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EXPLORING THE SYNERGISTIC EFFECTS OF ANTIOXIDANTS AND ANTI-INFLAMMATORY COMPOUNDS IN EDIBLE OILS FOR ENHANCED HEALTH BENEFITS-A REVIEW

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ABSTRACT

This review delves into the intricate relationship between antioxidants and anti-inflammatory properties within edible oils, exploring their combined impact on human health. We analyze the synergistic effects of various compounds, shedding light on the mechanisms underlying enhanced health benefits. Explore specific antioxidants present in various edible oils, such as polyphenols, tocopherols and carotenoids. Highlight the diverse sources of these antioxidants, ranging from olive oil to sunflower oil. The molecular mechanisms by which antioxidants neutralize free radicals, emphasizing their role in preventing oxidative stress. The potential role of antioxidants rich edible oils in mitigating chronic diseases associated with inflammations. The influence of dietary patterns on the effectiveness of edible oils in providing antioxidant and anti-inflammatory benefits.

KEYWORDS

Edible oils, Fruits, Vegetables, Anti-oxidant and Anti-inflammatory.

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INTRODUCTION

Inflammation is a biological reaction to a disrupted tissue homeostasis**.** Inflammation is a protective strategy evolved in higher organisms in response to detrimental insults such as microbial infection, tissue injury and other noxious conditions. It is an essential immune response by the host that enables the removal of harmful stimuli as well as the healing of damaged tissue. Acute inflammation has therefore been considered as a part of innate immunity, the first line of host defense against foreign invaders and danger molecules. Mankind has known the classical symptoms of inflammation for hundreds of years, which include redness, pain, swelling and heat[1]. Reactive oxygen species (ROS)

are chemical species containing unpaired electrons of oxygen and oxidizing agents that are readily turned to free radicals, such as hydroxyl radical (•OH), superoxide anion radical (•O−2), singlet oxygen (1O2), hydrogen peroxide (H2O2) and hypochlorous acid (HOCl)2^{-4}. Living organisms systematically keep a balance between ROS and antioxidant defenses including exogenous and endogenous antioxidants, such as Vitamin C, Vitamin E, glutathione, superoxide dismutase (SOD), catalase (CAT) and peroxiredoxins (PRXs). Basic levels of ROS play an essential role in the cellular signal transduction processes and maintain oxygen homeostasis in the physiological environment. However, excessive ROS can lead to oxidative stress, cause DNA fragmentation, protein oxidation and lipid peroxidation, which are associated with various inflammatory diseases, such as cardiovascular diseases, inflammatory bowel disease (IBD), neurodegenerative diseases, asthma, diabetes, and arthritis[5].

EDIBLE OIL IN INFLAMMATORY DISEASE

In inflammation and oxidative stress, edible oils and their constituents can play vareity and opposing roles[6]. Edible oils and fats are biological mixtures derived from plants that are made up of ester mixtures derived from glycerol and a chain of fatty acids. The type and proportion of fatty acids on the triacylglycerol influence both the physical properties and chemical properties of oils and fats[7]. Many studies on edible oils have been conducted[8]. Dietary factors, particularly edible oils, have a significant impact on disease causation, treatment, management, and prevention.

Edible oils contain several fatty acids, which can be divided into three classes: saturated fatty acids (SFA), monosaturated (MUFA) and polyunsaturated (PUFA) and trans fatty acids (TFA). Furthermore, edible oils contain antioxidants (such as tocopherols, oryzanol, carotenes, tocotrienols, and so on), phytosterols and micronutrients[9].

Virgin olive oil

Olive oil is a high-value edible oil that is valued for both its sensorial qualities and its nutritional value[10]. In the Mediterranean, olive oil is the primary source of fat[11]. Olive oil contains antioxidants such as oleic acid, phenolics, and squalene, which help to prevent oxidative stress and oxidation caused by the Mediterranean climate's high temperatures and UV radiation. The majority (72%) of oleic acids in olive oil are MUFA, which are less vulnerable to oxidation and provide the antioxidant potential, increased stability, and long lifespan of olive oil. Beef and poultry contain 30-45% oleic acid, whereas vegetable oils like palm oil, peanut oil, soybean oil, and sunflower oil contain 25-49% oleic acid[12]. Secondary physical extraction and centrifugation or chemical refining can be used to refine olive pomace (a crude oil produced by centrifugation of olives in water). Virgin olive oil is unrefined olive oil[8]. The alleged health benefits of extra virgin olive oil has been linked to its monosaturated fatty acids (MUFA, specifically oleic acid) and antioxidant components, such as hydroxytyrosol and oleuropein, the majority of which are phenolic in nature[11].

