

From Shark Liver to High-Value Oil: Unlocking the Potential of a Marine By-product

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Abstract

Shark liver, once regarded mainly as a processing by-product, is increasingly recognised as a valuable source of oil and bioactive compounds. Unlike most bony fishes, sharks possess a large, oil-rich liver that contributes to buoyancy and can contain substantial quantities of lipid. Shark liver oil (SLO) is particularly valuable because it contains compounds such as squalene, alkylglycerols and other beneficial lipids, which have attracted interest in nutraceutical, pharmaceutical, cosmetic and food-related applications. The oil can be recovered from shark liver through different extraction methods, followed by filtration and refining to obtain a high-quality product. Squalene is especially important because of its use in cosmetic formulations and as a component of certain vaccine adjuvants, while alkylglycerols have been investigated for their potential immunomodulatory and anti-inflammatory properties. Thus, efficient recovery of shark liver oil offers an opportunity to transform an underutilised marine resource into a high-value product while supporting better utilisation of seafood-processing resources. However, sustainable sourcing and responsible utilisation of shark resources are essential to ensure that the development of shark liver oil products does not contribute to pressure on shark populations.

Keywords: Shark liver oil; Squalene; Omega-3 fatty acids; Bioactive compounds.

Introduction

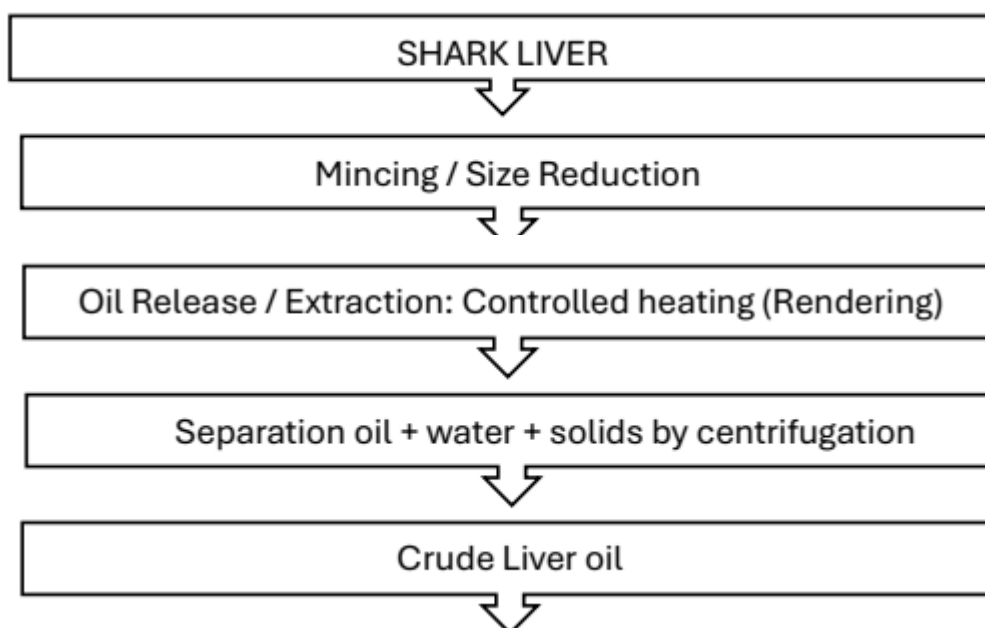
Fish and seafood processing generates substantial quantities of by-products, including heads, bones, skin, scales, viscera and other internal organs. These materials, once considered waste or used mainly for low-value purposes, are increasingly recognised as valuable sources of proteins, lipids, enzymes, collagen, gelatin, hydrolysates and bioactive peptides with potential applications in food, pharmaceutical, cosmetic and health-related industries (Coppola *et al.*, 2021; Ghalamara *et al.*, 2024). Among these by-products, the livers of certain marine species are of particular interest due to their lipid content and the presence of valuable bioactive compounds. Shark liver oil is especially known as a source of squalene and alkylglycerols, which have attracted attention for various nutraceutical and

pharmaceutical applications (Lewkowicz *et al.*, 2006). In recent years, increasing attention has been given to the recovery and utilisation of oils from fish-processing by-products. Researchers are therefore exploring different marine organs and tissues as alternative sources of high-value oils. Among these, shark liver is of particular interest because it can contain a substantial amount of oil enriched with valuable compounds. The growing interest in the extraction and utilisation of shark liver oil has opened new opportunities for converting this underutilised marine resource into high- value products.

Shark Liver: A Natural Reservoir of Valuable Oil

Unlike most bony fishes, sharks do not possess a swim bladder to maintain buoyancy. Instead, their large, lipid-rich liver plays an important role in reducing body density and assisting in buoyancy. As a result, the liver of many shark species can contain considerable quantities of oil. Shark liver oil is particularly valuable because it contains bioactive lipid compounds, including squalene and alkylglycerols, as well as other fatty acids and lipid components. The quantity and composition of the oil may vary depending on the shark species, age, size, diet, habitat and environmental conditions. Because of its unique composition, shark liver oil has attracted interest for its potential applications in nutraceutical, pharmaceutical and cosmetic products. Therefore, the recovery of oil from shark liver offers an opportunity to convert this marine resource into a high-value product (Lewkowicz *et al.*, 2006).

