Aqueous Garlic Extract; Natural Remedy to Improve Haematological, Renal and Liver Status

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Abstract

Functional foods are gaining popularity worldwide owing to the consumer’s preference towards the consumption of natural and safe products in dietary modifications. Garlic (Allium sativum L., Liliaceae) is an essential vegetable that have been widely utilized as seasoning, flavouring, culinary and in herbal remedies. Garlic is well known to acquire an array of phytochemicals. These bioactive molecules are playing pivotal role in maintaining human health and having potential to reduce various ailments like diabetes, cholesterol, cardiovascular diseases and cancer insurgence. Considering the aim, in vivo study was conducted using New Zealand type rabbits, providing aqueous garlic extract for a period of 28 days. Accordingly, four groups (G0, G1, G2 and G3) were designed and provide different doses of extract (control, 3, 6 and 9 mL/kg b.w). Functional garlic extract containing water soluble active components resulted in significant reduction in RBC (6.94 ± 0.47 (10^6/mm^3) in G3 while WBC improve (16.97 ± 1.70) in G2. Haemoglobin and haematocrit, packed cell volume, mean corpuscular volume, mean corpuscular haemoglobin and mean corpuscular haemoglobin concentration were also modulated well in G3 as compare to other groups. Regarding the total protein, maximum was recorded (7.23 ± 0.58) in G3 while lowest was (6.72 ± 0.15g/L) in G0. Albumin, globulin and electrolytes like Sodium (Na) and potassium (K) exhibited significant difference by using different concentration of aqueous garlic extract. Moreover, liver functioning test, urea, creatinine, alanine aminotransferase (ALT) and aspartate aminotransferase (AST) also showed significant modulation using the aqueous garlic extract. From the present investigation, it is deduced that garlic preparations like aqueous extract is effective against various maladies because of its functional and nutraceutical aspects.

Keywords: Functional food; Aqueous garlic extract; Safety product; Serum analysis; Hypercholesterolemia & Hyperglycaemia and Rabbit modelling

Introduction

Functional and nutraceuticals foods provide an opportunity to improve human health by reducing care cost and to support livelihood in rural development. Functional foods are those healthy foods claimed to have a health-promoting or disease-preventing property beyond the basic function of supplying nutrients [1]. They often work like pharmaceuticals with specific effects on physiological system. Consumption of such foods is an emerging trend worldwide owing to their increasing popularity among health-conscious consumers [2,3].

Pivotal links have been established between dietary components and human health. There are lot of evidences that consumption of different fruits and vegetables are important for human health [4] as they are excellent sources of dietary fibers, antioxidants, carotenoids, sulfur containing compounds, vitamins and minerals [5]. Epidemiological studies conducted worldwide have revealed that consumption of these foods and vegetables especially enriched functional ingredients is associated with reduction of health related chronic disorders [6].

Garlic (Allium Sativum) is one of the most commonly used plants, both for medicinal and culinary purposes as providing flavor and taste to the final product. It is believed to be originated from Central Asia over 6,000 years ago and has been extended towards west, south and east [7]. However, whole garlic as well as its components/fractions are used in medicines since long time and depict its presence in the Chinese medicines 3,000 years ago. Garlic-based medications were also famous in India about 5,000 years ago. Since from 1550 B.C. Egyptians fed garlic to boost their immunity thereby render safe from various maladies and improve their health performance [8].

Garlic health promoting perspectives have been proven and recommended worldwide as a dietary supplement [1]. In many countries, health potentials of garlic and its various products have been approved and are available as dietary supplements. Aqueous garlic extract, dehydrated garlic powder and its extracted oil is gaining popularity and sold as dietary [9,10].

Materials and Methodology

Preparation of aqueous garlic extract

The peeled garlic bulbs were weighed (100 g) and grounded thoroughly to obtain fine garlic juice. Afterwards, it was homogenized in 100 mL of 0.9% cold and sterile saline solution in a blender at high speed for 15 minutes followed by filtration with muslin cloth. Resultant aqueous extract of garlic was stored at −20°C and prepared its different concentrations with 0.9% saline solution for further analysis [11].