Only virgin olive oils retain 'fruity' sensory characteristics that attest to their natural origin and freedom from artificial processing other than mechanical extraction. Their distinct flavor is critical because it heavily influences consumer acceptability .The International Olive Oil Council (COI) proposed a method for evaluating the sensory properties of virgin olive oil in 1987, based on the opinions of "panel" tasters (EC 1991)[13]. The most commonly used cooking fat is virgin olive oil (VOO). When compared to other vegetable oils, VOO exhibits high resistance to oxidation processes and advantageous frying properties because of its fatty acid composition, which is high in monounsaturated fatty acids (MUFAs) (55-88%) and low in polyunsaturated fatty acids (PUFAs) (2-21%), in addition to the presence of highly antioxidative phenolic compounds, which primarily inhibit the production of hydroperoxides[14]. Natural

antioxidants (phenols and tocopherols) and aromatic compounds are also abundant in virgin olive oil[15].

This oil is made from olives through the following processes: (1) washing (2) crushing (3) kneading and (4) centrifugation[8].

Three olive varieties *(Leccino, Coratina, and Dritta*) were tested using an industrial scale apparatus on the farm of our institute *("Istituto Sperimentale per l'Elaiotecnica", Pescara, Italy).* The oil mill, a Novoil ED J/1 (*Rapanelli firm, Foligno, Italy),* was made up of a percolation extractor *("Sinolea")* and a centrifugal decanter. Double extraction tests were carried out.

There were two types of oil obtained:

Percolation oil (first extraction) and

Centrifugation oil(second extraction)[15].

The following were the steps of the industrial process:

Washing and defoliation of olive lots;

Milling of nonpitted drupes by a mobile hammer crusher;

Kneading of the final paste for 1 hour at 30°C (the plant was equipped with two kneaders, allowing continuous processing);

First extraction of oil must from paste by "Sinolea" (duration 50 min);

A second extraction using a novel centrifugal decanter equipped with special head plates; and

Separation of the oil must into oil and water using an automated discharge centrifuge.

The paste (550kg h-1) was fluidized during the second extraction by adding 400L h-1 of tap water at 30°C. A uniform sample of 1.8 ton of olives was divided into 6 equal 300kg components for each variety, which were prepared and performed testing as replicate units. During testing, samples of olives, byproducts, and oils were collected using the same sampling techniques briefly described in previous reports (Ranalli, 1992; Ranalli and Serraiocco, 1996a). These papers also summarize the methods used to perform the analytical assessments on the olives, husk, and vegetable water (olive juice)[15].

Analysis of virgin olive oil

Determination of the yield of olive oil extraction

The yield of olive oil was calculated using the weight of the olive paste (kg) after grinding and the amount of olive oil recovered after natural decantation (ml). The extraction yield was expressed as a percentage (%) of the final mass of olive oil to olive paste.

Olive oil chemical analysis

General chemical parameters such as free acidity (% oleic acid), peroxide value (meqO2/kg), K270, and K232 were determined using the analytical methods described in European Union Commission Regulation EEC/2568/91 and subsequent modifications.

Determination of the shelf life of olive oil

Multiple samples (15g) of HP or PEF pretreated and untreated olive oils were stored in amber glass bottles in the dark at various temperatures (25, 35 and 45°C). At predetermined time intervals, one bottle was removed from the incubator for analysis.

Olive oil chemical analysis

The oxidative stability of the oils was investigated using a shelf-life study that measured appropriate indices such as peroxide value (PV). The Rancimat method (Gutierrez, Albi, Palma, Rios, 1989) was used to assess oxidative stability, which was expressed as the oxidation induction. Time (hours) measured with a Rancimat (OXI test. VELP Scientifica. USA) using a 10g warmed to 90°Coil sample and 6 bar O_2. The Induction Period was found to be associated with oxidative stability (IP). At a given pressure, temperature and O_2 concentration, IP is the time required for oil oxidation. Higher IP indicates more oxidation-resistant oil.

