INNSPUB

Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 23, No. 6, p. 81-91, 2023
http://www.innspub.net

RESEARCH PAPER OPEN ACCESS

Molluscicidal effect of garlic bulb and ginger rhizome crude water extract against *Oncomelania* sp. snail

Krissa Mae B. Anabo, Ma. Chrischelle F. Bullecer*, Ariane Mae D. Caberio, Raffy Van Dwyer S. Del Pilar, Lorvejean C. Suyom

Applied Sciences Department, College of Arts and Sciences, Leyte Normal University, Tacloban City, Leyte, Philippines

Article published on December 12, 2023

Key words: Molluscicidal, Garlic, Ginger, Crude water extract

Abstract

The genus *Oncomelania* snails are intermediate hosts for the human parasitic worm *Schistosoma japonicum*, whereas adult schistosomes infect humans the most. It is critical to keep these medically important organisms under control. These organisms' developmental stages are ideal for molluscicidal testing. The researchers used dose-response modelling and Probit analysis to assess the molluscicidal potential of crude water extracts from locally available plants (garlic bulb and ginger rhizome). The researchers ran assays in quadruplicate for each test concentration in four trials with five snails. Each test concentration was paired with its corresponding negative control. The results showed that the treatments caused mortality over time, with snail mortality varying by hour of exposure. The ginger rhizome crude water extract with a concentration of 2000 ppm had a higher molluscicidal activity against *Oncomelania sp.* snails (45% dead snails) exposed for 24 hours, whereas garlic bulb crude water with 600 ppm and garlic-ginger mixture with 2000 ppm extract exhibited the same moderate activity against *Oncomelania sp.* snails (40% dead snails). The LC50 and LC90 values of crude water extract of ginger rhizome were 3581.580 and 13636790.706 ppm, respectively, and 194.728 ppm and 0.657 ppm for garlic bulb. These findings suggest that garlic bulb and ginger rhizome crude water extracts have molluscicidal effect against *Oncomelania sp.* snails. The findings of this study have important implications for the future use of garlic bulb and ginger rhizome as a replacement for synthetic molluscicides.

***Corresponding Author:** Ma. Chrischelle F. Bullecer ✉ machrischelle.bullecer@lnu.edu.ph

Introduction

Schistosomiasis is one of the most common parasitic infections and the world's second most common parasitic disease in terms of morbidity, socioeconomic impact, and public health importance (WHO, 2022). The three major schistosome species that infect humans are *Schistosoma japonicum, S. mansoni* and *S. haematobium*, are transmitted by specific snail genera, namely *Oncomelania spp*., *Biomphalaria spp*., and *Bulinus spp*. Around 10 million Filipinos are living in endemic areas with 1.9 million individuals directly exposed. The disease is distributed in specific provinces in Luzon, Visayas, and Mindanao (Leonardo, 2015). Schistosomiasis is endemic in 25 areas in Leyte province namely: Abuyog, Alangalang, Babatngon, Barugo, Burauen, Carigara, Dagami, Dulag, Jaro, Javier, Julita, La Paz, Macarthur, Mayorga, Matag-ob, Palo, Pastrana, San Miguel, Sta. Fe, Tabontabon, Tacloban City, Tanauan, Tolosa, Tunga, and Villaba. Several of them were confined at the Schistosomiasis hospital in Palo, Leyte. Since November until early December, at least 57 cases have been reported in Villa Solidaridad, Mailhi, and Monteverde villages in Baybay, with an attack rate of 22 percent for every 100 population (Meniano, 2018). As mentioned in the study that Palo, Leyte is one of the endemic places of the disease and is nearly located in the researcher's residence and the records of the number of cases was gathered in Governor Benjamin T. Romualdez, General Hospital and Schistosomiasis Center by Lyn L. Verona, MD, MHA Medical Center Chief.

