Toxicity Effect of *Dieffenbachia picta* on Myiasis

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Abstract

This study was conducted to determine the toxic effect of *Dieffenbachia picta* (*gabi-gabi* in Visayan), at different levels of concentration, on screwworm maggots or myiasis, which were used as test organism. It was conducted for a period of 50 days: the first and second trials on January 17 to 31, 2000 and on February 19 to March 4, 2000, at Bahayan 5 Subdivision, Upper Hinaplanon, Iligan City, and the third and final study on May 21 to June 10, 2000 at 7th Street, MSU Campus, Marawi City.

The results of the application of 100% or pure *Dieffenbachia picta* crude extract and 75%-25% basis dilution on the myiasis were highly significant, as analyzed using the Z-test under the SPSS computer program.

In conclusion, the higher concentration of *Dieffenbachia picta* crude extract from both stem and leaves is more effective at killing the test organism than the dilutions.

One major management problem in the economics of food production in the country is preventing and controlling plant disease. In this connection, the Bureau of Agriculture (BA) reported in 1998 that one cause of plant farming failure, despite the BA's supervision, has been insect pest infestation of crops and, together with it, the farmers' failure to use adequate quantity of pesticide. BA claimed that farmers failed to follow the exact amount of drugs recommended for their farms because they could not afford the cost. Faced with this problem, the government, as well as the private sector, has encouraged experimental studies and researches on available local and inexpensive materials that may prove to be pesticides.

Authorities in pharmacology say that, in the early days of medicine, the only effective drugs were those derived from plants. Galen, an ancient Greek physician and medical writer, used herbs prepared by maceration or decoction before being applied on or taken in by the patient. With regard to insecticide in the country, it is a part of folk knowledge that local people in the past used plant materials against insect attack or infestation.

Dieffenbachia picta, locally known in Visayan as "*gabi-gabi,*" is an ornamental plant that is related to the Gabi family. It has been proven in practical folk "medical" experience that the plant contained a toxic substance that caused paralysis in the tongue when a portion of this organ would come in contact with the plant's acrid juice.

Importance of Study

This study was conducted in connection with the perceived need to find locally available and inexpensive material that may substitute for expensive commercial and imported farm pesticides. It is also a contribution to the number of pioneering studies of locally available plants for medicinal, pesticidal and industrial uses. As such, it also may encourage further and similar studies on local plants and other natural resources.

Objectives & Limitations

This study was conducted with the following objectives: 1) to determine the toxic effect, at different levels of concentration, of *Dieffenbachia picta* on certain organisms often unwanted in the day-to-day affairs of human society, such as exemplified here by the screwworm maggots; and 2) to provide data for further studies on the *Dieffenbachia picta* for any other purpose.

The limitations included very limited funds and time constraints, plus inadequacy of laboratory facilities. Details on this item are given further down below.

Phytochemical screening of the Dieffenbachia picta was not conducted because the IIT-Biological Laboratory facilities used by the researcher could not test alkaloids, saponins, flavanoids and tannins. Thus the following questions could not be answered: What kind of alkaloid, saponin, flavanoid and tannin is present in the plant? What percent of alkaloid, etc. is present in the plant's body?

Due to the lack of sufficient laboratory facilities, it was not possible to determine exactly what particular substances present in the Dieffenbachia picta killed the test organisms.

On the other hand, the researcher tends to believe that alkaloids, saponins, flavanoids are probably component substances of the *Dieffenbachia picta*. With regard to alkaloid, Dorland's *Medical Dictionary* has indicated, that it "is one of a large group of organic, basic substances found in plants," which probably included the *Dieffenbachia picta*. The same dictionary said almost the same thing about flavanoid. With regard to saponin, the same reference has said: "It is a group of glycosides widely distributed in the plant world and characterize by their property of forming a durable foam when their watery solutions are shaken." This researcher has directly observed such an effect in the *Dieffenbachia picta,* which produced a foamy, soapy element when squeezed.

