INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES
[ISSN: 0975-4725; CODEN(USA):IJPS00]
Journal Homepage: https://www.ijpsjournal.com

OPEN ACCESS

Review Article

Comparative Estimation Of Vegetable Oil Extraction From Oilseed Sources

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ARTICLE INFO

Received: 15 May 2024
Accepted: 19 May 2024
Published: 29 May 2024
Keywords:
oil extraction, ajwain, Nigella, vegetable oil, oil expeller
DOI:
10.5281/zenodo.11383349

ABSTRACT

In this study, oil extraction from oilseed sources like Nigella sativa L. and Trachyspermum ammi has been done using oil expeller machine. Both the plants are medicinally important and their database and uses can be easily and highly found in any ancient Indigenous systems of medicines like Siddha, Ayurveda etc. These plants have anti-cancerous, anti-diabetic properties and help in digestion. They are frequently used as a edible source in many Indian households. The extraction process shows, oil yield ranged from 50-75% varying on the mechanical pressure applied and amount of heat provided. Free fatty acid content ranged from 0.78mg/100g in Nigella sativa L, to 0.86mg/100g in Trachyspermum ammi. Acid value ranged from 3.34mg KOH/g in Kalonji to 5.53mg KOH/g in Ajwain. The findings of this study demonstrate that oils from nonconventional sources possess the potential to sufficiently supplement oils used domestically and industrially. Consequently, they can help reduce reliance on imported oils, safeguarding foreign reserves, as most oil quality parameters were observed to be within acceptable levels, regardless of the oil source.

INTRODUCTION

The rising demand for fixed oils, especially vegetable oils, on a worldwide scale is having an effect on market prices .Vegetable oil preparation and consumption is in high demand in both domestic as well as industrial areas (Rahim et al., 2022). Pure form of oil having no extra chemicals added for extraction in in need. Thus, the use of traditional and mechanical pressing for oilseed sources comes as the best way. Oilseeds provide high nutrition to humans as well as animals, and is been used since ancient time (Gaba et al., 2018a). High amount of nutrient, vitamins, fatty acids essential for human are found in the oil. Whereas, the remaining oil cake consists of valuable source of protein content, used for animal fodder. This fixed oil is edible as there is no interference of any chemicals while extraction. They can be used as

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Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

food in various industries such as in making of bakery items, mayonnaise, canned food products, confectioneries and cooking oil (Lesten et al., 2019). Nigella sativa L. yields an oil rich in bioactive components, with potential health benefits into daily diets and addressing skin and hair health concerns. In a similar vein, the common Indian spice Ajwain (Trachyspermum ammi) has important pharmacological and physiological benefits. Thymol, γ-terpinene, and p-cymene are some of the main terpenoids found in the essential oil extracted from ajwain seeds, which has grown in significance (Shabnam Javed, 2012a). Cleaner, purer oil is obtained using the economical, chemical-free expeller pressing method used in the extraction of oil from Kalonji and Ajwain seeds. This cleaner technique recovers 70-75% oil and yields a cake that is high in protein and devoid of chemicals, accounting for about 90% of India's 24 million tons of processed oilseeds (Ashrafi et al., 2023a).

Plant Sources:

Nigella sativa L.:

It is a medicinally important plant widely found in India and belongs to family Ranunculaceae. The scripts related to this plant are found in ancient Indigenous system of Medicine like Siddha, Unani, and Ayurveda. It is commonly known as Kalonji and cultivated in various parts of India like Gangetic plains, Bihar, Himachal Pradesh, Bengal, Assam and Maharashtra. It is also commonly found in other countries of Southern Europe, Syria, Israel. The seeds of Nigella sativa L. are bitter, and have aromatic properties. They are used as appetizer, and help in digestion, constipation, and is purgative (Paarakh, 2010). The seeds of N. sativa L. are rich source of amino acids, proteins, and volatile oils and they have shown to have 30% of fixed oils and 1.5% of volatile oils (Gali-Muhtasib et al., 2006). Fatty acid composition study has shown to have high content of linoleic acid, followed by oleic acid and palmitic acid which is present in minor quantity (Ashrafi et al., 2023b). The seeds of Nigella sativa L. have antioxidant activity, anti-cancer, anti-inflammatory, and cytotoxicity against tumour cell lines(Bourgou et al., 2012). Some studies have shown that the seed cakes of Kalonji seeds show improved body weight and reproductivity, as well as improved immunity in various farm animals like buffalo, lambs and broiler chicks(Datta et al., 2012).

