REVIEW ARTICLE

The Therapeutic and Nutritive Potential of The Edible Fixed Oils

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Abstract

Edible oils are extensively consumed foods derived from various vegetables and animal parts. They are composed predominantly (approximately 96 %) of triacylglycerides, which include a diverse range of fatty acids, along with phospholipids, phytosterols, tocopherols, antioxidants and waxes. These oils constitute a significant portion of household food expenditure in India and have long been recognised for their medicinal and nutritional benefits. Data on the therapeutic activities of edible oils have been collected and compiled from scientific databases such as *Google Scholar* and *PubMed*. This review aimed to highlight both the health benefits and nutritional value of these oils. It provides an overview of their therapeutic properties, including anti-aging, antioxidant, anti-inflammatory and anti-cancer properties. Additionally, edible oils may help mitigate the risk of heart disease, reduce the formation of kidney stones and lower levels of bad cholesterol. The review examines a variety of oils, including soybean, sesame, sunflower, olive, palm, flaxseed, corn and coconut oil. Furthermore, edible oils are a rich source of phytochemicals, vitamin E and essential fatty acids, all of which are vital for maintaining good health. Overall, it can be concluded that edible oils serve as both a source of energy and nutrients necessary for growth and metabolism, as well as being valuable for numerous therapeutic and food applications.

Key words: Oils; Nutritional sciences; Nutrition; Therapeutics; Phytochemicals.

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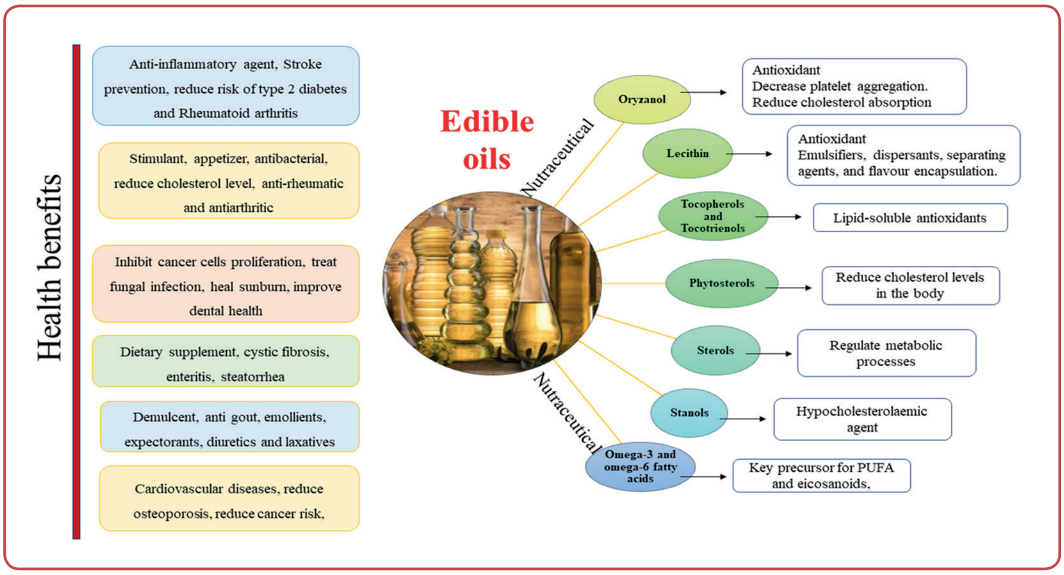

Graphical abstract

Introduction

Edible oils have been extensively consumed food derived from various plants and few animal sources.[1] Approximately 96 % of them were triacyl glycerides, consisting of a variety of fatty acids, phospholipids, phytosterols, tocopherols, antioxidants and waxes.[2] In the population diet edible oils are considered as the main source of unsaturated fats and vitamin E, both in industrial food production and in cooking. In addition to their nutritional value, they also possessed therapeutic effects.[3]

Industrial production of edible oils

Edible oils produced from seeds undergo several stages of preparation, beginning from seed pre-treatment and ending with refinement. Although there were common characteristics between seed and oil, the type and extent of the processes applied depending on their nature.[4]

Seeds are planted and harvested in the same manner as for any other crop. After harvesting, the harvest is cleaned to remove unwanted materials such as soil and other seeds. For better-quality product, it might be advantageous to shell the seed and remove the hulls.[5] A large seed might be crushed or broken into smaller pieces at this point if it was large. Prior to being pressed for oil, these uniform pieces are heated and conditioned. Press cakes compressed dry seeds and raw pressed oil, the two products of this process before getting to the final step requiring filtering the raw oil.[6]

Further oil extraction is carried out by flaking and breaking the pressed cake. As a result of the grinding and mixing of the flakes, a slurry is generated, upon further heating affected evaporation of hexane.[7] A small amount that does not evaporate out of the meal is mixed with the remaining oil.[8]

Refining involves the combination of several steps for the production of edible oils with desirable characteristics, such as bland taste, bland odour, clear appearance, light colour and stability to oxidation. An initial step in the process comprised of degumming a pre-treatment technique used on seed oils in order to reduce their phosphorus content.[9] During this process, phospholipids are hydrated using both water and acid. The free fatty acid concentration is reduced to less than 0.10 percent using an alkali solution, typically sodium hydroxide, to neutralise the second reaction after centrifuging to remove phospholipids.[10] This process can be carried out batchwise or continuously using a centrifuge or stirred vessel. A hot water wash or treatment with silica after alkali treatment is used to reduce the residue of soap contained in the neutralised oil, followed by bleaching to remove residual soap, pigments and oxidised components.[11] It is then filtered to remove the earth and absorbed impurities and polycyclic aromatic hydrocarbons using an absorbent material such as bleaching earth.[12] As a precautionary measure to ensure that phosphorus (maximum 30.0 parts per million) and/or metal is effectively removed in the bleaching earth process, an acid pre-treatment is recommended prior to adding the bleaching earth. Lastly, oil is deodorised under high vacuum by heating to 180 °C or 240 °C and cooling by using stripping steam in order to remove volatile components, resulting oil with no odour. Furthermore, at temperatures in the range of 220 to 270 °C, it is quite possible to remove free fatty acids during deodorisation and a bland taste and was more stable in storage.[13] Degumming and neutralisation are combined with bleaching and deodorisation as part of chemical refining. The process of physical refinement involves degumming, bleaching, acid pre-treatment and deodorisation at high temperatures to remove free fatty acids. This method is referred to as stripping.[14] Industrial production of edible oils were studied and shown in Figure 1.

