Evaluation Of Larvicidal Properties Of Some Plant Extracts On Simulium Damnosum Complex

M Malau, D James

Citation

M Malau, D James. *Evaluation Of Larvicidal Properties Of Some Plant Extracts On Simulium Damnosum Complex*. The Internet Journal of Toxicology. 2007 Volume 4 Number 2.

Abstract

Objective: The campaign for living in a friendly environment by reducing the rate of pollution through the use of biodegradable substances most especially plant materials for the control of insect vectors of man is major priority. Over the years the vectors of onchocerciasis (Simulium damnosum complex) have been controlled by the use of synthetic chemical compounds and this is known to left behind toxic chemical residues which get accumulated into the food chain. Attempt is therefore carried out to develop alternative control of insect vectors of parasitic disease through the use biodegradable plant materials.

Methodology: Five plants (Parkia biglobosa, Vitelaria paradoxa, Azadrachta indica, Chromolaena odorata and Lippia multiflora) were collected and their leaves extracted using ethanol extract. Serial dilutions of the crude extract was prepared (100mg/ml, 10mg/ml, 1mg/ml, 0.1mg/ml, 0.01mg/ml and 0.001mg/ml) and Simulium larvae exposed in it for a period of 3 hours.

Results: The result of phytotoxicity test of the five plants showed that all the plants extracts are toxic at high concentrations (100mg/ml and 10mg/ml) with 100% larval mortality. Toxicity was however noticed to decrease with decrease in concentration. C. odorata recorded the highest potency with 80.8% larval mortality while V. paradoxa recorded the least (50.4%) at 0.01mg/l. The five plants showed significant difference in their phytotoxicity ($F = 25.196$; $df = 4$; $P<0.05$). The relationship between concentration of plant extract and mortality showed positive correlation ($r = 0.538$; $df = 18$; 0.01).

Conclusion: the utilization of some of the plants parts in the control of endemic diseases through vector control and the maintenance of the ecosystem stability is the main objective in this study.

INTRODUCTION

Blackfly (a haematophagous fly) feeds on blood of man and domestic animals for the purpose of the maturation of its eggs. The fly breeds in fast flowing waters of large streams and sluggish rivulets of small streams. The fly has two phases of development; the pre-marginal phase comprising of eggs, larvae and pupae and the post-marginal phase comprising reproductive males and females ([1]). The fly has a wide distribution in South and Central America, Mexico, Brazil, Venezuela, Ecuador, Colombia and West Africa ([1]).

The fly transmits the disease onchocerciasis in man. The disease although not a life threatening one, is known to cause severe skin infections ranging from rashes, itching, nodules on bony areas, and de-pigmentation of the skin which usually leads to hanging groins and elephantiasis of the genital organs. The terminal effect of the disease is blindness; a condition that adds more mouths for the community to feed than benefit ([2],[3], [4], [5], [8], [7]).

Over the years, the disease is controlled by using of chemical insecticides on the vector and Ivermictin (Mectizan) drugs on the parasites living inside the tissues of man. The world health organization has over the years sought to reduce the threat of this infection (onchocerciasis) in most of endemic regions of West Africa by attacking the larvae of the fly with chemical insecticides ([8], [9], [10]). This effort requires that all potential breeding rivers are treated with chemical insecticides. But the major problem faced by this control method is that both targeted and non-targeted organisms are affected and the chemical accumulate within the biotic food change, thereby leaving a negative feedback on the ecosystem. Because of its poor level of biodegradability and its resultant effect on the ecosystem, new approaches to black fly control are currently being carried out. One of such control strategy is the use of biodegradable plant extracts.

Crude extracts of plant materials have been used by farmers in Africa, Asia and Latin America to control insects of medical and Agricultural importance ([11], [12], [13]). This research aims at evaluating the larvicidal potency of some indigenous plants from Nigeria for the control of black fly (vector of onchocerciasis) as a substitute for non biodegradable compounds that are harmful to the ecosystem.

MATERIALS AND METHODS

The study area is the federal capital territory (FCT), Abuja, Nigeria (latitude 8o 25'and 9o 20'N and longitude 6o 45' and 7o 39'E) ([14]). Larvae of Simulium species where collected from submerged vegetation in fast flowing streams of Shetuko River of the FCT, Abuja at 9:00am.

