

Success story: extraction method of neem oil from neem seed kernel in Eritrea

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Summary

This research aims to extract neem oil from kernels of Neem seed. The extracted neem oil was used for bio-pesticide to control pests. An oil presser machine extraction was used to extract the oil. The results obtained showed that an average 140ml/kg of neem seed kernel. Neem based insecticides are botanical pesticides safer to environment and public. Various studies have shown that neem is non-toxic to birds, beneficial insects. Moreover, neem oil can be used as fungicide, insecticide, acaricide and nematocide and could be used best alternative in organic farm. The neem cake produced organic fertilizer, containing high organic matter and 13.8% nitrogen, Phosphorus (0.5% to 1.0%) and potassium (1.0% to 2.0%). The dual activity of neem cake as fertilizer and pest repellent has made it a favored input. Neem cake is a by-product of oil extraction and since it represents 70% of the original seed by weight or volume. Neem is used in storage; pests can be kept away from the grain for a whole year; but if the grain is already infected with pests the protection will not work.

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Introduction

The Ministry of Agriculture (MoA) started an organic farming practice that included making bio-pesticides (BP), conducting trials, and training experts and farmers. The fundamental goal of the initiative was to shift agricultural practices away from chemical inputs and toward botanical inputs to contribute to long-term food security that is both safe and nutritious. The neem tree, *Azadirachta indica*, a member of the Meliaceae family, is a tropical evergreen with a wide adaptability. Native to India and Burma, it has been transplanted to Africa, the Middle East, South America and Australia. In Eritrea, the neem tree (*Azadirachta indica*) is mainly grown in lowlands, Gash barka, Anseba, Northern and southern Red Sea Regions. Neem contains 40 different active compounds called liminoids (Haldhar et al. 2022). The main active ingredient of neem leaf is Azadirachtin. It exhibits antifeedant, insect repellent and insect sterilization properties and is used as fungicide and acaricide. Formulation of new bio-insecticides, particularly those based on seed neem oil, is an exciting option for integrated pest management programs since such plant-derived insecticides have various benefits, including selectivity, excellent safety for non-target organisms, human and compatibility with biological control organisms. The primary active ingredient of most neem-based pesticides is azadirachtin, a liminoid compound, which has multiple biological activities on more than 400 insect species from several orders.

Neem trees start producing fruit when it reaches the age of three years where the tree is made up of flowers in the month of May and June and produce fruit in the month of July and August and falling fruits naturally at

maturity, where it can be collected from under the trees and gives the tree amounting to 20-40 kg of fruit per year and these are used in the manufacture of dry fruits exterminator including through simple and available.

Neem oil

Neem oil varies in colour; it can be golden yellow, yellowish brown, reddish brown, dark brown, greenish brown or bright red. It has a relatively strong odour that is said to combine the odours, of peanut and garlic. It is composed mainly of triglycerides and contains many triterpenoid compounds responsible for the bitter taste. It is hydrophobic in nature to emulsify. It in water for application purposes. It must be formulated with appropriate surfactants. Neem oil contains at least 100 biologically active compounds. Among them, the major constituents are triterpenes known as limonoids, the most important being azadirachtin, which appears to cause 90% of the effect on most pests. The compound has a melting point of 160°C and a molecular weight of 720g/mol. Other components include meliantriol, nimbin, nimbidin, nimbinin, nimbolides, fatty acids (oleic, stearic, and palmitic), and salannin. The main neem product is the oil extracted from the seeds by different techniques. The other parts of the neem tree contain less azadirachtin, but are also used for oil extraction. It has feeding of insects, while nimbin and nimbidin mainly present antiviral activity. Azadirachtin can also interfere in mitosis, like colchicine, and has direct histopathological effects on insect gut epithelial cells, muscles, and fatty tissues, resulting in restricted movement and decreased flight activity.

The oil is considered a contact insecticide, presenting systemic and translaminar activity (Cox 2002; Haldhar et al. 2021). It has a broad spectrum of action, inhibiting feeding, affecting hormone function in juvenile stages, reducing ecdysone, deregulating growth, altering

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development and reproduction, suppressing fertility, sterilizing, repelling ovipositional, and disrupting moulting processes (Brahmachari 2004). Little is known about the mode of action of azadirachtin as a feeding inhibitor, although it is possible that it stimulates cells involved in feeding inhibition, causing weakness and pest death (Brahmachari 2004; Haldhar et al. 2023).

The affections of Neem oil

Neem oil can be slightly irritating to the eyes and skin. Azadirachtin, a component of Neem oil, can be very irritating to the skin and stomach. The remaining portion of Neem oil is made of fatty acids, essential oils and other substances that are commonly eaten in a standard diet.

The effect of the environment on the neem oil

Azadirachtin, a significant component of Neem oil, is rapidly broken down. Microbes and light break down the pesticide in soil, water and on plants. The half-life of azadirachtin in soil ranges from 3 - 44 days. In water, the half-life ranges from 48 minutes to 4 days. It also rapidly breaks down on plant leaves; the half-life is 1 - 2.5 days. The remaining components of Neem oil are broken down by microbes in most soil and water environments.

The effect of Neem oil on birds, fish, or other wildlife

Neem oil is practically non-toxic to birds, mammals, bees and plants. Neem oil is slightly toxic to fish and other aquatic organisms. Azadirachtin, a component of Neem oil, is moderately toxic to fish and other aquatic animals. It is important to remember that insects must eat the treated plant to be killed. Therefore, bees and other pollinators are not likely to be harmed.

Neem cake

Neem cake organic manure is the by-product obtained in the cold pressing of Neem Tree Seed and kernels, and the solvent extraction process for Neem oil cake. It is a potential source of organic manure under the Bureau of Indian Standards. Neem has demonstrated considerable potential as an organic fertilizer. For this purpose, Neem cake is especially promising. Neem cake can be used for partial replacement of poultry and cattle feed.