Physicochemical properties

There are several evidence that showed the arrangement of fatty acids on the glycerol backbone altered the viscosity of the triglyceride molecules.[15] Unsaturated materials have a lower viscosity while saturated and polymerised materials have a higher viscosity.[16] Stress and temperature also affect viscosity. The sheer stress has little effect on the storage of edible oils, whereas temperature has a significant impact.[17] Stopwatches are used to measure flow time and viscous meters are used to measure viscosity.[18]

Since fatty oil is sold by weight and measured by volume, it is important to know the density of the shipments of this product. Density is the common link between these two values, so it's important to agree on the correct values.[19] The density of each oil varies depending on its fatty acid composition, minor components and temperature.[20]

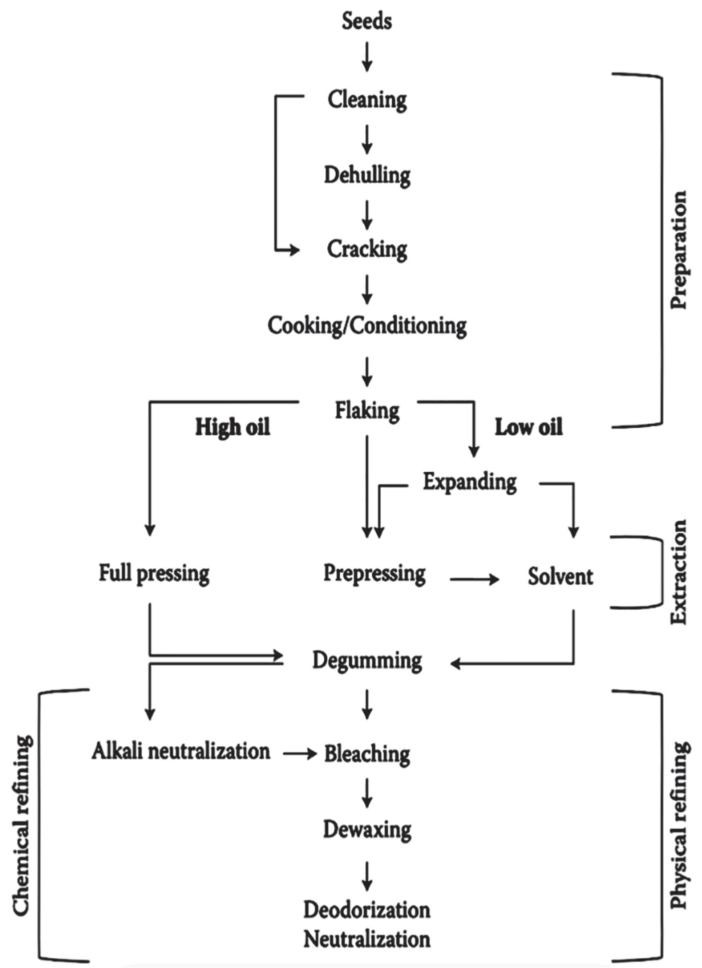

Figure 1: Industrial production of edible oils

Using the peroxide value, it is possible to determine the extent of rancidity reactions during the storage of edible oils.[21] A positive relationship is also observed between the peroxide value of the oil samples and the temperature, air contact and storage time. The peroxide value is determined by measuring the amount of iodine released from potassium iodide.[22] When the oil samples have been dissolved in acetic acid and combined with chloroform and saturated KI mixture, titrating with standard sodium thiosulphate is used to determine the amount of iodine released by peroxides present in oil by oxidative action. Starch solution was used as an indicator. Additionally, blanks are titrated.[23] A measure of an edible oil's unsaturation is its iodine content. The Iodine Value Test that can be used to determine the stability of oil for oxidation in order to determine its unsaturation, it is possible to make a qualitative determination of the fat unsaturation.[24] An oil sample weighing a known amount is treated with iodobromine added to glacial acetic acid in order to determine its weight. A reaction between iodobromine and potassium iodide converts the unreacted form of iodobromine to iodine. By titrating with standard sodium thiosulphate, the iodine concentration is determined.[25, 26]

Saponification values with a lower value suggested that the fatty acids have a lower mean molecular weight or that there were fewer ester bonds within the molecules. Therefore, there might not have been any interaction between fat molecules.[27] To saponify an edible oil sample, 10 mL of distilled water is mixed with 15 mL of 1 N KOH in a conical flask. The mixture is heated under a condenser for 30–40 minutes to ensure complete dissolution. A pink endpoint is achieved by titrating with 0.5 M of HCl after the sample had been cooled and adding phenolphthalein after the sample had been cooled. Using the same time conditions, a blank is determined.[25, 28]

In order to increase the oxidative stability of polyunsaturated fatty acids in food oils, like fish oil, hydrogenation is primarily used to increase the percentage of polyunsaturated fatty acids in the product.[29] A number of food applications (partic-

Table 1: Physical constants of the oil

Edible oils	Linseed oil	Coconut oil	Corn oil	Palm oil	Sesame oil	Soy bean oil	Olive oil
Density (kg/m^3)	924.0	930.0	919.0	914.0	920.3-923.7	920.0	911.0
Iodine value (g I_2/100 g oil)	170-203	6-11	107-128	50-55	104-120	124-139	75-94
Saponification value (mg KOH/g oil)	188-196	248-265	187-195	190-209	187-195	189-195	184-196
Peroxide value (Meq 0_2/kg)	2.21	4.97	3.93	1.30	1.13	2.39	8.50

ularly those that involve frying and baking) are unsuitable because of their high susceptibility to air oxidation. Furthermore, during storage, oxidation initiates the development of off-flavours, resulting in the reduction of shelf life.[30] Unsaturated oil's melting point increases as its unsaturation decreases, causing it to be transformed into fat at a faster rate.[31] In this way, it was possible to develop products characterised by specific characteristics through the use of the technique: selective hydrogenation produces stable liquid oil that can be used in cooking, whereas complete hydrogenation produced brittle, high melting fat that can be used for coatings, spreads, etc. Shortenings derived from cottonseed oil were the first hydrogenated products to be successfully marketed.[32] Summarisation of different physical constants for various edible oil is given in Table 1.

In order to prevent further oxidation during the processing of oils and fats, the processing of food and the storage of food until consumption, oxidation products are removed during the refining process.[33] Understanding this reaction is therefore crucial for handling lipids under appropriate conditions. To prevent non-enzymatic lipid oxidation, it is essential to protect against the two major non-enzymatic oxidation pathways. This can be achieved by avoiding pro-oxidants and incorporating antioxidants, which help inhibit lipid oxidation.[34] Metals, light, heat and several initiators accelerate lipid oxidation.[35] A comprehensive analysis of various edible oils is presented in Figure 2.