Leaves of five plants (Parkia biglobosa, Vitelaria paradoxa, Azadrachta indica, Chromolaena odorata and Lippia multiflora) were collected directly from plants and air-dried at room temperature for two (2) weeks. The leaves were pulverized to powdered form ([15]) and Ethanol was used for the extraction of active ingredients ([16]). 100g of the pulverized leaf was soaked separately in 500ml of ethanol in Erlenmeyer flask. The flask was covered with aluminum foil and allowed to stand for 48hours. The extract was filtered and marked pressed and evaporated to dryness over a steam bath. Ten (10g) gram of the crude extract was dissolved in 100ml of distilled water and 100mg/ml of the stuck solution was prepared. Serial dilutions of the stuck concentrations (10mg/ml, 1mg/ml, 0.1mg/ml,0.01mg/ml and 0.001mg/ml) were prepared ([15]) and tested for phytotoxicity against larvae of Simulium species. The result obtained was analyzed (ANOVA) for significant difference between the phytotoxicity of the five plant extracts on Simulium larvae. The corrected percentage mortality of the larvae due to crude extract phytotoxicity was determined.

RESULTS

Figure 1

Table 1: percentage mortality rate of larvae at different concentration levels of crude extract from five plants

Plant (ethanol) extracts	*Percentage mortality/concentration (mg/ml)*						*Mean % mort*	*CoV*	*Cor % mort*
	0.001	0.01	0.1	1	10	100			
C. odor	50.8	52.0	82.0	100	100	100	80.8	26.91	53.89
L. multi	16.0	25.2	46.8	98.0	100	100	64.3	56.25	7.05
P. biglo	21.2	32.0	54.4	73.2	100	100	63.5	49.21	11.29
A. indica	13.0	13.0	37.0	74.4	100	100	56.2	50.01	5.19
V. parad	11.6	20.0	24.0	46.8	100	100	50.4	50.03	0.01

Foot notes:
C. odorata; L. multiflora; P. biglobosa; A. indica; V. paradoxa; mort = mortality; S.d = standard deviation, CoV = coefficient of variation; Cor % mort = Corrected percentage mortality

Result of crude ethanol extract from five plants tested for phytotoxicity on larvae of S. damnosum complex at 3 hours exposure time is as shown I the table above. The five plants crude extracts showed various degrees of phytotoxicity at six different concentrations per 3 hours of exposure time. All the plants showed maximum toxicity at 100mg/ml and 10mg/ml with 100% mortality rate. However, percentage larval mortality was noticed to decline with decrease in concentration in all the five plants. V. paradoxa recorded the highest decline rate from 46.8% mortality at 1mg/ml to 11.6% at 0.001 mg/ml. C. odorata recorded the leas declining rate of 100% mortality at 1mg/ml to 50.8% at 0.001mg/ml.

The mean percentage mortality rate of S. damnosum complex larvae due to phytotoxicity from the five plants was calculated. C. odorata crude extract recorded the highest phytotoxicity. It gave an overall mortality rate of 80.8%. The other plants extracts from L. multiflora, P. biglobosa, A. indica, and V. paradoxa recorded a total mortality of 64.3%, 63.5%, 56.2%, and 50.4% respectively. The coefficient of variation in of mortality rates due to phytotoxicity by the crude extracts was evaluated; C. odorata recorded the least rate of variation (29.9%), while L. multiflora, P. biglobosa, A. indica and V. paradoxa recorded 56.25%, 51.21%, 66.05% and 72.82% respectively. Based on the information generated from table 1 above, C. odorata with the least rate of variation in mortality happens to be the most phytotoxic of the five plants, followed by P. biglobosa. This was further confirmed by determining the percentage corrected mortality rates of the five plant extracts where C. odorata recorded 73.09% larval mortality per 3 hours of exposure time. The other crude extracts (L. multiflora, P. biglobosa, A. indica and V. paradoxa) recorded 43.75%, 48.79%, 33.95% and 27.18%.

DISCUSSION

The crude ethanol plant extracts from five plants showed different degrees of phytotoxicity. C. odorata was the most potent of the five plant extract while V. paradoxa was the least potent.

It was also observed that the toxicity of the extracts varies with increase in concentration. Maximum mortality (100%) was recorded by all the plant extracts at 100mg/ml, while at 0.001mg/ml; all the plant extracts showed decrease in activity. This shows that C. odorata had more of the active ingredient responsible for high mortality at 0.001mg/ml than the other plant extracts.

