Chapter

Tree-Borne Edible Oilseeds as Sources of Essential Omega Fatty Acids for Human Health

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Abstract

Certain positional isomers of polyunsaturated omega-3 and omega-6 fatty acids are the essential fatty acids that the human body needs for metabolic functioning but cannot produce themselves and therefore must be acquired from the diet. The beneficial effects of omega-3 fatty acids are related to brain development, coronary heart disease (CHD), cancer, inflammatory bowel disease, rheumatoid arthritis, psoriasis, mental health, and neurodegenerative disorders. The essential omega-3 fatty acid is α-linolenic acid (ALA; 18:3ω3), found in green leafy vegetables and in the seeds of flax, rape, chia, and walnuts. The essential omega-6 fatty acid, linoleic acid (LA; 18:2ω6), is plentiful in nature and being found in the seeds of many edible plants. There are at least hundred species of plants occurring in wild or cultivated from forest areas that may be a source of vegetable oil. These vegetable oils are rich in polyunsaturated fatty acids, which are highly beneficial for human health.

Keywords: fatty acids, oilseeds, tree-borne, PUFA, prostaglandins, human health

1. Introduction

1.1 Tree-borne oilseeds

Triglycerides constitute a vital part of human nutrition, and 90% of the global production from plant, animal, and aquatic sources is used as edibles or as an ingredient in edible products. A major portion of the dietary energy comes from triacylgycerols which contain more than twice the value of identical amount of carbohydrate. Tree-borne seed oil can be defined as a vegetable oil that is obtained from the seed (endosperm) of some trees, rather than the fruit (pericarp).

Vegetable oil production and bioenergy generation from high oil-yielding tree-borne oilseeds have been a topic of interest [1]. The popular tree-borne oilseed (TBO) species include *Azadirachta indica* (neem), *Calophyllum inophyllum* (Undi), *Garcinia indica* (Kokum), *Jatropha curcas* (Ratanjot), *Madhuca longifolia* and *M. indica* (mahua), *Pongamia pinnata* (Karanj), and *Simarouba glauca* (*Simarouba*). Tree-borne seeds rich in non-edible oils, mostly produced by perennial species, are referred to as tree-borne oilseed species. *Simarouba*, which is not a familiar species in India, was studied to standardize various aspects of its cultivation [2]. *Simarouba glauca*, an exotic species belonging to family Simaroubaceae, is indigenous to North

America and commonly known as "American bitter wood." The species is native to places near the equatorial region having rain forest like Florida, Mexico, Cuba, Lesser Antilles, and other Central American counties like El Salvador, etc. It was first introduced in India from Brazil in the year 1966 under the plant introduction scheme of Indian Council of Agricultural Research (ICAR), New Delhi, in two places: NBPGR Maharashtra and the other at Akola in 1970 for its consumable acetone oil or aceituno [3]. Oil obtained from *S. glauca* is edible and probably requires comparatively better growing conditions. Kokum has recently become popular as edible oil with various benefits. *M. indica* oil is used by the local tribes as vegetable oil, but it is a slow-growing species hence may not fit into an agroforestry system. *C. inophyllum* seeds yield maximum amount of oil among these species but due to its restricted growth in sandy soil with humid environment, it is n0t widely available. *Azadirachta indica* has more insecticidal properties and less seed oil uses. Therefore, it can be summarized that only Simarouba and Kokum can be further processed for high production values as tree-borne edible vegetable oils.

About 80% of the global vegetable oil production is edible, while the remaining 20% is used in animal and chemical industries [4]. Bio-oils from oilseeds are used as straight vegetable oil (SVO) or as biomass fuel (transesterified oil) depending on the type of engine and level of blend of the oil; this also includes soya bean oil [5].

1.2 Definition of fatty acids

1.2.1 SFA

Single-bond containing fatty acids are termed as saturated fatty acids (SFA). Foods high in saturated fats include butter, whole milk, chocolates, cream, eggs, lard, red meat, and solid shortenings. An excess intake of saturated fat can raise blood cholesterol and increase the risk of developing coronary heart disease [6, 7].