Review of Literature

Toxicology

Understanding the mechanism of toxicity is of practical and theoretical importance. Such knowledge provides a rational basis for interpreting descriptive toxicity data, estimating the probability that a chemical can cause harmful effects, establishing procedure to prevent or antagonize the toxic effect, designing drugs and industrial chemicals that are less hazardous and developing pesticides that are more selectively toxic for their target organisms (Gregus and Klassen, 1990).

The fundamental objective of toxicology is the determination of safe levels at which human can be exposed to toxicants present in the environment. Unfortunately, uncertainties prevail in many aspects of the safety evaluation process (Miller et. al., 1983). Because the absence of adverse effects in a sample of test animals does not guarantee that the entire population will be insensitive to the agent under study, negative experiments can provide only upper limits of potential risk (Scheiderman and Mantel, 1973). With the recognition that humans do not and cannot live in a risk-free environment, there has been an increasing trend toward defining safety in terms of negligible or minimal risk rather than zero risk (Wilson, 1979, Office of Technology Assessment, 1981).

King, as cited by Beroza (1970), stated that USDA scientists have collected, synthesized and tested more than 20,000 chemicals as repellents against a variety of arthropods. Although many of the compounds were effective, few could be used.

Insecticides

In connection with its focus, this study may cite that Knipling (1966) has revealed that insecticides are a practical necessity in providing food and fiber to people. For their part, Hartmann, Flocker and Kopranek (1981) said that the use of insecticides, miticides, fungicides, nematicides and herbicides is essential in large-scale agriculture and in maintaining modern human standard of living.

Brander and Pugh (1977) say that an insecticide is a compound that destroys insect parasites. The term is applied on substances that are active against parasites living on animal skin. They further reveal that the ideal insecticide should destroy all the parasites at every stage of their life history; should be rapid in this action; should be non-toxic or of low toxicity to the host; should be compatible with the various bases and vehicles required for its application; should be economically practicable; should provide a minimum residue in or on the host and should be rapidly disintegrate in the environment after use.

Ectoparasites

Soulsby (1987) points out that ectoparasites are metazoan organisms living on the skin of animals. These parasites can be broadly divided into three main groups: those that migrate in their larval stages through the tissues of their hosts; those that burrow into and live in the superficial skin layers; and those that live in the skin but bite through into the deeper tissues. Soulsby further says that the parasites of the first group include horse boots, cattle warbles and sheep nostril larvae. They are removed during their larval migrating stage by the application of organophosphorus compounds topically or, in some cases, by oral dose. The second group, consisting of the mange mite, burrows into the skin or penetrate deep into the hair follicles. The third group lives mainly on the skin surface and includes the louse, poultry mite, flea, tick and the larva (maggot) of the Lucilia species. Its members are controlled effectively with surface sprays or dips.

Miyiasis

Dorland's *Illustrated Medical Dictionary* (1963) indicates eight different classes of myiasis: 1) creeping myiasis = larva migrans; 2) myiasis dermatosa = infection of the skin with the larvae of flies; 3) myiasis imaginosa = myiasis produced by the imago or full-grown fly; 4) intestinal myiasis = the presence of living fly larvae in the intestines; 5) myiasis larvosa = myiasis produced by larvae or maggots; 6) myiasis linearis = larva migrans; 7) myiasis muscosa = myiasis produced by the common housefly; 8) myiasis oestruosa = myiasis produced by the botfly or gadfly; traumatic myiasis = maggot infestation of wounds or ulcers.

Plant Bioactive Components

Among the possible bioactive components of many plants that are known to contribute to their biological effects are the alkaloids, saponins, flavanoids and tannins (Cayetano, 1988). Alkaloids are any of the class of nitrogen-containing compounds that have an alkaline or basic chemical nature. They usually occur in dicot plants in the form of ammonium salts that are water soluble and extractable by treatment of weakly acidic alcoholic solvents. They are by-products of plant metabolism, are a means of defense of plants against animal and insect attacks, are reservoirs for protein synthesis, are regulators of growth and reproduction and are detoxifying agents (Shamma, 1983).

