

Synthesis Bio-Pesticide from Custard Apple Seed

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Abstract— Pesticides boost agricultural productivity by controlling pests and other dangerous organisms. The use of synthetic pesticides has caused significant environmental and health issues, emphasizing the need for organic alternatives. This project aims to produce natural pesticidal oil from custard apple seeds (*Annona squamosa*) as an alternative to chemical pesticides. Custard apple seeds include phytochemicals with antibacterial, hepatoprotective, antioxidant, and anti-tumor effects. The extracted solvents used were n-hexane, benzene, and ethyl acetate, with comparative yields being investigated. To identify the main chemicals with pesticidal action and assess their suitability for medical use, FTIR was employed. According to these results, custard apple seed oil has a lot of potential for further medical research, particularly in the treatment of cancer, and might be a useful bioresource for natural pesticidal substances in the future. Therefore, with more research into the synthesis of natural pesticides from custard apple seed oil, the current study successfully supports the principles of ecologically friendly and sustainable pest management while also suggesting the likely health benefits of CAO. The results encourage further study into the numerous agricultural and medicinal uses of custard apple seed oil.

Keywords— Custard apple seed, methanol, distillation, benzene

I. INTRODUCTION

Pesticides are essential for preventing insect attacks on crops, preserving soil fertility, and boosting agricultural yields. There are two sorts of pesticides: natural and manmade. Natural ingredients such as cow urine, leftover leaves, seed oil, etc., are used to make natural insecticides. Maintaining soil fertility and biodegradability is advantageous, and the primary outcome is that pesticides are more efficient at killing insects than synthetic ones. Compared to synthetic pesticides, it is less expensive. The usage of synthetic insecticides has increased recently. As crop productivity declines, so does soil fertility. One area of the agricultural economy that is expanding quickly is organic farming. Pesticides and insecticides with fewer side effects and residual issues are sought after by contemporary farmers. Eighty per cent of people in developing countries solely use traditional medicine for their basic medical requirements, which typically involves the use of plant-based extracts (WHO, 2000).

The best way to address chemical losses is through bio-control. Using a different solvent, oil is extracted from custard apple seeds and used as a biopesticide to manage pests.

1.1 Custard Apple: *Annona Squamosa* (custard apple) seeds contain acerogenins, known for their cytotoxic and abortifacient properties. The seeds are bitter and toxic, and they are employed as a fish poison and pesticide.

They are also efficient insecticides against head lice, southern armyworms, and pea aphids, and their oil includes three acids with antioxidant characteristics.

1. Palmitic Acid.
2. Stearic Acid.
3. Lauric acid.

1.2 Solvent Selection: Maximum solvent efficiency for oil extraction: It is the most crucial element to consider when selecting an extraction solvent. We may utilize a variety of solvents in the aforesaid extraction, including NaOH, Pyridine DMA, and more. We have to pick the solvent that can deliver the highest extraction of oil that is required.

Cost of solvent: It is also a crucial consideration when picking a solvent. Many solvents are expensive and provide the highest oil extraction efficiency. However, due to the high cost, we cannot choose the solvent. We must select a solvent that is both cost-effective and efficient in oil extraction. Based on the two factors mentioned above, we selected.

- a) Benzene
- b) methanol
- c) ethyl acetate

Fatty acid composition	Weight %
Lauric acid	0.08
Palmitic acid	17.79
Stearic acid	4.29
Oleic acid	39.72
Linolic acid	29.13
Linolenic acid	1.37
Arachidonic acid	1.06
Behenic acid	2.01

II. LITERATURE REVIEW

This study on natural pesticides from custard apple seeds focuses on eco-friendly agriculture practices. Scholars have extensively explored the method of extracting and using custard apple seed oil as a bio-pesticide. This study focuses on synthesizing and characterizing natural insecticides, including evaluating the chemical properties and bioefficacy of extracts from custard apple seeds. Several investigations have focused on the oil in custard apple seeds as a potential organic pesticide replacement. The extraction process is crucial for determining the oil's pesticidal efficacy and purity. Characterization research attempts to identify the oil's components and how they effectively kill pests. Previous studies have examined the value of custard apple seed oil in agriculture. This study examines how a natural insecticide affects crop output and soil quality, in addition to pest control.