1.2.2 MUFA

Fatty acids (FAs) having double bonds are called unsaturated fatty acids. Fatty acids with only one double bond are termed as monounsaturated fatty acids (MUFAs). Avocados and nuts and olive, canola, and peanut oils are good sources of MUFAs. Increased consumption of MUFA is beneficial in lowering LDL cholesterol, and it also lowers the risk of coronary heart disease, especially if monounsaturated fats are used as substitute for saturated fats and refined sugars [8]. Omega-9 fatty acids are monounsaturated fatty acids.

1.2.3 PUFA

Unsaturated fatty acids with more than one double bond are polyunsaturated fatty acids. Polyunsaturated fatty acids are important constituents of the phospholipids of all cell membranes. Corn and soy are rich sources of PUFA. PUFAs are essential fatty acids that a human body needs for metabolic functioning but cannot produce on their own, so they have to be included in their diet. PUFAs are basically of two classes: omega-3 and omega-6 fatty acids.

Ω-3 fatty acids are a category of key PUFAs characterized by the presence of a double bond positioned in the third carbon away from the terminal methyl group. Flaxseed oil, canola oil, walnut, salmon, mackerel, trout, albacore herring, halibut, and sardines are the foods rich in omega-3 fatty acids. Spinach, catfish, light chunk tuna, clams, shrimp, etc. also contain some amount of ω-3. Omega-6, another group of essential PUFAs, has a carbon double bond in the sixth position counting from the methyl end. Ω-6-rich food includes cottonseed, safflower, sunflower, corn, and soybean oils. Trans-fatty acids undergo hydrogenation to solidify liquid oils. Heating vegetable oils at high temperature produces trans fats which increases the shelf life, hence providing stability to foods like vegetable shortenings, fried foods, few margarines, cookies, crackers, and packaged snacks. The intake of trans-fatty acids raises blood LDL-cholesterol (bad cholesterol) and lowers HDL cholesterol (good cholesterol) and that in turn increases the risk of coronary heart disease [9].

There are many types of omega-3 fatty acids, which differ based on their chemical structure and size. Here are the three most common:

Alpha-linolenic acid (ALA): This 18-carbon fatty acid can be converted into DHA and EPA, although the process is not very efficient. ALA mainly provides energy to the body [10].

Eicosapentaenoic acid (EPA): It is a 20-carbon fatty acid and mainly produces eicosanoids, responsible for reducing inflammation and symptoms of depression [11, 12].

Docosahexaenoic acid (DHA): It is a 22-carbon fatty acid which makes up about 8% of brain weight. It is essential for normal development and functioning of the brain [13].

N-6 fatty acids are another class of essential PUFA, which must be obtained from the diet. The most common omega-6 fatty acid is linoleic acid, which can be converted into longer omega-6 fats such as arachidonic acid (ARA) [14]. Like EPA, ARA is used to produce eicosanoids. However, the eicosanoids produced by ARA are more proinflammatory [15]. Proinflammatory eicosanoids are important chemicals in the immune system. However, when too many of them are produced, they can increase inflammation and inflammatory disease [16]. The recommended ratio of omega-6 to omega-3 fatty acids in the diet is 4:1 or less. However, the American diet has a ratio of 10:1 which is more than necessary. Therefore, although omega-6 fats are essential in the right quantities, most people in the developed world should aim to reduce their omega-6 intake [17]. Besides the drawbacks of overconsumption, omega-6 fatty acids are beneficial in treating symptoms of chronic disease. Gamma-linolenic acid (GLA), an omega-6 fatty acid, is found in evening primrose oil (EPO) and borage oil. When consumed, much of it is converted to another fatty acid called dihomo-gamma-linolenic acid (DGLA). An interesting study proved that taking GLA supplements along with a breast cancer drug was more effective at treating breast cancer than the drug alone [18]. Conjugated linoleic acid (CLA) is another form of omega-6 fat with some health benefits. For example, one large study found that intake of 3.2 grams of CLA supplements per day effectively reduced body fat mass in humans [19].

N-9 is the only class of monounsaturated fatty acids having a number of health benefits. Oleic acid is the most prevalent omega-9 fatty acid in the diet. A study reported that consumption of high monounsaturated fats could decrease triacylglycerol (TAG) of plasm by 19% and very-low-density lipoprotein (VLDL) cholesterol by 22% in diabetic patients. Another study in mice stated that high dose of monounsaturated fats improved insulin sensitivity and reduced inflammation. This study further reported that human diet rich in monounsaturated fatty acids suffered less inflammation and better sensitivity to insulin than diets with high saturated fats [20, 21].