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Efficacy Studies

In rabbit experimental modelling, twenty four New Zealand red eyes male rabbits with age of 20-23 weeks, average body weight 2.5 Kg were procured from National Institute of Health (NIH), Islamabad and housed in the Animal Room of National Institute of Food Science and Technology, University of Agriculture Faisalabad, Pakistan. During experiment, temperature (23 ± 2°C) and relative humidity (55 ± 5%) were controlled for 12 hours light and dark period. For efficacy trials, four groups of rabbits were made five in each as mentioned in Table 1. At the initiation of study some rabbits were sacrificed to develop baseline values. Different concentrations of aqueous garlic extracts (Table 1) were given orally by using 6-8 French feeding tube as gavage to the respective group for a period of twenty eight days regularly to determine the effect of functional garlic juice (aqueous garlic extract) in comparison to control (Normal Feed, no garlic extract). Feed and water intake were recorded daily whilst body weight was measured after three days in whole experiment. Left diet and faeces were also collected. In the end of study, the overnight fasted rabbits were sacrificed to evaluate the effect of respective treatments on the selected parameters including serum lipid profile, glucose level, haematological, renal & liver functions and protein analysis. Blood samples of rabbits were collected through main jugular vein and serum was collected in heparin coated tubes for different assays through Microlab-300, Germany [1].

It is assured that all the experimental trials were performed in compliance with the relevant laws and institutional guidelines of National Institute of Food Science and Technology, University of Agriculture Faisalabad, Pakistan. Furthermore, all the experimental modelling includes safety and dietary plans were reviewed and approved by the institutional committee(s) (Table 1).

Hematological Analysis

Hematological analysis mainly red blood cells, white blood cells, hemoglobin (Hb), packed cell volume (PCV), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), and hematocrit (hct) were estimated according to respective methods of Hillman and Finch [12].

Renal Function Test

Renal function include sodium, potassium urea and creatinine were evaluated by using commercial kits of Thomas [13].

Liver Function Test

Finally, their liver function tests were evaluated for the safety concern of the physiological body functions. Alanine aminotransferase (ALT) and aspartate aminotransferase (AST) were calculated by following the protocols of Moss [14].

Protein Analysis

Serum protein profile mainly total protein, albumin and globulin were calculated using kits of Sigma-Aldrich Chemicals Co. [15].

Statistical Analysis

The data obtained from entire study were subjected to statistical analysis to determine the level of significance described by Steel [16]. Analysis of variance was calculated by ANOVA test and means were interrupted by Duncan’s Multiple Range Test.

Results

It was concluded from my pervious experimental result published in Journal of Medicinal Plants Research, maximum cholesterol was recorded as (51.57 ± 0.7) in G0 followed by (50.24 ± 0.7) G1 and (49.28 ± 0.5 mg/dL). Furthermore, it was also predicted that during the whole study the total cholesterol reduced in all treated groups from 51.15 ± 0.5 to 49.66 ± 0.3 in G0, 52.83 ± 0.4 to 47.64 ± 0.2 in G1, and 49.73 ± 0.4 to 48.71 ± 0.3 mg/dL in G2 from the initiation to the end of the study. It was observed that total cholesterol was significantly different in days, groups and their interaction at the level of significance (P<0.05) [1].

Further investigated that serum glucose was recorded as (7.35 ± 0.1) in G0 followed by (6.43 ± 0.2) G1 and (6.30 ± 0.6 mg/dL). Moreover, it was also predicted that during the whole study the serum glucose was reduced in all treated groups from 6.50 ± 0.2 to 6.10 ± 0.4 in G0, 6.60 ± 0.2 to 5.80 ± 0.3 in G1, while 6.70 ± 0.3 to 6.20 ± 0.3 mg/dL in G2 in whole study. It was recorded that serum glucose was significant in the action of days, groups and their interaction at the level of significance (p<0.05) [1].