This study found that custard apple seed oil effectively eliminates pests and is less harmful than synthetic pesticides due to its biodegradability and reduced off-target effects. It may be a more environmentally friendly alternative for pest management, contributing to sustainability and reducing pesticide usage. This research highlights the significance of developing non-chemical insecticides to mitigate the negative effects of traditional farming practices in the field.

III. METHODOLOGY

3.1. SOXHLET EXTRACTION PROCESS

The Soxhlet extraction method is one of the oldest and most widely used methods for extracting soluble compounds from solid samples, and it is especially effective for extracting lipophilic molecules. These 11 include a round bottom flask, a Soxhlet extractor, and a condenser. In this technique, the solid sample, which is often predigested to increase surface area, is placed in an extractor's filter paper thimble. A suitable solvent is then poured to the round-bottom flask and heated until it evaporates. The vapour rises through the steam and enters the condenser, where it is cooled and turned into liquid.

This liquid then falls drop by drop into the extractor, where it mixes with the solid sample and dissolves the necessary chemicals. When the solvent reaches a certain level in the extractor, it overflows into the flask, carrying with it the dissolved products. This step is performed multiple times over several hours to

achieve maximum extraction effects. The solvent is then evaporated, primarily using a rotary evaporator, to yield a concentrated sample.

Soxhlet extraction is noted for its efficiency and reproducibility, however it can be time-consuming and need large volumes of solvent. Furthermore, heat-sensitive chemicals may degrade as a result of prolonged heat exposure. Nonetheless, this method remains important in a variety of fields, such as chemistry, food science, and natural product research for isolating bioactive compounds.

3.2 Raw Materials and Chemicals

1. Custard Apple Seed Powder
2. Solvent for Extraction (Methanol, Benzene, Ethyl Acetate)



Figure 1. Custard Apple Seed and Powder

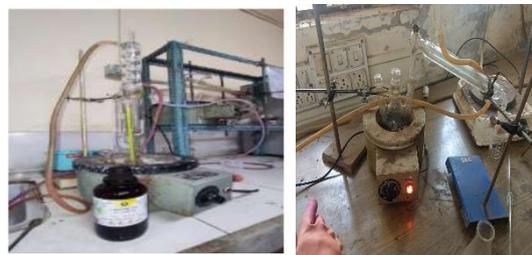


Figure 2. Experimental Setup

3.4 Experimental Process:

1. Wash and dry the custard apple seeds before grinding them.
2. Take 20 g of powdered seeds. Place it inside the Soxhlet device.
3. Fill a round-bottom flask with 300 mL solvent. The seed powder/solvent ratio is 1:15.
4. Place two neck round-bottom flasks on the mantle for heating. Attach the Soxhlet apparatus to the top of the round bottom flask.
5. Turn on the heating mantle and set the temperature to the solvent's boiling point. As the temperature exceeds boiling point, vapours form and condense owing to condenser cooling.
6. The extracted mixture will build in the vessel and reach the syphon tube. Once the mixture has been

poured into a round bottom flask, one cycle is complete. Perform 3-4 cycle.

7. After enough cycles, remove the round bottom flask from the Soxhlet Apparatus and transfer it to the distillation apparatus.

8. Distil the solution at the solvent's boiling point using simple distillation. After the solvent has been completely vaporised, collect the oil in testing vials.

