

REVIEW ARTICLE

BIOACTIVE CHEMICAL PROFILING OF PETIVERIA ALLIACEA AND LUFFA CYLINDRICA AQUEOUS EXTRACT USED AGAINST PODAGRICA UNIFORMA AND NISOTA DILECTA (COLEOPTERA: CHRYSOMELIDAE) INFESTATION OF OKRA (ABELMOSCHUS ESCULENTUS L.)

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ABSTRACT

In light of the harmful impact that pesticides have on both human and environmental health, there has been a significant growth in the employment of alternate approaches to pest management. The purpose of this investigation was to identify the bioactive chemical constituents of the aqueous extracts of *Luffa cylindrica* and *Petiveria alliacea*, which were utilised for controlling insect pest infestations. Two kilograms of fresh leaves of *P. alliacea* and *L. cylindrica* were collected and homogenized with a pestle and mortar separately. One litre of water and the crushed plant components were placed in a different plastic bucket. These were permitted to settle overnight while being stirred occasionally to produce crude aqueous extracts. After that, muslin cloth was used to filter the aqueous solution. The filtrate then served as a stock solution for the experiment and was placed separately in an EDTA bottle ready for GC MS analysis. Ten bioactive compounds were identified in *P. alliacea*. The most abundant bioactive compounds were Dodecanoic acid, methyl ester, Neophytadiene, Hexadecanoic acid, methyl ester, 9,12-Octadecadienoic acid (Z, Z)-, methyl ester, and 12 were found in *L. cylindrical*, including Neophytadiene, 2-Pentadecanone, 6,10,14-trimethyl, Hexadecanoic acid, methyl ester, and 9,12-Octadecadienoic acid (Z, Z)-, methyl ester. These suggested that *P. alliacea* and *L. cylindrical* aqueous extract could be a good source of insecticides that, because of their bioactive chemical composition, could be used to produce biopesticides and reduce crop damages and insect pest infestation more effectively.

KEYWORDS

aqueous extracts, bioactive chemical, *Luffa cylindrica*, GC MS analysis, *Petiveria alliacea*, synthetic insecticides.

1. INTRODUCTION

One of the major causes of crop losses worldwide is insect pest infestation, which can result in severe yield losses of up to 100% (Aderolu et al., 2013; Zhang et al., 2018; Desneux et al., 2010). Owing to the insects' widely recognised character, the crop plant in the field may suffer a significant loss each year. Insect pest damage to crops can also result in secondary plant pathogen infection, which can lead to incidental yield loss and aflatoxins product contamination (Osipitan and Oseyemi, 2012). Therefore, it is essential to create efficient management strategies for managing these formidable foes of the world's population and controlling insect pests is essential to maintaining high crop yields and food security.

The primary technique for controlling insect pests is still the application of synthetic insecticides (Senthil-Nathan, 2013). Currently, to ensure agricultural safety and increase the yield of crops, practically every nation in the world employs synthetic pesticides. But it has been established that the unrestricted and extensive use of these pesticides for agricultural productivity exposes people to mutagenesis, reproductive problems, and cancer through contact, inhalation, and food consumption. Some researchers hazardous to human health in addition to breeding pesticide-resistant insect and other pest species (Kazem and Shereif, 2010; Lu et al.,

2018; Attia et al., 2020). They are also known to pollute water bodies and the environment, have a fatal effect on organisms that are not the intended target (Sohail et al., 2011), and leave residue in harvested pods (Sohail et al., 2011; Adesina, 2013). Due to all of these disadvantages, it is desirable to use a different strategy that is more environmentally safe and has no harmful impacts on animals that are not the intended targets. A group researcher and one of the alternatives to synthetic insecticides is plant materials otherwise known as botanical (Nerio et al., 2010). Luckily, a variety of plants consist of distinct bioactive compounds known as secondary metabolites that have insecticide attributes and may be utilised for managing a range of insect pests (Adeyemi, 2010; Shrivastava and Singh, 2014).