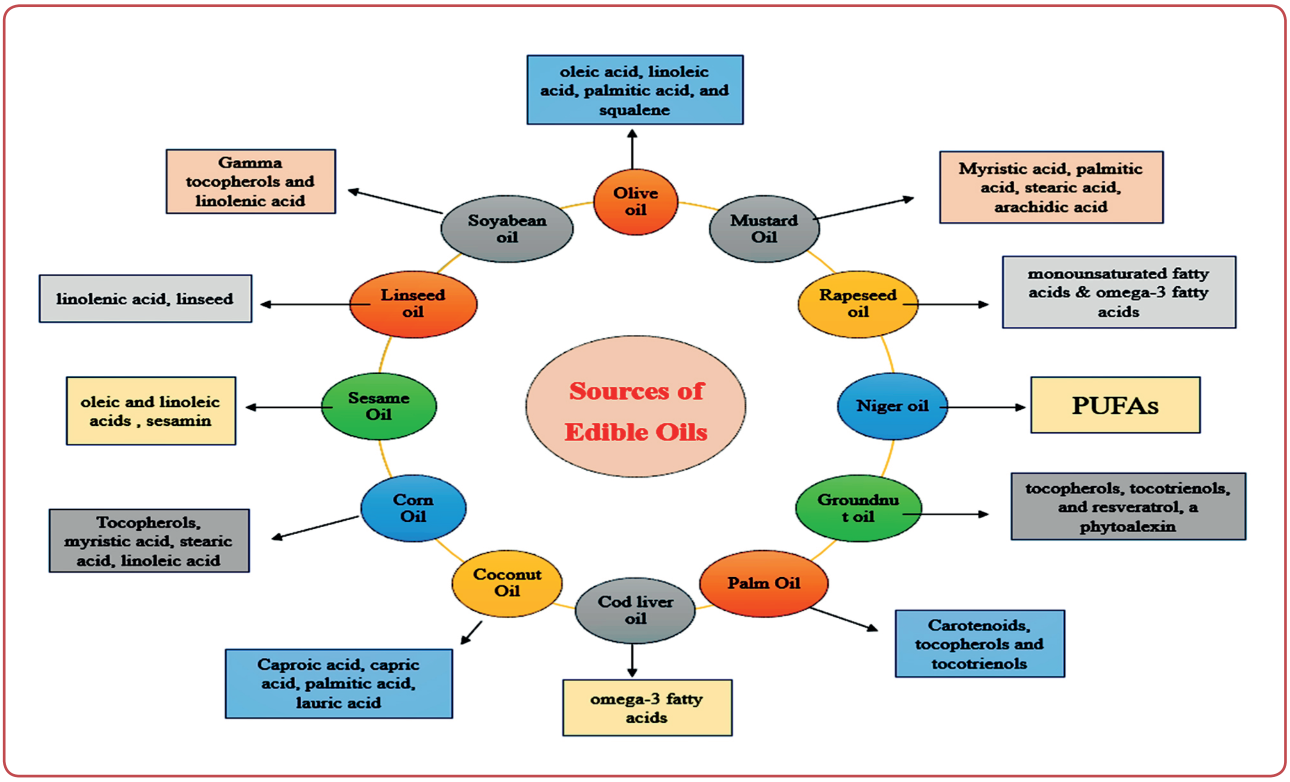

Figure 2: Chemical analysis of edible oils

Methods

This review was conducted using several scientific databases and search engines, including *Scopus, Elsevier, Bentham, Google Scholar* and *PubMed*. The keywords used in the search were: "Edible fixed oils and therapeutic potential," "Nutritional benefits of edible oils" and "Health-promoting effects of fixed oils." The data to write the article has been taken from year 2000-2023. The aim of this review was to compile and analyse studies highlighting the dual approach of edible fixed oils in both therapeutic and nutritional contexts.

Pharmacognostic account of edible oils

Olive oil

Olive oil is obtained from ripe fruits *Olea europea* by pressing the pericarp (family- Oleaceae).[36] The production of oil has been reported in India, France, Italy, Spain, South Africa and California. Himachal Pradesh, Kashmir and Nilgiri have been among the Indian states where the plant grew. A chemical analysis reveals that it contains mixed triglycerides of fatty acids, including linoleic acid, squalene, palmitic acid and oleic acid, as well as phytosterols and tocosterols depending on the region.[37] Different cultivars, regions, altitudes, harvest times and extraction processes also affects the composition. Colour of oil vary from pale yellow to greenish yellow with slightly unpleasant odour with no specific taste. Oil is found to be soluble in alcohol and slightly soluble in carbon disulfide, chloroform and ether.[38] When ripe, olives produce drupaceous fruits of a purplish hue. It might reach a 12 m of height. During the months of November through April, the fruits are collected.[39] A screw press is employed to press the pulp after it has been ground in coarse baskets made of grass the oil layer is skimmed from the oil after being collected in tubes containing water. After freeing the peeled pulp from the endocarp, the oil is pressed gently and referred to as virgin oil.[40] The marc is treated with water and repressed to yield an edible oil of a second grade. To obtain technical oil, the pulp is mixed with hot water and pressed a second time. A carbon disulfide treatment is applied to the pulp to obtain inferior olive oil.[41] The average yield of oil is reported to be 15 to 40 %. Unripe fruits gave poor oil yields and taste bitter if they were not fully mature. Numerous oil-based preparations have been developed, including liniments, salad dressings and cosmetics. It has been utilised as a demulcent, emollient and as a choleretic or cholagogue. In parenteral preparations, it serves as an excellent solvent. One of the marketed products available for use is *Figaro* oil.

Chronic inflammation has been significantly linked to the pathogenesis of various diseases, including coronary artery disease, cancer, type 2 diabetes and arthritis.[42] Its ability to reduce inflammation may be a major contributor to its health benefits. It is well established that antioxidants play a vital role in mediating anti-inflammatory mechanisms.[43] A significant component found in these products is oleocanthal, which has demonstrated anti-inflammatory effects similar to those of ibuprofen. Strokes, caused by blood clots or bleeding, interrupt the flow of blood to the brain and have been extensively studied in relation to olive oil consumption. In a large review involving 841,000 individuals,[44] olive oil was the only source of monounsaturated fat associated with a significantly reduced risk of stroke and heart attack.

Alzheimer's disease prevention is another potential benefit. Although many brain diseases can lead to dementia, Alzheimer's disease is by far the most common. One of its hallmark features is the buildup of beta-amyloid plaques in brain cells.[45] A human study revealed that a Mediterranean diet rich in olive oil has beneficial effects on brain health.

