

Research Article

Molluscicidal Effect of TUBA-TUBA (*Jatropha curcas* Linn) Extracts on Golden Apples Nail (*Pomacea canaliculata* Lamarck)

Jely L. de Pedro¹ and Abel Alejandro U. Flores, Jr.^{1,2*}

¹Department of Biological Sciences, College of Science

²University Research and Development Services, University of Eastern Philippines, University Town, Northern Samar, Philippines 6400

Received: 03 Oct 2018

Revised: 07 Oct 2018

Accepted: 12 Oct 2018

ABSTRACT

Objective: This experimental research primarily aimed to determine the molluscicidal effect of “tuba-tuba” (*Jatropha curcas* Linn) on golden apple snail (*Pomacea canaliculata* Lamarck) using extracts from the leaves, nuts, roots, and bark of the experimental plant. **Material and Methods:** Experimental evidence shows “tuba-tuba” leaf extract was able to attain a 100% mortality rate after 180 minutes of observation time, thus, was considered comparable to the commercial preparation (Porsnail®) and is therefore, the most effective part of the plant as a molluscicide. This claim is borne out by a one-way ANOVA and confirmed by the Scheffe’s test. It was also shown that the extracts affected the internal organs of the test animals, which manifested perforation of reproductive organs, inflamed intestine and collapsed lungs. Other manifestations of toxicity observed were spittle formation (salivation) and poor balance. **Conclusion:** Based on the findings, it is concluded that “tuba-tuba” was effective against the golden apple snail, with the leaves being the part of the plant whose extract was most effective as a molluscicide, although other parts were also found to also have molluscicidal effect; the root and nut extracts however, were not significantly different in its effects with the negative control. The gross effect of the plant extracts was manifest destruction of the snail’s internal organs. It is recommended that future research should focus on evaluating the efficacy of mature nuts, its minimum lethal concentration and the phytochemical analysis of the plant extracts.

KEYWORDS: Molluscicidal effect, tuba-tuba extract, *Jatropha curcas*, *Pomacea canaliculata*

Introduction

The golden apple snail, popularly known as “golden kuhol” [*Pomacea canaliculata* Lamarck], is originally a native of South America, has a high rate of reproduction (laying eggs up to 1000 to 1200 per month), is extremely tough, and matures sexually at 2 months old.

It can live for about four to six years, surviving even in drought conditions, pollution, and low

oxygen. They are usually found in many plant matters, ponds, swamps, irrigated fields, canals and water-logged areas (Mohan, 2002).

It was in the 1980s when golden apple snail was introduced to Asia as a food source for humans and as an aquarium pet. It also provides food for natural predators such as ants, birds, spiders, field rats, and fish. Aquatic snails are said to be good bio-indicators for water pollution, such as the presence of pesticides and trace metals (Leocadio, 2001).

However, despite their ecological importance, golden apple snails have destroyed about 1.2 to 1.6 million hectares of the rice fields in the Philippines. It also has destroyed plants which are the primary source of food, and affect the food web, which lead

Address for Corresponding author:

University Research and Development Services,
University of Eastern Philippines, University
Town, Northern Samar, Philippines 6400

abelalejandروفloresjr@gmail.com

to damage and economic loss. Human health threats are also associated with this species for it

could be a vector of parasites such as lung worm, which may cause the fatal *Eosinophilic meningoencephalitis* disease in humans. Aside from fatal diseases, it also contributes to skin irritations by being intermediate host to associated trematodes (Mohan, 2002).

Linnaeus (1753) first named the physic nut as *Jatropha curcas* L., and according to the binomial nomenclature, it is still valid to date. The plant, known as “tuba-tuba” or “tubangbakod” in the Philippines, is a small tree of the plant tribe *Oannesieae* of *Crotonoideae* in the *Euphorbiaceae* family that has approximately 170 known species worldwide (Dehgan and Webster 1979). *Jatropha* is a drought-resistant perennial shrub with an economic life of up to 35 years and can even extend up to 50 years. The shrub has a smooth, gray bark which exudes whitish colored, watery latex when cut. The size of the leaves ranges from 6-15 cm in length and width. It sheds leaves in the dry season and rejuvenates during the rainy season (www.mixph.com).

