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Review Article

# Insecticidal Activity of Plant Extracts

**Jagessar RC***

[1]*Department of Chemistry, University of Guyana, Turkey*

***Corresponding author:** Jagessar RC, Department of Chemistry, University of Guyana, Turkey

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## Abstract

Insecticides are a group of compounds with heterogenous toxicity, whose intended purpose is to kills insects. Synthetic insecticides are known for their very harmful environmental and health impacts. This therefore generates a need for a safer solution. Botanicals are a special group of insecticides with a natural origin, obtained primarily from plant parts. There is a continued interest to screen plants for their insecticidal activities in light of the great destruction done to crops that affect the livelihood of the populace worldwide, especially in countries, whose GDP depends primarily on agriculture. Guyana, a country on the mainland of South America is no exception. Agricultural produce is now threaten by emerging new species of insect pests, such as in the rice sector. Thus, there is a need to screen Guyana's richly biodiversified flora for its insecticidal activities and to promote research in biological control of crop pests and boost the agro industry.

**Keywords:** Insectides; environmental; Guyana; biodiversified flora

## Introduction

### Background

Insects, though useful in many ways to mankind, have had negative effects in the field of agriculture. They have attacked plant parts such as stored grains, seeds, flowers, leaves, stems, fruits etc and have had a significant effect on the agroeconomy of many countries [1-3] . One way to control insects deleterious effects on crops is to utilize chemical pest control, which employs potent chemical pesticides to curb, reduce or eliminate pests and thus sustain crop production throughout the world. However, most synthetic insecticides used to date are deleterious to human health and the environment [4]. Thus, an alternative strategy is necessary. That alternative strategy is the use of plant extracts and phytochemicals as natural antifeedant, insect deterrents and repellent [4]. Plant extracts are safe alternatives that are of low cost, convenient to use and environmentally friendly. Plant products have been successfully exploited as insecticides, insect repellents and insect antifeedants [1-3]. In addition, natural products insectides have been isolated from plants and serve the basis for structure mimicry synthesis. Figure 1 show a list of structure of some isolated natural products from crude plant extracts. Figure 2 shows a notorious insecticidal natural product, Azadirachtin Many countries whose GDP (Gross Domestic Product) depends on agriculture, have in recent times being affected by insects. Guyana, a country on the mainland of South America is of no exception. Agricultural produce is currently threaten by emerging new species of insect pests. One notable example is in the field of rice cultivation. Recent research in Guyana has shown that rice production is threatened by paddy bugs, leaf miners, water weevils and caterpillars [6]. Natural insecticides from Guyana flora, should be a good choice, apart from the synthetic analog imported. Thus, there is a need to screen Guyana's richly biodiversified flora for its insecticidal activities and to promote research in natural pesticides control. There is not much report of plant being screened for their insectidal activities here, even though research is currently being done. So, this area of research needs intensification in Guyana. In addition, the crude plant extracts can be subjected to chromatographic separation, which will lead to the isolation of known and unknown natural products which will continue to provide the platform for novel insectidal discoveries and structure activity relationship.