Although praziquantel and niclosamide are available and generally very effective, the treatments are expensive and not always successful. Biological control of snails that serve as intermediate hosts for Schistosoma appears feasible and cost effective in poor countries where schistosomiasis is common. Vectors are responsible for the spread and transmission of some of the world's most devastating human diseases, including malaria, dengue fever, schistosomiasis, chikungunya, yellow fever, Zika, leishmaniasis, Chagas disease, and Lyme disease (National Institute of Allergy and Infectious Diseases, 2022). Control of the intermediate host disrupts the parasite's life cycle, preventing infection transmission (WHO, 2022). Snails are the intermediate host for the trematode parasite of the Schistosoma genus, which is responsible for schistosomiasis, a disease that affects humans (Division of Parasitic Diseases and Malaria, 2019). The microbiota for Schistosoma has already been described as having an effect on host/parasite interactions, specifically through immunological interactions the continued transmission of snail-borne trematode infections in most endemic areas is facilitated by the presence and distribution of these important snail intermediate hosts that provide a suitable environment for the development of trematode parasites (Gerardo *et al.*, 2020). Schistosomiasis is enabled by poor sanitation, allowing schistosome eggs in feces or urine to pass into snail-containing habitats, and by the widespread use of such habitats for fishing or other occupations, bathing, recreation, washing of clothes, and as a source of drinking water. The long-term persistence of cercariae-producing snail infections in the water renders control more difficult. Even if infected people are successfully treated (usually with praziquantel) to eliminate their adult worms, they may quickly reacquire infections (Kamel *et al.*, 2021).

Molluscicide-based control of snail intermediate hosts is a quick and effective method for interrupting parasite transmission (King *et al.*, 2015). However, the synthetic chemical molluscicides commonly used to control these snails are costly and can be toxic to other living organisms in the snail's environment. Medicinal plants are the oldest and most widely used form of medication known to man, and they have gained prominence as a source of molluscicidal agents because they are less expensive and less harmful to the environment than their synthetic counterparts (Massoud *et al.*, 2012).

Garlic and gingers have been used for the treatment of diseases caused by parasites and microbes since ancient times. Lately, garlic has widely been used to treat intestinal parasites. The anthelminthic effect of garlic has been a matter of interest to researchers.

Their results showed that treatment with garlic evoked a significant reduction in the worm load (Riad *et al.*, 2009). Furthermore, an aqueous extract of the *Allium sativum* (garlic) bulb can effectively kill snails at concentrations ranging from 7.5 to 10 ppm (Picardal *et al.*, 2018). Several in and in vivo studies also have proven that *Z. officinale* and its constituents exert significant nematocidal cestocidal, trematocidal, anti-protozoal, insecticidal, molluscicidal and anti-leech effects. *Z. officinale* was reported to have molluscicidal and antischistosomal effect against *S. mansoni* miracidia and cercariae. The effect of *Z. officinale* on the survival rate, egg production, electrophoresis analysis, biochemical aspects of *Biomphalaria alexandina* snails infected with *S. mansoni*. *Z. officinale* has an effective anti-parasitic activity against several parasites and can be used for prevention of drug resistant parasitic diseases (Bakry *et al.*, 2013).

In this study, the researchers are evaluating and investigating the molluscicidal properties of garlic bulb and ginger rhizome crude water extracts of *Oncomelania sp.,* an intermediary host of *Schistosoma japonicum*.

Material and methods

Research design

This study made use of randomized experimental design where snails were randomly allocated to seven treatment groups (five snails per group) and were placed in plastic jar. The study is focused on evaluating the molluscicidal effect of garlic bulb and ginger rhizome against the intermediary host of *Schistosoma japonicum*, which is the *Oncomelania sp.* Snail (Fig 1).

The randomized experimental design was the most efficient design since what the researchers wants is to evaluate the molluscicidal performance of garlic and ginger. It was the most accurate type of experimental design and the most reliable method of creating homogeneous treatment groups, without involving any potential biases or judgments.

Research locale

Schistosomiasis Control Pilot Project developed a series of naturalistic measures to control *Oncomelania sp.*, the snail that serves as an intermediate host for bilharziasis in the Philippines, between 1954 and 1956. The measures devised involved radical changes to the habitat, rendering it unsuitable for the survival and reproduction of the snail. In 1956, the project embarked on a scheme to implement these measures in a large portion of the municipality of Palo, Leyte Province, where the project headquarters are located. After this, there were no recent published studies on schistosomiasis control and the other related studies were unpublished.

Fig. 1. *Oncomelania sp.* snail

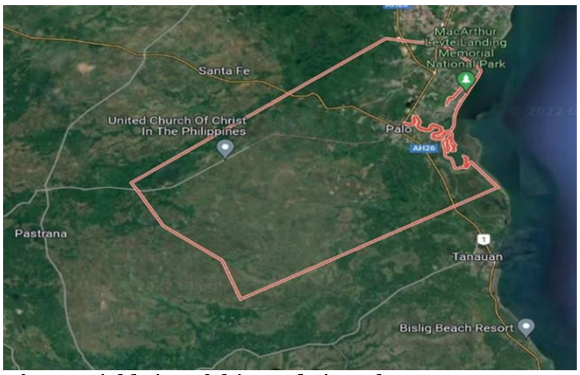

Fig. 2. Field site of this study in Palo, Leyte

Schistosomiasis is pandemic in 25 areas in Leyte province including Tacloban City and Palo, Leyte since it is a lowland area and flooding is rampant (Meniano, 2018). The data gathering was conducted in Palo, Leyte since this is where the snails were rampant apart from being one of the endemic municipalities (Fig. 2). The experiment was conducted specifically in Leyte Normal University, Tacloban City to have a better observation of the test samples/set ups and to avoid undesired interventions that might occur and possibly alter the result, since the specified snails were also collected near the municipality. With the geography of the place, snails are prevalent and were collected.

