Extraction of Wheat Germ oil Using Cold Press

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***Abstract*—Commercially, wheatgerm oil (WGO) is extracted using cold press, Soxhlet extraction and supercritical CO2. This paper discusses about the quality of WGO extracted using cold press. Typically, WGO is extracted below 50°C *via* cold press and stored in a cool and dry place away from direct sunlight at humidity of <60%. The quality of WGO is carried out using GC-MS, where, extent of purity is measured by quantification of the area at full width at half height in gas chromatography (GC), and the mass spectrometry (MS) confirms the peaks as a function of the molecular weight by the charge, thus signature peaks of that particular molecule is identified and assigned, for example, amount of alcohols like, α-tocopherol, β-sitosterol, and octacosanol; fatty acids like, linoleic acid, palmitic acid and oleic acid are quantified by GC and confirmed using MS. A domestic cold press unit yield of 8%w/w was achieved in 5 h at 47 ± 2°C, i.e. rate of extraction of 96 g/h or 103.8 mL/h at an operating cost of 210.8 INR/batch of 6 kg. Sustainability of the cold press route offers solvent-free i.e. reduced step of separation of oil from solvent; contamination-free oil and safe utilization of the waste generated into value added products.**

***Keywords*—wheatgerm oil, cold press, GC-MS, yield of oil, sustainability**

I. INTRODUCTION

Wheat germ oil, derived from the germ of wheat kernels, is a rich source of essential fatty acids, antioxidants, and bioactive compounds, making it highly valuable in various industries such as food, cosmetics, and pharmaceuticals. This oil is particularly known for its high concentration of vitamin E, which contributes to its antioxidant properties, as well as its beneficial effects on skin health and cardiovascular well-being. As consumers become more conscious of the benefits of natural products, there is an increasing demand for vegetable oils that can be used in food products, skincare formulations, and dietary supplements.

The extraction of wheat germ oil can be carried out using various methods, but the cold press extraction technique stands out as an environmentally friendly, solvent-free method that preserves the nutritional and bioactive properties of the oil. Cold pressing involves mechanically pressing the wheat germ to extract the oil, using minimal heat to avoid degrading the sensitive compounds. This process ensures the retention of vitamins, essential fatty acids, and antioxidants, making the oil more beneficial for health-conscious consumers.

The cold press method is particularly advantageous because it avoids the use of chemical solvents, which can compromise the purity and quality of the extracted oil. This study focuses on optimizing the cold press extraction process for wheat germ oil, aiming to enhance the yield and quality of the oil. By exploring different variables such as pressing temperature, pressure, and wheat germ quality, the research aims to provide valuable insights into maximizing oil extraction while maintaining its nutritional integrity.

The application of wheat germ oil extends beyond its use as a food ingredient; it is also highly sought after in the cosmetic industry for its moisturizing and anti-aging properties. The demand for this natural oil is expected to continue growing, driving the need for efficient, sustainable extraction methods. This research, by focusing on the cold press extraction method, contributes to the development of more efficient and environmentally friendly techniques for producing high-quality wheat germ oil.

II. LITERATURE SURVEY

1. Cold Press Extraction of Wheat Germ Oil:

Wheat germ oil, known for its high content of essential fatty acids (like linoleic acid), vitamin E, and antioxidants, has been extracted primarily using cold press methods, which preserve the oil's natural properties. Studies have demonstrated that cold pressing, due to its gentle extraction process, results in a high-quality oil that retains bioactive compounds, making it suitable for use in the cosmetic, food, and pharmaceutical industries [1].

