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Advance Methods for Extracting Fish Oil: A Review

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Abstract

Fish oil, rich in omega-3 fatty acids, is greatly sought after for its numerous health advantages, leading to a large-scale industry focused on its extraction. This case study delves into the different methods of fish oil extraction, looking at their mechanism of operation, strengths, weaknesses, and general efficiency. In-depth knowledge of these methods is essential for the development of efficient extraction processes in the food and pharmaceutical industries. The study examines conventional approaches like cold pressing and enzymatic hydrolysis, and contemporary methods including supercritical fluid extraction and solvent-based techniques. A comparison is made to analyze the advantages and disadvantages of every technique. This research provides an overview of the major techniques utilized for fish oil extraction, determining their efficiency, environmental sustainability, and economic feasibility. This article addresses the recent methods of fish oil extraction, highlighting their effectiveness, sustainability, and impact on oil quality. Traditional methods of extraction, including solvent extraction and rendering, have serious limitations such as environmental concerns and reduced oil quality. On the other hand, new methods such as supercritical fluid extraction (SFE), Enzymatic Hydrolysis Extraction, and Cold Press Extraction are on the rise for their ability to yield more volumes of oil while preserving nutritional and bioactive molecules. The review also describes the benefits of the new methods in producing high-quality fish oil, addressing issues of oxidation and maintaining a higher content of omega-3 fatty acids.

Keywords: *Fish Oil, Extraction Methods, Omega-3 Fatty Acids, Supercritical Fluid Extraction (SFE), Cold Press Extraction, Enzymatic Hydrolysis, Fish Oil Benefits, Fish Oil Quality.*

Introduction

Fish oil painting is inferred from the oily fish and is famous for its health-boosting parcels, such as curbing inflammation and promoting heart health. The birth process is essential for producing high- quality fish oil painting that meets request demands. Fish oil painting is a man-made product of high nutritive value because of its composition of long chain omega- 3 polyunsaturated adipose acids (PUFA), such as doco-sahexaenoic acid (DHA), doco- sapentaenoic acid (DPA) and eicosapentaenoic acid (EPA), which are currently highly appreciated for their preventive and curative parcels in nutritive and health aspects. Fish oil painting, which was preliminarily a by- product of fishmeal used for beast feed, is now honored as the primary source of these adipose acids (Valenzuela, Sanhueza, & De la Barra, 2012). Fish oil painting is often regarded as being among the richest and relatively cheaper source of omega-3 polyunsaturated adipose acids, particularly EPA and DHA. EPA and DHA are known for their bioactivities similar as forestallment of cardiovascular conditions, inflammation, tumours and for the functioning of brain, liver, heart (Agostoni, 2008; García Almeida et al., 2010). The part of DHA in visual development of foetuses and babies has been also reported (Arab- Tehrany et al., 2012). Piecemeal from the important omega- 3 fatty acids, fish oil painting is also found to be fat-full answerable vitamins, like vitamin A and D. Many health organizations have advised taking fish and fish oil painting for overall wellness of human beings. World Health Organization recommends about one to two serving of fish consumption weekly which corresponds to 200 – 500 mg of EPA DHA (Kris- Etherton et al., 2009). Likewise, the transnational Society for the Study of Adipose Acids and Lipids suggests diurnal input of about 500 mg EPA and DHA can help in forestalment from cardiovascular conditions (Cunnane et al., 2004). The rise in consumer awareness about the nutritive noisiness of fish oil painting has further encouraged its birth for human consumption. Numerous birth styles are utilized for production of high-quality fish oil painting. Fish oil painting is obtained from various species depending on the area of the product. The raw material consists of three large fragments, which are solids, oil painting and water. The key is to isolate these factors as fashionably as possible, typically bearing fishmeal and fish oil painting (United Nations Food and Agriculture Organization (FAO), 1986).

Styles to prize them include cuisine, use of detergents and, lately, birth by supercritical fluids, by enzymatic procedures and by chemical (i.e. applying acids) or natural silages (Mbatia et al., 2010; Menegazzo, Petenuci, & Fonseca, 2014). The interest in having advanced good quality pufa attention is evident in a number of studies that seek to trace fish oil painting, purify it and supplement its pufa content, particularly epa and dha, through various means. Regarding pufa some studies include birth and separation (Rubio et al., 2010; Sahena et al., 2009), but they concentrate on supercritical fluid technology and only cover studies carried out until 2009.

Methodology

Cold Press Extraction:
Cold pressing is a fish oil extraction technique where fish tissue is mechanically pressed at low temperature to yield oil without the need for solvents or heat. This process serves to retain the nutritional value and fatty acid profile of the oil, ensuring it retains its health benefits. Cold pressing is also becoming more sought after in the food and supplement sectors for its effectiveness and capability to yield good-quality oil together with possible recovery of proteins and other valuable constituents from fish residues. Times of 20 to 200 minutes at constant pressure were approximately. Fish is subjected to mechanical pressing to extract oil without the use of heat, which helps in retaining delicate nutrients. Yield Around 20-30%. Yields premium oil with little oxidation. Preserves the natural Flavors and nutrients of the fish. Environmentally friendly, using no chemical solvents.

Solvent Extraction:
Solvent extraction of fish oil uses organic solvents to remove the oil from the fish tissue. Hexane, ethanol, or ether are common solvents. The fish usually needs to be cooked or processed to drive out the oil, then it is mixed with the solvent and the oil allowed to dissolve. The solution is then filtered and the solvent removed by evaporation, leaving the pure fish oil. Supercritical fluid extraction with carbon dioxide is also being highlighted as a more environmentally friendly option. Involves dissolution and extraction of oil from fish tissue by using organic solvents (e.g., hexane). High, up to sometimes over 90%. High extracting efficiency maximizes the yield of oil from fish raw materials. Economical for commercial production on a large scale, thus widely applicable in commercial operations.