Trachyspermum ammi:

It is a herbaceous herb commonly known as Ajwain India. It belongs to the family Apiaceae and is widely grown in India, Europe, Pakistan, Egypt, and many other European countries(Bhadra, n.d.). The seeds of Ajwain are mainly used worldwide and are famous for its medicinal and nutritional properties. Chemical constituents like carbohydrates, tannins, protein, saponin, iron, copper, thiamine, are reported to be found in the seeds of this plant(Zarshenas et al., n.d.). Ajwain is seen as heroic plant in healing stomach disorders and in cure of asthama. Ajwan-ka-arak (aqueous extract preparation) is popularly used as traditional medicine for diarrhoea(Chauhan et al., 2012). The GC-MS data of essential oil extracted from Ajwain seeds showed presence of various phytochemical constituents like thymol (72%), α-terpineol (0.34%), β-pinene (0.11%)(Gaba et al., 2018b). Alkaloids, tannins, flavonoids, sterols were detected in a test in high amount(Shabnam Javed, 2012b). Also, antibacterial, antifungal, anthelmintic, diuretic, antioxidant, spermicidal, and detoxification activities are found in the seeds of Ajwain(Bhadra, n.d.). Ajwain seeds are also used as an edible component in many households of India in making Naan, parathas. It is also mixed with lemon juice, black pepper and used as a mouth refreshement (Darshankumar Bhingaradiya et. Al).

Various extraction methods:

Oil extraction process is carried out through various methods, like chemical processes that involve solvent extraction, and extraction using enzymes. Another method is distillation and cold press, and mechanical press that involves hydraulic press and screw press methods (Mariana et al., 2013). Amongst all of these methods the mechanical press method using screws give pure form of oil from oilseed sources. This method does not involve any chemical as intermediate and is in its pure state (Lesten et al., 2019). Only mechanical pressure is applied to crush the seeds and some amount of external heat is provided to the oilseeds so as oil extraction process can be fastened. A non-contaminated oil can be easily obtained through this method and fat cake rich in protein is the secondary product obtained which can also be further used (Shabrina & Wisnu Broto, 2023a).

APPLICATION:

The fixed oil extracted from oilseed sources are not only in high demand in food sector but also in pharmaceutical sector. Emulsified oil formulations are used in making of creams, lotions for body and in making of hair care products like conditioners and hair oil (Souza et al., 2021). They form a thin layer on skin and hair which favours hydration, providing moisture, softness and lubrication to surface area of skin and hair. Thus, a hair growth oil preparation from the oilseed sources of Ajwain and Kalonji is done in this study, to facilitate and promote hair growth (Shabrina & Wisnu Broto, 2023b).

MATERIAL AND METHODOLOGY:

Collection of oilseed plant sources: Seeds of Kalonji and Ajwain were collected from local market of Goregaon, Mumbai; and then identified properly.

Material and Tools:

Oil expeller machine is used here for the extraction of oil from oilseed sources. The machine comprises of various parts, such as the main body with stand. A worm on one side from where the cake will be thrown out. A fixed oil tray, a fixed cake tray for smooth and clutter free process. A funnel (hopper) from where the seeds will be passed on inside the machine. A hand rotator for rotating the screw machine mechanically. A glass bottle used as spirit lamp (Kuku et al., 2020).

Oil expeller machine:

A cost effective and light weight machine for extracting pure quality of oil without any addition of chemical components is demand of the current market. Unlike other commercially used method for oil extraction, where majority of chemical compounds are being used for oil extraction, this machine uses only the raw material i.e. oilseeds for extraction. The Oil Expeller is a screw type machine, which presses oilseeds through a barrel-like cavity. Raw material (oilseeds) enters one side of the press and by product (cake) exit the other side. The machine uses friction and continuous pressure from the screw drives to move and compress the oilseeds. The oil seeps through small openings that do not allow seed fiber solids to pass through. Afterward, the pressed seed sources are formed into a hardened cake, which is removed from the machine. This machine will satisfy the demand for the small and medium size industries because of its design, functionality and price. The measurements of the performance also being analyze by calculating the design efficiency.

Extract preparation:

Collect fresh shelled seeds, feed them into the machine hopper, and run for 8 minutes. If needed, re-test with 15-20 minutes of heating. Optimal performance relies expelling operation which can be more effective at around 60 revolutions per minute and an appropriate material quantity.

Fig no 1 Oil Expeller Machine

Phytochemical analysis:

1. Analysis of free fatty acids

1g of oil dissolved in 25 ml of absolute ethanol: diethyl ether (1:1 V/V). Utilize 0.1 M ethanolic KOH, titrating until a faint pink color appears, as indicated by phenolphthalein. Record the amount of KOH used to neutralize the oil (Iness et al., 2013).