Determination of total phenolic content

The total phenolic content was determined using a triple extraction of an oil in hexane solution with a methanol: water (80:20) mixture, as described by Gut finger (1981). Initially, 6.25g of olive oil was mixed with hexane to fill a 25ml volumetric flask to the top. Three times, 20ml of this solution was mixed with 5ml of methanol: water (80:20). Following the Folin-Ciocalteau assay, the extract

was measured at 765nm (Helios spectrophotometer, USA). The total phenol concentration was expressed in milligram of gallic acid per kilogram of oil.

Composition of fatty acids determination

The methyl-esters were prepared by vigorously agitating a solution of oil in hexane (0.2g in 3ml) with 0.4ml of 2N methanolic potassium hydroxide to determine fatty acid composition. FA methyl esters were measured using a 10-foot glass column with a 2 mm internal diameter. On Chromosorb WAW, the column was packed with 5% SP-2340 (100-120 mesh). A Hewlett-Packard 5880 gas chromatograph with a flame ionization detector was used for the analysis. At a flow rate of 28 ml/min, nitrogen was used as the carrier gas. The injection port temperature was 220°C, while the detector temperature was 300°C. The column temperature was held at 80°C for 2 minutes and then gradually increased.

Statistical investigation

All measurements were taken in triplicate for each parameter and statistically analyzed using Statistical 7 software (Stat Soft, Tulsa, OK, USA) with least significant difference (LSD) at p b 0.05[10].

Atherosclerosis is a immedicable low-grade inflammatory process characterized by lipid, immune cells, and fibrous tissue accumulation in the inner layer of the arterial wall. As the disease improves, it can cause atherothrombosis, resulting in ischemia and infarction of tissues supplied by vascular branches distal to the blockage and depends on the location of the plaque, a variety of cardiovascular diseases (CVD). As a result, therapeutic avenues for atherosclerosis using anti-inflammatory approaches, such as the use of functional foods with anti-inflammatory properties, have been investigated. A Mediterranean diet (Med D) is related with a reduction in a variety of inflammatory molecules linked in atherosclerosis, CVD incidence and mortality, in addition to an improvement in endothelial functions, according to research. The essential component of the diet, extra virgin olive oil (EVOO), contains a variety of bioactive phenolic compounds with anti-inflammatory and anti-oxidative properties. As a result, it is proposed that EVOO consumption is the primary contributor to the anti-inflammatory and cardioprotective effects of the Med D and that it may be used alone or as a supplement to prevent atherosclerosis and CVD.

A high-quality meta-analysis and systematic review, as well as other studies, show that olive oil interventions in the form of a regular meal or a Med D supplemented with EVOO resulted in a significant reduction in circulating inflammatory biomarkers associated with atherosclerosis. Furthermore, it has been witnessed that dietary interventions with phenolic compounds found in EVOO successfully reduced the levels of inflammatory molecules via the down regulation of NF-B and that a high intake of phenolic compounds, rather than other EVOO components, was related with a decrease in inflammatory biomarker levels. EVOO has anti-inflammatory effects in human models, and by reducing inflammation, the progression of atherosclerosis and endothelial dysfunction may be prevented. Several parameters were used to assess the ability of EVOO dietary intervention to prevent endothelial dysfunction.

After controlling for dietary and conventional risk factors, various case-control studies show that EVOO consumption is associated with a reduction in the incidence and recurrence of acute coronary syndrome (ACS). Adherence to a Med D supplemented with EVOO was also associated with a reduction in CVD incidence, including ACS, stroke, and peripheral arterial disease (PAD), as well as both all-cause and CVD mortality in both high-risk and healthy patients, according to the PREDIMED and other studies. Current evidence also supports the use of EVOO in the resisting common CVD complications such as heart failure and atrial fibrillation (AF). Recent population-based cohort studies in Greek and Swedish people show that adhering to a Med D with a high EVOO intake is related with a lower risk of HF in both people with CVD risk factors and those who have already had an episode of ACS[16].

Fish Oil

Many food products contain fish and algal oils high in LC-omega-3 fatty acids. The potential role of these oils in reducing coronary heart disease, inflammatory and immune disorders, colon cancer, and improving early development has sparked interest[17]. Omega-3 fatty acids have anti-inflammatory properties, they may be useful in the treatment of IBD. They are especially appealing to patients who see them as both safe and natural. The goal of this review is to look at the research and see how PUFAs can help with IBD management[7].