Red blood cells (RBC's) and white blood cells (WBC's)

The mean square values for the effect of treatments on red blood cells and white blood cells revealed significant differences in all groups. From mean (Table 2) it was observed that maximum red blood indices were recorded as (7.56 ± 0.2) in G1 means followed by (7.16 ± 0.2)G1 and G3 6.94 ± 0.4 (106/mm3). Furthermore, it also predicted that during the whole study the red blood cells were reduced in all treated groups i.e. 7.40 ± 0.1 to 6.96 ± 0.2 in G1, 7.45 ± 0.3 to 6.51 ± 0.2 in G2 while 7.30 ± 0.3 to 6.26 ± 0.3 (103/mm3) in G3 from the initiation of study to termination respectively. Regarding WBC's, mean values showed that maximum WBC's were recorded (16.97 ± 1.7) in G0 followed by (16.22 ± 0.9)G1 and G3 16.16 ± 1.1 (103/mm3). It was also observed from the table that maximum value for WBC's were 18.71 ± 0.2 G1 while lowest value was 15.15 ± 0.2 (103/mm3) in G2 from day 0 to 28th day trial (Table 2).

<table>
<thead>
<tr>
<th>Groups</th>
<th>Treatments</th>
<th>0 Days</th>
<th>14 days</th>
<th>28 days</th>
<th>Means</th>
</tr>
</thead>
<tbody>
<tr>
<td>G0</td>
<td>Control (Without garlic extract)</td>
<td>7.38 ± 0.11</td>
<td>15.35 ± 0.10</td>
<td>16.08 ± 0.19</td>
<td>15.96 ± 0.56</td>
</tr>
<tr>
<td>G1</td>
<td>3 mL garlic extract(per kg body weight of rabbit)</td>
<td>7.50 ± 0.14</td>
<td>16.16 ± 0.16</td>
<td>7.80 ± 0.17</td>
<td>7.56 ± 0.21</td>
</tr>
<tr>
<td>G2</td>
<td>6 mL garlic extract (per kg body weight of rabbit)</td>
<td>7.13 ± 0.32</td>
<td>16.33 ± 0.31</td>
<td>6.96 ± 0.23</td>
<td>7.16 ± 0.21</td>
</tr>
<tr>
<td>G3</td>
<td>9 mL garlic extract (per kg body weight of rabbit)</td>
<td>6.86 ± 0.30</td>
<td>16.90 ± 0.38</td>
<td>6.51 ± 0.29</td>
<td>6.94 ± 0.47</td>
</tr>
</tbody>
</table>

Table 1: Different groups conducted in the efficacy trials.

**Table 2: Means for red blood cells(RBC) and white blood cells (WBC).**

**Table 2: Means for red blood cells(RBC) and white blood cells (WBC).**
Hemoglobin (Hb), hematocrit (hct) and Mean corpuscular hemoglobin (MCH)

The mean square value for effect of treatments on Hb and hct revealed significant differences in all groups. From (Figure 1) it was observed that maximum Hb was recorded as (10.73 ± 0.1) in G0 means followed by (10.71 ± 0.2) G1 and (10.60 ± 0.1 g/dL). Regarding the hct, maximum value was recorded as (37.47 ± 0.5) in G1 means followed by (36.92 ± 0.4) G0 and G2 (36.14 ± 0.2 %). It was also observed from the graphical description that maximum value for hct was 38.30 ± 0.36 in G0 while lowest value was 35.02 ± 0.2% in G2. Mean values for MCH trait showed that maximum MCH was recorded as (18.42 ± 0.8) in G0 means followed by (17.93 ± 0.4) G1 and (17.33 ± 0.4pg). It was also observed from the graph that maximum value for MCH was 18.91 ± 0.3 in G0 while lowest value was 16.21 ± 0.2 pg observed in G1 from the 0 days study to 28th days trial (Figure 1).

Packed cell volume (PCV) and mean corpuscular volume (MCV)

It is obvious from the mean square values that treatments exhibited significant differences on PCV and MCV of different groups of rabbits. Mean values for this trait in study showed that maximum PCV were recorded as (35.48 ± 0.2) in G0 means followed by (34.28 ± 0.6) G2 and (32.66 ± 0.7 %) in (Table 3). It is observed from the table that maximum value for PCV was 35.48 ± 0.2 in G0 while lowest value was 30.16 ± 0.3 % observed in G1 from the 0 days study to 28th days trial. Regarding the MCV maximum value was recorded (52.58 ± 2.1) in G3 means followed by (52.01 ± 1.8)G0 and (51.68 ± 1.3 fl). Furthermore, it also predicted that during the whole study MCV was improved in all treated groups i.e. 50.30 ± 0.2 to 52.90 ± 0.3 in G0, 50.43 ± 0.7 to 54.68 ± 0.5 in G1 while 50.26 ± 0.8 to 53.91 ± 0.2 fl in whole study (table 3).