Plant-oriented pesticide formulations are thought to be more environmentally friendly, sustainable, and biodegradable than synthetic pesticides (Mossa, 2016). As a result of their affordable prices, absence of lasting effects, ecologically approachable nature, and lethal effects on important pests, the use of botanicals in agricultural fields has grown in popularity recently (Stumpf and Nauen, 2001). They have also been carefully investigated as herbal insecticides against numerous agriculturally economically important insect pests (Kumar et al., 2011). Plant extracts are thought to be the finest possibility for insect pest

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management for the cultivation of horticultural crops since they are harmless for useful organisms, target-specific, and work effectively with biological control agents (Tang et al., 2002). According to a study, there are currently more than 250,000 diverse plant species worldwide, and there may be as many as 500,000 (Farnsworth, 1990; Benner, 1993). Furthermore, there is a great deal of room for more research because it is believed that only 10% of plant species have been investigated chemically (Benner, 1993).

In the words of other researcher, the primary source of a plant's insecticidal properties is one of its secondary components, or organic extractives, which include gums, terpenes, essential oils, waxes, alkaloids, fat, gums, and resins (Pettersen, 1984). The majority of chemical toxic substances found in plants are alkaloids, which are nitrogenous plant compounds that have a potent effect on animals' neurological systems. When the insects are exposed to the alkaloidal extracts, their nervous systems are disrupted and eventually die (Okugawa et al., 1993). As reported by a group researcher, it is possible for plant bioactive components to enter an insect's physiological system and obstruct its natural growth, leading to death (Cynthia et al., 2016).

Because they contain many active constituents that prevent insect resistance development, it is crucial to evaluate and use extracts obtained from locally and readily available plants against agriculturally major insect pests (Braham et al., 2012). In the opinion of some of researcher, more than two thousand plant species possess insecticidal characteristics, and research has indicated that extracts from various plant products have increased bioactivity (Shivakumar et al., 2013). While protecting the environment, screening various plants to establish their potential against insect pests, such as *Podagrica* spp., would help achieve sustainable pest control.

Though research has demonstrated the effectiveness of easily obtained locally plant materials against an array of crop pests, more investigation is necessary to expand their application in combined insect pest tactics of different crops. These materials are known to possess the qualities that make up a perfect botanical insecticide. More local farmers are going to benefit if plant species with insecticidal attributes were discovered and combined with an easy method of production. This study's primary goal aim to discover the aqueous extracts bioactivity of *Petiveria alliacea* L. and *Luffa cylindrica* (L.) Rox. against *Podagrica unifirma* Jacoby and *Nisota dilecta* Jaq. (Coleoptera: Chrysomelidae) infestations on okra.

2. MATERIALS AND METHODS

2.1 Collection and Preparation of the Extracts

Fresh leaves of *P. alliacea* and *L. cylindrica* were sourced from Oka Akoko, Ondo State, Nigeria. After washing the leaves in clean water to remove any filth, 2.0 kg of plant material was weighed using a kitchen weighing scale, and the mixture was then homogenised using a separate pestle and mortar. One litre of water and the crushed plant components were placed in a different plastic bucket. To get crude aqueous extracts, the aqueous suspension was sieved using muslin fabric after being left to settle overnight with periodic stirring. The filtrate was then put separately in EDTA (ethylenediaminetetraacetic acid) vials so that it could be subjected to GC MS analysis and used as a stock solution for the experiment.

2.2 Gas chromatography-mass spectrometry

The plant bioactive chemical components were analysed using GC-MS on an Agilent Technologies 7890A gas chromatograph equipped with an Agilent Technologies 5975C inert XL EI/CI mass selective detector operating in electron impact mode. The HS-SPME medium polar fibre was completely purified of contaminants before to the experiment by conditioning it at 250 °C for 15 minutes. Helium was used as the carrier gas at a flow rate of 1 millilitre per minute, while air and hydrogen served as the detection gases. The initial temperature of the column oven was 40 °C for three minutes. The temperature was then increased to 280 °C at a rate of 10 °C per minute, maintained there for three minutes, and then maintained at that level for 16 minutes. With a mass range of 40–300 m/z, a scan speed of 10,000 amu/s, and a sampling frequency of 25 spectra/s, the sample was analysed using full scan mode. The ion source and contact had respective temperatures of 200 and 250 °C. To determine the bioactive components in the sample, retention times and a comparison of mass spectra with the Wiley 275 L mass spectral library were employed (Rajashekar et al., 2013).

