Research Article

Screening, Identification and Activity of Ant Repellant Compounds from Herbal Plants Extracts – A Biological Approach

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ABSTRACT

Ants are the most dominant group of social insects belonging to order Hymenoptera of class Insecta. Ants can contaminate and destroy some agricultural products and stored foods. High cost of chemical insecticides leads to search for an alternative source for the above pest management. The use of toxic chemicals as pesticides to control insects and other pestiferous organism has drawn public concern due to environmental and health implications hence the need for alternative techniques of integrated pest management is the need of the hour. Hence the present experiment is carried out to study the phytochemical analysis of *Coriandrum sativum, Ocimum basilicum* and *Cymbopogan citrates*. We found positive results for the presence of phytochemical components and bioactive compounds by GC-MS analysis. Later we tested these extracts for ant repellant activities in the field at different concentration. From the experiment it was observed that a minimum concentration of the plant extract had maximum ant repellency activity.

Keywords: Ants, insecticides, environmental, pest management and phytochemical analysis.

INTRODUCTION

Pesticides are available for most common household insect pests, but these potent chemical compounds may be more harmful to us and the environment than the pests. There are some natural, non-toxic ways to control household insect pests. The first line of defense against ants is to remove the attractants. To control these insect pests, peoples are using synthetic insecticides which are toxic to non-target insects. The natural ant repellant plays an important role in earth's natural ecosystem.[1] The use of toxic chemicals as pesticides to control insects and other pestiferous organisms has drawn public concern due to environmental and health implications hence the need for alternative techniques of integrated pest managements that are environmentally friendly. The plant kingdom can be a rich source of a variety of chemicals with the potential for development as successful pest control agents. Secondary compounds from plants include alkaloids, terpenoids, phenolics, flavonoids, chromenes and other minor chemicals can affect insects in several ways. They may disrupt major metabolic pathways and cause rapid death, act as attractants, deterrents, phago-stimulants antifeedants or modify oviposition. They may also retard or accelerate development or interfere with the life cycle of the insect in other ways. Morever, products from several floral species have been demonstrated to act as repellents, toxicants and antifeedants against a number of Coleoptera that attack stored products.[2]

Industrial interest in essential oils is due to their application as fragrances in perfumes, as flavor additives for use in food products or even as pharmaceutical products. In *Citronella* species the components present in the oil are responsible for the desirable repellent characteristics of the plant against mosquitoes Numerous plants and derived products, in particular essential oils, have been investigated and described as potential natural sources of insect repellent.[3]

The essential oil from the coriander herb contained the highest amount of aliphatic aldehydes, among which was decanal, E-2-dodecanol and E-2-decenol had the highest percentages. The contents of most aliphatic aldehydes decreased with each subsequent harvest of the herb. In addition to the above-mentioned aliphatic aldehydes, the presence of linalool, phytol, and oleic acid was found in the essential oil extracted from the coriander herb.[4] Hence the present study is undertaken with the following objectives to reveal the important physiochemical substances in our traditional herbs and which can be used against the chemical means of insect repellant available in the today's market.

MATERIALS AND METHODS

Collection of plant samples

In the present investigation, three different herbal extracts of *Coriandrum sativum, Ocimum basilicum* and *Cymbopogon citratus* were tested for ant repellent activity. The plant materials were collected from field areas around Srivilliputtur, Tamilnadu, India, where it was found naturally. The leave were separated and washed thoroughly in running tap water to remove soil particles and other adhered debris. The leaves were shade dried for 5 days and ground well into fine powder. The powdered materials were stored individually in air tight container until the time of use.

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Preparation of plant extraction

10g of the powdered sample of the plants were soaked in 100 ml of methanol in a 250 ml conical flask at room temperature (32-35^{0}C) with shaking after every 4 to 24 hrs. The extract was filtered using Whatman no.1 filter paper. The filterates were then evaporated to dryness to remove residual solvents and then stored in screw capped bottles for further use.

