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THE MOLLUSCIDAL ACTIVITY OF BIOMPHALARIA ALEXANDRINA SNAILS.

ABSTRACT: The present work evaluates the molluscicidal activities of certain plant extracts (water suspension, Cold water, Boiled water, methanol, ethanol, acetone and chloroform extract) against Biomphalaria alexandrina. Preliminary screening tests conducted on 10 plant species that belong to 9 different families showed that the higher potency was recorded for Agave celsii, Ammi visnaga and Chenopodium ambrosioides. Also, exposure of B. alexandrina snails to plant extracts led to a significant reduction in the survival and in the growth rates as well as in their infection with Schistosoma mansoni miracidia. The results obtained also revealed that the glucose concentration increased in haemolymph, while soft tissue glycogen and protein contents were decreased. The activities of Hexokinase, pyruvatekinase and lactate dehydrogenase were also significantly reduced in response to treatment, while adenosine triphosphatase (ATPase) activity of the tissue of the snails was significantly increased.

Key words: B. alexandrina - Schistosoma mansoni - plant molluscicides

INTRODUCTION

In Egypt, schistosomiasis represents a major health and economic problem as it affects millions of farmers, diminishing their productivity and exerting a serious socioeconomic problem. Biomphalaria alexandrina is the intermediate host of Schistosoma mansoni in Egypt. The use of plants with molluscicidal properties appears to be a simple and inexpensive alternative to chemical molluscicides (Perrett and Whitfield, 1996). More than 1000 plant species have been screened for molluscicidal activity (El-Bolkiny et al., 1997). Many investigators have studied the molluscicidal activity of certain plants and their extracts. In Egypt, screening of local plants for molluscicidal activity has received increasing attention (Mohamed et al., 1981; El-Sawy et al., 1983; Rawi et al., 1995; Bakry et al., 2002 a&b ; Sakran, 2004).

In order to promote energy production, gastropods categorize primarily carbohydrates, which are stored in certain tissues as glycogen and transported in the haemolymph as glucose (Livingstone and Dezwaan, 1983). The molluscicides greatly were found to affect the metabolic activities of the snail intermediate hosts (Rawi et al., 1995). They act on different enzymes chiefly those of respiration and carbohydrate metabolism (Bakry et al., 2002).

The present study aims at evaluation of the molluscicidal action of the most promising plant extracts as monitored by determination of survival and growth rate of Biomphalaria alexandrina and their rates of infection with Schistosoma mansoni miracidia, in addition to investigation of the characteristic pattern of changes in activities of hexokinase (HK), pyruvate kinase (PK), lactate dehydrogenase (LDH) and adenosine triphosphatase (ATPase).

MATERIALS AND METHODS

Laboratory bred Biomphalaria alexandrina (2.4-10 mm in shell diameter) and Schistosoma mansoni miracidia were obtained from Schistosome Biological Supply Centre (SBSC), Theodor Bilharz Research Institute, Cairo, Egypt.

The plants used in this study were Agave celsii (Agavaceae), Rumex dentatus (Polygonaceae), Ammi visnaga (Umbelliferae), Chenopodium ambrosioides (Chenopodiaceae),
Lycium schweinfurthii (Solanaceae) Lantana camara (Verbenaceae). Chenopodium murale (Chenopodiaceae), Launaea cassiniana (Compositae), Cassia nodosa (Leguminosae) and Eucalyptus rostrata (Mortaceae). Plants were collected from fields of Giza Governorate, during flowering stages (March-April). These plants were kindly identified by the Botany Department, Faculty of Science, Cairo University. The whole overground parts of these plants were left to dry in air and then in an oven at 50°C and powdered by a mixer.

**Preparation of plant extracts**

**Water suspension**

To investigate the potency of water suspension of the whole over ground parts dry powder of each plant, specific weights were added to 1000 ml of dechlorinated tap water to make the desired series of weight/volume concentrations.

**Cold water extract**

For each promising plant, a stock extract was prepared by soaking 10 grams of the powder in 250 ml of dechlorinated tap water for 3 days at room temperature. This suspension was occasionally shaken every 24 hours. The suspension was then filtered through filter paper followed by addition of cold water to adjust the filtrate at specific volume.

**Boiled water extract**

For each promising plant a stock extract was prepared by soaking 10 grams of the powder in 400 ml of dechlorinated tap water. This suspension was then heated at 100°C for one hour. Boiled tap water was added to replenish the evaporated part. The suspension was then left to cool at room temperature then filtered through filter paper.