Sampling technique

Probability sampling, specifically simple random sampling, was used in selecting the two hundred (200) samples of *Oncomelania sp.* snail upon collecting it from the fresh water, wet lands, and some small bodies of water like swamps, lakes and ponds in three (3) barangays of Palo, Leyte: Brgy. Gacao, Brgy. San Isidro and Brgy. Anahaway. The samples undergone equal distribution when it comes to exposing them to the treatments which are the garlic bulb and ginger rhizome. This was done to evaluate if the selected plants have different molluscicidal efficacy rate against the intermediary host of *Schistosoma japonicum*, *Oncomelania sp.* snail. Whereas, garlic bulb and ginger rhizome crude water extracts, were used as experimental units. In this study, researchers performed assays for each test concentration in quadruplicates and in three (3) treatments using five (5) snails. Each treatment comprised two (2) test concentrations, four (4) replicates and one negative control per test concentration. Each of the test concentrations was paired to a negative control (distilled water). There were a total of seven (7) set-ups including the control set up which is the distilled water. Moreover, four (4) trials that were collected called as test series was performed for each plant extract preparation. Pooled data from each test series was used in data processing and comparison.

Research procedure

Snail collection

Freshwater *Oncomelania sp.* full-grown snails (4-5 mm in length) were obtained for two hundred (200) samples from three (3) different barangays in Palo, Leyte, Philippines. Technical assistance was sought from a trained malacologist, Mr. Raffy Jay C. Fornillos who is also a graduate in a DNA Barcoding Laboratory, Institute of Biology, University of the Philippines, Diliman, Quezon City, for the identification, handling, preservation, and verification of test snails. To avoid possible contact with the infectious *S. japonicum*, complete suit (PPE, thick jeans, boots, goggles and hand gloves) was worn during the collection. Forceps were used to pick up the adult snails. The snails were immediately transferred to a container and were washed thoroughly to eliminate sticking mud and other debris.

Plant collection

Garlic bulb and Ginger rhizomes were collected at Palo Public Market. The researchers chose the generic ones for the availability and suitability of the place which is found in Palo Public Market. The collected plant materials were weighed, washed thoroughly with distilled water to remove adhering dirt, dried using a clean cloth and cut into small pieces using a knife. Before the extraction, pre-weighed bulb and rhizomes was air-dried for approximately 2 weeks. After the drying time, dried bulb and rhizomes were subsequently weighed assuring that 80% of their moisture content was removed.

Extraction of plant material

Garlic bulb and Ginger rhizomes were washed with running water, air dried for 2 weeks, shredded using food processor and a mortar and pestle, and then sieved with 1.5 mm pore-size strainer. All sieved samples were mixed for 30 minutes with distilled water. After 30 minutes, the mixture of plant extracts and distilled water were filtered with qualitative paper.

Snail acclimatization

Full-grown *Oncomelania sp.* snails that were collected from the three (3) barangays in Palo, Leyte were acclimatized to laboratory conditions for two days in a glass aquarium lined with qualitative paper on inner walls. The qualitative paper served as food for the snails. Dechlorinated water was used for acclimatization. The water inside the aquarium was maintained at a 5 mm water depth and the water was changed in every 24 hours. The snails were acclimatized under 12 hours: 12 hours light: dark cycles for two days.

Bioassay

Molluscicidal assays were performed according to WHO guidelines using 5 *Oncomelania sp.* snails immersing in test solution (2000 and 600 parts per million for garlic bulb), 5 *Oncomelania sp.* snails immersing in test solution (2000 and 600 ppm for ginger rhizome) and 5 *Oncomelania sp* snails immersing in test solution (2000 and 600 ppm for the combination of garlic bulb and ginger rhizome). Each test concentration was paired with one negative control (distilled water only). The molluscicidal activity of garlic bulb and ginger rhizomes extracts were tested against matured *Oncomelania sp.* snails. Mortality test was carried out for 24 hours, following the procedures of Rug and Ruppel (2000). Briefly, active test snails were placed randomly containers and was flooded with different test concentrations.