Acda (2009) reported that extracts and crude oil from the seeds of *J. curcas* have traditionally been used as an insect repellent, molluscicide, and rodenticide (Duke, 1985). Toxicity of *J. curcas* seeds is attributed to several components, including *saponins*, *lectin (curcin)*, *phytates*, *protease inhibitors*, *curcalonic acid*, and *phorbol esters* (Adolf, et al., 1985; Makkar, et al., 1997; Martinez-Herrera, et al., 2004). However, reports have identified *phorbol esters* as the main toxic agent responsible for the insecticidal and molluscicidal activities of *J. curcas* soil (Makkar and Becker, 1997a, 1997b; Liu, et al., 1997). *Phorbol esters* are tetracyclic diterpenoids that mimic the action of diacyl glycerol, an activator of protein kinase C that interferes with different signal transduction pathways and other cellular metabolic activities (Bershadsky, et al., 1990;

Goel, et al., 2007). Phorbol esters are also known purgative, skin irritants, and tumor promoters, but are not mutagenic or carcinogenic themselves (Adolf, et al., 1984; Hirota, et al., 1988).

This study therefore, was conducted to test the molluscicidal effect of *Jatropha curcas* L. on

Pomacea canaliculata L. And find a way to limit Golden Apple snail populations using tuba-tuba extracts, which may contain toxins that would help control the spread of this gas tropodpest.

METHODOLOGY

Tuba-tuba plant was collected from Barangay Macagtas, while the golden apple snails were collected from the rice fields of Barangay Bangkerohan, Catarman, Northern Samar. To ensure consistency of results, the experimental method of research was used in this study. ANOVA was used to analyze the differences among group means. This study used 3 experimental animals in each treatment with three (3) replications, corresponding to the following: T₁=100% leaf extract; T₂=100% nut extract; T₃=100% root extract; T₄=100% bark extract; T₅=negative control (dH₂O); and, T₆=Positive control (Porsnails®)

The Completely Randomized Design (CRD) with six (6) treatments in three (3) replications was used in this study, while the golden apple snails were put in 250 mL glass containers for experimentation.

Data Gathering Procedure

1. *Preparation of Tuba-tuba Extracts*

The preparation of extracts was done at the College of Science, University of Eastern Philippines. Each plant part was washed thoroughly to remove dirt and other contaminants, and then it was chopped into small pieces using a sharp bolo before extracting the juice using a manual juicer.

2. *Preparation of Commercial Molluscicide*

Approximately 1gram (0.83 gram to be exact) of Porsnail®, a commercially-prepared molluscicide powder was dissolved in seventy five milliliters (75mL) of water, and was divided into three replications of twenty five millilitres (25mL) each.

3. Preparation of the Distilled Water

Seventy five millilitres (75 mL) of distilled water was poured into a beaker and was divided into three, giving each replication twenty five milliliters (25 mL) of distilled water.

4. Treatment of Experimental Animals

Twenty five milliliters (25 mL) of the tuba-tuba (leaves, nuts, bark, and roots) extracts were poured into a glass container with the experimental animals, as well as the positive control(Porsnail®) and the negative (dH₂O) control, once while the golden apple snails were feed with young rice plants throughout the study.

5. Dissection

After the study duration, one of the snails in each treatment was dissected to determine if there were changes in the gross morphology of the internal organs of the test animal.

RESULTS AND DISCUSSION

This study attempted to determine which part of the tuba- tuba plant (*Jatropha curcas* Linn) has a molluscicidal effect, and compare it to a commercial molluscicide. This also observed the changes that happen to the internal organs of the experimental animals, and the general behavior upon the administration of the test extracts.

Snails were continuously observed 360 minutes (6 hours), at 30-minute intervals, from the application of the experimental extracts. After three trials, results show that the leaves produced the most effective extract, which on average manifested its strongest effect almost three hours (160 minutes) after application, whereas Porsnail® (positive control) has taken only about half the time (80 minutes) to exhibit its effect. Extracts from other plant parts (bark, roots, and nuts) manifested their mortality effects in about 300 – 320 minutes after application, and as was to be expected, the negative control (T₅ = dH₂O) did not have any effect on the experimental animals. At the end of the experiment, all of the experimental animals, except those in T₅, were dead, confirming the molluscicidal effect of the plant extracts, implying that extracts from tuba-tuba could substitute for commercial molluscicides.

At the end of the experiment, one snail from each treatment was dissected in order to observe the changes that occurred to its internal organs, and results show that the lungs had collapsed, the intestines were inflamed, and there were perforations in the female reproductive organs. Such gross anatomical changes are concrete manifestations of the molluscicidal effect of the plant extracts and the commercial preparation.