Abundant hydroxyl, ether and lactones linkages attribute saponins. Most of them are glycosides and secondary plant products with detergent properties, characterized by foaming when shaken in aqueous solution. Saponins have hemolytic properties and antimicrobial activity at certain levels (Friend, 1968).

Flavanoids constitute a huge group of complex, water-soluble compounds that are widespread in the plant kingdom. They range in color from white, yellow, red and blue. Known to have medicinal usefulness, flavanoids have exhibited anti-viral, anti-fungal, anti-inflammatory and cytotoxic actions (Ting, 1992).

Tannins are generally amorphous polyhydroxyl phenolic compounds, non-crystalline when solid but readily soluble in water or alcohol to give colloidal solutions that are strongly astringent. They occur in the cell sap, often in distinct vacuoles, and are found to exert inhibitory effects on many enzymes due to protein precipitation. They aid in the resistance of cells against fungal attacks and other pathogens (Noggle and Fritz, 1983).

Steiner (1960) reveals that *Dieffenbachia* is an ornamental plant that can be deadly. The slightest contact of its highly acrid juice with a portion of the tongue could cause paralysis of this organ, making speech difficult for some time. She further points out that this paralyzing effect of the plant has given rise to its nickname, "dump cane."

Methodology

A. *Locale and Duration of the Study*

First and second trials in this study were conducted on January 17 to 31, 2000 and February 19 to March 4, 2000, at Bahayan 5, Upper Hinaplanon, Iligan City. The third and final one was conducted on May 21 to June 10, 2000 at 7th Street, MSU campus, Marawi City.

B. Materials and Methods

B-1. Materials

The materials and equipment used in conducting the experiment were the following:

1. Four hundred and thirty-two (432) heads of worm
2. Dieffenbachia plant

3. Water
4. Four (4) kilos beef
5. Equipment
    5.1 Widemouth bottle
    5.2 baker
    5.3 basin
    5.4 Petri dish
    5.5 mortar and pestle
    5.6 plastic container
    5.7 disposable syringe
    5.8 600 mesh silkscreen
    5.9 grater
    5.10 camera and film
    5.11 gloves
    5.12 batteries
    5.13 cylinder
    5.14 stockings
    5.15 knife
    5.16 Elernmeyer flasks
    5.17 Dropper
6. Miscellaneous
    6.1 table
    6.2 chair
    6.3 data sheet
    6.4 ball pen
    6.5 marker pen
    6.6 bond paper

B-2. Methods

Experiment No. 1

Three kilos of beef was purchased at the Old Market of Iligan City and, immediately upon arrival in the laboratory, the meat was divided equally into three parts or blocks. Each meat block weighed 1000 grams. The meat in each block was again equally divided into four lots. Each meat lot was 250 grams. In Lot I, the meat was soaked in distilled water for two hours and served as the Control. The meat pieces in Lots II, III and IV were soaked for two hours in crude extract from leaves of *Dieffenbachia picta* with a concentration of 100%, 75% and 50%, respectively. The meat in each Lot was exposed to the Blue Fly until such time that larvae were produced.

Experiment No. 2

The same materials and methods in Experiment 1 were used, except those used in and for Lot II, Lot III and Lot IV. The meat in this experiment was soaked in crude extract from stems of *Dieffenbachia picta* (Fig. 2).

Experiment No. 3

The materials and methods used in this study were similar to Experiments No. 1 and 2, except that the meat was no longer soaked in distilled water and crude extract of *Dieffenbachia picta.* Instead, it was exposed directly to the Blue Fly until such time that the fly's larvae appeared. When the larvae appeared, the containers were covered with stocking net to prevent the worms from coming out during the treatment. Thus, meat in Lot I with the larvae was treated with distilled water, by the use of a dropper, and served as the control, while the pieces in Lots II, III and IV were treated with 100%, 75% and 50% crude extract of Dieffenbachia from leaves.