9. Follow the method for three solvents. 1) n-hexane 2) Benzene 3. Ethyl acetate.



Figure 3. Extracted Oil Sample

IV. RESULT

4.1 Fourier Transform Infra-Red Spectroscopy (FT-IR) analysis

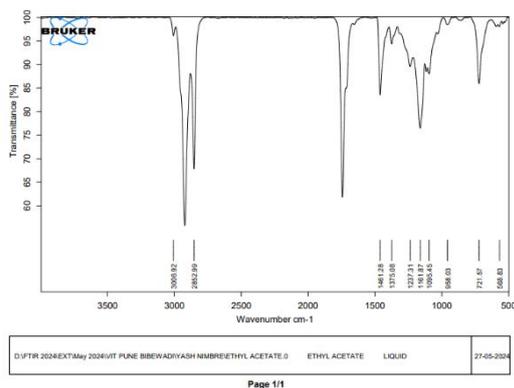


Figure 4. FTIR Spectrogram of oil Extracted using Ethyl Acetate

The figure is an FTIR spectrum of ethyl acetate. FTIR stands for Fourier-transform infrared spectroscopy. It is a technique used to identify organic compounds by analyzing the infrared light absorbed by the sample.

The x-axis of the spectrum is wavenumber, which is measured in cm^{-1} . The y-axis is transmittance, which is measured in %. A peak in the spectrum indicates that a certain wavenumber of infrared light was absorbed by the sample. The higher the transmittance, the less light was absorbed at that wavenumber.

The FTIR spectrum of ethyl acetate has several characteristic peaks. These peaks correspond to

different functional groups in the molecule. For example, the peak at around 1740 cm^{-1} corresponds to the carbonyl group ($\text{C}=\text{O}$). The peaks at around 1240 cm^{-1} and 1020 cm^{-1} correspond to the C-O bond in the ester group.

The specific peaks in the image you sent match those of ethyl acetate, which means the sample is likely ethyl acetate.

V. FUTURE SCOPE

The potential future applications of producing natural insecticides from custard apple seeds include Sustainable agriculture, Green chemistry, and therapeutic uses. Combining energy-efficient methods like microwave or ultrasonic with bio-sustainable, efficient solvents like ethanol or supercritical CO_2 might increase production while lowering environmental impact. Pilot-scale research is crucial when moving to the commercial scale, as it is more comparable to the commercial scale. It could be necessary to formulate the production of biopesticides into easy and stable forms, including spray or powder formulations. The delivery techniques may guarantee improved controlled release and increased nanoparticle efficiency.

Toxicological testing is necessary to evaluate the effects on soil, water, and other third parties since environmental protection is crucial. It is equally important to investigate the biodegradability of Pex and its long-term impacts on soil health. Combination with extensive, large-scale field testing and official Integrated Pest Management (IPM) methods may help manage pest resistance. Beyond agriculture, Squamocin and Bullatacin, two bioactive chemicals derived from the plant, have potential medicinal applications, including anti-cancer properties, that need more investigation.

In addition, it contributes to rural development and offers a benefit in comparison to other synthetic pesticides. It is envisaged that increasing farmer knowledge and education on optimal practices would lead to a greater use of them.

The circular economy's tenet of reduced carbon emissions and the use of agricultural waste may also be seen as improving environmental sustainability. Finally, developing and introducing into the market efficient medication and pest control using custard apple seed will require obtaining government license

and establishing certain production and manufacturing procedures.

VI. CONCLUSION

Natural insecticides can be synthesised using oil taken from custard apple (*Annona Squamosa*) seeds, which is a very cost-effective, efficient, and simple method. To establish the best conditions and solvents for this extraction process, trials with three different solvents were conducted, with Ethyl Acetate emerging as the best solvent. The temperature must be maintained at the boiling point of the solvent employed. It is established that at least three extraction cycles will be performed in order to extract a sufficient amount of oil from custard apple seeds.

The custard apple seed oil is evaluated using FTIR analysis, which reveals the many beneficial chemicals that may be present in the oil sample. Furthermore, to determine the exact components in the oil sample, GC/MS and LC/MS. is done, resulting in the presence of two essential components, namely Squamocin and Bullatacin, which are used in pesticide and medicinal applications, respectively. The study successfully determined the pesticidal characteristics of custard apple seeds. Aside from that, its medical applications, such as toxicity to certain cancer cells, have been established and require more investigation. So far, this study has shown that custard apple seeds have very vital and impacting pesticidal properties, which encourages researchers to perform additional research on their medical applications.

VII. REFERENCES

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