There has been a raise in demand for purified PUFA lipids due to their numerous applications, but due to the scarcity of present plant, fish, and mammal sources there has been an urge to explore alternatives such as bacterial, algal, and fungal production systems. Hence it is important to screen unexploited tree-borne oilseeds for polyunsaturated fatty acid-rich oil production as the country is not producing sufficient quantities of PUFA-rich oils particularly enriched with alpha-linolenic, gamma-linolenic, eicosapentaenoic, and docosahexaenoic acids. These omega3 fatty acids are nutritionally important and are needed by infants for development of the brain, retina, etc., as well as by geriatric adults, both of whom cannot synthesize them.

2. Importance of essential fatty acids

Balancing fatty acids is all about decreasing intake of the "inflammatory" omega-6 fatty acids versus "anti-inflammatory"omega-3 fatty acids in order to have a better omega-6/omega-3 ratio.

A typical Western diet includes a lot of heavily processed and fried oils, so their intake of ALA (omega-3) is lower than LA (omega-6) as per the permissible limits. ALA is a plant-based fatty acid, so dietary sources include flaxseed oil, canola, walnuts, chia seeds, perilla seed oil, pumpkin seeds, tofu, spinach, mustard green, etc. Only a small amount, i.e., 5–10%, of these fats can be converted into EPA and DHA by the body. EPA and DHA content in the body can be increased by consuming cold-water fishes such as red salmon, mackerel, anchovies, and sardines. Some algae also contain DHA [22].

By altering the kinds of fatty acids that a person eats to more alpha-linolenic acid (omega-3) and less linoleic acid (omega-6), it is quite possible to effectively produce more anti-inflammatory prostaglandins than inflammatory prostaglandins which can help reduce the pain caused by PMS [23–25].

Prostaglandin production, which is the primary function of EFA, regulates body functions such as pulse, blood pressure, coagulation of blood, fertility, and conception and also plays a role in the immune system. Deficiency of EFAs and imbalance in ω-6/ω-3 cause serious health conditions such as heart attacks, asthma, depression, insulin resistance, schizophrenia, cancer, early aging, obesity, stroke, diabetes, Alzheimer's disease, ADHD, and arthritis, among others [26, 27].

Acute psychological stress in humans generates the production of proinflammatory cytokines, such as interferon gamma, tumor necrosis factor-a (TNFa), IL-6, and IL10. Overproduction of proinflammatory cytokines in the peripheral blood is caused by an imbalance of omega-6 and omega-3 polyunsaturated fatty acid. Evidences reveal that alteration in composition of fatty acids is involved in the pathophysiology of major depression. Theoretically, changes in PUFA cause changes in serotonin (5-HT) receptor number and function, thus resulting in the current receptor and neurotransmitter theories of depression [28–30]. Increased production of proinflammatory cytokines and eicosanoids might increase C20:406/C20:503 ratio and omega6/omega3 imbalance in major depressions [28]. DHA and EPA reduce the risk of relapse in patients with manic depression [31, 32].

Omega-3 fatty acids are a crucial part of human cell membranes. They also have a number of other important functions, including:

Improving heart health: Daily intake of omega-3 fatty acids can increase HDL cholesterol which is good cholesterol for the body. It can also reduce blood pressure and the formation of arterial plaques [33, 34].

Reducing weight and waist size: Omega-3 fats play an important role in weight management and can help reduce waist circumference [35].

Decreasing liver fat: Addition of omega-3 fatty acids in the diet can help decrease the amount of fat in the human liver [36].

Supporting infant brain development: Omega-3 fatty acids are extremely important for brain development in infants [37].

Fighting inflammation: Omega-3 fats are anti-inflammatory, meaning they can reduce the inflammation in the body which contributes to a number of chronic diseases [38].

Preventing dementia: People who eat more fish, which is high in omega-3 fats, tend to have a slower decline in brain function in old age. Thus, omega-3 s may also help to improve memory in older people [39].

Promoting bone health: People with higher omega-3 intake and blood levels tend to have better bone mineral density [40].

Preventing asthma: Omega-3 intake can help reduce symptoms of asthma, especially in young age [41].