Experiment No. 4

For this experiment, the materials and methods used were similar to those in Experiment No. 3; however, the extracts were taken from stems of *Dieffenbachia picta.*

Collecting the *Dieffenbachia picta*

Commonly found growing on the MSU main campus, the *Dieffenbachia picta* specimen plants for the experiments were collected from the garden of the researcher on 7th St., MSU, Marawi City. After the collection, the plants were thoroughly washed of soil.

Preparation of the Extract

The leaves were finely chopped, placed in mortar and pounded with a pestle until thoroughly crushed, then transferred to a piece of cloth and squeezed for the extract. For their part, the stems were grated then transferred also to a piece of cloth and treated the same way for the extract.

Immediately after the process, the extract was applied, by use of a dropper, on the test organism and the results observed every 30 minutes within a period of five hours. Every lot was treated similarly until the worms and the meat were totally immersed in the extract.

The formula for taking the volume of the extract ia as follows:

$C_1 V_1 = C_2 V_2$

<u>For 75%:</u>
(100%)(x) = (75%)(1 mL)
x = 75/100 = .75 mL (from stock solution);
add 25 mL distilled water

<u>For 50%:</u>
(100%)(x) = (50%)(1 mL)
x = 50/100 = .50 mL + distilled water to make 1 mL
solution

<u>For 25%:</u>
(100%)(x) = (25%)(1 mL)
x = 25/100 = .25 mL, then add .75 mL distilled H_2O,
make 1 mL sol.

All data gathered were analyzed, using the normal approximation to binomial distribution z-test on proportion. To obtain the total number of worms killed for the period of five hours in the experimental unit, the actual count of worms killed per thirty minutes were added together.

Results

Table 1 shows the total and average numbers of worms killed every 30 minutes for the period of five hours, using the *Dieffenbachia picta* stems extract. The greatest mortality rate of the worms was in

Lot II (100% pure extract). Lot III followed it with a concentration of 75% extra and 25% water. Lots I and IV, with distilled water only and with 50% extract and 50% water, respectively, showed no mortality.

In Experiments No. I and II, only Lot I of Blocks I, II and III attracted the Blue Flies immediately after exposure, while Lots II, III and IV did not. On the sixth day of the meat exposure, the *Drosophila* (fruit fly) and the black beetle, both competing, attacked the meat pieces in Lots II, III and IV, causing them to dry up and rot.

Table II shows the total number of worms killed in five hours with the use of *Dieffenbachia* stem extract.

Table III shows the total and average number of worms killed every 30 minutes for the period of five hours with the use of Dieffenbachia leaves extract. It shows that Lot II has the highest number of worm mortality due to the use of 100% pure and thus concentrated *Dieffenbachia* extract.

After five hours, the number of dead worms was counted, as well as the number of live ones. In Block I, Lot I, only one was dead out of 16. In Lot II, 17 (81%) out of 21 worms died. In Lot II, nine (or 69%) from the 13 were dead. Of the 18 in Lot IV, only 1 or 6% died.

Table I. Total and average number of worms killed every 30 minutes for the period of five (5) hours with the use of *Dieffenbachia* stem extract.

Treat-	Blocks																														
Ment	I										II										III										Total
	30	60	90	120	150	180	210	240	270	350	30	60	90	120	150	180	210	240	270	350											
Lot I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lot II	0	0	0	0	0	0	0	3	4	2	0	0	0	0	0	0	1	3	2	3	0	0	0	0	0	0	1	3	1	4	27
Lot III	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	1	3	0	0	0	0	0	0	0	1	0	1	9
Lot IV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total								3	6	3							1	3	3	6							1	4	1	5	36

Table II. Total number of worms killed in five hours with the use of the *Dieffenbachia* stem extract.