The aquaculture (fish farming) industry is heavily reliant on fish oil as a commodity ingredient for the formulation of fish feeds, owing to the nutritional requirements of marine and salmonid species for LC-PUFAs in their diets, as well as to ensure that the final product destined for the consumer contains these health-beneficial fish oils .Contrary to popular belief, most farmed fish species are unable to synthesize omega-3 fatty acids such as eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), and must rely solely on dietary sources .Thus, farmed species such as salmon and trout are major consumers of occasinally sourced fish oils (harvested from so-called reduction fisheries containing species including anchovies, menhaden, and capelin) and the aquafeed industry consumes over 750,000 metric tones of fish oils annually. When this demand is combined with the ongoing expansion of fish farming (an average of 6% per year over the last two decades) and the ever-growing human population, a number of significant issues arise. For starters, fish farming is the most efficient system for producing animal protein for human consumption input/output aquaculture's ratios are superior to all terrestrial animal production systems. Second, farmed fish is now almost universal in many countries; for example, 95% of all salmon sold in the UK is farmed. Third, the finished products contain well-defined levels of health-beneficial omega-3s[7], though feed inclusion rates are decreasing, most likely due to price sensitivity for raw materials like fish oil. Attempts to replace fish oils in aquafeed diets with conventional vegetable oils (which lack critical fatty acids like EPA and DHA) result in finished products lacking the health-beneficial omega-3 fish oils and risk undermining consumer trust in oily fish as a healthy food[18].

IBD's aetiology is unknown, but local mediators such as cytokines, altered cell mediated immunity and arachidonic acid metabolites, , are likely to play a role. The rationale for prescribing n-3 PUFA to promote gastrointestinal health has been connected to their anti-inflammatory properties. The main chemotactic signals seen in the mucosa during a relapse are reluction of natural cytotoxicity, changes in interleukin 2 (IL-2) and arachidonic acid metabolites, such as LTB4. All have been shown to mediate natural killer activity. A second hypothesis is based on the possibility of essential fatty acid (EFA) deficiency in IBD and its effect on cell membranes. Another possibility is that fish oil reduces oxidative stress in IBD patients. Fish oil supplements reduced LTB4 levels in a rectal dialysate in a randomised crossover trial involving eighteen patients with ulcerative colitis (UC).

The authors recommended that patients with IBD be tested for EFAD and given large amounts of supplements with a high EFA content. In contrast, a Japanese study discovered that EFAD is uncommon in Crohn's disease. A prospective study in the UK involving 26000 recruits from Norfolk found that total dietary n-3PUFAs, EPA, and DHA were related with a lower risk of ulcerative colitis. A small cross-sectional study of 51 patients with IBD from Hungary found no evidence of this. A Brazilian crossover study of nine patients on sulfasalazine treatment received omega-3 fatty acids or placebo for two months separated by two months to see if fish oil can reduce oxidative stress in ulcerative colitis. They were pitted against nine healthy people. A variety of standard serological measures, in addition to endoscopy and histology, were used to assess disease activity. According to the findings, fish oil can act as a free radical scavenger and thus protect patients.

In Spain, researchers looked into the effects of monounsaturated, n-3 and n-3 + n-6

polyunsaturated fatty acids on histology, mucosal defense, mucosal prostaglandin E2 and LTB4 in a rat model. It was determined that while n-3 PUFAs can prevent inflammation, they also reduce the colon's defense system, leading to oxidative injury. As a result, while it appears that these compounds have anti-inflammatory properties, the mechanism by which they do so requires further investigation[7].

Palm Oil

Palm oil is a natural edible oil[19]. Palm oil is the second most important edible oil, obtained from the fleshy mesocarp of the oil palm fruit (*Elaeis guineensis*). It has a naturally reddish color because presence of beta-carotene and a high concentration of antioxidants (vitamin E, beta -carotene, lycopene, and phytosterols)[12]. It is also an important component of soaps, washing powders, and personal care products and also useful in wound healing[19]. Palm oil is widely used as cooking oil, frying oil, shortening, and bakery fat in a variety of food products due to its stability, composition, and lower production cost[12]. The link between nutrition and health in oxidative stress has sparked interest in red palm oil and its potential to improve oxidative status by lowering it in patients suffering from cardiovascular disease, cancer and other chronic diseases. However, excessive consumption of red palm oil may cause liver toxicity and damage, as evidenced by increased alanine transaminase (ALT) and aspartate transaminase (AST) activities. Surprisingly, moderate consumption of red palm oil has been shown to reduce oxidative stress[19].