Components of Neem cake

Neem Cake has an adequate quantity of NPK in organic form for plant growth. Being a totally botanical product, it contains 100% natural NPK content and other essential micronutrients as N (Nitrogen 13.8%), P (Phosphorus 0.5% to 1.0%), K (Potassium 1.0% to 2.0%), Ca (Calcium 0.5% to 3.0%), Mg (Magnesium 0.3% to 1.0%), S (Sulphur 0.2% to 3.0%), Zn (Zinc 15 ppm to 60 ppm), Cu (Copper 4 ppm to 20 ppm), Fe (Iron 500 ppm to 1200 ppm), Mn (Manganese 20 ppm to 60 ppm) PH (5.53), EC 4.32, OM (organic matter 276.37%). It is rich in both Sulphur compounds and bitter limonoids. According to research calculations, Neem cake seems to make soil more fertile due to an ingredient that blocks soil bacteria from converting nitrogenous compounds into nitrogen gas. It is a nitrification inhibitor that prolongs nitrogen availability to short-duration and long-duration crops (Neem Tamiladu.com).

Benefits of neem cake

- It enriches the soil and can be used as another soil conditioner
- It is biodegradable
- It is chemical free
- It ensures the fertility of the soil and improves the organic matter content of the soil
- It has a long-lasting effect on soil
- It is cost-effective

Materials and Methods

The stages of the extraction of the Neem seed oil

i) combining stage

Are gathering under deciduous trees Neem during the season to produce seeds and transport them to the work site, where they are cleaned of dirt. In Eritrea, the seed were collected from low land areas Northern red sea, Gash-barka, anseba regions and transported to the central region at the national animal and plant health laboratory for oil extraction processing.

ii) drying and storage stage

The seed is dried with natural sunlight in a black plastic tent with a dedicated drying stirred from time to time using sunlight and is then stored in a cool and dry store.

iii) pre-extraction oil stage

Seeds are cleaned and washed by tap water to remove dust and any inner matter after that, drying in a black plastic tent and thoroughly dried with natural sunlight. The content of water/moisture in ready seed for extraction is less than 7%.

iv) Extraction neem oil pesticide stage

The process of extraction of neem oil is done with the help of an oil press machine. The machine screw heated up to 85°C before pouring the seed into the machine. After heating the machine screw, start pouring the neem seed kernel into the machine. The temperature of the screw maintains from the range of 85-100°C. the machine input power 220 voltage. during screw rotation pressing, the neem oil was extracted. Besides the byproduct, neem cake was produced. Depending on the quality of the neem seed kernel, an average oil extracted 140ml/kg of seed kernel was produced.

The neem seed kernel was cleaned and washed with tap water and dried on the black plastic tent in natural sunlight to lose water content for one day in the sunny season. After that, the clean and dried neem seed kernel was read for oil extraction.

For Extraction of Neem oil: The processing neem oil was extracted by presser machine, model (6YL-60), power (2.2kw), dimension (1200*700*1020mm) Gongyi Zhanjie Hengtong Machinery Factory. When the neem oil is extracted, then squeezed and packed into 1.5 litres for small and medium farmers and 5 litres for the commercial farmer. The packed container was levelled correctly with a user instruction manual and distributed to the farmer.



Fig.1 Cleaned seed read for extraction



Fig.2 Neem oil During extraction



Fig.3 Extracted neem oil packed

Result and Discussion

The experimental design was RCBD with three replications. The Three doses of neem seed oil formulated 60% active ingredient; 5ml/l, 7ml/l, 10ml/l and control plot (unsprayed) for comparison was tested. The potato variety is local (Electra). Each plot size is 4*5=20m². Total number of plots is 12 plots. Spacing between plants is 40cm and between rows 60 cm. distances between plots is 1m. Distance between blocks is 1m. Number of representative samples per plot was 5 and total number of representative samples was 60. Net plot size 10.64m². Total experimental area is 192.5m². Application of spray is at the interval of 7days. Disease inoculation was naturally. Supplementary irrigation and other agronomical husbandry are practiced. Data parameters to be collected are disease incidence percentage, disease severity percentage and yield (qt/ha). Beside these parameters, the presence of insect pests before and after spray will be observed. The data collected was analyzed by Genstat 18th Edition software.

The neem Tree is more available in Eritrea in the low land area. The neem seed still now it is not used in economic value. Now a day, they are valueless neem seeds shifting to value full and the neem seed oil pesticide is eco-friendly as well as replacing the synthetic pesticide. The byproduct neem cake is promising organic fertilizer. An average extracted neem oil 140ml/kg of neem seed kernel. This extraction of neem oil is economically feasible and the dose rate application 60% EC formulation 5ml/ litre of water is an effective control for fungal disease (blight, rust, powdery mildew) and insect pests. The farmer of Eritrea was well adapted and accepted. Efficacy study of neem seed oil as bio-fungicide against late blight on potato at Zoba Maekel (July,2022).

Conclusion

Based on the above research and finding results, it concluded and recommended that neem oil processing is promising and economical, ecologically and socially acceptable and feasible in Eritrea. There are several advantages of processing neem, including creating jobs to collect neem seeds in rural peoples, providing botanical pesticides eco-friendly, locally producing botanical pesticides and the organic fertilizer of byproduct neem cake.

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Data Sharing: All relevant data are within the paper and its supporting information files.

Abbreviations

MOA: Ministry of Agriculture
AED: Agricultural Extension Department
NAPHL: National Animal and Plant Health Laboratory
BP: Bio Pesticide
°C: Degree Celsius
%: Percentage
OM: Organic Matter
Ppm: Part Per Million
Kw: Kilowatt

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