Mean corpuscular hemoglobin concentration (MCHC) and Total protein

Mean square values of MCHC exhibited significant differences between treatments and different groups of rabbits. Regarding the MCHC maximum value was recorded (37.47 ± 0.6) in G1 means followed by (36.92 ± 0.4) G0 and G2 (36.14 ± 0.3 %) in Figure 2. The mean square values for effect of treatments on total protein revealed significant differences in all groups. It was evaluated that maximum total protein content was recorded as (7.45 ± 0.5) in G2 means followed by (7.21 ± 0.4)G1 and G0 (6.93 ± 0.1 g/L). Furthermore, it also predicted that during the whole study the total protein was improved in all treated groups during the whole study (Figure 2).

Albumin and globulin

It was obvious from the mean square values that albumin and globulin exhibited significant differences with different groups of rabbits. Mean values (Table 4) showed that maximum albumin was recorded as (3.52 ± 0.3) in G2 means followed by (3.27 ± 0.4)G3 and G1 (3.07 ± 0.2 g/dL). It was also observed from the table that maximum value for albumin was 3.88 ± 0.2 in G2 while lowest value was 2.76 ± 0.2 g/dL observed in G1 from the 0 days study to 28th days trial. Regarding the globulin, maximum value was recorded (3.91 ± 0.4) in G2 means followed by (3.68 ± 0.2)G1 and (3.67 ± 0.4 g/dL). Furthermore, it also predicted that during the whole study the globulin was improved in all treated groups during the whole study (Figure 2).

Table 3: Means for Packed cell volume (PCV) and mean corpuscular volume (MCV).

<table>
<thead>
<tr>
<th>Groups</th>
<th>0 Days</th>
<th>14 days</th>
<th>28 days</th>
<th>Means</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PCV (%)</td>
<td>MCV (fl)</td>
<td>PCV (%)</td>
<td>MCV (fl)</td>
</tr>
<tr>
<td>G0</td>
<td>34.21 ± 0.59bcd</td>
<td>50.13 ± 0.25f</td>
<td>0.695 ± 0.37ef</td>
<td>34.33 ± 0.27b</td>
</tr>
<tr>
<td>G1</td>
<td>33.50 ± 0.21e</td>
<td>50.30 ± 0.25f</td>
<td>32.40 ± 0.20f</td>
<td>51.86 ± 0.49d</td>
</tr>
<tr>
<td>G2</td>
<td>33.85 ± 0.28de</td>
<td>50.43 ± 0.76ef</td>
<td>31.26 ± 0.46g</td>
<td>52.65 ± 0.38c</td>
</tr>
<tr>
<td>G3</td>
<td>35.48 ± 0.20a</td>
<td>50.26 ± 0.08f</td>
<td>34.11 ± 0.31bdc</td>
<td>51.85 ± 0.38d</td>
</tr>
<tr>
<td>Mean</td>
<td>34.26 ± 0.86a</td>
<td>50.28 ± 0.12c</td>
<td>33.02 ± 1.44b</td>
<td>51.73 ± 0.86b</td>
</tr>
</tbody>
</table>
treated groups i.e. 3.46 ± 0.2 to 3.88 ± 0.2 in G1, 3.43 ± 0.2 to 4.43 ± 0.2 in G2 while 3.33 ± 0.1 to 4.11 ± 0.2 g/dL in G3 in whole study (Table 4)

Sodium (Na) and potassium (K)

The mean square value for effect of treatments on sodium and potassium revealed significant differences in all groups. From mean (Table 5) it was observed that maximum Na was recorded as (139.11 ± 1.3) in G0 means followed by (138.94 ± 2.2)G1 and (136.61 ± 1.6 mmole/L). Furthermore, it also predicted that during the whole study the Na was reduced in all treated groups i.e. 141.33 ± 2.1 to 136.83 ± 2.8 in G1, 139.66 ± 2.1 to 127.83 ± 2.8 in G2 while 138.16 ± 2.3 to 136.83 ± 2.8 mmole/L in G3, respectively. Regarding the potassium (K), maximum value was recorded as (6.81 ± 0.3) in G0 means followed by (6.40 ± 0.3) G1 and (5.57 ± 1.2 mmole/L). It was also observed from the table that maximum value for K was 7.08 ± 0.2 in G1 while lowest value was 4.36 ± 0.2 mmole/L in G3 from the 0 days study to 28th days trail.