Various reports on the use of environmentally friendly

substances for the treatment and control of various pest and vectors of disease agents have been documented. Thomas et al. ([12]) pointed out the importance of using plants extracts. They stated that these plant residues are biodegradable; take shorter period to disintegrate in the soil and water and do not leave behind chemical residues in the ecosystem. The bio-chemical substance in them is not accumulated in the food chain as do in other synthetic chemical compounds which are the major cause of environmental pollution. Also, Green et al. ([17]) accentuated this fact by pointing out that plant products are effective larvicides of most insect vectors of man. The high toxicity recorded by C. odorata (73.09%) and P. biglobosa (48.79%) concur with these reports. These plants (especially C. odorata) have shown high phytotoxic activity against Simulium larvae, detail study to ascertain the lethal doses required for field treatment is a necessity for the control of onchocerciasis in most endemic regions.

ACKNOWLEDGEMENT

We wish to thank the University of Abuja, Department of Biological Sciences for providing facilities for this research work to be carried out.

References

1. Crosskey, R.W. and Howard, T.M (1997): A New Taxonomic and Geography Inventory of World black flies (Dipthera: Simulidae) Department of Entomology, The Natural History Museum, London 101-117
2. Lewis, D.J. (1953) Simulium damnosum and its relation to onchocerciasis in the Anglo. Egyptian Sudan, Bulletin of Entomological Research. 43, 597-644
3. Harwood, R.F. and James, M.T (1979); Entomology in human and animal health, Ed. Macmillan Publishing Co. Inc. New York.
4. WHO (1985) Observation on Simulium damnosum s.l in the Thyolo Highlands of Malawi by J.B. Davies. WHO/ONCHO/85.165 WHO/VBC/85/909 p.2
5. WHO (1995): Onchocerciasis and its control. Reports of the WHO Eph. Committee on Onchocerciasis control. World Technical Report Series 852 Geneva
6. Nwoke, B.E.B., (1990): The Socio-economic aspects of human onchocerciasis in Africa. The present appraisal Journal of Hygiene Epidemiology, Microbiology and Immunology, 34(1) 37-44
7. Nwoke, B.E.B., Dozie I.N.S. Gemade E.I.I. Jiya J.Y. (1996): The present status of human onchocerciasis in Southern Nigeria using rapid epidemiological mapping on onchocerciasis (REMO) The Nigerian Journal of Parasitology, 19:11-16
8. Walsh, F.F, Davis J.B. Leberve, R and Garms, R (1978) Standardization criteria for assessing the effect of Simulium control in onchocerciasis control programmes. Transactions of the Royal Society Tropical and Medicine Hygiene, 72:675-676
9. Davis, J.B. Crosskey, R.W. Johnson M.R.L & Crosskey M.E. (1962): Bulletin World Health Organisation 27-491
10. Davis, J.E, Seketeli. A. Walsh, J.F, Barro, J.A. and Sawadogo, R (1981): Studies on biting Simulium damnosum S.I at a breeding site in the onchocerciasis control programme area during an interruption of insecticidal treatments. Tropenmedizen and parasitology, 32:17-24
11. Abubakar, M.S and Abdulrahman E.M (1998) Useful plants in Traditional control of insect pests. Journal of Herbs, Spices and Medicinal plants, 6 (2): 49-54
12. Thomas, T.G. Sharma, S.K. Jalees, S and Rahman, S.J. (1994) J Basic Appl. Bio-Med., 2,53-5516. Ayensu, 1978,
13. Okwute S.K (1992): Plant-derived pesticidal and antimicrobial agents for use in agriculture; A review of phytochemical and biological studies on some Nigeria plants. Journals of Agriculture, Science and Technology, 2(1) 62-70.
14. WHO (1981) Instruction for determining the susceptibility or resistance of blackfly larvae to insecticide WHO/VBC/81.811 Geneva 5pp
15. Wonang, D.L., F.C. Onuwuliri and C.I.O Ogbonna (2000): The effect of extracts of some Nigerian plants on bacteria and fungi implicated in skin diseases. Nigeria Journal Experimental Applied Biology pp. 19-23
16. Okorie, T.G. and Lawal, L.A (1998): The toxicity of ethanotic extracts of fruits of Piper guineese (African Black Paper) Monodara myristica (NUTMEG) Eugenia aromatica and Dennettra tripetala (Pepper fruit) on Larvae of Aedes aegypti (L). Nigerian Journal of Science Vol. 32:79-82
17. Green, M.M, Singer, D.M. Sutherland, D.J and Hibben, C.R. (1991). J. A.M. Mosquitoes Control Association, 2,282-286

Author Information

Matar B. Malau
Biological Sciences, University of Nabuja

Davou B. James
Biological Sciences, University of Nabuja