**Other plant extracts**

Each promising plant powder was then exhaustively extracted with different solvents (methanol, ethanol, acetone and chloroform) by soaking at room temperature (25 ± 3°C). Each solvent was used at a ratio of 2 ml/1 g for at least 7 days, extraction period. Each solvent was distilled off under vacuum and the crude extract residues were assayed as aqueous solutions.

The efficacy of the plant extracts prepared against adult snails was determined according to the standard procedure recommended by WHO (1965). The LC₅₀ and LC₁₀ were determined according to Litchfield and Wilcoxon (1949); LC₅₀ was determined as 1/10 LC₁₀ (WHO, 1965).

The Effect of the promising plants on some biological and biochemical aspects of snails:-

For studying the growth rate of *B. alexandrina* snails (8 -10 mm), snails were daily fed boiled or oven dried lettuce leaves and blue green algae *Nostoc muscorum*. Each aquarium was provided with polyethylene sheets for snail oviposition. Dead snails were removed daily from aquaria and the survival rate (l, fraction of the correct one) was recorded weekly. The shell diameter was measured weekly throughout the exposure period using a caliper (El-Emam and Madsen, 1982).

*B. alexandrina* eggs of one - three and six- days age were determined to examine the effect of LC₁₀ of methanol extracts of *A. celsii*, *A.visnaga* and *C. ambrosioides* on the different stages of egg development. The number of egg masses and eggs laid on polyethylene sheets were counted daily using a binocular stereomicroscope. Each group of eggs in a Petri dish was exposed to 100 ml of LC₁₀ of methanol extracts of *A. celsii*, *A. visnaga* and *C. ambrosioides*, till hatching. Another group of eggs was maintained in dechlorinated water as control.

The effect of the plants on the infection rate of *B. alexandrina* with *S. mansoni* miracidia and cercarial production was examined by exposing 3 groups each of 50 snails (2.6 -2.9 mm) individually to a dose of 10 miracidia/snail and maintained in LC₁₀ of methanol extract of each plant for 24 hours under room temperature (24±1°C) and illumination. After exposure to miracidia, snails were kept in the methanol extract. Another group of 50 snails was exposed to miracidia in the absence of the tested plants and maintained under the same conditions (control group). Examination of snails for cercarial shedding was carried out twice a week, 25 days post exposure, and the cercarial suspension was poured in a graduated Petri dish, then a few drops of Bow's fluid were added and all cercariae were counted, using a dissecting microscope. Shedding snails were then isolated and kept in special aquaria in complete dark.

For studying physiological parameters of *B. alexandrina* snails (8 -10 mm), snails were randomly divided into 4 groups (50 snails each). The 1st, 2nd and 3rd groups were exposed to LC₁₀ of methanol extract from *A. celsii* (6.5 ppm), *A. visnaga* (14 ppm) and *C. ambrosioides* (38 ppm) for one month, respectively. A fourth group of snails was left unexposed under the same laboratory conditions as control. Snails that survived after exposure were used to study the effects of the plant extracts on protein and glycogen contents in their soft tissues and glucose level in their haemolymph. The activities of hexokinase (HK), pyruvate kinase (PK), lactate dehydrogenase (LDH), and adenosine triphosphatase (ATPase) were also investigated in treated and untreated snails.

Haemolymph samples were collected according to Michelson (1966) by removing a small portion of the shell and inserting a capillary tube into the heart. Haemolymph was pooled from 10 snails and collected in a tube (1.5 ml) in an ice-bath. For preparation of tissues of snails, one gram of snails' soft tissues from each group was homogenized in 5 ml distilled water at pH 7.5. A glass homogenizer was
used and the homogenate was centrifuged for 10 minutes at 3000 rpm, then the fresh supernatant was used.

Biochemical parameters were determined spectrophotometrically using kits purchased from BioMerieux Company, France. Total protein content was determined according to Lowry et al. (1951). Tissues glycogen was evaluated according to Carroll et al. (1951) and haemolymph glucose concentration was determined according to the glucose oxidase method of Trinder (1969).

Hexokinase (HK) was assayed according to the method of Uyeda and Racker (1965). Pyruvate kinase (PK) relative activity was measured spectrophotometrically by the method of McManus et al. (1956) and haemolymph glucose concentration was determined according to the method of Giles and Vanstone (1976). Adenosine triphosphatasae activity was assayed according to the modified method of Giles and Vanstone (1976).

Statistical analysis

Analysis of data was carried out by Student’s t-test for comparing the means of experimental and control groups (Spiegel, 1981).