Chemical and sensory analyses are used to evaluate the quality of palm oil

Chemical analysis

The free fatty acid level was determined using AOCS Method Ca-5a-40. The peroxide value was calculated using AOCS Method Cd-8 53. The p-anisidine concentration was calculated using IUPAC Method 2.504. The tox value was calculated using the following equation based on the peroxide and p-anisidine values.

TV = 2 PV + p-AV T

Where TV, totox value; PV, peroxide value; and p-AV, p-anisidine value[20].

Sensory evaluation

Based on a five-point scoring system, an analytical sensory test was designed to determine flavor intensity and overall quality of the oil. The sensory test was carried out in an air-conditioned sensory laboratory with ten individual booths. Fluorescent red and blue lights made up the lighting system. The red light was used to mask any differences in color between samples. Ten specially trained panelists served as judges. They were chosen for their ability to detect minor differences in oil quality. Prior to the evaluation, they had attended 12 training sessions aimed at familiarizing them with various sensory test methods and techniques for evaluating various products, including oils and fats. Oil samples were melted and 25mL were transferred to clear, narrow-mouth glass bottles (30mL capacity) and screw-capped. Each sample was coded using three-digit random,-members. Samples were evaluated in three groups, and panelists evaluated each group three times. The first set included selected red palm oil, while the second and third sets included RBD palm oil. Physical refining of palm oil assesses flavor intensity and overall oil quality. The scale of 1 to 5 was used. The flavor intensity scores were as follows: 1, bland, 2, trace, 3, moderate, 4, strong and 5, extreme. Overall quality scores were as follows: 1, very poor; 2, poor; 3, fair; 4, good and 5, very good. A duplicate of sample C was presented as the reference sample (REFI) in the first set, with a flavor intensity rating of 4 and an overall quality rating of 3. In the second and third sets, a duplicate of sample J served as the reference sample (REF2), with a flavor intensity of 3 and an overall quality rating of 3. Panelists were asked to sniff the coded unknown) samples and rate their flavor intensity and overall quality in comparison to the reference sample. Finally, a descriptive test was performed[20].

Statistical analysis

To determine the relationship between sensory and chemical analyses, the obtained data were subjected to linear and stepwise multiple regression[20].

The activation of initiator caspases (caspase-8 or -9) causes apoptosis, which then activates effector

caspases (caspase-3, -6 and -7). A study using a highly malignant mouse mammary epithelial cell line to determine whether tocotrienol-induced apoptosis is communicated by the caspase-8 or caspase-9 pathway found a gradual increase in caspase-8 and -3 activities but not caspase-9. When tocotrienol was combined with caspase-8 or caspase inhibitors and administered to the same epithelial cell line, it was discovered that they completely blocked tocotrienol-induced apoptosis and caspase-8 and caspase-3 activation. Red palm oil has the highest concentrations of natural tocotrienols, which have been shown to have potent anticancer activity at treatment doses while having little or no effect on normal cell growth or viability. Tocotrienols have been shown in studies to provoke apoptosis in breast cancer cells. It is also called that the activation of caspases, which are cysteine proteases, mediates the morphological and biochemical characteristics of apoptosis, such as nuclear and cytoplasmic condensation and DNA fragmentation. These findings demonstrated that tocotrienol-induced apoptosis in highly malignant mammary epithelial cells is communicated by caspase-8 activation and provide important information for understanding the health benefits of tocotrienol-rich RPO in preventing or lowering the effectiveness of breast cancer in women. Previous research has found that tocotrienols, rather than tocopherols, have serious antiproliferative and apoptotic activity against breast cancer cells. These findings suggest that RPO tocotrienols could be useful as therapeutic agents for breast cancer prevention and treatment[19].

COMMERCIALLY AVAILABLE EDIBLE OILS

Soybean oil

Soybean oil is a vegetable oil derived from *soybean seeds* (*Glycine max*). It is one of the most popular edible oils and the second most popular vegetable oil.

Composition

Soybean oil contains only small amounts of fatty carboxylic acids (approx. 0.3% by mass in crude oil and 0.03% in refined oil). Instead, esters are present. The terms acid and fatty acids in the following contet refer to esters rather than carboxylic acids. Some applications, such as edible oils, require a high proportion of oxidation-prone polyunsaturated fatty acids.