3. RESULTS

3.1 GC-MS analysis of aqueous extracts of *Petiveria alliacea*

Aqueous *P. alliacea* extract subjected to GC-MS analysis, detected several phytochemical components and demonstrated the presence of both major and minor peaks. Ten key bioactive compounds were found by GC-MS profiling; the phytochemicals with the highest peak area percentage are dodecanoic acid and methyl ester, while the phytochemical with the lowest peak is 1,2-Benzisothiazol-3-amine (Table 1). Twelve bioactive chemical substances were found in the *L. cylindrica* extract, with Neophytadiene, 2-Pentadecanone, 6,10,14-trimethyl, Hexadecanoic acid, and methyl ester being the main ingredients.

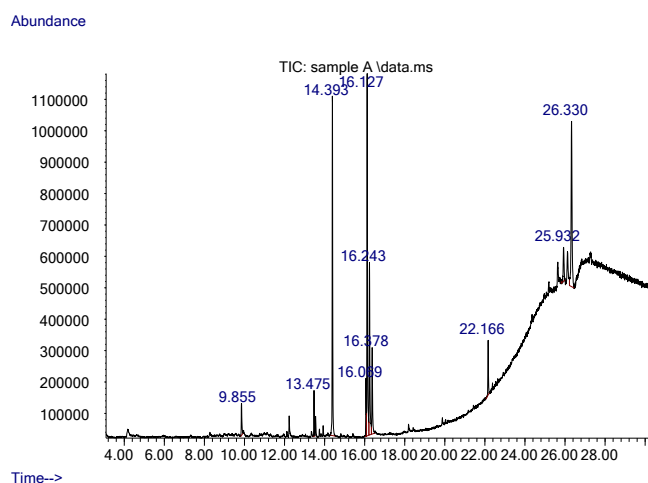


Figure 1: *Petiveria alliacea* aqueous extract GC-MS chromatographic profile

Table 1: Chemical composition of aqueous extract of *Petiveria alliacea*

Peak no	Compound	Retention Time	% Match
1	Dodecanoic acid, methyl ester	9.856	2.29
2	Neophytadiene	13.478	2.34
3	Hexadecanoic acid, methyl ester	14.394	21.68
4	9,12-Octadecadienoic acid (Z, Z)-, methyl ester	16.070	3.34
5	11-Octadecenoic acid, methyl ester	16.127	24.98
6	3,7,11,15-Tetramethyl-2-hexadecen-1-ol	16.242	13.01
7	Methyl stearate	16.379	6.64
8	1,2-Benzisothiazol-3-amine	22.164	3.51
9	Cyclotrisiloxane, hexamethyl-	25.935	3.42
10	1,2-Benzisothiazol-3-amine	26.330	18.78

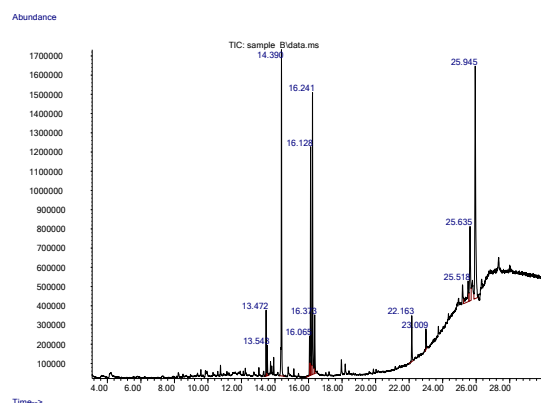


Figure 2: Chromatographic profile GC-MS of aqueous extract of *Luffa cylindrica*

Table 2: Chemical analysis of *Luffa cylindrica* aqueous extract

Peak no	Compound	Retention Time	% Match
1	Neophytadiene	13.472	3.12
2	2-Pentadecanone, 6,10,14-trimethyl	13.541	1.70
3	Hexadecanoic acid, methyl ester	14.388	18.54
4	9,12-Octadecadienoic acid (Z, Z)-, methyl ester	16.064	2.26
5	9,12,15-Octadecatrienoic acid, methyl ester	16.127	14.11
6	3,7,11,15-Tetramethyl-2-hexadecen-1-ol	16.242	16.55
7	Methyl stearate	16.373	3.75
8	Squalene	22.164	2.83
9	Methyl tris(trimethyl siloxy)silane	23.011	1.32
10	Cyclotrisiloxane, hexamethyl-	25.517	3.52
11	1,1,1,3,5,5,5-Heptamethyltrisiloxane	25.637	8.16
12	beta.-Amyrin	25.946	24.15