Omega-6 fatty acids also play a crucial role in brain function, normal growth, and development along with omega-3 fatty acids. Ω-6 helps in stimulating skin and hair growth; it also maintains bone health, regulates metabolism, and also maintains the reproductive system. The roles of omega-6 in certain diseases are given below:

Diabetic neuropathy: Keen et al. showed that taking gamma-linolenic acid for 6 months or more may reduce nerve pain in people suffering from diabetic neuropathy. People with good blood sugar control found GLA more effective than other community [42].

Rheumatoid arthritis: There have been mixed results related to the role of evening primrose oil (EPO) in Rheumatoid arthritis. Initial evidences suggest EPO to be helpful in reducing pain, swelling, and morning stiffness, while other studies have found no effect. GLA requires 1–3 months for benefits to appear in patients, but it is unlikely that EPO would help stop progression of the disease [43].

Breast cancer: Consumption of tamoxifen (drug for treatment of estrogen-sensitive breast cancer) along with GLA resulted in commendable improvement in breast cancer patients than those who consumed it alone. Some investigation also suggested that omega-6-rich diet might promote development of breast cancer [18].

3. Process of extraction of oils from oilseeds

Oil extraction process undergoes two basic steps: solid–liquid extraction and solvent extraction. Prior to these processes, mechanical and thermal pretreatments are carried out which enhances their performance. The standard pretreatments for oilseeds include de-husking, size reduction, breaking, grinding, as well as hydrothermal treatment, cooling, or steaming. De-husking separates the oil-rich seeds from hulls and eliminates the antinutritional factors unattractive to consumption. Crushing and grinding changes the cake permeability and thus promotes solvent extraction. Moisture conditioning of seeds, oil viscosity reduction, increasing plasticity of seed, breaking of cell walls, protein clotting by denaturation, sterilization and deactivation of thermosensitive enzymes, and destruction of thermolabile toxic components are several of the benefits provided by cooking [44–47]. Enzymatic hydrolysis opens up the oilseed cell walls through biodegradation and thus provides an alternative for pretreatment. It also breaks up the complex lipoprotein and lipopolysaccharide molecules into simple molecules releasing extra oil for extraction [48, 49]. The increase in demand for vegetable oils both for human consumption and industrial application has prompted and encouraged the evolution and optimization of procedures leading to efficient production of oil of high quality and purity [50, 51].

Oil yield from an oleaginous seed material is generally dependent on the quality of oilseeds. However, certain factors like moisture content of material, particle size, and temperature can be controlled during pretreatment in order to increase the oil yield. However, according to Olaniyan [52], oilseed pretreatment prior to oil extraction normally affects oil yield and quality. Similarly, Faugno et al. [53] concluded that the combination of seed preheating and high extraction temperature, among others, had a significant effect on oil yield. Thus, oilseed processing or pretreatment provides a platform for manipulating key parameters and conditions for enhanced oil yield and quality [54].

Nowadays, several promising technologies are available for extraction of vegetable oils such as ultrasonic processing, mechanochemical processing (MCP), etc. UAE is a new innovation which makes use of the ultrasonic sound waves to increase vibration and heat, resulting in the destruction of rigid plant cell walls, thereby enhancing contact between the solvent and the plant material [55]. When coupled with solvent extraction, the UAE method represents an innovative way of increasing extracted oil yield by making plant cell walls thinner, thus enhancing the interaction of the solvent. Samaram et al. [56] analyzed oil production from papaya seeds by both UAE and solvent extraction. They reported that conventional solvent extraction lasted 12 hours, whereas the UAE method lasted only 30 minutes. Thus UAE is more timesaving and gives better yield. UAE plays a significant role in edible oil industry due to its potential to modify efficiency and decrease production time [57].

Mechanochemical processing activates chemical reactions and structural changes by using mechanical energy. The field of mechanochemistry has vivid applications ranging from waste management to the production of advanced materials with novel microcomponents and enhanced mechanical properties. MCP has similar potential to screw expelling as high shear force can act on the cell wall of seeds resulting in its breaking and subsequent oil expulsion [58]. The extraction medium used in supercritical extraction (SFE) is predominantly environmentally benign carbon dioxide (CO2). The extraction of specific lipid components, like cholesterol, can be achieved with SC-CO2 [59–61]. SFE is also applied to determine the fat-soluble vitamins in food. Bruhl and Matthaus [62] reported that the highest yield of lipids and tocopherol content were achieved with the SFE method. Thus it was summarized that SFE-based methods have a promising future in analytical lipid chemistry [63].