Dose-response modelling

Lethal concentrations (LC50 and LC90) were calculated for Garlic bulb, Ginger rhizome and combination of garlic bulb and ginger rhizome crude water extracts against the *Oncomelania sp.* snail with Probit analysis.

Preparation of test concentrations

For the test concentrations, the researchers based on accumulating the measurement of test concentration to a published study of Aromin *et al.* (2020), the Molluscicidal potential of selected plants against *Pomacea canaliculata*. In their study they used three concentrations in parts per million (ppm) for small concentrations: 1000 ppm, 500 ppm & 250 ppm, by this, the researchers made their test concentrations with modification for a lower risk of susceptibility to the snails due to limited equipment the researchers have. For the first concentration, the indication was 2 grams (g) of plant extract that was mixed in a 1000 ml of distilled water which will result to 2000 ppm test concentration. For the second concentration, the indication was 0.6 g of plant extract that was mixed in a 1000 ml of distilled water which will result to 600 ppm.

Snail mortality assessment

After 24 h of exposure to tests substances, snails in containers were assessed for mortality using motility criterion in every hour. Aside from motility criterion, the degree of decomposition and its associated foul smell were also used for mortality assessment after 24 hours. To determine the count of dead snails after 24hrs, the snails were placed separately on a clean dissecting pad followed by a drop of water to each snail. The snails were crushed gently with tongs to expose snail motility and tissue. The snails were gently prodded with a tong and lack of response after prodding was used as the mortality criterion. As validation, the researchers always observed noticeable reaction among snails in negative controls upon stimulation with the needle tip, which is, after crushing with tongs.

Measure parameters and statistical analysis

Snail mortality of after 24 hours exposure to various treatments was computed following the equation (Soulsby, 1982).

Snail disposal

At the end of the experimental trial, test snails were stocked in aluminum can containing synthetic molluscicide Niclosamide (Bayluscide® 250EC) at a recommended concentration of 0.002 mg mL−1. Snails, along with the other contaminated items that were used during the conduct of the experiment were burnt, and subsequently buried it in a 3 ft. below the ground in a vacant lot.

Results and discussion

Different concentrations from garlic bulbs and ginger rhizomes combined with constant solvent can serve as molluscicides against the adult *Oncolemania* sp. snails based on the comparable mortality between the control set-ups which is the distilled water. Sampled *Oncomelania* sp. were identified by the researchers through comparisons of related literature from

Genetic Comparison of *Oncomelania hupensis quadrasi* (Möllendorf, 1895) (Gastropoda: Pomatiopsidae), the intermediate host of *Schistosoma japonicum* in the Philippines, based on 16S Ribosomal RNA sequence (Chua *et al*., 2012) and furtherly confirmed by Dr. Raffy Jay Fornillos.

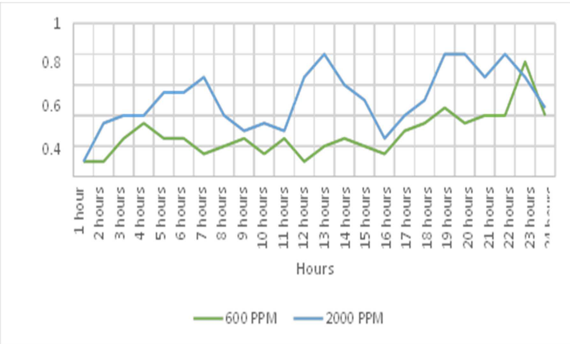

Fig. 3. Time series on the molluscicidal effect of Garlic bulb crude water extract

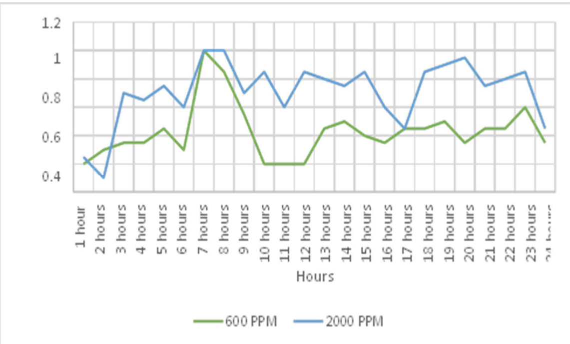

Fig. 4. Time series on the molluscicidal effect of Ginger rhizome crude water extract