Moreover, consuming olive oil may help prevent type 2 diabetes, as several studies have shown its ability to improve insulin sensitivity and regulate blood sugar levels.[45] A meta-analysis included four cohort studies with 15,784 type 2 diabetes cases and 29 trials. The final result showed that people who administered the highest amount of olive oil had a 16 % lower risk of developing type 2 diabetes compared to those who consumed the least. In people with type 2 diabetes, supplementation led to a decline in HbA_1c levels and fasting blood sugar compared to those who did not take olive oil. A Mediterranean diet rich in olive oil prevented over 40 % of type 2 diabetes, according to this study.[46]

In rheumatoid arthritis, deformed and painful joints result from an autoimmune disease. There has been no clear understanding of its exact cause, but it, thought that the immune system attacks normal cells inappropriately. Individuals suffering from rheumatoid arthritis may benefit from supplements containing extract due to their ability to reduce inflammation and oxidative stress. According to one study, people with rheumatoid arthritis experienced better hand-grip strength, reduced joint pain and improved morning stiffness following consumption of olive and fish oil.[47] The nutrients present in olive oil are capable of inhibiting or killing harmful bacteria. One of the bacteria that inhabit our bodies is *Helicobacter pylori*, a bacterium capable of causing stomach ulcers and stomach cancer.[48] In a study conducted on humans, taking 30 g of extra virgin extract daily was found to be effective in eliminating *Helicobacter pylori* infection within two weeks.[48] Characteristics of various oils can be seen in Table 2.

Table 2: Properties and profiles of different edible oils

S. No.	Oil type	Source and family	Chemical composition	Therapeutic and other uses	Refences
1.	Olive oil	Obtained from ripe fruits *Olea europea* (Oleaceae)	Mixed triglycerides of fatty acids (linoleic acid, squalene, palmitic acid, oleic acid), phytosterols, tocosterols (varies by region)	Used as demulcent, emollient, choleretic/cholagogue, solvent in parenteral preps; anti-inflammatory (oleocanthal), reduces risk of stroke, Alzheimer's disease, type 2 diabetes, rheumatoid arthritis, antibacterial	36-48
2.	Linseed oil	From dried ripe seeds *Linum usitatissimum* (Linaceae)	Proteins (25 %) like linin, colinin, linamarin; fixed oils (30-40 %); mucilage (6-10 %); trace carbs	Used for treating gout and rheumatoid arthritis swellings, demulcent; treats gonorrhoea and genito-urinary irritation; used in oil cloths, polymers, greases	49-56
3.	Coconut oil	Dried endosperm of *Cocos nucifera* (Palmae)	Triglycerides of saturated fatty acids, average carbon atoms 8 and 10	Dietary supplement; oral drug medium; treats cystic fibrosis, enteritis, steatorrhea	57-61
4.	Corn oil	From embryos of *Zea mays* (Graminae)	Fixed oil (20 %); hexadecanoic acid (8-13 %), oleic acid (24-33 %), octadecanoic acid (1-4.5 %), omega-6 (55-62 %), gadoleic, behenic acids (0.5 %); β-sitosterol, compesterol traces	Food production; frying oil, salad oil; margarine hydrogenation; inks, paints, soaps, insecticides; lowers cholesterol	62-70
5.	Sesame oil	Seeds of *Sesamum indicum* (Pedaliaceae)	Mixture of glycerides: omega-9 (43 %), hexadecanoic acid (9 %), omega-6 (43 %), octadecanoic acid (4 %), lignoceric acid	Used in cosmetics, iodised oil, antacids, insecticidal sprays; antioxidant, protects against radiation, colon cancer, fungal infections, skin protection, improves infant growth/sleep	71-80
6.	Mustard oil	Prepared from seeds of *Brassica juncea* or *Brassica nigra* (Brassicaceae)	Composed of glycerides	Used in pharmaceuticals (soaps, condiments), biodiesel production; externally acts as rubefacient and vesicant; stimulates circulation, digestion, excretion; appetiser; antibacterial; treats rashes, skin infections, dryness, itchiness; improves blood circulation; heart-protective by maintaining HDL, lowering LDL; relieves rheumatism, arthritis, joint pain (magnesium and selenium content)	81-91

7.	**Sunflower oil**	Seeds of *Helianthus annuus*	Triglycerides; palmitic acid (5 %), stearic acid (6 %), monounsaturated omega-9 (30 %), polyunsaturated omega-6 (59 %)	Cooking (low to high temperatures); seed meal high in protein and fibre for animal feed, fuel, fertiliser; treats arthritis, prevents rheumatoid arthritis; benefits preterm infants' immune barrier; prevents cancers (uterus, lung, skin); vitamin A prevents cataracts; vitamin E (tocopherols) protects from free radicals and cancer	92-99
8.	**Cod liver oil**	Fish liver oil from *Gadus morrhua* (Gadidae)	Saturated acid glycerides esters; small amounts unsaponifiable matter (cholesterol, fatty alcohol, squalene, alpha-glyceryl esters)	Multivitamin for rickets, tuberculosis, dietary supplement; omega-3 fatty acids reduce inflammation (IL-6, TNF-α, IL-1); vitamins A and D antioxidant; supports bones; reduces rheumatoid arthritis symptoms; protects eyes (prevents macular degeneration); may reduce heart disease risk; may alleviate anxiety, depression symptoms	100–110
9.	**Soyabean oil**	Dried soyabean seeds *Glycine max*	Many fatty acids; contains phytoestrogens (isoflavones)	Used in processed foods; soy meal for animal feed; eicosapentaenoic acid (EPA) beneficial for cardiovascular health, anti-inflammatory, antihypertensive, antithrombotic; phytoestrogens reduce osteoporosis and menopause symptoms; substitute for oestrogen therapy; lowers breast, uterine, prostate cancer risk; some breast cancer caution; lowers stroke risk	111–125

Linseed oil

Source comprised of dried ripe seeds *Linum usitatissimum* Linn by pressing the pericarp (family- Linaceae).[49] The production of oil has been reported in India, South America, Canada, the United States, England, Russia, Greece, Algeria, Spain and Italy. Chemically it was derived from linseeds, found to be composed of proteins (25 %) like linin, colinin and linamarin, fixed oils (30-40 %), mucilage (6-10 %) and trace amounts of carbohydrates.[50, 51]

The colour of the oil ranges from yellow to light amber and it has a characteristic odour. Oil is found to be soluble in ether, chloroform, carbon disulphide, ligroin and turpentine. As erect annual herbs, Linseed grows to 60 to 120 cm in height, with blue flowers and capsules with globular shapes. It was found that a large number of seeds and fibres (flax) are produced from this plant.[52] It grows best in moderate rainfall and moisture-retaining soils thrive. It is usually sown either in rows alternating with other crops or on the margins of fields. Crops yield better results with nitrogenous fertilisers.[53] Drying the capsules takes place in February and March after the crop has been harvested. In order to separate seeds from plants, the seeds are cut near the ground, allowed to dry in the field and then threshed. Steam is used to soften the seed tissues by crushing the dried seeds in rollers, moistening them and heating them to 80–90 °C in steam. A hot hydraulic press is then used to press them under high pressure.[54] Alkali separates the free fatty acids from the oil by adding charcoal. When the oil is cooled, waxy substances are removed. Contains several therapeutic roles such as it have been utilised in treating swellings associated with gout and rheumatoid arthritis, oil is often used as a demulcent. In terms of internal use, effective in treating gonorrhoea and irritation of the genital-urinary tract.[55] It is also used in numerous products, including oil cloths, polymers, greases and many more.[56] Marketed products available for usage include *Scavon* and *Canisep* (Himalaya Drug Company).