2. Impact of Cold Press Conditions on Yield and Quality:
   Research focused on optimizing cold press extraction parameters, such as pressure, temperature, and extraction time, to enhance oil yield and quality. It was observed that a lower temperature during extraction led to better preservation of the oil's nutrients, while higher pressures resulted in increased oil yield, though it slightly compromised the oil's antioxidant properties. Therefore, optimizing the balance between yield and nutritional retention is critical for industrial applications [2].
3. Comparison of Cold Press and Other Extraction Techniques:
   Comparative studies between cold press and solvent-based extraction methods (such as hexane extraction) have shown that while solvent methods generally yield higher quantities of oil, cold press extraction provides a more natural, chemical-free oil with superior nutritional value. Cold press wheat germ oil was found to contain higher levels of vitamin E, an important antioxidant, and essential fatty acids, compared to oils extracted using other methods.
4. Chemical Composition of Cold Pressed Wheat Germ Oil:
   Cold pressed wheat germ oil has been shown to contain a wide variety of bioactive compounds, including linoleic acid, oleic acid, and vitamin E. The composition is highly dependent on the variety of wheat, storage conditions, and extraction parameters. The presence of tocopherols, particularly gamma-tocopherol, has been identified as a key contributor to the oil's antioxidant properties, which make it beneficial for skincare and nutraceutical applications.
5. Antioxidant and Anti-Inflammatory Properties:
   The antioxidant activity of wheat germ oil has been widely studied, with findings suggesting that the oil's polyunsaturated fatty acids and tocopherols contribute significantly to its ability to neutralize free radicals. In addition to antioxidant properties, wheat germ oil has demonstrated anti-inflammatory effects in in-vitro studies, making it a potential ingredient for anti-aging skincare formulations and for promoting overall skin health [5].
6. Storage and Stability of Cold Pressed Wheat Germ Oil:
   Wheat germ oil, due to its high polyunsaturated fat content, is highly susceptible to oxidation. Several studies have focused on evaluating the stability of cold pressed wheat germ oil under various storage conditions, such as different temperatures and light exposure. The findings highlighted the importance of proper storage to preserve the oil's quality, with recommendations for refrigeration and opaque packaging to reduce oxidation and extend shelf life [6].
7. Applications in the Cosmetic Industry:
   The rich nutrient profile of wheat germ oil, including its fatty acids, vitamins, and antioxidants, has made it a popular ingredient in the cosmetic industry, particularly in products aimed at promoting skin health. Wheat germ oil has been found to improve skin elasticity, reduce wrinkles, and provide nourishment to dry skin. Its high vitamin E content also contributes to its effectiveness as a skin moisturizer and anti-aging agent [7].
8. Potential Uses in Food and Nutraceuticals:
   In the food industry, wheat germ oil is recognized for its nutritional benefits and is often used as a salad oil or ingredient in functional foods. It has also been studied for its potential as a nutraceutical, with research suggesting that it may help reduce cholesterol levels and improve cardiovascular health due to its high content of essential fatty acids [8].
9. Environmental and Economic Aspects of Cold Pressing:
   Cold pressing is considered an environmentally friendly extraction method because it does not require the use of solvents or high-energy inputs. This method also results in minimal waste and is more sustainable compared to other extraction processes. From an economic perspective, while the yield per unit of raw material is lower compared to solvent extraction, the higher market value of the cold pressed oil due to its premium quality often makes it a viable option for small-scale producers [9].

III. METHODOLOGY

Wheat Germ Preparation

Fresh wheat germ was collected and used as the primary raw material for the oil extraction process. Different quantities of wheat germ—100g, 150g, and 200g—were tested to optimize the extraction yield. No chemical solvents were used, as the cold press method relies solely on mechanical pressure. The wheat germ was cleaned and stored under dry

conditions to maintain its quality before the extraction process. A cold press machine with temperature control was employed to ensure minimal heat exposure during extraction, preserving the sensitive nutrients and bioactive compounds in the oil.

B. Extraction Methods

1. Cold Press Extraction:
   - The prepared wheat germ was weighed and fed into the cold press machine.
   - The cold press machine was set to a low-temperature range (below 50°C) to avoid degrading the sensitive nutrients and bioactive compounds.
   - A gradual increase in mechanical pressure was applied to squeeze out the oil from the wheat germ.
   - The extracted oil was collected in a separate container, while the pressed wheat germ residue was removed.
   - The process was repeated for different quantities of wheat germ (100g, 150g, and 200g) to determine the optimal conditions for oil yield.

2. Purification and Filtration

- The crude extracted wheat germ oil was passed through a fine mesh filter to remove any solid particles and impurities.
- A gravity-based filtration process was employed to maintain the cold-pressed nature of the oil, avoiding the application of excessive heat or chemicals.
- The purified oil was collected in sterilized glass containers for further analysis.

3. Physical Characteristics and Yield

The physical characteristics of the extracted wheat germ oil were noted, including its color (golden yellow) and viscosity (thick and smooth). The distinct nutty aroma of the oil was also documented. The yield of the oil was recorded for each quantity of wheat germ tested, and a comparative analysis was performed to determine the extraction efficiency. This assessment provided insights into the relationship between wheat germ quantity and oil yield, guiding the optimal parameters for efficient extraction using the cold press method

Fig 3.4 Shimadzu GC-2010

IV. RESULT AND DISCUSSION

Extraction:

Cold Press Extraction:

In cold press extraction we took 10 kg of raw material (wheatgerm), we cleaned it so as to remove all the impurities such as dirt, dust and foreign materials. This was then dried. We then measured 6 kg of raw material precisely as the capacity was between 5 to 7 kg. From the cold press we received 480 gm or 520 mL of wheatgerm oil and the rest was value-added-waste. The yield was thus calculated to be 8%w/w. The process took 2 h to complete. We have also done the calculation of the operating cost of 1 batch.