RESULTS

It is clear from Tables (1) that out of the studied plant species only seven were effective as water suspensions against B. alexandrina snails after 24 hours exposure. These plants are Agave celsii, Ammi visnaga, Chenopodium ambrosioides, Rumex dentatus, Lycium schweinfurthi, Lantana camara and Chenopodium murale, where Launaea cassiniana, Cassia nodosa and Eucalyptus rostrata plants were did not show activity against the snails.

Table (1) Molluscicidal activity of different plants as a cold water suspension of the dry powder, against Biomphalaria alexandrina snails after 24 hours exposure under laboratory conditions.

<table>
<thead>
<tr>
<th>Plant species</th>
<th>Family</th>
<th>LC10</th>
<th>LC50</th>
<th>LC90</th>
<th>Slope</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agave celsii</td>
<td>Agavaceae</td>
<td>22</td>
<td>40</td>
<td>73</td>
<td>1.62</td>
</tr>
<tr>
<td>Ammi visnaga</td>
<td>Umbelliferae</td>
<td>38</td>
<td>94</td>
<td>180</td>
<td>1.67</td>
</tr>
<tr>
<td>Chenopodium ambrosioides</td>
<td>Chenopodiaceae</td>
<td>82</td>
<td>150</td>
<td>260</td>
<td>1.57</td>
</tr>
<tr>
<td>Rumex dentatus</td>
<td>Polygonaceae</td>
<td>320</td>
<td>580</td>
<td>1100</td>
<td>1.53</td>
</tr>
<tr>
<td>Lycium schweinfurthi</td>
<td>Solanaceae</td>
<td>340</td>
<td>740</td>
<td>1300</td>
<td>1.82</td>
</tr>
<tr>
<td>Lantana camara</td>
<td>Verbenaceae</td>
<td>820</td>
<td>1230</td>
<td>2400</td>
<td>1.54</td>
</tr>
<tr>
<td>Chenopodium murale</td>
<td>Chenopodiaceae</td>
<td>1100</td>
<td>2450</td>
<td>5200</td>
<td>1.94</td>
</tr>
<tr>
<td>Launaea cassiniana</td>
<td>Compositae</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Cassia nodosa</td>
<td>Leguminosae</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Eucalyptus rostrata</td>
<td>Moraceae</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

The data presented in Table (2) show that the A. celsii, A. visnaga and C. ambrosioides plants had apparent, molluscicidal activity. Generally the most effective extract was that of methanol (LC50 value was 10 ppm for A. celsii) while cold water, cold water, ethanol, acetone and chloroform extracts showed less molluscicidal effect (LC50 values of A. celsii were 32, 21, 30, 44 and 52 ppm, respectively).

Table (2): The molluscicidal activity of some plant species against Biomphalaria alexandrina snails after 24 hours of exposure under laboratory conditions.

<table>
<thead>
<tr>
<th>Extracts</th>
<th>Antifilarial activity</th>
<th>LC10</th>
<th>LC50</th>
<th>LC90</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cold water</td>
<td>13 32 54 1.72</td>
<td>32 53 88 1.44</td>
<td>46 118 219 1.65</td>
<td></td>
</tr>
<tr>
<td>Hot water</td>
<td>32 21 26 0.92</td>
<td>32 26 85 1.52</td>
<td>32 66 96 1.52</td>
<td></td>
</tr>
<tr>
<td>Methanol</td>
<td>6.5 30 53 1.45</td>
<td>32 26 82 1.52 32 66 96 1.52</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethanol</td>
<td>38 30 48 1.38</td>
<td>32 41 76 1.35</td>
<td>38 78 120 1.41</td>
<td></td>
</tr>
<tr>
<td>Acetone</td>
<td>82 80 82 1.06</td>
<td>82 80 125 1.09</td>
<td>82 160 160 1.02</td>
<td></td>
</tr>
<tr>
<td>Chloroform</td>
<td>38 82 78 1.39</td>
<td>38 74 120 1.37</td>
<td>38 160 160 1.36</td>
<td></td>
</tr>
</tbody>
</table>

Moreover, methanol extract of the plants caused significant reduction (P<0.01) in shell diameter of exposed snails. The diameter was 5.2 mm, 6.2 mm and 6.6 mm at 5 weeks for snails exposed continuously to LC10 of methanol extract of A. celsii, A. visnaga and C. ambrosioides plants, respectively, which are significantly less than that of control group (8.52 mm).