Uses

Soybean oil is predominantly used in baking and frying. It is also used as a salad dressing. As a essential fatty acids and source, soybean oil is recommended for parenteral nutrition[21,22].

Palm oil

Palm oil is an edible vegetable oil derived from the *mesocarp* (*reddish pulp*) of oil palm fruit.

Composition

Palm oil, like all fats, contains fatty acids that have been esterified with glycerol. Palm oil contains a particularly high concentration of saturated fat, specifically the 16-carbon saturated fatty acid palmitic acid, after which it is named. Palm oil contains a lot of monounsaturated oleic acid. Tocotrienol, a member of the vitamin E family, is abundant in unrefined palm oil. Indonesia, Malaysia, Thailand and Nigeria are largest producer of palm oil. Biodiesel is primarily produced in Indonesia from palm oil.

Uses

Palm oil's highly saturated nature makes it solid at room temperature in temperate regions, making it a cheap substitute for butter or hydrogenated vegetable oils in applications where solid fat is desired, such as pastry dough and baked goods. Palm oil has been found in West African dishes like egusi soup and okra soup. Concerns about trans fats in hydrogenated vegetable oils may have influenced the increased use of palm oil in the food industry. Palm oil is occasionally used as a minor ingredient in calf milk substitute[21,23].

Olive oil

Olive oil is a liquid fat derived from olives (the fruit of *Olea europaea; family Oleaceae*), a traditional tree crop of the Mediterranean Basin, and is extracted by compressing whole olives.

Composition

Olive oil is primarily composed of mixed triglyceride esters of palmitic acid, linoleic acid,

oleic acid and other fatty acids, with trace amounts of squalene (up to 0.7%) and sterols (about 0.2% phytosterol and tocosterols). The composition varies according to cultivar, region, altitude, harvest time, and extraction process. Spain produced the most, followed by Italy, Tunisia, Greece, Turkey, and Morocco. San Marino has the world's highest per capita intake of olive oil.

Uses

Olive oil is widely used cooking oil in Mediterranean countries, and it is one of the three staple food plants of Mediterranean cuisine, the other two being wheat (as in pasta, bread, and couscous) and the grape, which has been used as a dessert fruit and for wine[22,24].

Sesame oil

Sesame oil is a vegetable oil made from sesame seeds. The oil is one of the first crop-based oils to be discovered. The manual harvesting process required to extract the oil limits global mass modern production.

Composition

Sesame oil contains the fatty acids in small amounts includes linoleic acid (41% of total), oleic acid (39%), palmitic acid (8%), stearic acid (5%) and others.

Uses

Sesame oil made from untoasted seeds is a pale yellow liquid with a pleasant grain-like odour and a slightly nutty taste that is used as frying oil. Sesame seed oil is amber-colored and aromatic, and it is used as a flavouring agent in the end of cooking.

Rice bran oil

Rice bran oil is derived from the hard outer brown layer of rice known as bran.

Composition

Rice bran oil is composed of 38% monounsaturated, 37% polyunsaturated and 25% saturated fatty acids, similar to peanut oil.

Uses

Rice bran oil is an cooking oil that is used in a variety of food preparation methods. It is also the starting point for some vegetable ghee. Rice bran wax, derived from rice bran oil, is used in cosmetics, shoe creams, confectionery and polishing compounds as a substitute for carnauba wax[21,25].

ANTIOXIDANT PROPERTY IN FOOD, VEGETABLE AND FRUITS

Food

Antioxidants in foods have been defined as "substances that, in small amounts, can prevent or greatly retard the oxidation of easily oxidizable materials such as fats .As a result, in food science, antioxidants are commonly associated with chain-breaking inhibitors of lipid peroxidation, but this is not always the case.

Food preservatives

Antioxidants are a particularly important type of preservative. Food additives with antioxidant to help prevent food spoilage. As a result, packaging of Milk and milk products such as cheese; meat, fish, and their products; spices and other dry foods such as sugar, honey, beverages, and chewing gum have an 8% oxygen atmosphere. Aside from being added directly to food, antioxidants were used to preserve food by preventing the degradation of food packaging during processing and storage. Thus, antioxidants can be added to packaging materials such as paper, polyethylene, plastic, and paperboard to prevent oxidation or to allow the added antioxidants to migrate into the packaged food inside and prevent oxidation there. Natural antioxidants includes ascorbic acid and tocopherols are among these preservatives .T-butylhydroquinone, BHA, and BHT are examples of synthetic antioxidants. To prevent rancidity, antioxidant preservatives are also added to fat-based cosmetics such as moisturizers and lipstick[26].