4. DISCUSSION

The insecticidal potency, lack of side effects, and economic benefits and cost-effectiveness for people especially those in developing countries, have made the ethnobotanical and therapeutic qualities of plants relevant subjects for contemporary international research. The *P. alliacea* plant have proven useful in all areas, and various biologically active chemicals have been identified thus far. A lot of volatile constituents from different parts of *P. alliacea* have been found in extracts; the most notable of these constituents are methyl ester, hexadecanoic acid, 2, 2-Pentadecanone, 9,12-Octadecadienoic acid (Z, Z)-, 6,10,14-trimethyl, 11-Octadecenoic acid, cyclotrisiloxane hexamethyl, and methyl stearate. This was in line with reports from most of study (Cruz-Salomón et al., 2022; Adesanya et al., 2023; Akintan and Akinneye, 2020).

The result of the GC-MS analysis of *L. cylindrica* leaf extract of this research validate the reports of who report the presence of 15-octadecanoic acid, Neophytadiene, methyl ester, 2-Pentadecanone, 6,10,14-trimethyl, methyl stearate, Squalene, 9, 12,15-Octadecadienoic acid, methyl ester (Z, Z, Z) from different parts of *L. cylindrica* with different solvents (Godwin et al., 2020; Koledoye et al., 2021; Alagbe et al., 2023). This work confirms earlier findings by that plant extracts are complex combinations of bioactive components and plant metabolites (Emimal, 2010; Russell and Lane, 1993). The occurrence of bioactive compounds associated with the two plants has been implicated in their insecticidal activities against different insect pest (Obafemi et al., 2006; Adeniyi et al., 2010; Byron et al., 2015; Qwarse et al., 2016; Akintan and Akinneye, 2020; Adesina et al 2021; Farag et al., 2021; Bharathithasan et al 2021; Alagbe et al., 2023; Thomas and Anderson, 2003). In addition, the bioactive compound in the plant possesses antioxidant properties, supports enzyme induction, boosts organ detoxification and inhibits oxidative stress (Sarumathy et al., 2011; Shmuel, 2012).

The plants used in this investigation have different compositions from those in prior publications, according to the GC-MS analysis. According to study, the observed variation in chemical contents may be caused by a variety of factors, including harvesting technique, plant age, species or a component of the plant used (root, seed, stem bark, flower, etc.), and extraction procedures (Agubosi et al., 2022; Alagbe and Akintayo, 2020). In a related development, opined that solvent polarity and their solubility determine the types of bioactive chemical compounds available in the plant extract (Mahmoudi et al., 2013; Adesina et al., 2020). Some of researchers established the relationship between the type of solvents used in extraction and plant extracts efficacy (Patra et al., 2022; Kapadia et al., 2022).

Furthermore, some researcher suggested that the first screening of plants for potential bioactivity should start with water (universal solvent) extract; extraction using different organic/synthetic solvents may follow (Gurjar et al., 2012). According to plant materials extracted with water extracts outperformed their powders or other solvent extracts in terms of

effectiveness (Achio et al., 2012). The study goal was to find native plant species with insecticidal potentials and a simple preparation technique that would benefit the local farmers; hence the aqueous extraction method was used.

5. CONCLUSION

Incorporating environmentally friendly substances, in particular those originated from plant sources, into insecticides is crucially needed due to the challenges surrounding the utilization of synthetic chemicals for pest control. The findings of this study indicate that *P. alliacea* and *L. cylindrica* aqueous extract may be a valuable source of biopesticides in reducing insect pest infestation and crop damage in okra due to the presence of bioactive chemical components with insecticidal characteristics. The current research has significant ramifications for the application of botanical insecticides in the real-world management of agriculturally important insect pests. To ascertain the safety of the extracts, more research is needed to assess their toxicity to albinos and their method of action on insect pests.

AUTHOR CONTRIBUTIONS

AJM Conceptualized, designed the experiment and prepared the draft manuscript; AMA Conceptualized the study, sourced for the experimental materials, carried out the study and collect all necessary data; ARA validate the research concept and methodology and supervise the experiment; AOP validates the data analysis, review and edited the manuscript OOA analysed the data and interpreted the results.

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CONFLICT OF INTEREST

The authors do not have any conflict of interest

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