Components of Wheatgerm Oil:

Linoleic Acid (Omega-6): 55%, Palmitic Acid: 17%, Oleic Acid: 15%, Linolenic Acid (Omega-3): 7%, Octacosanol: A long-chain fatty acid known for building muscle strength and stamina, Tocopherols (Vitamin E): Rich in tocopherols, particularly α\alpha-tocopherol and β\beta-tocopherol, Phytosterols: Especially campesterol and beta-sitosterol, Squalene: A polyunsaturated fatty acid that ensures easy absorption in skin cells

These components contribute to wheat germ oil's health benefits, including improving skin and hair health, regulating lipid metabolism, and providing antioxidant

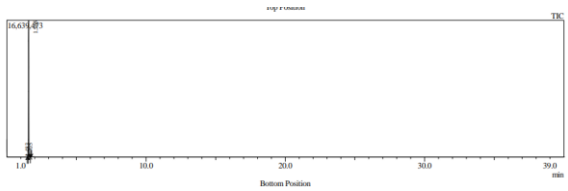

Fig 4.1. Chromatogram of Wheatgerm Oil

Peak Report TIC

Peak#	R.Time	Area	Area%	Height	Height%	Name
1	1.483	41464	0.13	34213	0.21	Carbonochloridic acid, ethyl ester
2	1.565	33123200	99.86	16624792	99.75	Acetonitrile
3	1.705	4755	0.01	6860	0.04	Propanenitrile
		33169419	100.00	16665865	100.00	

Table. 4.5. Chemical Composition of Oil (Wheatgerm)

Comparative Insights:

The Soxhlet extraction of mint oil using ethanol and acetone as solvents revealed distinct differences in the chemical composition, extraction efficiency, and solvent behaviour:

1. Extraction Yields:

480 gm or 520 mL wheatgerm oil per 6000 gm wheatgerm. i.e., 8% w/w yield.

Gas Chromatography-Mass Spectrometry (GC-MS) Method Information:

The GC-MS analysis was performed using the Shimadzu GC-2010 instrument. The Shimadzu GC-2010 is a high-precision instrument used for Gas Chromatography-Mass Spectrometry (GC-MS) analysis. It provides accurate separation and identification of compounds with advanced carrier gas control, high sensitivity, and compatibility with various columns. This makes it ideal for analyzing complex mixtures like essential oils efficiently and reliably.

Key parameters of the setup and operation are as follows:

1. Column Conditions
    - Column Oven Temperature: 70°C initially, with a programmed ramp of 10°C/min until reaching 230°C, where it was held for 10 minutes.
    - Injection Temperature: 250°C.
    - Injection Mode: Split injection, with a split ratio of 100:1.
    - Flow Control: Pressure mode with a column pressure of 66.4 kPa.
    - Column Flow: 1.06 mL/min.
    - Linear Velocity: 37.8 cm/sec.
2. Carrier Gas Conditions
    - Gas Used: High-purity helium as the carrier gas.
    - Total Flow: 110.4 mL/min.
    - Purge Flow: 3.0 mL/min.
3. Equilibration and Miscellaneous Conditions
    - Equilibrium Time: 3.0 minutes to stabilize the system.
    - High-Pressure Injection: Disabled.
    - Carrier Gas Saver and Splitter Hold: Disabled

V. CONCLUSION

The study successfully demonstrated the extraction of wheat germ oil (WGO) using the cold press method, emphasizing its efficiency, sustainability, and alignment with modern industrial requirements. Cold press extraction, conducted at low temperatures below 50°C, preserved the natural bioactive compounds, including essential fatty acids, tocopherols (vitamin E), and sterols, which are integral to the oil's health benefits and commercial applications. The resulting oil met high-quality standards, as confirmed by GC-MS analysis, and is free from chemical residues, enhancing its suitability for use in personal care, cosmetics, and pharmaceutical products.

The experimental setup achieved an 8% weight yield with an extraction rate of 96 g/hour, making the process operationally efficient and cost-effective. Additionally, the cold press method avoided the challenges associated with solvent-based techniques, such as solvent removal, contamination risks, and cost-intensive separation steps. This ensured that the extracted oil retained its natural aroma, nutrients, and antioxidant properties, distinguishing it as a superior product compared to oils derived through conventional methods.

Moreover, the study highlights the environmental sustainability of the cold press process. Unlike solvent-based or supercritical CO2 methods, this technique minimizes energy consumption and waste production, adhering to zero-waste manufacturing principles. The residual wheat germ cake, a byproduct of the process, was identified as a valuable resource that can be repurposed into animal feed, soil conditioners, or other value-added products. This approach supports circular economy practices while reducing environmental impact.

From a broader perspective, the adoption of cold press extraction not only facilitates the production of a high-quality product but also contributes to the economic viability of the industry. The report underscores the potential for cold-pressed WGO to capture global market demand, particularly in the export sector, where solvent-free and nutrient-rich oils are preferred. With demonstrated cost savings and a 30% margin on exports, the method also creates opportunities for local employment and sustainable industrial growth.

In conclusion, cold press extraction of wheat germ oil represents an optimal balance between sustainability, economic feasibility, and product quality. This method serves as a model for the integration of traditional knowledge with modern engineering techniques, paving the way for environmentally conscious and economically viable manufacturing practices. Further research and industrial-scale implementation could enhance its efficiency and application scope, contributing to a more sustainable future in oil extraction industries.

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