Treatment	**Block**	**Block**	**Block**	
	I	**II**	**III**	**Total**
Lot I	0	0	0	0
Lot II	9	9	9	27
Lot III	3	4	2	9
Lot IV	0	0	0	0
Total	12	13	11	36

Table III. Total and average number of worms observed every 30 minutes for the period of five (5) hours to have been killed with the use of *Dieffenbachia* leaves extract.

Treat-ment	**Blocks**																														
	I										**II**										**III**										**Total**
	30	60	90	120	150	180	210	240	270	350	30	60	90	120	150	180	210	240	270	350	30	60	90	120	150	180	210	240	270	350	
Lot I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Lot II	0	0	0	0	0	0	0	1	5	3	0	0	0	0	0	0	0	0	2	5	0	0	0	0	0	0	0	0	2	3	21
Lot III	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	3	0	0	0	0	0	0	0	0	2	1	9
Lot IV	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Total	0	0	0	0	0	0	0	1	5	6	0	0	0	0	0	0	0	0	0	3	8	0	0	1	0	0	0	0	4	4	32

Table IV. Total number of worms observed after five (5) hours to have been killed with the use of *Dieffenbachia* leaves extract.

Treatment	**Block**	**Block**	**Block**	
	I	II	III	Total
Lot I	0	0	1	1
Lot II	9	7	5	21
Lot III	2	4	3	9
Lot IV	1	0	0	1
Total	12	11	9	32

Table V. Total number of worms killed and left alive after application of *Dieffenbachia picta* leaves crude extract of different concentrations.

Block I	Number of Dead Worms	Number of Live Worms	Total
Lot I	0	19	19
Lot II	9	8	17
Lot III	2	15	17
Lot IV	1	19	20
Total	12	61	73
Block II	**Number of Dead Worms**	**Number of Live Worms**	**Total**
Lot I	0	16	16
Lot II	7	6	13
Lot III	4	10	14
Total	11	50	61
Block III	**Number of Dead Worms**	**Number of Live Worms**	**Total**
Lot I	1	18	19
Lot II	5	9	14
Lot III	3	18	21
Lot IV	0	15	15
Total	9	60	69

Table VI. Total number of worms found dead and alive after application of *Dieffenbachia picta* stem crude extract at different concentrations.

Block I	Number of Dead Worms	Number of Live Worms	Total
Lot I	0	27	27
Lot II	9	13	22
Lot III	3	21	24
Lot IV	0	29	29
Total	12	90	102
Block II	**Number of Dead Worms**	**Number of Live Worms**	**Total**
Lot I	0	33	33
Lot II	9	16	25
Lot III	4	24	28
Lot IV	0	18	18
Total	13	91	104
Block III	**Number of Dead Worms**	**Number of Live Worms**	**Total**
Lot I	0	16	16
Lot II	9	22	31
Lot III	2	21	23
Lot IV	0	13	13
Total	11	72	83

Other Observations

The *Dieffenbachia picta* crude extract was sticky and volatile, or easily evaporated. When applied on the worms, the latter tended to become very motile.

The larvae that were not killed after the application did not develop into adults. On the other hand, some of the test organisms in the control group did develop into adults after two weeks.

Analysis of Data

The data gathered were analyzed, using the SPSS (Appendix A and Appendix B) with the aid of a statistician at Mindanao State University, Marawi City.

Conclusion

The higher the concentration of the *Dieffenbachia picta* extract the more effective it becomes at killing the test organisms. The pure (100%) crude extract of the plant, both from the leaves and from the stems, was more toxic than the diluted crude extract.

Recommendation

1. It is recommended that analysis be made of the chemical components of the *Dieffenbachia picta* that killed the test organisms.
2. Detailed study is recommended in the application of the *Dieffenbachia picta* on other test organisms.

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