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# CRITICAL EXTRACTION IN ORGANIC SEEDS - A CASE STUDY

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## ABSTRACT

Growing seed crops according to a set of rules that forbid the use of artificial goods or chemicals is known as organic seed farming. Growing seed crops requires a longer growing season since the crop has to be monitored more closely to guarantee excellent seed quality and purity and because it must remain in the field for twice as long as a typical crop harvested for grain. Chemical fertilizers, insecticides, fungicides, and herbicides are needed for the conventional production of seeds. Because flax oil has a high ratio of omega-3 and omega-6 fatty acids, it is often utilized in food. In the current study, supercritical CO2, a green solvent, was used to extract flax seed. The results were compared to soxhlet and mechanical screw press procedures. GC-FID, GC/MS, 1 H NMR, and the CHNS analyzer were used to identify the chemical compositions of the oils. The high proportion of omega-3 and omega-6 fatty acids in the fatty oils were extracted with selectivity using the supercritical CO2 technique. Although screw press oil yields around 27% less than supercritical CO2 extracted oil, its chemical makeup is similar to that of the latter process.

***Keywords:*** *Organic seed, high percentage, chemical composition.*

## INTRODUCTION

Any material at a temperature and pressure above its critical point, when separate liquid and gas phases do not exist, but below the pressure needed to compress it into a solid, is referred to as a supercritical fluid (SCF).(Source: ) It can overcome the mass transfer restrictions that impede liquid movement through porous surfaces by effusing through them like a gas. In terms of their capacity to dissolve substances like liquids or solids, SCF are much more effective than gases. Also, many features of a supercritical fluid may be "fine-tuned" around the critical point since minor changes in temperature or pressure cause substantial changes in density.

The atmospheres of the ice giants Uranus and Neptune, the gas giants Jupiter and Saturn, and the terrestrial planet Venus all contain supercritical fluids. On Earth, supercritical water may be found in places like black smokers, which are a kind of hydrothermal vent.[/2] SCFs are used in a variety of industrial and scientific procedures in place of organic solvents. The most often used supercritical fluids are carbon dioxide and water, which are frequently employed for power production and decaffeination, respectively. One intriguing characteristic of some compounds is their solubility in a solvent's supercritical state but insoluble in its gaseous or liquid state, or the opposite. By only permitting or initiating a phase change in the solvent, this may be utilized to extract a material and transfer it somewhere in solution before depositing it in the intended location.

The cultivation and harvesting of industrial hemp has sparked a global interest boom. Hemp is farmed in New Zealand for fiber, seed, and extracts from the leaves and flowers. Up until recently, New Zealand regulations

only allowed hemp to be used for the production of fibers and hemp seed oil, which is mostly made by cold pressing entire hemp seeds. Press cake is a rather low-value by-product of pressing the seed. However, recent changes to the laws governing the usage of hemp seed have made it permissible to produce hemp seed oil and hemp protein products from entire but non-viable seeds as well as from hemp "hearts" that were acquired by first dehulling the seed. Hemp seed oil has a high concentration of polyunsaturated fatty acids, including both gamma and alpha linolenic acid and the omega-6 fatty acid linoleic acid. The majority of the globular proteins found in hemp seed protein are edestin (60–80%) and albumin (20–40%). All of the necessary amino acids are present in these proteins, with lysine serving as the limiting acid. A relatively new product on the market is hemp hearts. Hemp hulls, a low-value, high-fiber commodity, are produced during the manufacturing of hemp hearts. Low concentrations of nitrogen-containing phenolics, such as cannabisins, are also present in hemp hulls.