4. Oilseeds as source of omega fatty acids

Triacylglycerols together with carbohydrates, proteins, vitamins and minerals are the important nutrients of the body. Triglycerides contain two and a half times the calories of carbohydrate (per unit weight), hence being a rich source of energy. TAGs are not only sources of vitamins A, D, E, and K but also contain EFAs. These EFAs must be included in diet as they cannot be created by the body [64].

Recently, oilseed crops were genetically engineered (GE) to produce two new bioactive omega-3 long-chain fatty acids (eicosapentaenoic acid [EPA, 20:5n-3] and docosahexaenoic acid [DHA, 22:6n-3]) which significantly enhance the nutritional value of the seeds. These GE oilseed plants represent a new type of crop because these fatty acids cannot be manufactured naturally by terrestrial crop plants. These two bioactive compounds are known to have critical involvement in key physiological activities in chordates and non-chordates particularly for their positive effects on chordate cardiovascular and neurological health [16, 65, 66]. Together, DHA and EPA reduce inflammation and the risk of heart disease. Recommend daily intake of EPA and DHA depending on age, gender, reproductive status, health status, various institutes like World Health Organization, American Heart Association, etc. recommend daily intake of EPA and DHA [67]. Algae in aquatic environment produces both EPA and DHA naturally [68–70] while retained y upper trophic level organisms. Both EPA and DHA can be obtained in bulk by consuming seafood, fish, or algal oil spills [16, 71]. Though aquaculture is a major source of sea food, but dietary source of EPA and DHA required by farmed fishes is obtained from the oil derived from wild fisheries [72]. Nowadays, limited exploitation 0f wild fishes are insufficient to support the increasing demand of fish oil necessary for aquaculture and other industries like pharmaceutical, livestock, and food fisheries [73]. Therefore, a feasible source of EPA and DHA would definitely reduce dependency on wild fisheries. Thus these GE crops will provide an alternative source of DHA and EPA for various industries including human utilization. The functional genes introduced into these new crops were primarily extracted from marine algae, a marine fungus, and a moss [74–76]. These genes and the enzymatic activities they encode together represent a tool by which biological engineers can reconstruct the capacity to synthesize EPA and DHA in a crop plant species [77]. The seed oil thus obtained resembled fish oil when compared to the wild-type cultivar, because it contained similar levels of EPA and DHA as fish oil. Thus, two oilseed crops have been identified so far as prospective host for the omega-3 LC-PUFA biosynthetic trait: canola (*Brassica napus L.*) and *Camelina* (*Camelina sativa*). The transgenic lines developed from these two species have enabled the manufacture of nearly 30% DHA + EPA of the total FAs [77] or 12% DHA only in *Camelina* [74] and 4% of both (EPA + DHA) in canola [76].

Among these only *Camelina* has undergone field trials [78, 79]. Technology for commercial development of transgenic canola have been patented by Cargill and BASF [80], Dow AgroSciences, and DSM Nutritional Products [76, 81]. Nevertheless, this commercialization has not received much public acclaim [82]. While nutritionally improved crop traits intend to prMcGlouovide health benefits but these improvements are due to conventional plant breeding and selection [83].

EPA and DHA are considered to be the main drivers of the difference in fatty acid content observed between aquatic and terrestrial primary producers. Introduction of higher amount of EPA and DHA to terrestrial ecosystems would be unique as they would provide the opportunity for these bioactive FAs to be consumed and metabolized for the first time by consumers in agroecosystem. Since these new GE-oilseed crops are not equivalent to other GE crops, so it warrants careful regulatory consideration of them.

Scientists working on oils and fats have recently reported about a potential oil crop that can match fish oils in nutritional value. This oil crop called corn gromwell or field gromwell (*Buglossoides arvensis*) is abundant in the wild in the higher elevations of the Jammu and Kashmir such as Pampore but can be adapted to other agroclimatic conditions in the country. The seeds of this plant are rich in polyunsaturated fatty acids, including nutritionally important omega-3 fatty acids. More importantly, they contain stearidonic acid (SDA), which is generally absent in regular oilseed crops. Omega-3 content of the oil is found to be 18–20% in lab studies. SDA is a key precursor in the biosynthesis of those omega-3 acids that are commonly found in fish oils. While health benefits of fish oils are well-accepted, those who do not eat fish are often deprived of these benefits from their diet [84].