Vegetable

Vegetables are well-known key components of the human diet and are beneficial because of presence of various phytonutrients with strong antioxidant properties, such as polyphenols, flavonoids, and carotenoids[27].

Tomato

The tomato fruit, which is a member of the Solanaceae family, which is economically important and widely produced plants in terms of food

production. Tomatoes are high in phytochemicals, which include a variety of vitamins, minerals, and antioxidants. There is a lot of scientific evidence that tomato fruit can help with chronic NCDs like CVD, hypertension, T2DM, obesity and cancer[28].

Garlic

The Liliaceae family includes garlic, onions, shallots, leeks and chive. Garlic (Allium sativum) has been used for thousands of years in many cultures for both culinary and medicinal purposes. Garlic is one of the herbal medicines that is currently being researched and used as a complementary therapy due to its potential health benefits. Garlic supplementation has also been shown to help with hypertension[28].

Broccoli

The Brassicaceae and Cruciferae families include broccoli, brussels sprouts, mustard, cauliflower, radish, cabbage, cress, and kale. Broccoli contains provitamin A (-carotene), vitamin C, and vitamin E (tocopherol), as well as phytochemicals (lutein, zeaxanthin, -carotene), phenolic compounds (mainly flavonoids), sulphur glycosides and minerals (calcium, magnesium, phosphorus, selenium, potassium, and sodium). Several studies have found that broccoli-rich diets may have anticarcinogenic and antioxidant properties. In fact, eating more glucosinolates (GSL), tocopherols, and carotenoids has been associated to a lower risk of cancer, CVD and poor eye health[28].

Fruits

Fruits are high in antioxidants, which help to reduce the occurrence of degenerative diseases such as heart disease, arteriosclerosis, inflammation, cancer, arthritis, and the ageing process[29].

Berry

Berries are the variety of fruits, including strawberries, raspberries, blueberries, black currants, and blackberries. Berries are low in calories and high in vitamins such as vitamins A, B complex, C, E, essential minerals such as calcium, magnesium, selenium and so on, as well as fat (especially unsaturated fat) and dietary fibre such as pectin (soluble fiber). Furthermore, berries have the highest antioxidant capacity of any food due to their high content of antioxidant compounds such as polyphenols (primarily procyanidins, quercetin, phenolic acids and anthocyanins), carotenoids and vitamin C. It is worth noting that the amount of antioxidant components varies between berry species, as well as climatology, ripening grade, post-harvest treatments and processing, and so on. There is growing scientific evidence that berry consumption is linked to CVD prevention via a number of mechanisms including improved lipid profile, inflammation, T2DM, hypertension, and coagulation. Consuming 1-2 portions of strawberries, raspberries, and blueberries daily, for example, is linked to a reduced risk of CVD. Polyphenols, which are bioactive compounds found in blueberry, appear to be responsible for this protective effect[28].