Coconut oil

It had been obtained from dried endosperm of *Cocos nucifera* (family- Palmae). The production of oil, reported in India, Indonesia, China and

Sri Lanka. Chemically it derived from coconuts which was found to composed of triglycerides of saturated fatty acids with an average carbon atom count of 8 and 10.[57]

Colour of oil varied from light yellow to white with neutral odour and sweet taste.[58] A comparison of the saponification value of this oil and the iodine value of the other vegetable oils also revealed that the oil was the most saponification-rich. The oil was extracted from coconut milk by grating the coconut, mixing it with water and then squeezing it. A fermentation of the milk for 36-48 h, the removal of the oil and heating of the cream are also options for removing the remaining oil from the milk.[59] As a third option, the oil can be separated from the other liquids by using a centrifuge. A dry residue remaining after the production of coconut milk may also be used to extract coconut oil. Talking about its utilisation it has been employed in many countries as a dietary supplement.[60] Certain medicaments can be administered orally through it in a nonaqueous medium, also utilised to formulate oral suspensions of drugs that had been unstable in aqueous media. It has been suggested that a diet rich in triglycerides with medium chain, such as coconut oil preparations, may be effective for treating conditions such as cystic fibrosis, enteritis and steatorrhea that are associated with malabsorption of fats.[61] Marketed products available for usage include *Evecare* and lip balm.

Corn oil

It is obtained from *Zea mays* by expressing embryos (family- Graminae). The production of oil has been reported in India, United States, Brazil, Russia, Argentina, Canada, Thailand, Mexico and France.[62] Chemically it derived from corn embryos which was found to composed of fixed oil (20 %), fatty acid like hexadecanoic acid (8–13 %), oleic acid (24–33 %), octadecanoic acid (1–4.5 %), omega-6 (55–62 %) and gadoleic and behenic acids (0.5 %) with trace amounts of β-sitosterol and compesterol.[63] A light to clear golden colour is present along with a faint odour and distinct taste. A mildly soluble oil is found to be miscible with ether and light petroleum, as well as slightly soluble in alcohol and chloroform. It weighs between 0.915 and 0.923 g/mL. Sterilisation can be accomplished by holding at 150 °C for one hour and storing in an airtight container protected from light in a cool environment.[64] Corn germ oil can be obtained by drying the germ in a kiln and then extracting it using a hydraulic press. A solvent, usually hexane, can then be used to wash the pressed cake and the oil can then be gained by evaporating it. Hominy feed is made from the oil cake left after solvent extraction.[65] It has been primarily used in the production of food.[66] Considering its relatively low cholesterol level, frequently used as frying oil and salad oil and a substantial amount of it is hydrogenated into margarine, a process in which the oil, dissolved in hydrogen and combined with a catalyst at high temperatures and pressures. It has been also utilised in manufacturing of inks, paints, soaps and certain insecticides.[67] Marketed products available for usage involved *Esoban* which used for the treatment of dermatitis and allergic rashes. Phytosterols and vitamins E in extract, along with linoleic acid and linoleic acid, might lowered risk of heart disease.[68] Free radicals can cause cardiovascular disease due to their oxidative properties, which vitamin E possessed.[69] The presence of phytosterols in corn oil may also contributed to its ability to lower cholesterol, particularly LDL cholesterol.[70]

Sesame oil

It is obtained from seeds of *Sesamum indicum* (family- Pedaliaceae).[71] The production of oil has been reported in Caribbean Islands, China, Japan, Africa and the United States. Chemically, derived from sesame which was found to be composed of mixture of glycerides contain omega-9 (43 %), hexadecanoic acid (9 %), omega-6 (43 %), octadecanoic acid (4 %) and lignoceric acid.

Colour of oil varied from pale yellow to brown with fragrant odour and neutral taste. Oil was found to be soluble in isopropyl esters, mineral oil and insoluble in water.[72] Hydraulic presses or screw presses with low or medium power are used to express the oil. Three successive expressions result in a high yield of oil. Cooking is performed on the seed in advance of its processing in the screw press.[73] The cuticles and kernels separate during cooking and the mixture of kernels, cuticles and seeds falls into the cage, resulting in lumpy material rather than firm content. Seeds heated without steam or water can be extracted much more efficiently. It was found that there was very little loss in sesame oil when it was refining, bleaching, hydrogenating, or decolourising with alkali.[74] It is utilised in cosmetics, iodised oil and antacid products. Insecticidal sprays also contain the oil.[75] Marketed products available for usage includes *Dabur Lal* tail and *Saaf Organic Eraser Body Oil*. Research has shown that it contains a compound called sesamol that protects DNA against radiation damage. In *in vitro* studies, exposure of mice to 7 Gy γ-radiation, which led to increased in the percentage of tail DNA, tail length, tail moment and olive tail moment in blood lymphocytes. However, pretreatment with extract (100 mg/kg body weight) effectively declines these parameters in irradiated mice lymphocytes. These findings indicate that extract offers protection against γ-radiation-induced DNA damage in mice lymphocytes, likely due to its antioxidant properties.[76] Its administration (500 ppm for eight weeks) in Min mice declined small intestine and colon polyps by 75 % without abnormal effects. In Wistar rats, whole sesame paste and resistant starch type 2 (RS2) restricted DMH-induced colorectal cancer initiation by reducing mucin-depleted foci. Similarly, sesame demonstrated protective effects against azoxymethane-induced colon carcinogenesis.[77] As an antioxidant, gamma tocopherol found in extract can aid in the treatment of fungal infections.[78] Skin will be protected against the harmful UV rays of the sun if extract is applied daily to the affected areas. If you have been exposed to the sun and have developed sunburn, you can use sesame oil to treat the condition. Also, it served as a natural barrier that protects your skin from air pollutants and smoke. Reduces skin cancer risk as well as wrinkles. Oil massage, rather than control oils such as mineral oil, led to better growth and sleep in infants, according to a study published in the *Indian Journal of Medical Research* in 2000.[79, 80]

Mustard oil

It is prepared from seeds of *Brassica juncea* or *Brassica nigra* (family Brassicaceae).[81] The production of oil has been reported in India, England, Canada and China. Chemically it derived from mustard seeds which were found to compose of glycerides.