Supercritical Fluid Extraction (SFE):
A supercritical fluid is a material in a state of temperature and pressure higher than its critical point, where it has parcels of both feasts and liquids. For CO_2, this occurs above roughly 31 °C (88 °F) and 73.8 bar (1,070 psi). In this state, C_2 has low viscosity (like a gas) and high diffusivity (like a liquid), allowing it to pierce solids and dissolvenon-polar mixes effectively. Supercritical CO_2 is circulated through the material, dissolving the asked mixes (e.g., oils, fats) and transporting them out of the material. After birth, the pressure and temperature are dropped to allow the CO_2 to return to a gaseous state, which separates from the pulled oil painting oil. Supercritical fluid birth is just like any other fashion of birth; the difference also being the utilization of supercritical fluids as cleansers for birthing. Supercritical fluid s(SCF) are those cleansers which retain both liquid and gas- suchlike parcels when the temperature and pressure are above their critical point (Khaw et al., 2017). The low viscosity and high diffusion facilitate the rapid-fire-fire diffusion of soap into the matrix and thus facilitating the birth process. Among the different SCFs available for birth, supercritical carbon dioxide (SC- CO_2) is the most generally employed soap (Duarte et al., 2014). The easily attainable critical conditions (critical temperature 31.1 °C, critical pressure 72.8 bar) along with its non- toxin and easy vacuity has made SC- CO_2 as the most desirable soap for SFE (Espinosa- Pardo et al., 2017; Wrona et al., 2019). Produces high- quality oil painting oil without dangerous cleansers, guarding sensitive factors. Environmentally sustainable, as CO2 is a non- poisonous soap. suitable of lodging other precious mixes along with oil painting oil.

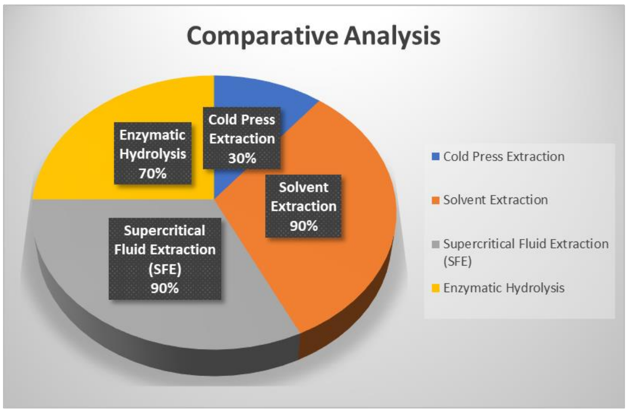
Enzymatic Hydrolysis:
Enzymatic hydrolysis birth of fish oil painting is conducted with protease- intermediated hydrolysis of proteins in the samples to facilitate the release of fish oil painting; the oil painting and water are also separated by centrifugation. This system has been extensively used to recover fish oil painting while producing hydrolysed proteins(Kechaou et al., 2009). Enzymatic hydrolysis is an effective system for rooting oil painting from fish rest raw material, substantially using exogenous enzymes to grease the process (Hathwar S.C., 2010; Šližyte R., Daukšas E et al., 2011). Despite the cost of the enzymes, the long processing time, and the high temperatures needed for the inactivation of the enzymes (Ivanovs K., et al., 2017). Enzymatic hydrolysis is valued for its ease of control and high reproducibility compared to indispensable styles like heat birth, hydraulic pressing, and supercritical fluid birth (Deepika D., et al., 2014., et al., Guadix A., 2014., Rubio- Rodríguez N., 2012). One of the benefits of enzymatic hydrolysis is that it operates at low temperatures, acting in a superior quality and improved recovery rate of the uprooted oil painting than canvases achieved through necessary styles. still, colourful factors similar as hydrolysis conditions, fish species, and the type of fish rest raw material employed can significantly impact the attained oil painting yield (Routray W., 2018., et al., Pérez- Martín R.I., 2019). Fish apkins are hydrolysed using heat and humidity to separate oil painting from solids. Simple process that can use by- products from fish processing. Integration into being processing lines is straightforward. Heat can lead to the declination of sensitive composites, reducing oil painting quality. May bear fresh refining way to ameliorate the chastity of uprooted oil painting.

Result:

Comparative Analysis:

Method	Quality	Reasons
Cold Press Extraction	High	Low temp, no chemicals, retains nutrients.
Solvent Extraction	Moderate to Low	Risk of chemical residues, oxidation, and nutrient loss.
Supercritical Fluid Extraction (SFE)	Very High	Pure, no oxidation, retains delicate nutrients but costly.
Enzymatic Hydrolysis	Moderate to High	Quality depends on temp; preserves nutrients if controlled effectively.

Method	Yield	Quality
Cold Press Extraction	Moderate (30%)	High
Solvent Extraction	High (90%)	Moderate to Low
Supercritical Fluid Extraction (SFE)	High (90%)	Very High
Enzymatic Hydrolysis	Moderate (70%)	Moderate to High



Conclusion:

The choice of extraction method is determined by a number of factors such as yield needed, level of desired oil quality, and economics. Cold pressing and Enzymatic Hydrolysis extraction are ideal for superior oil, especially for the niche market. Solvent extraction, on the other hand, is still the most viable for large-scale operations due to its cost-effectiveness. Supercritical fluid extraction is a future-friendly option that deserves consideration due to its high initial price tag. Cold pressing and enzymatic processes are capable of producing high-quality products, targeting superior market segments. Streamline solvent extraction processes for safety and quality of the product, potentially incorporating additional refining procedures. Invest in SFE technology to improve sustainability and product diversity.

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Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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