Table (3): Mean shell diameter (mm) of Biomphalaria alexandrina snails continuously exposed to methanol extract (LC50) of three plant species.

<table>
<thead>
<tr>
<th>Observations period (weeks)</th>
<th>Cold water</th>
<th>Hot water</th>
<th>Methanol</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0.4</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0.2</td>
<td>0.8</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>5</td>
<td>0.04</td>
<td>0.04</td>
<td>0.04</td>
<td>0.04</td>
</tr>
<tr>
<td>6</td>
<td>0.04</td>
<td>0.04</td>
<td>0.04</td>
<td>0.04</td>
</tr>
<tr>
<td>7</td>
<td>0.04</td>
<td>0.04</td>
<td>0.04</td>
<td>0.04</td>
</tr>
<tr>
<td>8</td>
<td>0.04</td>
<td>0.04</td>
<td>0.04</td>
<td>0.04</td>
</tr>
<tr>
<td>9</td>
<td>0.04</td>
<td>0.04</td>
<td>0.04</td>
<td>0.04</td>
</tr>
<tr>
<td>10</td>
<td>0.04</td>
<td>0.04</td>
<td>0.04</td>
<td>0.04</td>
</tr>
</tbody>
</table>

The data obtained (Table 3) showed that growth of snails is a continuous process throughout their life span. There are two phases of growth: the first is characterized by a fast growth rate (4 weeks). The growth rates in this period for snail groups exposed to LC50 of methanol extract of A. celsii, A. visnaga and C. ambrosioides plants were 71.4%, 85.7% and...
107.14%, respectively which were significantly lower than that of control group (142.86%, P<0.001). The second phase of growth characterized by a slower growth rate where the rate was 12.5% for snails exposed for 2 weeks to LC10 of methanol extract of A. celsii (Table 4).

Table (4): Growth rate (%) of Biomphalaria alexandrina throughout their life span under continuous exposure to methanol extract (LC10) of three plant species

<table>
<thead>
<tr>
<th>Growth phase</th>
<th>Agave celsii</th>
<th>A. visnaga</th>
<th>Chenopodium ambrosioides</th>
<th>Control snails</th>
</tr>
</thead>
<tbody>
<tr>
<td>First 2 week</td>
<td>4.1 ± 0.2</td>
<td>4.6 ± 0.3</td>
<td>4.4 ± 0.2</td>
<td>4.9 ± 0.1</td>
</tr>
<tr>
<td>Second 2 week</td>
<td>2 ± 0.1</td>
<td>2.2 ± 0.3</td>
<td>2.1 ± 0.2</td>
<td>2.4 ± 0.1</td>
</tr>
</tbody>
</table>

The eggs hatchability of snails exposed to the methanol extract was decreased by increasing their age after deposition (Table 5). Thus, hatchability rates of eggs exposed to LC10 of methanol extract of A. celsii were 38, 30 and 26% for 1, 3 and 6 days old eggs respectively Which significantly less than that of control group (P<0.001).

The methanol extracts caused significant reduction in hatchability of B. alexandrina eggs, where, the values at LC10 of methanol extract of A. celsii, A. visnaga and C. ambrosioides for 6 day old eggs were 26, 32 and 44 respectively with significant difference than that of control group (72%, P<0.01).

Table (5): Effect of methanol plant on hatchability of Biomphalaria alexandrina eggs.

<table>
<thead>
<tr>
<th>Plant species</th>
<th>Hatchability of Biomphalaria alexandrina eggs (%)</th>
<th>1 day old</th>
<th>3 days old</th>
<th>6 days old</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>88</td>
<td>80</td>
<td>72</td>
<td></td>
</tr>
<tr>
<td>Agave celsii</td>
<td>38</td>
<td>30</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>A. visnaga</td>
<td>48</td>
<td>38</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>C. ambrosioides</td>
<td>62</td>
<td>54</td>
<td>44</td>
<td></td>
</tr>
</tbody>
</table>

The infection rate (Table 6) was significantly lower than that of the control snails (85.1%) being 29.16%, 53% and 31.5% (Table 1) for snails exposed to LC10 of methanol extract of A. celsii, A. visnaga and C. ambrosioides respectively. There is no significant difference between prepatent period of the snails exposed to LC10 of the methanol extracts and the control group. The duration of cercarial shedding for snails treated with LC10 of methanol extract of A. celsii, A. visnaga and C. ambrosioides plants decreased to 4.6 ± 1.2, 66.2 ± 1.25and 7.8 ± 2.2 days respectively, compared to 9.6 ± 2.4 days for the control snails. A highly significant reduction of total cercarial production by treated snails in comparison with control group was also observed (Table 7).