Urea and creatinine

The mean square value for effect of treatments on urea and creatinine revealed significant differences in all groups. From mean (Table 6) it was observed that maximum urea content was recorded as (58.11 ± 2.8) in G0 means followed by (49.94 ± 3.9)G3 and G1 (49.16 ± 2.1 mg/dL). Furthermore, it also predicted that during the whole study urea content was reduced in all treated groups i.e. 55.16 ± 2.8 to 43.16 ± 2.8 in G1, 55.66 ± 2.1 to 40.83 ± 2.8 in G2 while 54.33 ± 2.1 to 46.83 ± 3.3 mg/dL in G3, respectively. Regarding the creatinine, maximum value was recorded as (0.81 ± 0.8) in G0 means followed by (0.67 ± 0.2) G2 and G1 (0.64 ± 0.1 mg/dL). It was also observed from the table that maximum value for creatinine was 0.88 ± 0.1 in G0 while lowest value was 0.46 ± 0.2 mg/dL in G2 from the 0 days study to 28th days trail (Tables 5 and 6).

Alanine aminotransferase (ALT) and aspartate aminotransferase (AST)

The mean square values for effect of treatments on ALT and AST revealed significant differences in all groups. From mean (Table 7) it was observed that maximum ALT was recorded as (199.38 ± 1.6) in G4 means followed by (181.61 ± 1.5)G0 and G2 (144.05 ± 3.8 U/dL). Furthermore, it was also predicted that during the whole study the ALT was reduced in all treated groups i.e. 179.33 ± 2.1 to 111.83 ± 2.8 in G1, 181.33 ± 2.1 to 107.66 ± 2.7 in G2 while 187.16 ± 3.54 to 218.16 ± 2.31 U/dL in G3, respectively. Regarding the aspartate aminotransferase (AST), maximum value was recorded as (32.05 ± 1.4) in G0 means followed by (27.44 ± 5.4)G1 and G3 (27.33 ± 6.0 U/L) (Table 7).
Discussion

Mikail reported that there was decrease in the red blood cell in garlic extract and Berenil-treated rabbits group compared to the infected non treated ones [17]. He observed that red blood cells were reduced by the extract and Berenil-treated rabbits group compared to the infected non intake dose from 17 ± 0.9 to 20 ± 0.6 (10^3/mm^3). Kung-chi extract and Berenil-treated rabbits group compared to the infected non mm^3). However, increase in the WBC's count was observed in garlic discussion.

Table 6: Means for Urea and Creatinine.

<table>
<thead>
<tr>
<th>Groups</th>
<th>0 Days</th>
<th>14 days</th>
<th>28 days</th>
<th>Means</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Urea (mg/dL)</td>
<td>Creatinine (mg/dL)</td>
<td>Urea (mg/dL)</td>
<td>Creatinine (mg/dL)</td>
</tr>
<tr>
<td>G_0</td>
<td>56.16 ± 2.92b</td>
<td>0.88 ± 0.18a</td>
<td>56.83 ± 2.85b</td>
<td>0.62 ± 0.24ab</td>
</tr>
<tr>
<td>G_1</td>
<td>55.16 ± 2.85b</td>
<td>0.83 ± 0.16ab</td>
<td>49.16 ± 2.85c</td>
<td>0.61 ± 0.23abc</td>
</tr>
<tr>
<td>G_2</td>
<td>55.66 ± 2.16b</td>
<td>0.88 ± 0.19a</td>
<td>44.83 ± 2.85de</td>
<td>0.66 ± 0.20abc</td>
</tr>
<tr>
<td>G_3</td>
<td>54.33 ± 2.16b</td>
<td>0.66 ± 0.17abc</td>
<td>46.86 ± 2.85bc</td>
<td>0.56 ± 0.25bc</td>
</tr>
<tr>
<td>Mean</td>
<td>55.33 ± 0.78a</td>
<td>0.81 ± 0.10a</td>
<td>49.87 ± 5.02b</td>
<td>0.66 ± 0.11b</td>
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</table>

Table 7: Means for Alanine aminotransferase (ALT) and aspartate aminotransferase (AST).