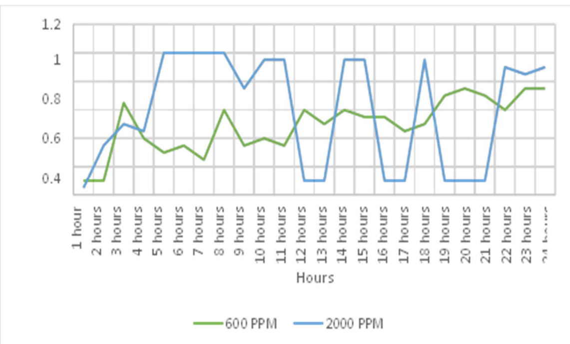

Fig. 5. Time series on the molluscicidal effect of Garlic bulb and Ginger rhizome crude water extract

A two-day acclimatization of sample *Oncomelania* sp. snails prior the application of treatments with 6 set and the mortality rate was calculated for each of the concentration. Data from four (4) replicates with six (6) treatments were set and the mortality rate was calculated for each of the concentration. Data from three separate treatments Figs 6, 7, and 8 were calculated and presented in graphs. Furthermore, mean mortality rates showed range from 0 to 50 percent.

This time series graph shows the relationship between molluscicidal performance and hours observed over exposure hour period (Figs 3, 4, and 5). The x-axis represents the number of hours observed in a row, ranging from 1 to 24 hours, while the y-axis shows the molluscicidal performance per 20 snails. The graph reveals a random variation: as the number of hours observed in a row increases, the molluscicidal performance either increases or decreases. Both of the concentrations at the beginning showed relatively low molluscicidal performance hovering around 2 deaths per 20 snails which was observed from 1-2 hours in a row.

However, 2000 ppm concentration on garlic bulb showed sudden rise movement, hovering around 7 deaths per 20 snails. At exactly 12 hours of observation, both of the two (2) concentrations showed opposite molluscicidal performance where the 600 ppm hovered around 2 deaths and the 2000 ppm hovered around 13 deaths per 20 snails. At the lower end of the x-axis, molluscicidal performance of garlic bulb remain relatively low, hovering around 8 deaths for 600 ppm and 9 deaths for 2000 ppm per 20 snails which were observed exactly 24 hours. Interestingly, as the number of hours observed increases, the molluscicidal performance appears to have random rising and falling movement. This may suggest that there is particular time in the hours of observation that do not contribute significantly to molluscicidal performance of garlic bulb crude water extract. There is a fixed and known frequency of each 600 ppm and 2000 ppm concentration for a constant number of snails, and the graph shows strong seasonality within each hour.

There are increases and decreases in the number of deaths in both concentrations of ginger rhizome crude water extract, as can be seen in the graph, but there are no conclusive fatality counts within the anticipated time frame. In 600 ppm, the death rate did not reach half of the total number of n in the first six hours, but after another hour, as shown in the graph, the plot was at its peak, indicating that all the snails had died. Even so, the death count immediately declines over the course of the following 24 hours. The 2000 ppm, on the other hand, exhibits a consistent high range of death count. Started at the first two hours where 5 and 2 respectively was recorded dead, then the majority of the snails were recorded as lifeless until the 23rd hour of time, ranging from 12 to 20 dead snails, and then noticeably decreased to 9 snails in the last hour. When the time interval series is examined, both concentrations are completely different. The mortality rate for the 600 ppm concentrations on garlic bulb and ginger rhizome of the series starts out decreasing, hovering around 2 deaths per 20 snails around 1-2 hours, but then increases in subsequent hours. At a concentration of 2000 ppm, the mortality rate gradually increases and then decreases several times.

As for the interpretations in Fig. 6, the imposition of the graph revealed the mortality rate of the garlic bulb crude water extract implying to its molluscicidal performance. Recorded molluscicidal performance were assessed for 24-hour soak time and the mortality was computed using the equation of Soulsby (Soulsby, 1982). During the 24 hours assessment, some of the snails showed no motility and a foul smell was present. With the help of prodding, the researchers confirmed their deaths and recorded. A prodding action causes a depression or hole to be left on the snail. The shell of the snails was gently broken in this study using tongs. The absence of a response after poking the exposed tissue with a tong served as the death criterion. Lack of movement and lack of bleeding when the snails were crushed were indicators of death.

The mean mortality rate of the *Oncomelania sp.* from the garlic bulb crude water extract at 600 ppm concentration respectively implies that the treatment 1 has greater molluscicidal effect on the *Oncomelania sp.* snails compared to treatment 2 which is the 2000 ppm concentration. This means that there were recorded 40% dead snails among the population of the sample snails for treatment 1 having 600 ppm concentration of garlic bulb extract. Meanwhile, treatment 2 having 2000 ppm concentration recorded only 30% dead snails among the total population of sample snails from quadruplicates. Similarly, a study entitled *Allium sativum* (Garlic), a potent new Molluscicide, stated that water extracts of the bulb of Garlic have high molluscicidal activity (Singh *et al.*, 2011).