Apple

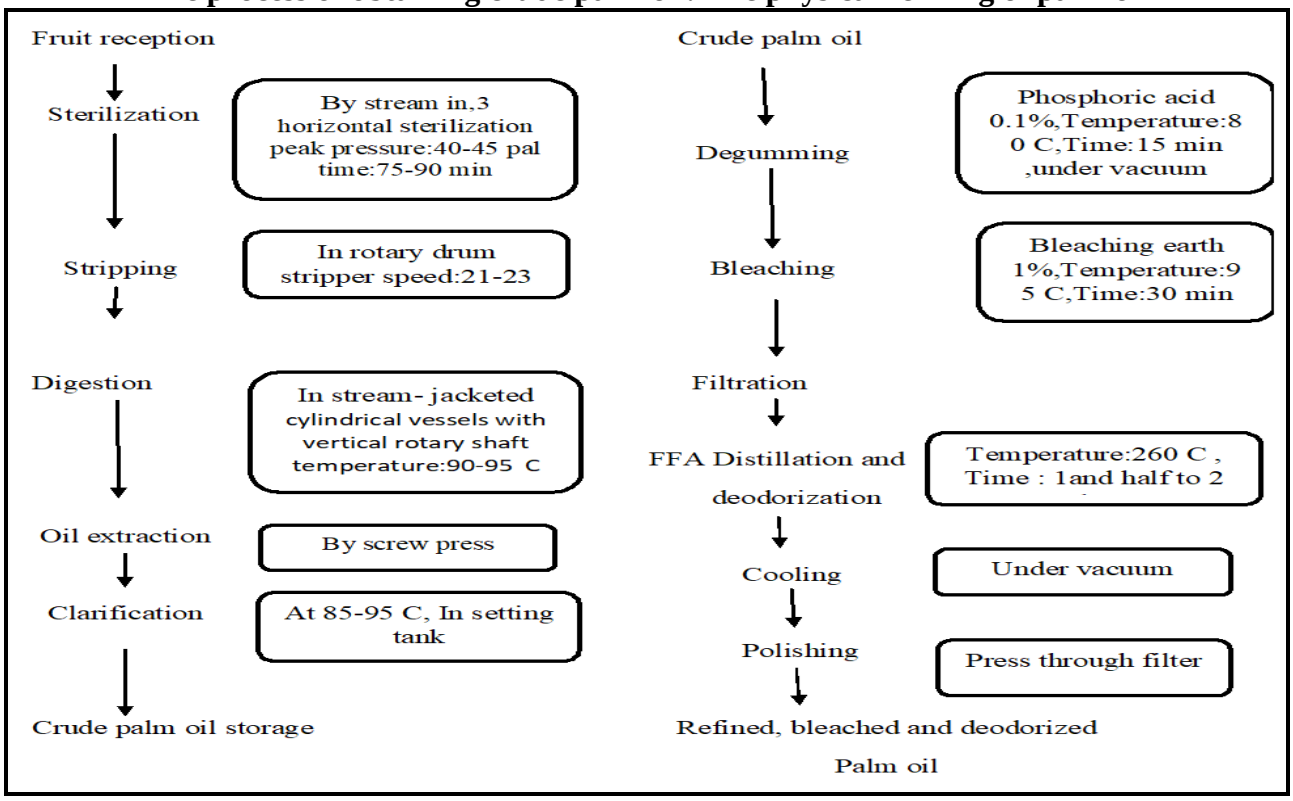
Apples are the most popular fruit in many countries, and they can be eaten fresh, juiced, or dried. Apples contain a variety of macronutrients and non-nutrient compounds, including dietary fibre, minerals, and vitamins as well as phytochemicals. Apples contain important antioxidants such as phloridzin, phlorizin, quercetin, catechins, procyanidins, epicatechin, rutin and chlorogenic acid, among others. Apple variety, ripening, storage, and processing are all factors that can influence the content, bioavailability and quality of phytochemical compounds. Because of their antioxidant, anti-inflammatory, antiproliferative, and cell signaling properties, apples and apple products (extracts and juices) may lowers the risk of NCDs (cancer, CVD, asthma, Alzheimer's disease, T2DM, weight management, bone health, pulmonary function and gastrointestinal protection) by several mechanisms. Furthermore, apples and apple products reduce lipid oxidation and raise cholesterol levels[28].

Grapes

Grapes (Vitis vinifera) are a popular fruit in the Mediterranean diet, as well as one of the most popularized and widely cultivated fruits in the world. It is estimated that approximately 60 grape species exist today. The skin, seeds, and juice of grapes contain the most phytochemicals. Although

resveratrol is the most well-known polyphenol found in grapes, other phytochemicals such as carotenoids, flavonoids and so on can have significant health benefits as well. In recent years, resveratrol (3, 4', 5-trihydroxystilbene), found in grapes and wine and pterostilbene have gained prominence as potentially beneficial components to health, particularly cardiovascular health[28].

The process of obtaining crude palm oil: The physical refining of palm oil



CONCLUSION

Hence concluded that, edible plays a significant role in combating inflammation and providing antioxidant benefits. Their diverse composition, including omega-3 fatty acids and polyphenols, contributes to these anti-inflammatory and antioxidant properties. Integrating a variety of edible oils into a balanced diet can potentially promote overall health and well-being by mitigating oxidative stress and inflammation in the body.

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CONFLICT OF INTEREST

We declare that we have no conflict of interest.

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