Colour of oil vary from yellow to brown with strong acrid odour and pungent taste.[82] Oil is found to be insoluble in water. It is found that a two-week drying process was first conducted on mustard seeds after they have been collected. A mill is then used to grind the seeds. A crushing machine puts them in a howler. The oil is extracted well with the addition of a little water. Oil is collected in containers after the cake has been separated from oil. A good seal is then applied to the containers. This gives edible oil its ready-to-use state.[83] It has been employed in pharmaceutical preparations such as soap, condiments etc. It is also utilised in the production of biodiesel.[84] Externally it acts as a rubefacient and vesicant.[85] Marketed products available for usage includes *Dabur Mustard Oil, Saaf Organic Eraser Body Oil*. It is regarded as one of the strongest stimulants. Circulation, digestion and excretion are stimulated by it very effectively.[86] Massage with this oil stimulates blood circulation very effectively when used externally.[87] An appetiser that stimulates appetite is mustard oil. The consumption of this substance can irritate the lining of the intestines and stomach, stimulate the release of digestive juices and produce a hunger sensation.[88] The oil can be used as an antibacterial agent. Rashes and skin infections can be treated effectively with the antibacterial properties of this product. Dryness, dullness and itchiness are prevented by the oil.[89] Boosting blood circulation enhances the rejuvenation and cleansing of skin when a body massage is performed with mustard oil. The most heart-protective oils are monounsaturated oils such as mustard oil, which maintain high HDL cholesterol levels and reduce LDL cholesterol levels.[90] Rheumatism and arthritis symptoms may be relieved by extract, which has been used for these purposes for many years.[91] Found to be beneficial in easing joint pain. Magnesium and selenium found in extract can be used to reduce pain.

Sunflower oil

This oil is obtained from seeds *Helianthus annuus*. The production of oil has been reported in India, Russia, Mexico, the United States, Ethiopia and Australia. Chemically it is derived from sunflower seeds which is composed of triglyceride, palmitic acid (5 %), saturated stearic acid (6 %), monounsaturated omega-9 fats (30 %) and polyunsaturated omega-6 fats (59 %).

Colour of oil varied from clear to slightly amber with fatty odour and nutty taste. It has a refractive index of 1.4735 at 25 °C, 188-194 saponification value and 120-145 iodine value.[92] Oil was found to be soluble in benzene, chloroform, carbon tetrachloride, partially soluble in ethanol and insoluble in water. There was several manufacturing processes involved in sunflower seed oil production, including cleaning the seeds, grinding them, pressing them and extracting crude oil. The crude oil is further refined before packaging.

Oil is extracted using a volatile hydrocarbon such as hexane.[93]

Found to be utilised for cooking at low temperatures to extremely high temperatures. As sunflower seeds are crushed during the extraction of sunflower oil, seed meal is formed, which is high in proteins and fibre and can be utilised as animal food, fuel and fertiliser.[94] Marketed products available for usage includes *Fortune Sunflower Oil*. It contains proteins that are necessary for the production of hormones, enzymes and tissues to be built and repaired. It meets this need since protein cannot be stored in the body.[95] Those who are concerned about developing arthritis should use sunflower oil as a treatment. Rheumatoid arthritis can be prevented with sunflower oil.[96] In order to reduce the risk of infection in low-birth-weight preterm infants, extract may be beneficial. Generally, infants have a weak immune system and underdeveloped organs such as the skin, which makes them more susceptible to infection. A protective barrier is created by extract and this prevents such infections from occurring.[97] The prevention of other cancers - cancers of the uterus, lung and skin can be prevented by the carotenoids in sunflower oil. Additionally, they contain vitamin A and prevent cataracts.[98] Vitamin E, or tocopherols, in sunflower oil protect the body from free radical damage that can lead to cancer. There has been direct connection between free radicals and the damage caused to cells and the immune system.[99]

Cod liver oil (fish oil)

Fish liver oil, obtained from *Gadus morrhua* (family - Gadidae).[100] The production of oil has been reported in Scotland, Iceland, Germany, Norway and Denmark. Upon chemical analysis, it was found to be composed of saturated acid glycerides esters. It contains a small amount of unsaponifiable matter such as cholesterol, fatty alcohol, squalene and alpha-glyceryl esters.[101]

It has a yellow colour and an unpleasant fishy smell and taste. Ether, chloroform, petroleum ether and carbon disulphide have been found to be soluble in oil. It has a refractive index of 1.4725 to 1.4745, specific gravity of 0.922 to 0.929 and an iodine value of 155 to 172.[102] Oil is found to be produced by cleaning and mincing the liver into small pieces and heated it at 80 °C for half an hour in a vat while admitting steam. Temperatures above 70 °C destroy the enzyme lipase. As soon as the oil has been extracted, it was placed in tin drums encased in wooden barrels.[103] It was necessary to place the barrels inside the snow and to cool the oil to between -2 °C and -5 °C in order for the palmitin to precipitate. After filtration, the palmitin was separated from the oil.[104]

Utilised as a multivitamin in treating rickets, tuberculosis and can also be eaten as a dietary supplement.[105] Marketed products available for usage includes *Seacod Cod Liver Oil*. Omega-3 fatty acids comprised in fish liver oil may suppress inflammation-promoting proteins. They comprised of IL-6, TNF-α and IL-1. Vitamin A and D are also powerful antioxidants found in cod liver oil.[106] Free radicals can be neutralised and bound by them, thus reducing inflammation. Deficits in vitamin A and D have been linked to chronic inflammation, according to studies. The vitamin D found in oil helps maintain healthy and strong bones. People living far from the equator are especially in need of it.[107] Rheumatoid arthritis symptoms may be reduced in individuals who suffer from rheumatoid arthritis, cod liver oil may reduce joint pain due to its anti-inflammatory properties. [108] Fish liver oil contains vitamin A and omega-3 fatty acids, which can help prevent age-related macular degeneration caused by aging.[109] Oil might reduce the risk factors associated with heart disease. Studies often compare cod liver oil with regular fish oils without specifically examining the association between cod liver oil and the risk of heart disease.[109] The omega-3 fatty acids and vitamin D in oil may contribute to reduced symptoms of depression and anxiety, according to a study.[110]

Soyabean oil

Obtained from dried soyabean seeds (Glycine max).[111] The production of oil was reported in India, China, Germany, Argentina, Netherlands and Mexico. Chemically it derived from soyabeans which was found to be composed of many fatty acids.[112]