2. Determination of acid value

Weigh 1.0 g of oil in a 250 ml conical flask with 25 ml of absolute ethanol and diethyl ether (1:1) solution. Heat the mixture in a 40°C warm water bath for 5 min. Add 3 drops of phenolphthalein indicator. Titrate the mixture against 0.1 M potassium hydroxide (KOH) until a faint pink color appears, persisting for 30 seconds. Record the volume of KOH used.

Preparation of hair growth oil:

Keep 05ml of coconut oil for boiling on low gas flame. Add 05ml pure oil of Kalonji or Ajwain extracted from oil expeller. Addition of any other essential oil or almond oil and fragrance can be done for enhancement of the oil. Store the prepared oil in air tight container, and keep away from sunlight to avoid any oxidation.

RESULT AND DISCUSSION:

The experimental results of this study were processed. Extraction of oil through oil expeller machine was done, mechanically for 1 hour on both the plant seeds Nigella sativa L. and Trachyspermum ammi. The oil yield was obtained from 0.20kg of both the oilseeds individually and then from 0.50kg. External heat was provided to the machine, especially on the screw press for almost 10 minutes each, and then mechanical crushing of the oilseeds were done for another 10 minutes. The oil thus obtained after crushing was removed in a bottle. The quality of oil was impure as it contained some amount of crushed seed particles, dust. It was filtered using whatman filter paper No.1 and then the pure oil was weighed. The quantity of oil produced was approximately 0.010kg per 0.20kg of sample. Data of both the oilseed sources is provided in the table 1.1 and 1.2

Table no. 1: Data for oil extracted from oilseed source of Nigella sativa L.

	First Test run	Second Test run	Third Test run
Quantity of oilseeds	0.20kg	0.20kg	0.50kg
Time allows for heating	05 mins	10 mins	10 mins
Time of crushing and extraction	10 mins	10 mins	15 mins
Quantity of oil:	0.010kg	0.020kg	0.050kg
Quality of oil produced	Impure	Impure	Impure
Quality of cake produced	Dry	Dry	Dry
Quantity of cake	0.52kg	0.56kg	0.70kg

Table no. 2: Data for oil extracted from oilseed source of Trachyspermum ammi

	First Test run	Second Test run	Third Test run
Quantity of oilseeds	0.20kg	0.20kg	0.50kg
Time allows for heating	05 mins	10 mins	10 mins
Time of crushing and extraction	10 mins	10 mins	15 mins
Quantity of oil:	0.020kg	0.025kg	0.065kg
Quality of oil produced	Impure	Impure	Impure
Quality of cake produced	Dry	Dry	Dry
Quantity of cake	0.60kg	0.60kg	0.75kg

Analysis of results:

Furthermore, the tests of the obtained oil was done for estimating free fatty acid and determining acid content. The results obtained through experiments showed that there is a presence of free fatty acid of 0.78mg/100g in Nigella sativa L and 0.86mg/100g in Trachyspermum ammi. The acid value content with reference to titration against potassium hydroxide is 3.34mg KOH/g in Nigella sativa L. and 5.53mg KOH/g in Trachyspermum ammi.

CONCLUSION:

Based on the results obtained, the amount of oil produced using mechanical oil expeller machine is sufficient enough. Though the amount obtained through any other chemical extractions or electric machines is higher than that of obtained with mechanical machine, it can be said that the product is pure. Any other methods used for extraction require further process for eliminating the extra chemical present with the oil; whereas here the product obtained is in its pure form. No extra chemical or even water content is added in the process and purely the oilseed sources have extracted the oil present in it. Thus, the oil expeller can be used as a good source for extracting pure oil. Also, due to the high protein and rich bioactive components present in both Nigella sativa L and Trachyspermum ammi, they can be used as hair oil for promoting hair growth. Comparative estimation of both the oilseeds also show that ajwain oilseeds develop more amount of oil through oil expeller machine than the quantity of oil extracted from Kalonji, therefore, ajwain oil can be highly used in more quantity in the preparation of hair oil.

ACKNOWLEDGMENT:

The authors express gratitude to Patkar-Varde College and the Department of Botany for fostering an environment supportive of research and experimentation in the field of Botany. Special thanks are extended to Dr. Sachin Bhagat, Head of the Department of Botany, and Assistant Professor Dr. Anil Bhalerao, and Ms. Ankita More for their unwavering guidance and support throughout this research project.

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HOW TO CITE: Jidnyasa Rane, Sachin Bhagat, Comparative Estimation Of Vegetable Oil Extraction From Oilseed Sources, Int. J. of Pharm. Sci., 2024, Vol 2, Issue 5, 1632-1638. https://doi.org/10.5281/zenodo.11383349