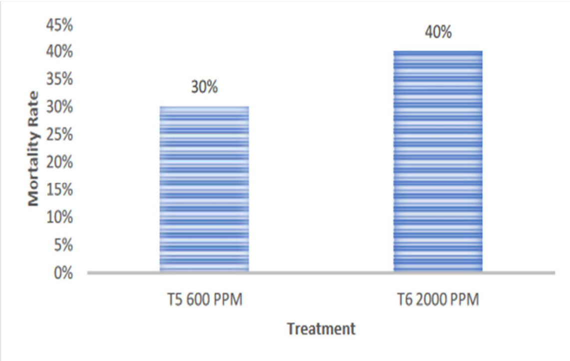

Fig. 6. Mortality rate of Oncomelania sp. snail to Garlic bulb crude water extract

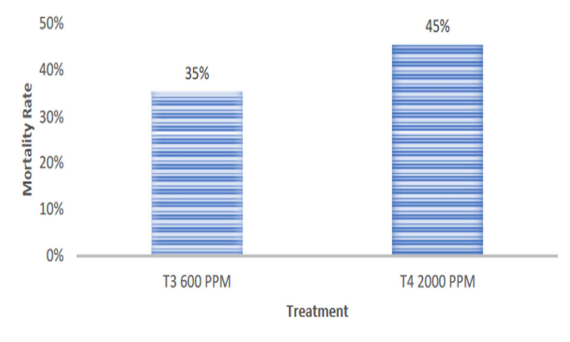

Fig. 7. Mortality rate of Oncomelania sp. snail to Ginger rhizome crude water extract

It was observed that the extracts of garlic against the snail *Lymnaea acuminata* was time as well as dose dependent where the effectivity of the plant was dependent on the amount of the concentration. It can be observed from Fig. 7 that the performance of ginger rhizome under 24- hour soaking time in 600 ppm concentration has 35% likelihood in killing the

Oncomelania sp. snail. This means that in a total of 20 sample snails from the 4 replicates, 7 snails were recorded dead. Meanwhile, in 2000 ppm concentration of the same plant extract, there is a 45% recorded dead snails. This means that there were 9 out of 20 died when exposed to the concentration 2000 ppm with ginger rhizome extract. In the study the effect of *Z. officinale* on the survival rate, egg production, electrophoresis analysis, biochemical aspects of *Biomphalaria alexandina* snails infected with *S. mansoni* (2013). Their results also showed that there was a rapid decline in survival rate and egg production of infected snails with *S. mansoni* exposed to ginger and also, showed that the glucose concentrations in infected snails exposed to ginger were increased in the hemolymph, while soft tissue glycogen decreased. It can be gleaned in Figure 9 that the mortality rate of the combination of garlic bulb and ginger rhizome crude water extract under 24-hour soaking time against *Oncomelania sp*. snail in two concentrations. For 600 ppm concentration, there was a prevalence of 30% mortality rate. This means that in a total of 20 sample snails in 4 replicates, for 600 ppm concentration there were 6 out of 20 of the sample population snails died. Meanwhile under 2000 ppm concentration, there was a 40% mortality rate recorded. This means there were actually 8 out of 20 sample snails died when they were exposed to this concentration.

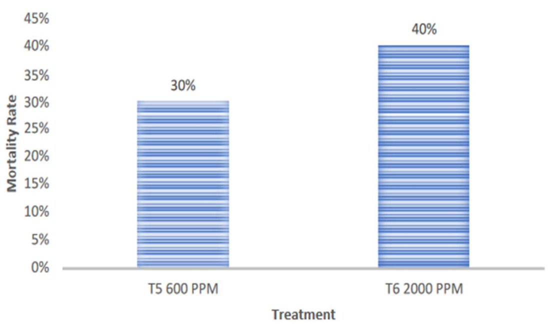

Fig. 8. Mortality rate of Oncomelania sp. snail to the combination of Garlic bulb and Ginger rhizome crude water extract

Increased mortality rates were greatly observed in replicates with higher concentrations (T3, T5) than those with lower concentration (T4, T6). This implies that there is a restricting factor that acts fast on the snail most especially on increasing concentration while being exposed to the Garlic bulb and ginger rhizome (Fig. 8). It has been supported that the active component, Allicin, found in garlic, shows molluscicidal potential (Gebreyohannes *et al*., 2017). This further implies that there is a biological component active in garlic that inhibits snail's biological function that could further warrant a detailed investigation on garlic-based molluscicide.

