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Evaluation alcoholic garlic extract to use as a safe alternative of chemical pesticides against *Eubania vermiculata* (O. F. Müller, 1774)

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ABSTRACT

Objective: To evaluate the safety of using alcoholic garlic extract as a molluscicide (as a safe alternative), its efficacy was compared to that of the commercial molluscicide metaldehyde. **Methods**: Both were used as oral baits against the ground snail *Eubania vermiculata* under laboratory conditions. Three concentrations (100, 150, and 200 mg) of both the alcoholic garlic extract and the molluscicide were tested over 168 hours. Mortality rates were recorded at 72, 96, 120, 144, and 168 hours. **Results**: The results showed a clear and proportional increase in mortality with increasing dose and duration. The highest concentration (200 mg) resulted in a 100% mortality rate after 168 hours, while no mortality was recorded in the control group. **Conclusion** : These results indicate that alcoholic garlic extract possesses strong biological properties and efficacy against molluscs and may become a potential alternative to current synthetic and chemical molluscicides.

Key words: *Eobania*; Müller; Garlic; Comparative; Molluscicide; Snail; Extract

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INTRODUCTION

Land snails are among the most prominent mollusks belonging to the phylum Mollusca. They are characterized by their calcareous shells, which cover their bodies and protect them from adverse environmental conditions. These snails often face significant challenges when exposed to unstable conditions in their natural habitats. They are considered among the most important pests affecting crops, especially in coastal agricultural environments characterized by moderate temperatures and high humidity [1,2]. The snail is one of the common snail species adapted to our Iraqi environments in the central and southern regions, as researched extensively [3, 4]. Garlic is a widely consumed aromatic herb used globally as both food and traditional medicine for a number of ailments. Studies have shown that garlic possesses numerous biological properties, including antioxidant, anticancer, and antidiabetic effects, as well as nephroprotective, anti-atherosclerotic, antibacterial, antifungal, and antihypertensive effects. Garlic is characterized by its content of sulfur-containing plant compounds such as alliin, allicin, ajoene, and phenylethylene, along with flavonoids such as quercetin. Garlic extracts and compounds have been studied to evaluate their biological activities, including antibacterial, antiviral, antifungal, and antiparasitic activities, in addition to anti-inflammatory, antioxidant, and anticancer activities [5,6]. Garlic contains chemically active compounds that distinguish it from other plants. Among the most important is allicin, a sulfur compound that is formed when garlic is crushed or chopped. It also contains other sulfur compounds such as alliin, allyl disulfide, and allyl trisulfide, which are responsible for its distinctive pungent odor. Garlic contains flavonoids and phenols, as well as amino acids and enzymes that contribute to its active ingredients. It also contains volatile oils derived from sulfur compounds, vitamins such as vitamin C and vitamin B6, and minerals such as sulfur and selenium [7, 8].

The current study aimed to try to evaluate the effectiveness of alcoholic garlic extract as a molluscicide and to assess its potential for use as a safe, effective and at the same time environmentally friendly alternative to the use of the synthetic molluscicide metaldehyde against the land snail *Eobania vermiculata*, but under laboratory conditions.

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MATERIAL AND METHODS

Materials and Reagents

Adult Eobania vermiculata snails were manually collected during the morning hours from Al-Husayniyah District and the gardens of the University of Kerbala in November 2025. The collected snails were transferred to well-ventilated plastic containers under laboratory conditions. Fresh garlic obtained from local Iraqi markets was washed, peeled, chopped, and stored at 4°C until extraction. The alcoholic garlic extract was prepared using 70% ethanol as an organic solvent. Approximately 500 g of chopped garlic were soaked in 5000 mL ethanol (1:10 w/v) for 48–72 h at room temperature with occasional stirring. The extract was filtered and concentrated at temperatures below 50°C using a hot air oven, then stored in sealed glass containers at 4°C until use [9,10]. Experimental baits were prepared by mixing flour, lettuce powder, molasses, and different concentrations of garlic extract or metaldehyde pesticide according to Table (1). The mixture was shaped into uniform pellets and slightly dried before application [11]. The experiment included four groups (control, 100, 150, and 200 mg/kg), with 10 snails per group and two replicates for each treatment. Snails were orally exposed to the prepared baits twice daily under controlled laboratory conditions for 168 h. Mortality was recorded at 72, 96, 120, 144, and 168 h, and dead snails were removed immediately to avoid contamination. The obtained data were statistically analyzed using two-way ANOVA to evaluate the effects of concentration, exposure time, and their interaction on snail mortality [12]. Figure 1. The baits were divided into different concentrations according to the treatments. The animal was then orally exposed to these baits as food rations [11].