Table (6): Effect of methanol plant extract on infectivity of Schistosoma mansoni miracidia to Biomphalaria alexandrina snails.

The results (Table 8) showed also, a significant reduction in the total protein content of the soft tissues throughout the exposure period. The rates of reduction were 55.22% and 28.18% after one month of exposure. The glycogen content in tissues of the treated snails was also significantly reduced. The maximal reduction rates were 65.5% and 28.2% after one month of exposure to LC10 of methanol extract of A. celsii, A. visnaga and C. ambrosioides plants, respectively. On the other hand, the glucose concentration in haemolymph of the snails exposed to the tested methanol extracts showed a significant increase in comparison with the control group (18±1.2 mg / ml). The values recorded were 28.4 ± 2.1, 22 ± 2.3 and 20.4 ± 1.6 mg / ml in haemolymph of snails exposed to LC10 of methanol extract of A. celsii, A. visnaga and C. ambrosioides plants, respectively.

Table (7): Effect of methanol plant extracts on cercarial production of Schistosoma mansoni from infected snails.

Table (8): Effect of one month exposure to LC10 of methanol plant extracts on glucose level in haemolymph, total protein and glycogen content in soft tissues of Biomphalaria alexandrina snails.
The present study showed that LC$_{10}$ of methanol extract of *A. celsii*, *A. visnaga* and *C. ambrosioides* plants induced a significant increase in the activity of ATPase being 0.62 ± 0.034 (86.4%) and 0.64 ± 0.032 (45.45%) and 0.52 ± 0.021 (18.2%) umoles pi/min/g of wet tissue, respectively in *B. alexandrina* tissues (Table 9 and Fig3). The activity of hexokinase (HK), pyruvate kinase (PK), lactate dehydrogenase (LDH), in the soft tissue of normal and treated snails are displayed in Table (9) and Fig(2). The LDH activity in the soft tissue of normal and treated snails are statistically significant as compared to the corresponding control value (6.4±1.8). The maximal effect however was attained in hexokinase activity; the values detected were decreased by 76.45, 61.19 and 18.75 %, respectively. Such values were statistically significant as compared to the control level.

**DISCUSSION**

A among the ten plants tested, *Agave celsii* had the highest molluscicidal activity against *Biomphalaria alexandrina* snails, followed by *Ammi visnaga* then *Chenopodium murale*. The high molluscicidal activity of *Agave celsii*, *Ammi visnaga* and *Chenopodium ambrosioides* are apparently attributed to the high concentration of active constituents. This is supported by Shoeb et al. (1982), Rawi et al. (2000); Mansour et al. (2002); and Abdel Kader (2005). Based on the 24-LC$_{50}$ values, methanol extract of the plants displayed marked more molluscicidal potency as compared with the other extracts. This finding may be related to plant specific differences in active gradients, differences in their mode of action, and their effect on the snails (Sakran and Bakry, 2005).

Prolonged exposure of the snails to LC$_{10}$ of methanol extract of *A. celsii*, *A. visnaga* and *C. ambrosioides* reduced their shell diameter than that of the control. This finding agrees with Mahmoud (1993) when the snails were exposed to sublethal concentrations of the pesticides and Mohamed et al. (2000) for snails exposed to sublethal concentration of Abamectin.

The growth rates of all treated snails were lower than that of the control, similar to that was found by Gawish (1997) and Mohamed et al. (2000). The reduction in growth of treated snails may be due to interference of molluscicides with the physiological activities of these snails (Cheng and Sullivan, 1974; El-Gindy and Mohamed, 1978; Bakry, 2002a).

The second phase of growth of treated and control snail groups were shorter than that of the first one. Suppression in growth rate is presumably due to utilizing part of metabolic energy in oviposition process and consequently affects the growth of snails. Moreover, treated snails suffered from higher mortality in this phase associated with a negative effect on their growth (Gawish, 1997; Mohamed et al., 2000).

Concerning the hatchability, the present study showed that hatchability of *B. alexandrina* eggs exposed to LC$_{10}$ of methanol extract of the plants decreased by increasing their age after deposition. This is in agreement with Gawish (1997) who reported that the older embryonic stages of *B. alexandrina* eggs were more susceptible to the molluscicides than freshly laid ones. This may be due to the thicker yolk layer surrounding the embryo in fresh laid eggs than in older ones. This layer and the egg membrane act as a mechanical barrier against the molluscicides or other pesticides that could not penetrate it (El-Emam and Madsen, 1982).