The effectiveness of combining garlic bulb and ginger rhizome crude water extracts against the adult *Oncomelania sp*. snails seemed to be concentration-dependent based on significantly higher mortality rates at higher concentrations for ginger rhizome as compared to low concentrations. Recent studies also showed that ginger have a considerable killing effect against *B. alexandrina* snails with LC50 & LC90 1.25 and 3.15 ppm, respectively (Bakry *et al*., 2013). In contrary, the result showed lower mortality rate when combined of the plant crude water extract, compared to garlic and ginger as an individual, where the garlic bulb showed low mortality rate rather than ginger rhizome. There could have been an alteration on the molluscicidal properties of both ginger and garlic being combined. This indicates that even when both of the plant crude water extracts of garlic and ginger combined having both molluscicidal properties, they still resulted to same less toxic against the intermediate host snails. One plausible explanation for this could be due to the different concentrations made at different levels of extract. Several studies have also indicated poor. performances of crude water extract of garlic against *Pomacea canaliculata* (Aromin *et al*., 2020) and performances of ginger rhizome against *Biomphalaria alexandrina*, the intermediate host of *S. mansoni* (El Sayed *et al*., 2015). There is still no report on molluscicidal effect of ginger rhizome against *Oncomelania hupensis quadrasi* snail.

To sum up, the garlic bulb crude water extract shows that the potency does not depend on the higher dosage, rather, a lower concentration promotes a higher mortality rate. Meanwhile, the ginger rhizome concentration, together with the combination of ginger and garlic shows the traditional pattern of dose-dependence. This means that a higher concentration, the more likely that the potency of the concentration be prevalent.

Table 1. Calculated mean (LC50) and maximal (LC90) lethal concentrations of each plant crude water extract against *Oncomelania sp.* Snail

Plant crude water extract	LC50 (ppm)	LC90 (ppm)
Garlic	194.728	0.657
Ginger	3581.580	13636790.706
Combination of garlic and ginger extract	6162.432	1827870.504

Table 2. Results of the treatment groups

Cases	SS	df	M S	F	p
Treatment	0.528	5	0.106	0.276	0.920

SS= Sum of Squares, df=Degrees of freedom, MS= Mean Square

It can be gleaned from Table 1 the mean (LC50) and maximal (LC90) lethal concentration estimates of the three treatments. Relative to the said findings was the identification of significant difference between the lethal concentration, LC50 and LC90. After 24-hour soaking time against *Oncomelania sp.*, the total calculations for LC50 of the following selected plant crude water extract were stated; garlic bulb crude water extract revealed that 194.728 ppm concentration would kill 50% of the sample snails, 3581.580 ppm concentration was required for the ginger crude water extract and 6162.432 ppm concentration for the combination of garlic and ginger extract was required to kill half of the sample size. With these results, garlic showed higher potency at lower concentration compared to other concentrations with the similar percent of death. Moreover, the significant difference of the concentration that would kill 90% of the sample snails for the garlic bulb extract also showed the highest potency rate with 0.657 ppm. Meanwhile, 13636790.706 ppm for the ginger and 1827870.504 ppm concentration for the combination of garlic and ginger crude water extract, respectively. This was calculated using probit analysis.

It can be observed from Table 2 the results of the analysis using One-Way ANOVA, conducted of all the treatment groups. After the conduct of the statistical test, the researchers found out the p-value of 0.920. Considering its high p-value, ginger rhizome and the combination extracts against the adult *Oncomelania sp.* snails, there were no significant differences seen at any concentrations indicating that all of the treatments may yield the same effectiveness against the intermediate host snail and thus, may be used vice versa. Of the six (6) treatments, although garlic bulb crude is mostly suitable for plant extraction as per recent studies concluded the molluscicidal potential of garlic; it possesses inherent disadvantages such as relatively high concentration losses during the mixing process. Therefore, it has been assumed and concluded that there is no significant difference of the following treatment groups as stipulated and supported by the results shown in Table 2. Alternatively, there could have been an increment of the concentration of ginger rhizome extracted mixed with distilled water and a reduction of concentration of garlic bulb, as they showed low mortality rate after the experimentation. This warrants further study, as reports in the literature have also indicated.

Conclusion

Garlic bulb and ginger rhizome possess molluscicidal activity in which it can infer with *Oncomelania sp.* snail. This aims to lessen the *Schistosoma japonicum* snail host, a carrier of schistosomiasis disease.