Table 1. Baits components and their proportions

Treatment	Concentration(mg/kg)	Flour (g)	Lettuce powder (g)	Molasses (g)	Garlic extract or metaldehyde (g)
T0 (Control)	0	4	4	2	0
T1	100	4	4	2	0.001
T2	150	4	4	2	0.0015
T3	200	4	4	2	0.002

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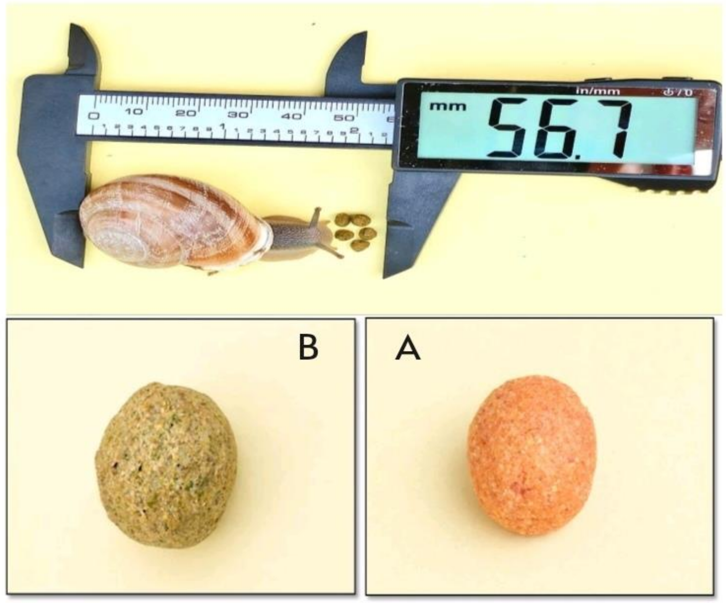

Figure 1. A snail being feeding.

A) Pesticide bait, B) Alcoholic garlic extract bait.

RESULTS AND DISCUSSION

The study results showed a significant and gradual increase in snail mortality as the extract concentration and exposure time increased. No deaths were recorded in the control group throughout the experiment. Effect of alcoholic garlic extract on cumulative mortality of *Eobania vermiculata* . The results demonstrated a gradual increase in cumulative mortality of *E. vermiculata* with increasing concentrations of alcoholic garlic extract and exposure duration. No mortality was recorded in the control group throughout the experimental period, indicating the suitability of laboratory conditions and the absence of external mortality factors. In contrast, mortality rates increased progressively in the treated groups (A1–A3), particularly at higher concentrations and longer exposure periods (Table 2). The concentration of 200 mg (A3) showed the highest molluscicidal activity, reaching complete mortality (10 snails) after 168 h of exposure, whereas the concentration of 100 mg (A1) exhibited the lowest cumulative mortality. These findings indicate a direct relationship between concentration and toxic effect. The gradual increase in mortality may be attributed to the cumulative effect of sulfur-containing compounds,

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particularly allicin, which can disrupt vital physiological and enzymatic functions in snails over time. These findings are consistent with previous studies reporting increased mortality rates in snails treated with plant extracts as exposure time and concentration increased [13-18].

Table 2. Cumulative mortality of *E. vermiculata* exposed to different concentrations over time

Treatment	Concentration	72 h	96 h	120 h	144 h	168 h
A0	Control	0	0	0	0	0
A1	100 mg	1	1	1	4	7
A2	150 mg	2	3	3	6	9
A3	200 mg	3	6	7	9	10

Table 3 presents the mortality percentages of E. vermiculata exposed to different concentrations of alcoholic garlic extract over time. Mortality percentages increased gradually with exposure duration in all treated groups. The highest mortality percentage was recorded at the concentration of 200 mg, reaching 100% after 168 h, while the concentration of 150 mg achieved 90% mortality at the same exposure period. The observed increase in mortality percentage confirms the effectiveness of alcoholic garlic extract as a bioactive molluscicidal agent. The delayed toxic effect compared with chemical pesticides may be associated with the mechanism of action of garlic compounds, which require accumulation within tissues before exerting physiological damage. Although metaldehyde showed faster toxicity and caused complete mortality within 48 h, the alcoholic garlic extract demonstrated considerable biological efficacy with potentially lower environmental risk and higher safety compared with conventional chemical pesticides.