Whole hemp seed cold pressing is done on an industrial scale using well-proven methodology. The moisture content, pressure level, and temperature attained at the conclusion of the press all have a role in determining the oil production. The exterior of the pellet experiences case hardening and plastic deformation of the seed cake. The seed cake pellet's outer layer becoming impermeable eventually limits the oil output. Even so, a premium edible oil is produced, but the seedcake has a high hull content and is of relatively poor value. Following grinding and storing, any remaining oil in the meal oxidizes, giving it a rancid and unpleasant flavor. Therefore, in order to collect the greatest value from the seedcake, the oil must be removed and the hemp meal further processed. Supercritical and sub-critical fluids, especially supercritical CO2, are commonly utilized as an efficient and eco-friendly way to extract oil from a variety of seeds, including pomegranate, sunflower, canola, grape, sesame, rosehip, bilberry, mango, and apple. Numerous research on the CO2 extraction of oil from hemp seeds have been published in recent years. In a pioneering study, Da Porto et al. used CO2 to extract crushed hemp seeds at 300 and 400 bar, comparing the fatty acid content and oxidation stability of the CO2 extracted oil to that of the n-hexane extracted oil. Although there were no appreciable variations in the fatty acid content, the oil that was CO2-extracted was said to have a greater antioxidant capability in certain circumstances. Comparing this oil to oil obtained from n-hexane extraction and cold pressing, Aladić et al. investigated the extraction of hemp seed oil using CO2 at various pressures (300 and 400 bar) and temperatures (40 and 60 °C). They discovered no differences in the fatty acid profile, but the CO2 extracted oil had a higher tocopherol content. Comparing a CO2 extracted oil (obtained at 300 bar and 40 °C) with an n-hexane extracted oil, Aiello et al. recently came to similar conclusions: the CO2 extracted oil had the same fatty acid profile but was less oxidized, had a lower peroxide value, and a lower spectrophotometric index. Tomita et al. investigated the solubility of hemp seed oil at temperatures and pressures ranging from 40 to 80 °C and 200 to 400 bar. The model parameters were obtained by fitting the experimental data to the Chrastil equation. Additionally, CO2 has been effectively employed to remove leftover oil from seedcakes after processing.

## OBJECTIVE

1. To Research Organic Seeds' Critical Extraction.
2. To Researching Organic Farming As A Production Method.

## ORGANIC VS CONVENTIONAL

- The primary distinction between conventional and organic seeds is the lack of artificial chemicals.

- Synthetic fertilizers and insecticides derived from petroleum are used in conventional vegetable seed plantings.
- Conversely, the preparation of organic seeds alone use minimal quantities of natural insecticides and fertilizers.

**One kind of agricultural practice that**

- Doesn't Use Artificial Fertilizers Or Pesticides
- Focuses On Using Cover Crops And Organic Matter To Increase Soil Fertility.
- Encourages And Increases The Quantity Of Helpful Insects
- Requires Three Years Of Being Free Of Banned Materials And Yearly Inspections By An Authorized Certifier.

**To farm in organic way, farmers should follow some principles:**

- To Generate Enough Food That Is Both Nutritious And Of A High Enough Grade.
- To Promote And Improve The Biological Cycles That Include Microorganisms, Soil Flora And Fauna, Plants, And Animals Within The Agricultural System.
- To Preserve And Improve Soil Fertility Over The Long Run.
- Using Renewable Resources In Locally Managed Agricultural Systems To The Greatest Extent Feasible
- To Employ Resources And Products That Are Recyclable Or Reusable, Whether On The Farm Or Somewhere Else.
- To Reduce Any Potential Contamination From Agricultural Activities In Any Kinds.

**Suggested Organic Farming Techniques**

**Green manuring:** Green manure is a cheap form of organic fertilizer that may be used to increase or maintain the organic content and fertility of soil. It is produced by trees, shrubs, crops, cereal legumes, grasses, weeds, ferns, and algae. In addition to the delivery of nitrogen, the cumulative impacts of using green manures are significant for soil organic matter, phosphate, and micronutrients that are mobilized, concentrated in the top soil, and made accessible for plant development.

**Organic manure:** FODM, crop wastes, oil cakes, sheep dung, chicken dung, coir pith compost, and other agricultural wastes. Composting is one example of an indigenous and biodynamic preparation that may be utilized to organic nutrition management.

**Vermicompost:** It's the compost that earthworms have made. Earthworm feed is made from organic waste that breaks down biologically.

Microorganisms that fix atmospheric nitrogen, release and mobilize phosphorus, and provide other nutrients are known as biofertilizers. natural fertilizers that incorporate microorganisms based on carriers, such as phosphobacteria, mycorrhizae, rhizobium, azotobacter, and azospirillum.

**Plant products (botanicals):** Garlic extract, Prosopis, Pungam, Acacia, Calotropis, and other leaf extracts are used in seed hardening processes. To encourage plant development, the decomposed plant extracts may be used as liquid manure.

