total serum cholesterol showed a significant (P < 0.05) reduction between control and garlic supplemented groups. These findings are in agreement with earlier reports of Choudhury et al. (2002) who observed a marked decrease in total serum cholesterol and yolk cholesterol concentration due to supplementation of *A. sativum* in diet of broilers (Lijuan, 2001). Chen and Li (2006) also observed that the addition of 1 to 2% garlic reduced the serum and muscle cholesterol in broilers similarly. Mottaghtitalab and Taraz, (2004) reported that feeding of garlic powder and tylosin reduced serum and egg yolk serum concentration. Similar observations were also observed by Yun et al. (2005) in chicken and Sakine and Onbaslar (2006) in laying hen. Garlic extracts exhibited hypcholesterolemic effects; possible reason for this may be mainly because of the inhibition of the key enzymes, such as hepatic 3-hydroxy-3-methylglutaryl coenzyme A (HMG-CoA) reductase, cholesterol 7α-hydroxylase, and fatty acid synthetase in cholesterol and lipid.
Effect of *A. sativum* supplementation on serum glucose (mg/dl) of broilers at the 28th and 42nd day of study.

Enzymatic profile

**Serum alkaline phosphatase (ALP)**

Table 2 furnishes the serum ALP concentration (KA Units) in different treatment groups. The serum ALP concentration was found to be non-significantly different among garlic supplemented groups and control group at the 28th day of study with the value of 11.75 ± 2.96 KA Units in T1, 11.62 ± 0.29 KA Units in T2, 11.96 ± 0.27 KA Units in T3, 12.33±0.1527 KA Units in T4 and 11.83 ± 0.05 KA Units in T5 (Figure 3.). There were significant decrease in T3, T2, T4 and T5 as compared to the control group of serum ALP concentration (KA Units) in different treatment groups at the 42nd day of study (Table 3). The mean values of ALP concentration in T1, T2, T3, T4 and T5 groups were 12.25 ± 0.13, 11.34 ± 0.11, 11.18 ± 0.02, 11.7 ± 0.23 and 11.44±0.12 KA, respectively on the 42nd day. Maximum value of serum ALP concentration was observed in T1 group. However, treatment groups did not differ significantly among themselves. Present research reveals that up to 28th day of supplementation of *A. sativum*, there were no significant changes in ALP concentration. Our finding is in accordance with Elhaster et al. (1997) who also found that broilers fed with 5% did not affect ALP activity. Augusti et al. (2005) observed that there was significant decrease in ALP in serum of rats. These results can be attributed to *A. sativum*, which may cause stabilized cell membrane and protect the liver against deleterious agents and free radical-mediated toxic damages to the liver cells. This is reflected in the reduction of liver enzymes. *A. sativum* helps the liver to maintain its normal function by accelerating the regenerative capacity of its cells.

**Serum glutamate oxaloacetate transaminase (SGOT)**

The data regarding serum GOT concentration (IU/L) in different treatment groups recorded at the 28th and 42nd day of study is summarized in Tables 2 and 3. The SGOT concentration was found to be minimum in T5 group (164.69 ± 0.23 IU/L) followed by T2 (165.06±0.60 IU/L), T3 (165.14±0.33 IU/L) and T4 (165.57±0.15 IU/L) in comparison to the control group (176.85±1.41 IU/L) at the 28th day of study (Figure 4). There was significant difference between the treatment groups as compared to the control group. At the 42nd day of the study, a similar trend in serum GOT concentration was observed as that of 28th day of study. Mean values of SGOT in T4, T2, T5, T3 and T1 groups were 161.01 ± 0.15, 161.16 ± 0.40, 161.40 ± 0.28, 161.44 ± 0.48 and 176±1.85 IU/L, respectively. Maximum value of SGOT was observed in T1 group. These findings are in accordance with Elhaster et al. (1997) who found that SGOT levels decreased when rats were fed diet containing 5% *A. sativum*. In another study, Augusti et al. (2005) also observed that the *A. sativum* supplementation significantly decreased SGOT in serum of rats. Ibrahim et al. (2000) supplemented garlic in rabbit and observed that SGOT decreased significantly. Ganiyu (2006) observed the effect of garlic supplementation on SGOT of rat and found that there was significant decrease (P < 0.05) in SGOT of rats fed diet containing 4% garlic. Salahy (2003) reported that when fish was orally given garlic and onion with feed, there was decrease in SGOT. These results can be attributed to *A. sativum*, which may cause stabilized cell membrane and protect the liver against deleterious agents and free radical-
mediated toxic damages to the liver cells. This is reflected in the reduction of liver enzymes. *A. sativum* helps the liver to maintain its normal function by accelerating the regenerative capacity of its cells.

**Serum glutamate pyruvate transaminase (SGPT)**

Tables 2 and 3 represent the SGPT concentration in different treatment groups. The serum GPT concentration was found to be lowest in T₅ group (23.13 ± 0.24 IU/L) followed by T₃ (23.66 ± 0.46 IU/L), T₂ group (23.73 ± 0.29 IU/L) and T₅ group (24.53 ± 0.17) in comparison to the control group (28.3±0.49 IU/L) at the 28th day of study (Figure 5). At the 42nd day of study, mean values of SGPT in T₅, T₄, T₃, T₂ and T₁ groups were 22.13±0.17, 22.93 ± 0.29, 23.33±0.24 and 28.53 ± 0.52 IU/L, respectively. During the 28th and 42nd day, there was significant difference between the treatment groups as compared to the control group. This study demonstrates that the activities of SGPT were much influenced by dietary garlic. Lower values of SGPT were observed in treatment which indicates *A. sativum* up to 3% concentration has no adverse effect on liver. These findings are in accordance with those of Elhaster et al. (1997) who found that 5% *A. sativum* in rat diet significantly decreased SGPT. Augusti et al. (2005) also observed that *A. sativum* supplementation decreased SGPT significantly in serum of rat. Ibrahim et al. (2000) supplemented garlic in rabbit and observed that SGPT decreased significantly. Ganiyu (2006) observed the effect of garlic
supplementation on SGPT of rat and found that there was significant decrease (P < 0.05) in SGPT of rats fed diet containing 4% garlic. Salahy (2003) reported that when fish was orally given garlic and onion with feed, there was decrease in SGPT. These results can be attributed to \( A.\ sativum \), which may cause stabilized cell membrane and protect the liver against deleterious agents and free radical-mediated toxic damages to the liver cells. This is reflected in the reduction of liver enzymes. \( A.\ sativum \) helps the liver to maintain its normal function by accelerating the regenerative capacity of its cells.

**Conclusion**

The results on serum biochemical parameters indicate that there was significant reduction in glucose, cholesterol, SGOT and SGPT concentration due to \( A.\ sativum \) supplementation in broiler checkens diets. The study demonstrates that \( A.\ sativum \) administration did not have effect on serum alkaline phosphatase concentration at the 28th day however at 42 days of age, it was also significantly reduced in garlic supplemented groups and the presented study reveals that \( A.\ sativum \) supplementation, through drinking water and feed, reduced glucose, cholesterol, SGPT and SGOT. Finally, from the obtained results, it could be recommended that garlic (\( A.\ sativum \)) may be used as a growth promoter and antibiotic for the treatment or prevention of diseases and for enhancing chicken tolerance to environmental stress; therefore garlic powder should be added to the diets of poultry.

**ACKNOWLEDGEMENT**

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**REFERENCES**