Phytochemical analysis of extracts

Detection of Alkaloids using Mayer's test to a 2 ml of plant sample extract, two drops of Mayer's reagent were added along the sides of test tube. Appearance of white creamy precipitate indicates the presence of alkaloids.

Detection of Triterpenes using Salkowski test Chloroform solution of the extract when shaken with concentrated sulphuric acid, lower layer turns to yellow on standing.

Detection of Terpenoids

Crude extract was dissolved in 2ml of chloroform and evaporated to dryness. To this, 2ml of conc.H_2SO_4 was added and heated for 2 minutes. A grayish colour indicates the presence of terpenoids.

Detection of Phenols

Crude extracts was mixed with 2ml of 2% solution of $FeCl_3$. A blue and green colour or black coloration indicates the presence of phenols.

Detection of Quinones

To the 1 ml of extract add 1ml of conc.H_2SO_4. Formation of red colour shows the presence of quinones.

GC-MS analysis

The *C.sativum, O.basilicum, C.citratus* methonolic extracts were quantified by Gas chromatography Mass spectrometry. The sample was injected into GC-MS port and the compounds were analysed based on the retention time.

Experimental animal

The colonies of *Selonopsis invicta*, red fire ant species were used as experimental animal for the present investigation. The ant species were identified with the help of cotton research station Srivilliputtur. Extracts from plants *Coriandrum sativum, Ocimum basilicum, Cymbopogan citratus* were prepared by grinding the above mentioned part of plant in distilled water. Extracts were centrifuged for 5 minutes and supernatant was collected and used as different concentration for ant repellant activity. The extracts of mentioned plants were prepared by grinding with water. The aqueous extracts were treated against the colonies which were attracted towards bait and the repellence activity was observed by spraying the extracts with different concentrations *C.sativum, O.basilicum, C.citratus* in 1, 5 and 10 % followed by the methodologies of Chaudhari *et al*.[5]

RESULTS AND DISCUSSION

In the phytochemical analysis of *Coriandrum sativum*, the aqueous extracts are found to be positive for Triterpenoids, Terpenoids, Quinones and Flavonoids and negative for alkaloids, tannis, saponin, phenols and glycosides (Table 1). In the phytochemical analysis *Ocimum basilicum* it was found to be positive for Terpenoids, phenols and negative for alkaloids, tritepenoids, quinines (Table 2). In the phytochemical analysis of *Cymbopogan citrates*, all chemical compounds except Phenol, quinones were found to be present (Table 3). Similar kinds of results were also supported by Nimish *et al*.[6] in which they preliminarily screened the phytochemical analysis of *Coriander sativum*. Likewise the phytochemical screening of the leaves extract of *O.basilicum* by Adham[7] revealed the presence of saponin, alkaloids, phenols, glycosides, carbohydrates and flavonoids. The preliminary phytochemical test screening of *C.citratus* extract by Umar *et al.*[8] showed the presence of flavonoids, proteins, carbohydrates, steroids and saponins.

In CG-MS analysis of *Coriandrum sativum* leaf extract the following bioactive compounds were identified such as 1,3 cyclopentadiene, cyclopentene,1- cyclohexene, Pentadien-1-ol, Cyclopentaepropanoic acid, Cyclopentane- carboxylic acid, 1, 3- Dimethyl cyclohexene, Decanal dimethyl acetate, 1-Di (tert-butyl) silyloxytetradecane, 5-Tetradecanol acetate, Cyclohexane and 1,2,5-Oxadiazol-3 amine.