**Mulching:** Enhancing soil life, structure, and fertility, preserving soil moisture and energy, curbing weed development, minimizing damage from solar radiation and rainfall (erosion management), and lessening the need for plowing are all made possible by this crucial approach. Traditional mulches that are often utilized include layers of dried grass, green manures made from domestic waste, fresh organic material from trees, shrubs, and grasses, and agricultural wastes like straw and leaves.

**Panchmukhi:** The Panchmukhi farming procedure, which increases agricultural yields, combines five agricultural treatment variables used by natural farmers: seed treatment, soil treatment, water treatment, environmental treatment, and crop treatment.

**Panchagavya:** Organic farmers make this foliar spray using the following components and techniques: The components include 5 kg of biogas slurry/cow dung, 3 liters of cow pee, 2 liters of cow milk, 2 liters of curd, 1 liter of clarified butter or ghee, 3 liters of sugarcane juice, 1 kilogram of palm sugar, 3 liters of soft coconut water, and 1 banana. The materials are well stirred before being combined in a mud pot. After that, it is fermented for a week in a shaded area. Next, 100 liters of water are mixed with 3 liters of Panchagavya. Four acres may be sprayed with this combination. Before spraying, the diluted liquid has to be well mixed for twenty minutes. It has a one-month shelf life. In addition to promoting rapid blooming and decreasing vegetative growth, it also increases resilience to illnesses and pests.

**Organic Seed Production Practices Land selection**

- Land management need to be organic. Steer clear of low-lying areas to limit the pollution of runoff water from typical agricultural practices.
- A live fence or artificially created organically managed crop may be maintained as a buffer zone between the organic farm and the conventional farm to prevent wind contamination.
- There must be a minimum 3-meter barrier between conventional and organic managed land.
- Before usage, all tools or equipment used for organizational or natural resource management must be cleaned.
- Rotating crops may help minimize insect issues and seed contamination caused by open pollination of similar species.
- There shouldn't be any weed issues in the seed producing field that are too challenging to eradicate using organic methods.

**Land preparation**

- Tilling the soil is necessary to create a fine seed bed, which is essential for germination—especially for crops with tiny seeds.
- Good water-holding capacity of the soil is necessary for consistent germination and continuous vegetative development.
- Raising and shaping the beds in accordance with rainfall is necessary.
- Because seeds are often sown precisely and consistent emergence and seedling growth are necessary for the best possible management, seedbed uniformity is very crucial.

**Soil fertilization**

1. Because chemical fertilizers cannot be utilized while producing organically, it is crucial to increase the soil's fertility.
2. Crop rotation, the use of a cover crop, green manure crops, mulch, animal compost, and compost made of plant materials may all be utilized to guarantee high soil fertility and a decrease in soil-borne illnesses.
3. For organic crops, a variety of commercial organic fertilizers are available; the main ones are mentioned below:
4. Utilizing composted manure raises the nitrogen content.

helpful fungal inoculants that assist plants in fixing nitrogen from the atmosphere via their roots.

- Green manures and crop wastes.
- Turf and additional mulches
- Biofertilizer (preparation of bacteria)
- ashes from wood to raise potassium.
- Rock phosphate is typically crushed rock with high phosphate content.
- Although seaweed extract is not a fertilizer, it does help plants develop and become more resilient to illnesses and pests.
- preparation of plants and extract from them.
- Both peat and vermiculate.

**Choice of crop and varieties:** Any type or hybrid crop—aside from genetically modified organisms—that is appropriate for the area may be planted or utilized. Varieties resistant to diseases and pests are often favored.

**Seeds and planting material: Seeds/planting material shall**

be sourced from sources with organic certification. If organic seed is not available, conventional farm untreated seeds will be used the first year, and organic seeds will be used the following years. Conventionally grown material that has not been chemically treated must be utilized when cultivating other types that are not planted in the first year. Pollen, transgenic plants, seeds, or plant components that have been genetically altered are prohibited.

**Planting techniques:** Typically, seeds are immediately sown by transferring from a greenhouse-grown seedling or by drilling in the ground. It is best to create these seed transplants naturally. The seeds need to be planted with the right spacing and depth in the bed to provide appropriate vegetative growth, which will encourage the development of fruit and seeds.

To guarantee appropriate seed set, row spacing and plant density must permit optimum flowering plant growth as well as unhindered pollinator access to inflorescences. In addition to improving air flow and lowering infections, proper spacing will also free up space for harvest operations at the end of the season.