Colour of oil vary from pale yellow to dark yellow with neutral taste. Oil is found soluble in ethanol, ether, chloroform and carbon disulphide.[113] In order to produce soybean oil, the soybeans must first be cracked, the moisture content adjusted, the beans must be heated between 60 and 88 °C, the beans roll into flakes and solvent-extracted. In addition to refinement and blending for different applications, the oil might also undergo hydrogenation.[114] Various processed foods contain soybean oil, either as a liquid or partially hydrogenated form. As a result of the processing of soybean oil, a large amount of the residue (soybean meal) was used for animal feed. There have been several commercial products that use it to prolong the action of essential oils such as geranium oil.[115] Marketed products available for usage includes *Fortune Soya Bean Oil*, in soybean oil, eicosapentaenoic acid a natural compound present that contains several unique biological properties that make oil effective in promoting health and preventing disease in cells and tissues.[116] It is probably best understood how EPA works in cardiovascular disease, although it had been active in other areas of human biology as well. In addition to altering the structure and fluidity of the cell membrane, long chain EPA can prevent lipid rafts from occupying a significant proportion of the membrane.[117] There is an evidence that (n-3) FA has cardiovascular benefits in terms of lowering arrhythmias, lowering TG, as well as providing antithrombotic, anti-inflammatory and antihypertensive properties.[118] Reduces the risk of osteoporosis and the symptoms of menopause - soy-derived foods contain phytoestrogens called isoflavones. In the body, isoflavones, which are called phytoestrogens, function similarly to estrogen.[119] It has been found that women who receive oestrogen or progesterone treatments are more likely to develop strokes, breast cancer and heart attacks. The increased risk of strokes, breast cancer and heart attacks has led to the consumption of isoflavones being recommended as a substitute for oestrogen therapy.[120] Isoflavones exhibit weak estrogenic properties due to their binding to oestrogen receptors in cells, particularly in the absence of adequate oestrogen levels in the body. Besides performing these two functions in the body, isoflavones have also been shown to slow osteoporosis and menopause progression, as well as reduce the risk of uterine and breast cancers through their ability to block the growth of oestrogen receptors.[121] Cancer and tumour risks have been shown to be lower when soy has been consumed. The conversion of testosterone into dihydro testosterone (DHT), inhibited by isoflavones and prostate cancer associated with high levels of DHT. In human breast cell cultures, soy isoflavones are shown to inhibit oestrogen release, thus having an antiestrogenic effect; however, some experimental evidence suggests that soy isoflavones may stimulate the proliferation of breast cancer cells.[122]

When oestrogen levels are high, uterine cells are stimulated and uterine cancer is more likely to occur in individuals who are prone to it. The

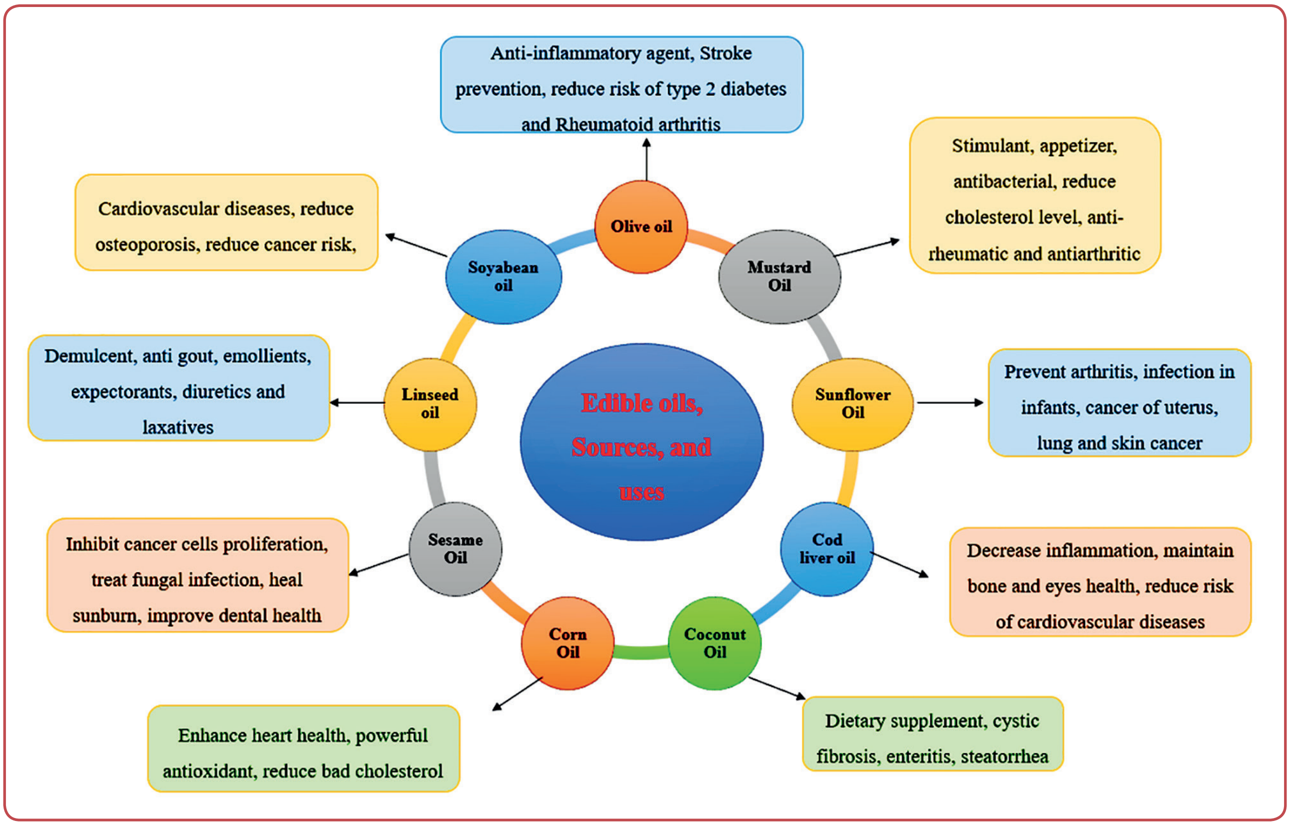

Figure 3: Source and pharmacological actions of edible oils

growth of uterine cells is not affected by isoflavones, as evidenced by several studies.[123]

Many case-control studies have serious limitations when it comes to evaluating the effects of soy isoflavones on breast cancer risk. There was no effect on serum oestradiol level, mammography density, luteinising hormone level or follicular stimulation hormone level when isoflavones were supplemented for 12 months or 85.5 mg for 6 months in postmenopausal women.[124] Breast cancer patients are generally more susceptible to isoflavone stimulation. Furthermore, it has been reported that postmenopausal women who consume soybeans on a chronic basis have a low risk of developing endometrial cancer.[125]

Significant number of antioxidants are contained in palm oil, including tocotrienols. Phytosterols have an effect on lowering cholesterol by deactivating free radicals at cellular, molecular and subcellular levels.[126] There have been several studies showing that palm oil may increase the risk of cardiovascular disease. Combining non-hydrogenated polyunsaturated oils with a compound in palm oil can lower the risk of heart attacks.[127, 128] Multiple therapeutic effect along with their source of said edible oils best depicted in (Figure 3).