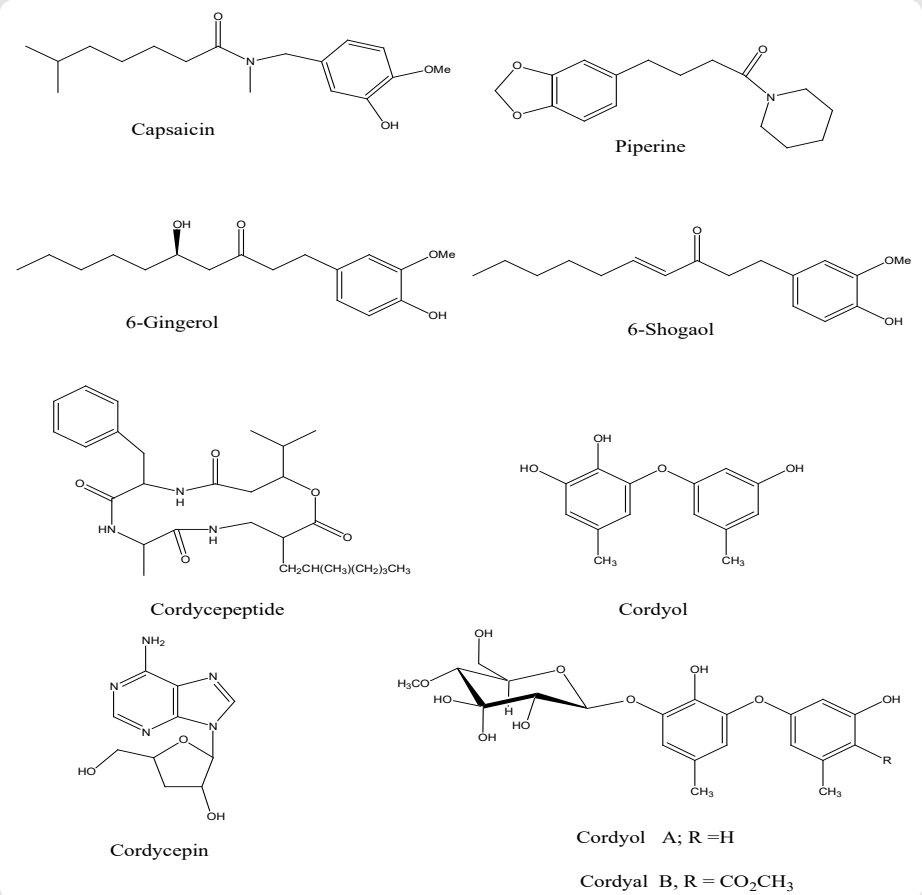


**Figure 1:** The structure of some selected isolated insecticides.

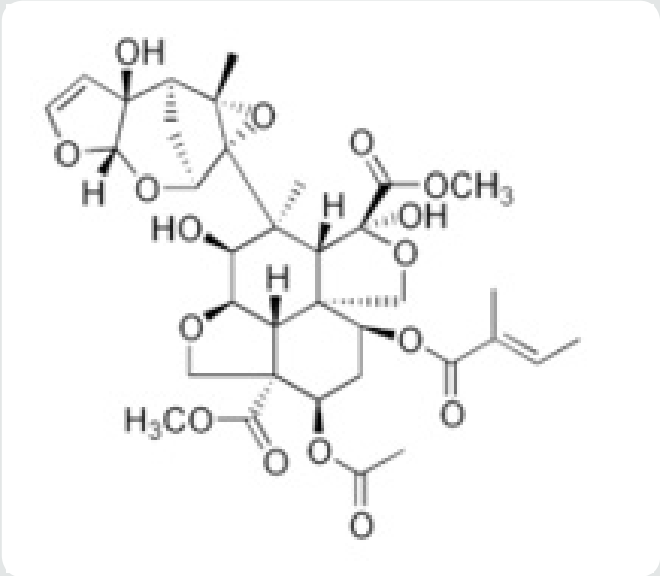

**Figure 2:** Azadirachtin, a notorious insecticidal isolate from *Azadirachta indica.*

## Brief survey of some selected natural insectides

Internationally, there are many reports of plant extracts being used for their insecticidal properties. Several will be briefly reviewed here. For example, *Morinda citrifolia* leaf extract was tested for larvicidal activity against three medically important mosquito vectors such as malarial vector *Anopheles stephensi*, dengue vector *Aedes aegypti*, and filarial vector *Culex quinquefasciatus* Insecticidal activity of essential oil [7], extracted from *Morinda lucida* was tested on pulse beetle *Callosobruchus maculatus*, which is a pest that causes serious damage to several pulses. The insecticidal activity was compared with two pesticides, Phostoxin and Primo-ban-20. Results clearly indicate that *M. lucida* essential oil can be used as an effective alternative for pulse beetle *C. maculatus* control, and it could be tested against other pulse beetles affecting Asia and Africa and throughout the world, thereby reducing use of synthetic pesticides [8].

The insecticidal and antifeedant activity of the ethanolic extracts from *Allium rotundum L* has been noted against the larvae of the *L.decemlineata* [9]. It was found that the ethanolic extracts from the aerial part possessed moderate level (40.0%) of insecticidal properties against the larvae of the *L. decemlineata* and low against the imago (6.7-13.3%0) [9]. The petroleum ether, ethanol and aqueous extracts from the leaves of Artemisia herbalba, Asso, *Euclayptus camaldulensis Dehnh* and *Rosmarinus officinalis L* were investigated for their insectidal activity against 3 to 4 days old Myzus persicae individuals at 1,2.5, 5 and 10% and observations were made after 24 hours. Etheric extracts of all plants were effective and induced mortalities (100%, 53% and 60% respectively) at the highest concentration. However, the ethanolic and aqueous extracts did not show any significant insecticidal effect [10] Sixteen aromatic plant extracts from three species belonging of the *Asteraceae* family, were tested for their insectidal activity against adults and larvae of confused flour beetle Tribolium confusum du Val (Coleoptera *Tenebrionidae*).