Rouging: During the generation of hybrid seeds, rouging is done at regular intervals to eliminate the off types from both male and female lines.

Management of diseases, pests, and weeds: Controlling pests and weeds is essential to guaranteeing excellent quality and yield from organically grown seeds. Grazing by animals, manual weeding in conjunction with machine cultivation, and mulching with plant leftovers and other completely biodegradable materials are some methods for controlling weeds. Due to the extended duration of the seed crop in the field, several possibilities exist for various diseases to interact with a single crop. It is difficult to manage these infections naturally and needs ideal growth circumstances.

Organic seed production is particularly compatible with the technique of biological pest management. Three natural enemy sources are employed in biological management to manage dangerous pests and cut down on the use of organic pesticides.

Insects classified as parasitoids are those that deposit their eggs within other insects. The wasp Aphidius colemani, which deposits its eggs in adult aphids, is one example. Predators are the second kind of helpful insects; they consume other insects. The lady beetle is a widespread predator that feeds on mites and insects. The weed feeders are in the third category. Weevils like Halobios transversovittatus consume certain weeds, such purple loosestrife. The following procedures are included in the short biological methods: biocontrol agent such as Trichoderma and Pseudomonas. bacteria, fungi, viruses, and protozoa. introduction of the pest's parasites or predators. Natural adversaries include nematodes, mites, spiders, insects, and birds. non-synthetic means of control, such repellant, lures, and traps. Nets and mulches. Sanitation to get rid of pest organism habitat, weed seeds, and disease-carrying vectors. formation of the pest's natural enemy's habit. herbal insecticides. agricultural rotation, using different host crops and trap crops. Pheromena that trap insects.

**Physical method:** This approach uses human labor to manage illness and insect pests. The many physical techniques are mentioned below:

- Regulation of temperature: applicable for stored place
- Regulation of light: applicable for field crop
- Regulation of moisture: Use for stored insect pest control
- Use of sound waves

**Mechanical method:**

Mechanical method:

The mechanical method of insect pest management includes:

- Hand picking
- Sieving and winnowing
- Shaking and beating
- Netting
- Wrapping
- Painting
- Banding

Parent's line should be harvested, threshed, and dried first. The kind of seed being generated determines the harvesting method. Seed breaking has to be avoided while harvesting dry-seeded crops since seed harvesting usually takes place after the crop achieves physiological maturity. The plant's stalks must be trimmed when still green and field dried to promote consistent seed development and minimize breaking.

Maintaining and Storing: After seeds are gathered, sieved, and separated. They need to be assessed in order to ascertain their physical purity. Every seed need to be a solitary unit and ought to be preserved in accordance with its own needs regarding humidity and temperature. For storage, the moisture level should typically be less than 12%.

Treatment of seed: Organic seeds are conventionally treated using compounds derived from organic sources. These are:

**Table 1: The organic seed are treated normally with materials from organic sources**

| Botanicals | Bio fertilizers | Cow's product | Biocontrol agent | Others |
|---|---|---|---|---|
| Neem leaf extract | Rhizobium | Panchagavya | Pseudomonas spp. | Coconut milk |
| Mint leaf extract | Azotobacter | Cow milk | Trichoderma spp. | Tender coconut |
| Sarani leaf extract | Azospirillum | Curd | | Vermicompost |
| Prosopis leaf extract | Phosphobacteria | Cow urine | | Vermiwash |
| Arappu leaf extract | | Cow dung | | |

Since it is often impossible to produce seed free of disease and since traditional Synthetic substances cannot effectively treat seeds; thus, much research and development have been done on alternate seed treatments.

**The various tested treatments can be classified in several categories:**

Thermal treatment: Hot water seed treatments work well for a variety of crops, but they must be used carefully to prevent seed germination. The drawback is that, after treatment, the seed has to be dried quickly, which is challenging to do on an industrial scale. An aerated steam approach has been suggested to get around that problem. The seed is no longer at risk of drying since it is no longer submerged in water but rather exposed to hot, humid air. Selecting and maintaining the right temperature is essential.