According to Sreedhar et al., though oils extracted from chia and flax seeds, too, are rich in omega-3 fatty acid, they contain only alpha-linolenic acid, one of the three types of omega-3 fatty acids. "Consumption of *B. arvensis* seed oil has been reported to increase the circulating omega-3 PUFA levels in a dose-dependent manner and associated with anti-inflammatory phenotype in healthy people." This oil needs to be consumed in the form of softgel capsule, salad dressing oil, powder or protein/cereal bars, he said, adding that it may not be an ideal cooking medium as it has low smoke point and degrades upon heating, losing its nutritional qualities [84].

Vegetable oils are a major source of low-cost dietary fatty acids in modern diets. Considerable research has been undertaken in the public and private sectors into the feasibility of producing of omega-3 LC-PUFAs in oilseed crops. The first reports of engineering oilseed plants to produce EPA in seed oils were published in 2004, and subsequent work has achieved levels of up to 20% EPA in *Glycine max* and *Brassica carinata*. Though it has proven to be challenging to produce DHA in plants; however hindrance in pathways have been identified and surpassed expanding the list of useful transgenes. The outcome of this has been recently the production of 4–15% of DHA in seeds of the model oilseed plant *Arabidopsis*. These studies present striking proof of principle that oilseed plants can surely be engineered to synthesize and store "ω-3 fish oils" in oilseeds [85]. Production of oilseed crops rich in omega 3 LC-PUFA have technically provided a new answer to meet the increasing consumer demands for convenient, low-cost, and sustainable sources of these healthy dietary fatty acids. LC-PUFAs can be manufactured in oilseed plants by two indigenous approaches:

i. Omega-3 LC-PUFAs can be formed by modifying existing plant fatty acids with novel elongases and desaturases.

ii. Introduction of a self-contained microalgal PUFA synthase enzyme system for synthesis of LC-PUFA de novo [86].

Although these processes have their own characteristics and flaws, it would be exciting to see the impact of these technologies in providing omega-3 supplements for improvement of human health.

However, no such attempts have been made to produce tree-borne oilseeds which are enriched with omega acids. Oilseed trees are easily and widely available throughout the forest of the globe both in wild and cultivated forms. There are many trees like *Garcinia, Cinnamomum, Litsea*, etc. which can be utilized as oilseed sources. *Garcinia morella* and *Sapindus mukorossi* are nutritionally considered as a few of the best salad vegetable oils due to the highest content of MUFA (75–79.8%) [87]. If these resources are properly analyzed and collected for the production of omega-rich oils, then we can surely overcome the crisis of vegetable oils rich in omega acids and replace the non-vegetarian sources of omega-rich oils which will be beneficial for both the vegetarian and non-vegetarian communities of the world. Therefore it has become a necessity to search for alternative sources of omega fatty acids in the nature that are available and unexplored. In this regard the tree-borne oilseeds are the best potential source as they have not been exploited much. In this way we will not only discover new sources of omega rich oils but also improve India's sustainability in this sector.

5. Conclusion

- Fats and oils form an important part of the human diet, though less-exploited tree-borne oilseeds have untapped potentialities as sources of vegetable oil.

- Omega-3 and omega-6 are essential polyunsaturated fatty acids (EFAs) which the body cannot produce in adequate amount and have to be obtained from other sources. The recommended ratio of omega-6 to omega-3 fatty acids in the diet is 4:1 or less.

- The primary function of EFAs is the production of prostaglandins which regulate various functions of the body like the immune system, vision, and cell structure.

- Reliable food sources for these EFAs include vegetable oils present in mayonnaise and salad dressings. Other ω-3 fatty acids like eicosapentaenoic acid and docosahexaenoic acid are also important for the immune system, cellular processes, and neural responses.

- The intake of more alpha-linolenic acid (omega-3) and less linoleic acid (omega-6) effectively produces more anti-inflammatory prostaglandins than inflammatory prostaglandins.

- Hence it has become a necessity to screen unexploited tree-borne oilseeds for production of polyunsaturated fatty acid-rich oils as the country is not producing sufficient quantities of PUFA-rich oils particularly enriched with alpha-linolenic, gamma-linolenic, eicosapentaenoic, and docosahexaenoic acids.

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