The present result showed that exposure to the LC$_{10}$ of methanol extract of *A. celsii* was significantly more effective against the hatchability of all development stages of eggs than exposure to the LC$_{10}$ of methanol extract of *A. visnaga* and *C. ambrosioides* plants.
The infectivity of *S. mansoni* miracidia to *B. alexandrina* was greatly reduced by LC\(_{10}\) of methanol extract of the tested plants. Comparable results were obtained by Tantawy et al. (2000) using *Solanum lubium* plant, Sharaf El-Din et al. (2001) using *Zygophyllum simplex* plant and Bakry et al. (2004) using methanol extract of *Oreopanax reticulum* and *Furcraea selloea*.

However, there was no significant difference between the prepatent period of the snails exposed to LC\(_{10}\) of methanol extract of the tested plants and the control. Despite that, a highly significant reduction in the duration of cercarial shedding and total cercarial production per snails was reported. This reduction in cercarial shedding period and total cercarial production per snails is probably due to rupture of snails’ tissues through miracidial penetration in the presence of those molluscicides which increased the harmful effects of these plant (Bakry et al., 2004). These observations are in accordance with many authors using different plant species as molluscicides. Thus, El-Ansary et al. (2000) reported that *A. maritima* caused a remarkable decrease in cercarial shedding and cercarial production in *B. alexandrina* snails treated with this plant powder. Sharaf El-Din et al. (2001) obtained similar reduction in cercarial shedding and cercarial production from *B. alexandrina* treated with sublethal concentrations of aqueous suspension of *Zygophyllum simplex*.

In the present investigation, a significant decrease has been recorded in the tissue protein in snails treated with LC\(_{10}\) of methanol extract of the tested plants. This decrease may be due to interference of active substance of the tested plants in protein metabolism by inhibiting protein synthesis. Similar results were obtained by Abdel Kader and Tantawy (2000) *Agave filifera* and *Agave attenuate* plant and Bakry et al. (2002a) using *Calotrops procera*, *Euphorbia nubia* and *Atriplex halimus* plant.

Regarding the sources of energy for snails, LC\(_{10}\) of methanol extract of the tested plants significantly decreased the glycogen content of soft tissues while increased the glucose level in haemolymph. This may be attributed to the effect of active substance of the tested plants that impedes oxygen consumption of snails, thus inducing anaerobic respiration. To restore its energy requirements, the snail has to increase the rate of glycolysis thus bringing about a reduction of its energy requirements, the snail has to increase the rate of glycolysis thus bringing about a reduction of ATPase activity in tissue homogenate of *B. alexandrina*. This increase in ATPase activity reflects the drastic rise in ATP requirements due to the toxic insult of the molluscicides and induced anaoxia.

From the above data, it could be concluded that the depletion in tissue protein, glycogen, and activity of some enzymes of energy metabolism (HK, PK, LDH, ATPase) of *B. alexandrina* snails treated with LC\(_{10}\) of methanol extract of *A. celsii*, *A. visnaga* and *C. ambrosioides* plants is mostly responsible for the high mortality of treated snails, reduction in their growth, hatchability of their eggs and their infection with *S. mansoni* miracidia.

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تأثير بعض المستخلصات البائنة ذات التأثير الإبدائي على فقاعات البيومفلاريا الكسندرنيا

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و. علم الحيوان-كلية العلوم-جامعة القاهرة

وقد أظهرت النتائج أن هذا التركيب (LC10) لهذه المستخلصات البائنة الثلاثة أدى إلى انخفاض في نسبة معدل النمو للفقاعات ومعدل نسب بعض الفقاعات. بالإضافة إلى أن مجالان الإحصائيتين عند مقارنته بنتائج الجهاز الميداني الصعب. زوائدً نسب نباً في بداية مراحل الجلوتين. ولهذا يمكننا أن نفكر في استعداد محتوى الثلثة البائئة لهذه المستخلصات البائنة. وتظهر أيضاً تم دراسة كيفية المستخلص الكحولي بالتركيز الغير مميت (ورلي) لهذه البحوث على معدل نمو فقاعات البيومفلاريا الكسندرنيا ومعدل نسب البائئة. وكذلك على محتوى الصفرات في السيروم و المجاوين ونشاط بعض الإحصائيات في أنماط الفقاعات المعرفة لهذا التركيب لمدة شهر.

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