This study examines the different concentrations of garlic bulb and ginger rhizome crude water extract to the said *Oncomelania sp.* snail. An experimental research study that sought to answer the significant molluscicidal effect of different concentrations of the selected plant extract. Molluscicidal assays were performed according to WHO guidelines using 5 *Oncomelania sp.* snails immersing in test solution (2000 and 600 parts per million for garlic bulb), 5 *Oncomelania sp.* snails immersing in test solution

(2000 and 600 ppm for ginger rhizome) and 5 *Oncomelania sp*. snails immersing in test solution (2000 and 600 ppm for the combination of garlic bulb and ginger rhizome)

Literatures internationally, nationally and locally were deeply studied to serve as the base for the background of the study. There were studies that were specifically tackling the case in Brgy. Gacao, Palo, Leyte which was one of the barangay where the sample snails were collected, including Brgy. San Isidro and Brgy. Anahaway of Palo Leyte. The study was pursued as the rising calamity was reported for this schistosomiasis including one of the researchers.

The research populations are the 200 *Oncomelania sp*. snails that were collected from the mentioned three (3) barangays of Palo, Leyte. The study made use of randomized experimental design, where samples were randomly assigned to each replicates of set-up. The researchers also used a checklist as an instrument in recording the hourly death count of the snails. The checklist was composed of two sections: section 1 was the application of treatment on their respective set-ups and section 2 is the number of dead per replicates.

The collected data were analyzed and interpreted using Jeffrey's Amazing Statistics Program (JASP) computer program and Probit Analysis for the estimations of LC50 and LC90. Relative to the said findings was the identification of significant difference between the three treatment groups. One of the data analysis tools used was the One-Way Analysis of Variance (ANOVA). The findings were presented and discussed in chapter 4 aided with data tables.

The findings revealed that there is no significant difference on the molluscicidal effect of the plant crude water extract among the three (3) treatments. Molluscicidal performance were estimated by mean (LC50) and maximal (LC90) lethal concentration of the three treatments. Total calculations for LC50 of the following selected plant crude water extract were stated; garlic bulb crude water extract revealed that 194.728 ppm concentration, ginger rhizome revealed 3581.580 ppm and the combination of garlic bulb and ginger rhizome revealed 6162.432 ppm concentration would kill 50% of the sample snails. On the other hand, the concentration that would kill 90% of the sample snails of the selected plant crude water extract were 0.657 ppm for garlic bulb, 13636790.706 ppm and 1827870.504 for the combination of garlic bulb and ginger rhizome.

References

Schistosomiasis. 2022. World Health Organization (WHO). https://www.who.int/news-room/fact-sheets/detail/schistosomiasis

Vector-borne Diseases. 2020. World Health Organization. https://www.who.int/news-room/fact-sheets/detail/vector-borne-diseases

Leonardo L. *et al.* 2020. Current status of neglected tropical diseases (NTDs) in the Philippines. Acta tropica **203**, 105284.

Meniano S. 2018. Snail fever outbreak in non-endemic Leyte area alarms DOH. https://www.pna.gov.ph/articles/1056872

U.S. Department of Health and Human Services. 2022. Vector Biology. National Institute of Allergy and Infectious Diseases. https://www.niaid.nih.gov/research/vector-bio

Picardal MT. *et al.* 2018. Molluscicidal activity of the aqueous extract of garlic (*Allium sativum* L.) bulb against golden apple snail (*Pomacea canaliculata* L.). International Journal of Biosciences **13**(2), 75-87.

Meniano S. 2018. Snail fever outbreak in non-endemic Leyte area alarms DOH. https://www.pna.gov.ph/articles/1056872

Aromin EJ. *et al.* 2020. The Molluscicidal Potential of Selected Plants against *Pomacea canaliculata*. IARJ Agrires Life Sci. **1**(1), 26-34.

Chua JC. 2012. Genetic comparison of *Oncomelania hupensis quadrasi* (Möllendorf, 1895) (Gastropoda: Pomatiopsidae), the intermediate host of *Schistosoma japonicum* in the Philippines, based on 16S Ribosomal RNA sequence. Science Diliman **29** (2).

Fornillos R. *et al.* 2019. Detection of *Schistosoma japonicum* and *Oncomelania hupensis quadrasi* environmental DNA and its potential utility to *Schistosomiasis japonica* surveillance in the Philippines. PLoS ONE **14**(11), e0224617.

Gebreyohannes G. 2017. Medicinal values of garlic: Review.

El-Sayed NM, El-Saka MM. 2015. Anti-parasitic activity of *Zingiber officinale* (Ginger): A brief review. ResearchGate. DOI:10.14437/2378-7864-2-112