Employing antagonists Employing antagonists The list of antagonists that have been tried is enormous. Here are a few non-exhaustive results: - Trichoderma spp. against Aspergillus niger, which causes collar rot in groundnuts. - On Brassica seed, Pseudomonas chorographic, Bacillus subtilis, Fusarium oxyporum, and Streptomyces spp. oppose Alternaria spp. Bacillus subtilis on wheat in opposition to Tilletia caries. - Trichoderma viride against Bipolaris and Fusarium spp. Iana Sorokina on barley and wheat. - Numerous adversaries of Rhizoctonia solani.

Natural compounds: Essential oils have been studied, sometimes in conjunction with chelators and natural detergents. It has been observed that thyme and oregano oils work well against Xanthomonas campestris pv. campestris, Clavibacter michiganensis pv. michiganensis, Alternaria dauci, and Botrytis aclara. Tellecur, a substance made from yellow mustard flour, is said to work well against a variety of diseases, most notably Telletia caries in wheat. On wheat and barley, chitosan is said to work well against Fusarium spp. and Bipolaris sorokiniana. It has been claimed that the complex product Biokal, which contains 57% medicinal plant extracts, 38% bio-humus extracts, 5% volatile oil, and metal and trace elements, works well against Ascochyta pisi on pea seed.

Additional products: Antiseptics like $KMnO_4$ and $CuSO_4$ as well as organic acids (lactic, acetic, citric, propionic, and ascorbic) are now being tested.

**Organic Seed Certification**

The National Organic Program Standards, to put it simply, mandate that agricultural farms: Three years (36 months before harvest) must pass before certification without the use of any banned substances (no synthetic pesticides, fertilizers, or genetically modified organisms). clear, specified limits for the operation. taking proactive measures to stop pollution from nearby land users. application of an organic system plan that includes preventive methods for managing fertility, conservation measures, and ecologically responsible methods for managing weeds, diseases, pests, and manure. keeping an eye on the management procedures used by the organization to ensure compliance. Use of authorized synthetic compounds and/or natural inputs included on the National List, subject to the implementation of proactive management techniques before using approved inputs. No use of drugs that are forbidden. Genetically modified organisms (GMOs), which are referred to in the regulation as "excluded methods," are not used. Not using radiation or sewage sludge. When available commercially, utilize organic seeds (no seeds treated with banned synthetic agents, including fungicides). using organic seedlings for crops that are annual x. limitations on the use of compost and raw manure.

must prevent soil erosion, apply crop rotations that build soil, and preserve or enhance the physical, chemical, and biological qualities of the soil. Fertility management must not introduce plant nutrients, diseases, heavy metals, or illegal substances into crops, soil, or water. buffer zones are maintained based on the likelihood of contamination. Prevent mixing on split operations (if enough precautions are used to separate organic from non-organic crops and production inputs, the whole farm need not be converted to organic agriculture). Burning agricultural waste in the field is prohibited (burning may only be done to prevent disease or promote seed germination; flame weeding is permitted). No banned substance residues more than 5% of the EPA tolerance (the certifier may request a residue study if there is cause to suspect that a crop was genetically modified or has come into contact with prohibited chemicals).

**Table 2: Advantages and disadvantages of organic seed production**

| Advantages | Disadvantages |
|---|---|
| Production of nutritious food | Lesser productivity |
| Poison-free produce | Cultivation practices are more |
| Increase long term fertility of soils | Time consuming |
| Food storability/longevity is high | Skills required |

## CONCLUSION

The yield of the key components, omega-6 and omega-3 fatty acids, is higher with the supercritical CO2 process than with the Soxhlet and screw press methods. Under the previously stated supercritical circumstances, the procedure extracted the neutral fatty acids with preference. Although the yield of fatty oil achieved via the screw expression technique is 27.8% lower than that of the supercritical CO2 process, the chemical makeup of the fatty oil is equivalent. However, it was discovered that the hexane extraction method produced a higher yield. However, the oil's quality was worse, with a higher acid value (1.1%), a higher peroxide value (3.6%), and a lower proportion of omega fatty acids (54.4%). The total components found in

the FAME analysis of the hexane, screw press, and supercritical CO2 extract were 92.5%, 95%, and 96.8%, respectively. It showed that hexane and some waxy components were removed together. The removal of hexane during extraction is the main issue; as a result, the oil ultimately had a very little quantity of solvent residue. Supercritical CO2 is an eco-friendly method that allows for the selective extraction of omega-3 and omega-6 fatty acids. The extracted oil is best used in food items since it is of higher quality and leaves no solvent residue behind.

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