Nutritional role of edible oils

Edible oils are important sources of energy and nutrient carriers for growth and metabolism. Carbohydrates make up the majority of the human diet, followed by oils. Among edible oils, glycerides of fat have been the most abundant component. The composition usually includes water-soluble phospholipids, unsaponifiable components and free fatty acids.[129]

There have been visible fats and oils added to the diet as well as the invisible fats found in plant and animal foods. Most organic solvents, soluble in hexane, benzene, chloroform and methanol, but they have been insoluble in water. Their density has been lowered than that of water. In the case of solids at normal room temperature (RT), the

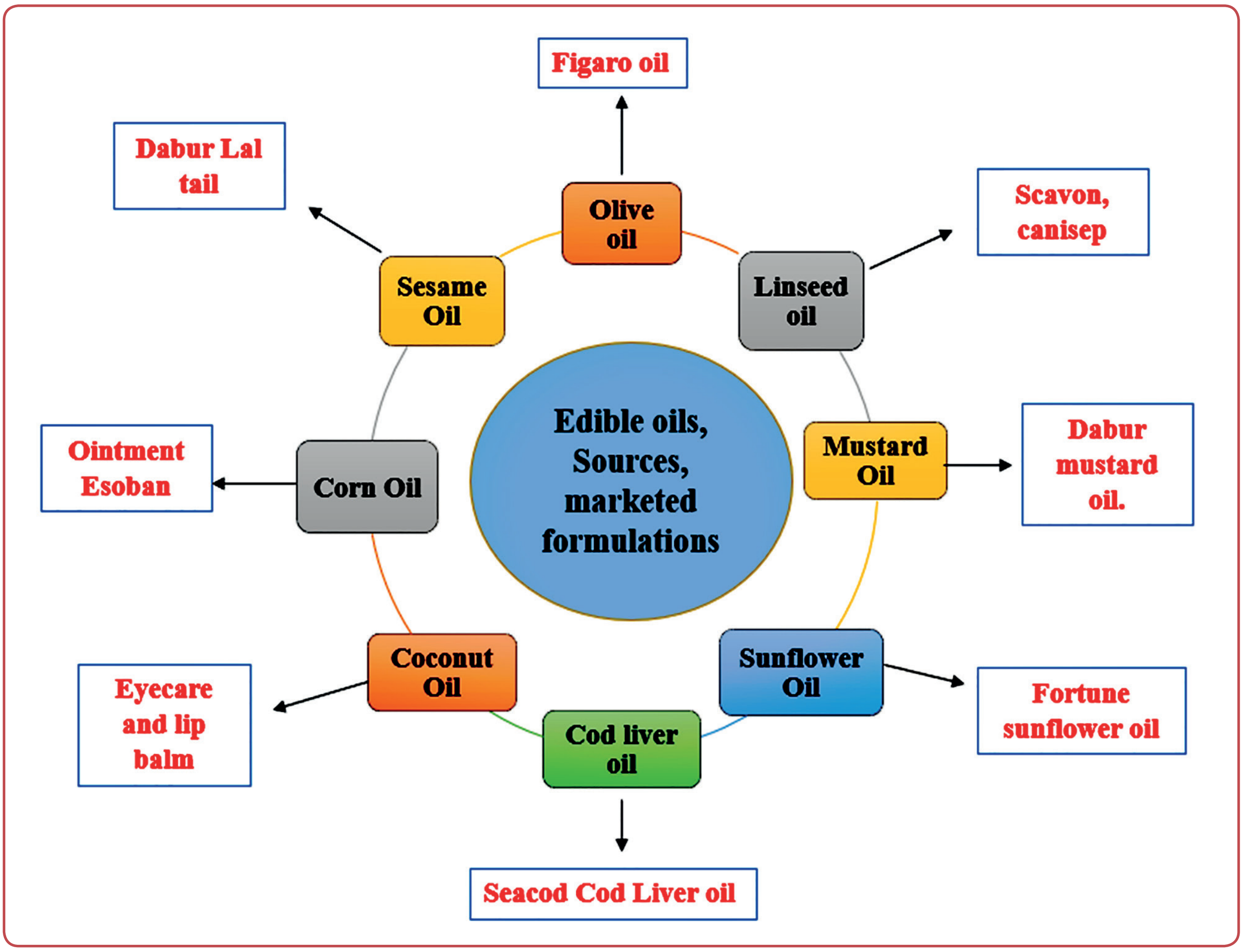

Figure 4: Marketed formulations and their pharmacological actions

term "fat" is used, while liquids at RT, referred to as "oil".[130] Some of marketed formulations of different edible oils are presented in Figure 4.

Sources of edible oils

Primary sources

- Soyabean oil - Gamma tocopherols and linolenic acid, abundant in this oil.
- Linseed oil – Linseed, conditionally edible food that have an excellent source of linolenic acid
- Rapeseed oil - An essential fatty acid and monounsaturated fatty acid
- Niger oil - An oil rich in PUFAs can be found in Niger
- Sunflower oil - Monounsaturated and polyunsaturated fatty acids, present in it, as well as vitamin E.
- Groundnut oil - Contains tocopherols, tocotrienols and resveratrol, a phytoalexin that has anti-cancer, anti-platelet and antioxidant properties.
- Sesame oil - There are almost equal quantities of oleic and linoleic acids in sesame. Antioxidant properties of sesamin and sesmol have been discovered in sesamin lignans. Salad dressings can be made with this.
- Cod liver oil - The oil, rich in omega-3 fatty acids.[131]
- Secondary sources
- Corn oil -Corn oil, rich source of tocopherols
- Coconut oil - Short chain fatty acids can be easily digested in coconuts.
- Palm oil - Oil palm contains a high number of tocopherols, carotenoid pigments.[132]

Conclusion

Edible oils are procured from various plant and animal sources and plays a pivotal role in human nutrition and health. It is basically comprised of triacylglycerides, rich in essential fatty acids, phytochemicals, tocopherols and antioxidants, contributing to their nutritional and therapeutic benefits. These oils composed of unsaturated fats and vitamin E, supporting metabolic functions, heart health, disease prevention. In this review, detailed explanation about the activities of several edible oils have been deliberated. The industrial production of edible oils involves several refining steps to augment their stability, purity and shelf life. Viscosity, density, peroxide value, iodine value and saponification value are the various physicochemical properties, helpful in evaluating the quality and usability of these oils. Overall, edible oils provide both energy and essential nutrients, contributing to growth, metabolism and overall well-being. While progressing research continues to optimise their health and benefits and industrial processing.

Ethics

This study was a secondary analysis based on the currently existing data and did not directly involve with human participants or experimental animals. Therefore, the ethics approval was not required in this paper.

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Conflicts of interest

The authors declare that there is no conflict of interest.

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Data access

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