<table>
<thead>
<tr>
<th>Groups</th>
<th>0 Days</th>
<th>14 days</th>
<th>28 days</th>
<th>Means</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>ALT (U/I)</td>
<td>AST (U/I)</td>
<td>ALT (U/I)</td>
<td>AST (U/I)</td>
</tr>
<tr>
<td>G_0</td>
<td>180.33 ± 2.16e</td>
<td>30.83 ± 2.85ab</td>
<td>181.16 ± 2.31de</td>
<td>33.66 ± 2.16a</td>
</tr>
<tr>
<td>G_1</td>
<td>179.33 ± 2.16f</td>
<td>32.68 ± 3.32a</td>
<td>134.83 ± 2.31g</td>
<td>27.83 ± 3.71b</td>
</tr>
<tr>
<td>G_2</td>
<td>181.33 ± 2.16de</td>
<td>34.16 ± 3.31a</td>
<td>143.16 ± 2.85f</td>
<td>16.83 ± 3.48g</td>
</tr>
<tr>
<td>G_3</td>
<td>187.16 ± 3.54c</td>
<td>34.16 ± 2.85f</td>
<td>192.83 ± 2.31b</td>
<td>21.83 ± 2.31c</td>
</tr>
<tr>
<td>Mean</td>
<td>182.04 ± 3.51a</td>
<td>32.70 ± 1.39a</td>
<td>163.00 ± 28.32b</td>
<td>24.87 ± 7.40b</td>
</tr>
</tbody>
</table>

Conclusion

Functional foods are gaining popularity worldwide owing to the consumer's preference towards the consumption of natural, fewer side effects, cost effective and safe products in dietary modifications. Garlic (Allium sativum L.) is an essential vegetable that has been widely utilized as seasoning, flavoring, culinary and in herbal remedies. Bioactive molecules present in garlic are playing pivotal role in maintaining human health and reduce various ailments like diabetes, cholesterol, cardiovascular diseases and cancer insurgence. Functional garlic extract containing water soluble active components resulted in reduction in cholesterol, red blood cells, PCV, Na, K, urea, creatinine, ALT and AST indicating their effectiveness against hypercholesterolemic perspectives. Likewise, serum glucose was also significantly reduced the serum urea levels compared with the reperfusion group (P < .001) [21]. Pretreatment with aqueous garlic extract also resulted in significant increase in urine potassium (P = 0.03) compared to reperfusion. It is also reported that serum creatinine reduced by the intake of aqueous garlic extract as compare to normal from 0.82 ± 0.04 mg/dL to 0.76 ± 0.05 mg/dL. El-Demerdash reported that the value of ALT in control group was (51 ± 2.07 U/dL) but after taking the feed of garlic it was slight improved as compared to control group [22]. In case of diabetic group value of ALT was (82 ± 4.3 U/dL) that was greater than that of control group. Metwally also reported that by feeding the garlic to the fish Tilapia nilotica significant changed in AST level was observed in different groups [23]. It was concluded that different groups like control group, fed natural garlic, garlic oil and garlic powder had reduce AST as 117.86 ± 4.57 U/L, 92.63 ± 3.50 U/L, 80.73 ± 2.63 U/L and 82.46 ± 1.92 U/L respectively. It was concluded that AST level decrease in serum by consuming different sources of garlic. El-Demerdash reported that the value of ALP in control group was (48 ± 3.03 U/dL) after feeding the onion and garlic it was reported that it reduced while in case of diabetic group the value of ALP was slightly increased (73 ± 3.40 U/dL)[22].
substantially reduced and hematological analyses were also improved by phytotherapy of functional food diets. Moreover, renal and liver function test, serum biochemistry, protein ratios, electrolites and non-electrolites were within normal range revealing safety health concerns of garlic. However, improvement in WBC’s, MCV, albumin and globulin may also confirm its functional and nutraceutical utilization. From the present investigation, it is deduced that garlic preparations like aqueous extract, garlic oil, garlic macerates are effective against hypercholesterolemia and hyperglycemia therefore, proposed to cure various life threatening disorders.

References