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Table 3. Mortality percentage (%) of *E. vermiculata* different concentrations over time.

Treatment	Concentration	72 h	96 h	120 h	144 h	168 h
A0	Control	0%	0%	0%	0%	0%
A1	100 mg	10%	10%	10%	40%	70%
A2	150 mg	20%	30%	30%	60%	90%
A3	200 mg	30%	60%	70%	90%	100%

Figure 2 illustrates the difference in mortality patterns between alcoholic garlic extract and metaldehyde pesticide. The pesticide showed rapid toxic action, causing severe dehydration and excessive mucus secretion that resulted in snail death within 24–48 h [19]. In contrast, the alcoholic garlic extract produced a slower but progressive toxic effect, with mortality increasing gradually until reaching maximum values after prolonged exposure. This gradual toxicity is likely related to the action of biologically active sulfur compounds such as allicin and allyl sulfides, which interfere with metabolic and physiological processes after sufficient accumulation within snail tissues [20,21]. Despite the slower initial response, the alcoholic garlic extract achieved high mortality rates during later exposure periods, suggesting that it may serve as an environmentally safer alternative to synthetic molluscicides. Similar observations have been reported in studies evaluating plant-derived molluscicidal compounds against terrestrial and freshwater snails [22-25].

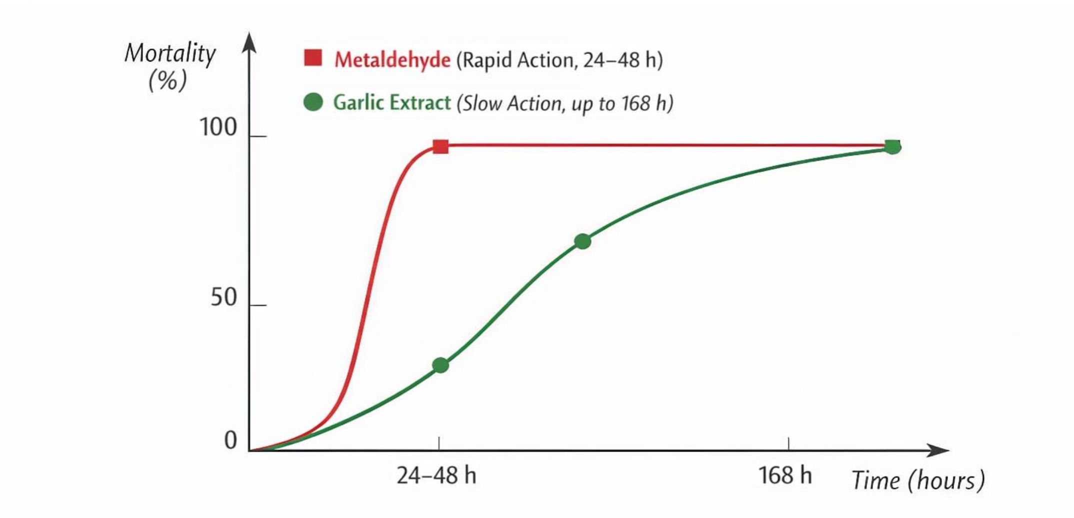

Figure 2.Comparison of *E. vermiculata* mortality rates over time between the effectiveness of alcoholic garlic extract and the pesticide metaldehyde.

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Conclusions

Alcoholic garlic extract can be used as a safe alternative against the agricultural pest, the snail, as it has a cumulative lethal effect, although its effectiveness is less than that of chemical pesticides. Alcoholic garlic extract can be used as a safe alternative against the agricultural pest, the snail, as it has a cumulative lethal effect, although its effectiveness is less than that of chemical pesticides. Alcoholic garlic extract can be used as a safe alternative against the agricultural pest, the snail, as it has a cumulative lethal effect, although its effectiveness is less than that of chemical pesticides.

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