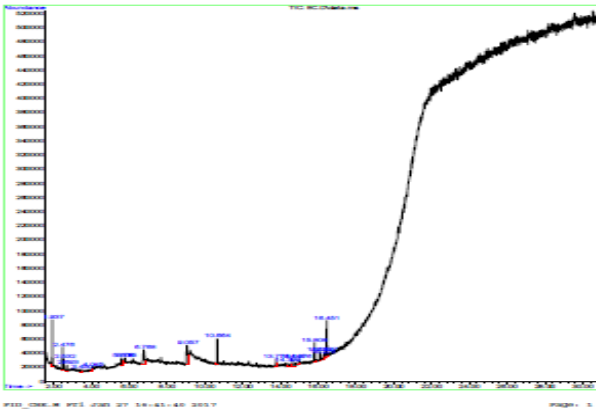

Figure 1: CG-MS analysis of *Coriandrum sativum* leaf extract

In CG-MS analysis of *O.basilicum* leaf extract the following bioactive compounds were identified such as are most beta-Ocimene, Carene, Trans-alpha-Bergamotene, 1,3,6,10-Dodecatetraene, 6-Octen-1-ol, Octasiloxane, and Eicosane. The compound Carene was also reported by Barkatullah *et al.*[9] in *Skimmia laureola* leaves found to have antimicrobial and antifungal activities.

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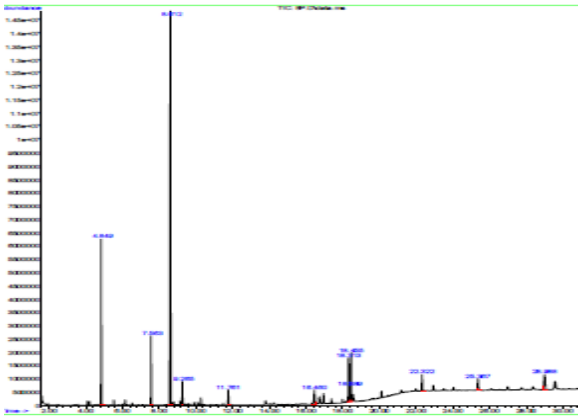

Figure 2: CG-MS analysis of *O.basilicum* leaf extract

In *C.citratus* plant extract the major compounds present is 1,6-Cyclodecadiene.

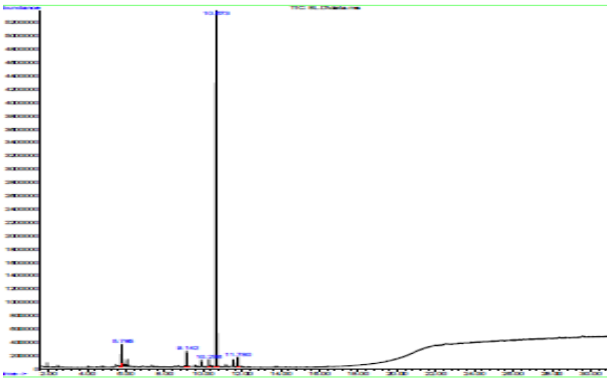

Figure 3: CG-MS analysis of *C.citratus* leaf extract

Similarly kinds of GC-MS observations were also supported by Bhuiyan *et al.*[4] who identified 53 compounds *C.sativum* in which the major compounds are linalool, geranyl acetate and γ-terpinene.

Ant Repellent Activity

Ant repellency of herbal plant extracts of *C.sativum, O.basilicum, C.citratus* were carried out in concentration 1, 5 and 10 %. It was found that the repellency activity was not found in 1% whereas it was found to be present in 5 and 10% concentration. The maximum repellency activity was found to be present in the extracts of *O.basilicum* and *C.citratus*. Similar kind of results were supported by Chaudhari *et al.*[5] who observed highest percentage of repellency in cucumber-mint (100%), lemon-garlic (100%), garlic mint (100%) and all plant mixture (100%) extracts at 10 % concentration.

Plate 1: E – Attraction of ants towards bait; F- repellency of ants after spraying extract

Anita *et al.*[10] reported repulsion of aphids and mealy bugs under laboratory condition for three plants extracts namely, *A. indica, A. Juss, E. globules L*. and O. basilicum L. Repellency was recorded by methanol leaf extract in the following order *A. indica* > *E. globules* > *O. basilicum a*s against aphids and mealybugs.

CONCLUSION

From the investigation it was found that natural compounds would be used as a substitute for synthetic pesticides available in the market and to reduce the persistence of chemical compounds in the nature. The phytochemical compounds screened in the present study from different herbal plant extracts showed a good ant repellent activity.

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