Table 1. Anatomical Changes in the Internal Organs of the Snails after Treatment

Organs affected	Treatment						Changes
	T ₁	T ₂	T ₃	T ₄	T ₅	T ₆	
Lungs	+	+	-	+	-	+	Collapsed
Intestine	+	+	-	-	-	+	Swollen
Reproductive	-	-	-	-	-	+	Perforated

Legend: + = Positive Observation
- = Negative Observation

Other symptoms manifested by the animals after administration of the test extracts were poor balance and mucus secretion (spittle formation

manifested by frothing), which occurred in all trials.

Table 2 : Other symptoms manifested by the golden apple snail.

Symptoms	Treatments					
	T ₁	T ₂	T ₃	T ₄	T ₅	T ₆
Poor Balance	+	+	+	+	-	+
Mucus Secretion	+	+	-	+	-	+

Legend: + = Positive Observation
- = Negative Observation

Statistical analysis of data utilizing the One-Way Analysis of Variance (ANOVA) showed significant differences among the six treatments in terms of their molluscicidal efficacy at 0.05 level of significance. Results imply that the extracts manifested molluscicidal effects on the test animals which were somehow comparable to the effect of the commercially prepared product. This further implies that the plant can be utilized as an effective bio control agent against the golden apple snails.

It is evident that some of the treatments show no significant difference in the molluscicidal effect in the three trials of the experiment, clearly showing that the source of the extract (leaves, nuts, barks, or roots) have almost similar efficacy when compared with the positive control (Porsnail®), while the extracts were significantly different in their effects when compared with the negative control. However, across treatments and trials, Treatments 2 and 3 constantly showed no significant difference in effect when compared with Treatment 5, which may be interpreted as being statistically the same, simply saying that the extracts (T₂ and T₃) have no effect, if at all, on the golden apples nail.

CONCLUSIONS AND RECOMMENDATIONS

After evaluating the molluscicidal effect of the extracts from tuba-tuba leaves, nuts, bark, and roots, it can be concluded that the plant is effective in killing the experimental animals, with the leaf extract being the most effective, exhibiting 100% mortality after 160 minutes, which was comparable to the commercial product Porsnail® at 120 minutes.

The study also revealed changes in the internal organs of the animals, such as the collapse of the lungs, inflammation of the intestines, and the perforation of the reproductive organs of the female golden apples nail. Such conditions led to the death of the animals, thus providing an avenue for the decline of natural snail populations.

It is thus recommended that a similar investigation be done to test the efficacy of mature nuts, determine the lethal concentration (LC50) and/or lethal dose (LD50) of extracts from different plant parts, and their possible effects on humans, animals, or the environment.

REFERENCES

- Acda, MN. 2009. Toxicity, tunneling, and feeding behavior of termite, *Coptotermes vastator* in sand treated with oil of the Physic nut, *Jatropha curcas*. *Journal of Insect Science*, 9 (1): 2009; 64.

- Kamal, S., S. Manmohan, and S. Birendra. 2011. A Review on Chemical and Medicobiological application of *Jatropha curcas*. International Research Journal of Pharmacy. 2:61-66.
- Kloos, H. and McCollough, F.S. (1987). Plants with recognized molluscicidal activity. *Planta Medica* 57, 190- 199.
- www.mixph.com/growing-jatropha-tuba-tuba/. Accessed: February 2017.
- www.applesnail.net. Accessed: February 2017.
- Adolf W, Opfenkuch HJ, Hecker E. 1984. Irritant Phorbol derivative from four *Jatropha*. *Phytochemistry*. 23: 129-132.
- Duke JA. 1985. Handbook of Medicinal Herb. CRC Press.
- Makkar HPS, Becker K, Sporer F, Wink M. 1997. Studies on nutritive potentials and toxic constituents of different provenances of *Jatropha Curcas*. *Journal of Agriculture and Food Chemistry*. 45:3152-3157.
- Martinez-Herrera, Sidduraja P, Fraccis G, Davila-Ortiz G, Becker K. 2006. *Food Chemistry*, 96, 80-89.
- Makkar HPS, Becker K, 1997a, *Jatropha curcas* toxicity identification of toxic principle(s) Proceeding of 5th international symposium on poisonous plants. San Angelo Texas USA.
- Liu SY, Sporer F. Wink M. 1997. Anthraquinones in *Rheum palmatum* and *Rumex dentatus* (Polygonaceae), and phorbol esters in *Jatropha curcas* (Euphorbiaceae) with molluscicidal activity against the schistosome vector snails *Oncomelania*, *Biomphalaria* and *Bulinus*. *Tropical Medicine and International Health* 2: 179-188.