Extraction of Shark Liver Oil



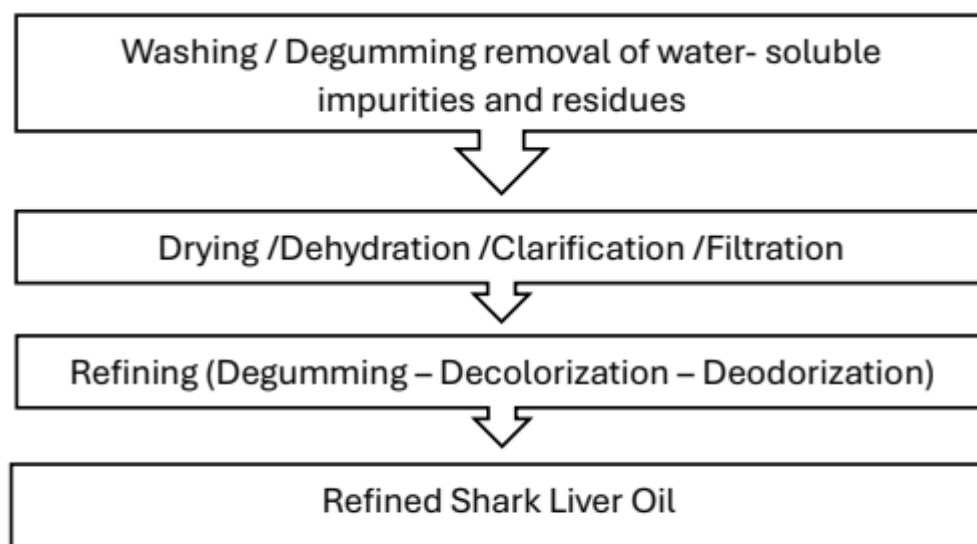


Figure 1. Process Flow Chart of Shark Liver Oil
(source: Joseph & Charkaborty,2017)

Applications of Shark Liver Oil

Shark liver oil (SLO) has attracted considerable interest because it is rich in bioactive compounds such as squalene and alkylglycerols (AKGs). Researchers have investigated these compounds for their pharmaceutical and therapeutic potential, particularly for immunomodulatory, anti-inflammatory, and anticancer activities. AKGs from shark liver oil have been studied for their effects on immune responses, macrophage activity and inflammatory mechanisms, although recent evidence indicates that their clinical benefits remain promising but preliminary (Lewkowicz *et al.*, 2006). Shark liver oil is also used as a nutraceutical and dietary supplement, mainly because of its bioactive lipid constituents, including AKGs, squalene, polyunsaturated fatty acids and fat-soluble vitamins (Suhaimi & Zulfakar, 2026). In cosmetic applications, squalene and its hydrogenated derivative squalane are valued for their emollient, moisturising, and antioxidant properties and are used in skin-care and personal-care formulations (Mendes *et al.*, 2022).

Squalene purified from shark liver oil has also been used in the development of vaccine adjuvants. Squalene-based oil-in-water emulsions, including MF59, AS03 and AF03, have been used as adjuvant systems in influenza vaccines to enhance immune responses to vaccine antigens (Mendes *et al.*, 2022).

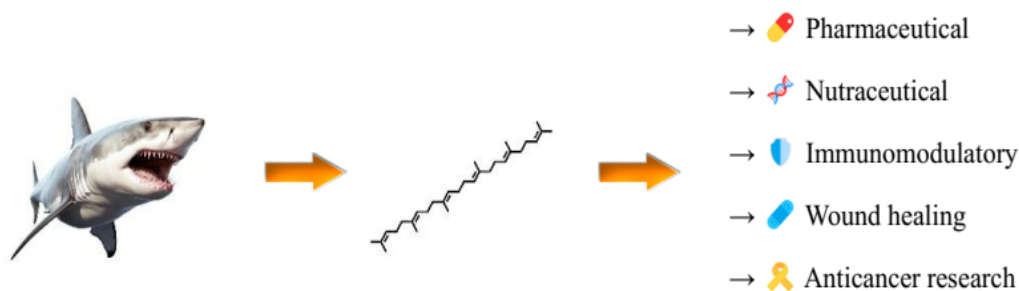


Figure 2. Potential application of shark liver oil

Conclusion

Shark liver oil is a valuable marine-derived oil containing important bioactive compounds, particularly squalene, alkylglycerols, and omega-3 fatty acids. These constituents have attracted considerable attention because of their potential pharmaceutical, nutraceutical, cosmetic, and vaccine-related applications. Squalene is especially important for cosmetic formulations and vaccine adjuvants, while alkylglycerols have shown promising immunomodulatory and anti-inflammatory properties. Therefore, efficient extraction and utilisation of shark liver oil can contribute to the value addition of shark-processing resources. However, increasing demand for shark-derived squalene also highlights the need for sustainable utilisation and the development of alternative sources of squalene to reduce pressure on shark populations

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