The methanolic and ethyl acetate extracts of *Mantisalca duriaei* Briq. Cavill. and petroleum ether, chloroformic and methanolic extracts of Raconteur acute DC, significantly induced larval growth. Antifeedant properties were detected in methanolic extracts of *M. duriaei* and *R. acaule*, petroleum ether and chloroformic extract of *R. acaule* and ethyl acetate extract of *M. duriaei*. For all extracts, mortality was higher for larvae than adults. Values of 83% and 77% were obtained using petroleum ether and methanolic extracts of *R. acaule*. These results suggest that *M. duriaei* and *R. acaule* may be used in grain storage against insect pests [11]. Leaf oil of *Psidium guajava L* obtained from Soxhlet extraction was tested for insecticidal effect and phytochemical screening against khapra beetle, *Trogoderma granarium* Everts (*Coleoptera*: *Dermestidae*. The application of the oil at the rate of 0.5ml gave significantly ($p < 0.05$) higher percentage mortality than the control [12].

A study was conducted to determine the insecticidal activity of essential oils from oregano, *Origanum onites L.* (*Lamiales: Lamiaceae*), savory, *Satureja thymbra L.* (*Lamiales: Lamiaceae*), and myrtle, *Myrtus communis L.* (*Rosales: Myrtaceae*) against three stored-product insects such as the flour moth *Ephestia kuehniella Zeller* (*Lepidoptera: Pyralidae*), the Indian meal moth *Plodia interpunctella Hübner* (*Lepidoptera: Pyralidae*) and the bean weevil *Acanthoscelides obtectus* Say (*Coleoptera: Bruchidae*). *A. obtectus* was the most tolerant species against the essential oils. However, the insecticidal activity of the myrtle oil was more pronounced than other oils tested against *A. obtectus* adults. The essential oils of oregano and savory were highly effective against *P. interpunctella* and *E. kuehniella*, with 100% mortality obtained after 24hrs [13].

**Table. 1:** Some selected plants from the Guyanese flora with folklore insecticidal activities.

| Scientific Name of Plant | Local Name of Plant | Uses |
|---|---|---|
| *Azadirachta indica* | Neem | Weevel, paddy bugs, moths and a wide range of insects |
| *Cassia alata* | Carrion-Crow Bush | Effective against weevils and bugs |
| *Citrus aurantifolia* | Lime | Effective against a range of insects |
| *Clathrotropis brachypetala* | Aromata | Effective against a range of insects |
| *Cordia curassavica* | Black sage | Leaves extract is potent against mites in chicken pens. |
| *Bauhinia scala simiae* | Hikuri-Tarafo, Monkey ladder | Use against malaria fever |
| *Lantana camara* | Sweet Sage | Effective against weevils and malaria fever |
| *Passiflora laurifolia* | Bell-apple | Use against insect pests |
| *Persea americana* | Avogadro pear | Useful against insect pests |
| *Quassia amara* | Quashie-Bitters | Used as an insecticide |
| *Scheffiera morototoni* | Karohoro | Suspected insecticidal activities |
| *Solanum americanum* | Bitter Gumma | Insecticidal activities against weevils and bugs |

Six different indigenous plants were screened for antifeedant and insecticidal activities against fourth instar larvae of Epilachna beetle, Henosepilachna vigintioctopunctata, a severe pest on brinjal. Amongst the plants screened, *Achyranthes aspera* showed higher activity against the selected pest. Ethyl acetate extracts of *A. aspera* showed higher antifeedant index and insecticidal activity against fourth instar larvae of *H. vigintioctopunctata*. Preliminary phytochemical analysis revealed that the presence of alkaloid and quinines in the ethyl acetate extracts indicating higher percentage of activities [14]. The insecticidal activities of four local plants extracts *Rhazya stricta Decne*, *Lantana camara L.*, *Ruta chalepensis L.* and *Heliotropium bacciferum Forssk* against subterranean termites *Psammotermes hybostoma (Desneux)* were reported. Of the four extracts, the hexane extract of *R. stricta* was more pronounced, having an acute (24hr) and chronic (48hr) LC50s of 194.8 and 147.4ppm, compared to 221.7 and 149.9; 288.9, 185.6 and 391.3 and 244.5ppm for *L. camara*, *R. chalepenesis* and *H. bacciferum* respectively [15]. There are other reports of plant extracts used for their insecticidal activities [16-22]. There are few reports of plants from the Guyana flora with insecticidal activities, even though research has been pursued in that direction. Table 1 shows a list of ten plants with selected insecticidal activity from the richly biodiversified Guyana flora.

## Conclusion

Insects are indeed a threat to mankind, especially in the field of agriculture. Many countries, whose economy depends on the agro-industry are threaten with new emerging destructive insects. Guyana is of no exception. Whist synthetic insecticides can do the job in many cases, there use is deleterious to the environment etc. Insecticides derived from plant extracts is far more environmentally friendly and far less expensive to make compare to synthetic ones. From an economical point of view, it would be best to use the aqueous extract of selected plants with insecticidal activities. There are many plants with folklore insecticidal activities in Guyana and their extracts: organic and aqueous need insectidal investigation. Also, the isolation of natural products from the crude plant extracts can lead to the discovery of new isolates and it would form the basis for continued novel drug discovery.

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