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Study on Nutritional Quality Characteristics of Blended Edible Oils

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ABSTRACT

Fats and oils are essential components of all body tissues and are particularly necessary for the growth of cell membranes, retina and cerebral tissue. In order to support proper development and growth, particularly in the early stages and youth, the body needs fats and oils. Basic unsaturated fats that cannot be integrated by the life form and must be obtained by nourishment are the vast majority of the fats and oils required to structure these tissues. The drain of the mother has an excellent fat organization that makes it exceptional for good sustenance for children. The body requires extra calories to assist growth spurts and progress in particular phases of early stages, adolescence and pre-adulthood. The monounsaturated and polyunsaturated forms will provide the additional calories required in the middle of the period while expending solid fats. To discover the consistency parameters of mixed oils, the current research 'Physic-synthetic and Nutritional attributes of Blended palatable oils' is completed. Mulling over the neighborhood population's territorial inclinations to Sunflower oil, Soybean oil, Rice bran oil, Groundnut oil, Olive oil and Palm oil has led to the present study of wholesome attributes of six different oil mixes

Keywords: *Nutritional, Blended, Edible Oils*

INTRODUCTION

Deep fried food items constitute a large portion of the diet and thus the thermal stability of frying oils is very important as toxic products are formed at high temperatures due to their degradation. Oil is, however, continually exposed to air at high temperatures during frying and contact with moisture, which accelerates the oxidation of the oil. The rate of formation of decomposition products varies with the quality of the oil used during frying, the fried foods and the temperature. By combining various types of oils, a better quality product with regard to taste, frying quality and nutritional value can be provided to the customer. In order to achieve a long shelf life for fried goods, the oil used for frying must have good flavor and oxidative stability. The frying oil must be low in saturated fat, linolenic acid and have good taste, strong oxidative stability and should be trans-fat-free to meet today's market demands.

One of the most used cooking ingredients worldwide is edible oils. In addition, their applications in the oleo-chemical industry, soap processing, washing powders, cosmetics, and biofuels are well known. Soybean oil and palm oil occupy the majority (> 65 percent) of all edible oils produced in the world in the production process (Figure 1.1). The world's edible oil production has steadily increased over the past few years. By the year 2014/15, the total of 126,02 MMT of major edible oils produced in 2010/11 had reached 152,29 MMT. The worldwide production of edible oils by form of oil was shown in Figure 1.1 from 2010/11 to 2014/15. This data clearly indicates that the main oils produced are palm oil (48.84 to 63.29 MMT) and soybean oil (41.29 to 46.95 MMT), compared to groundnut oil (23.46 to 26.76 MMT) and sunflower oil (23.46 to 26.76 MMT) (12.43 to 15.29 MMT).

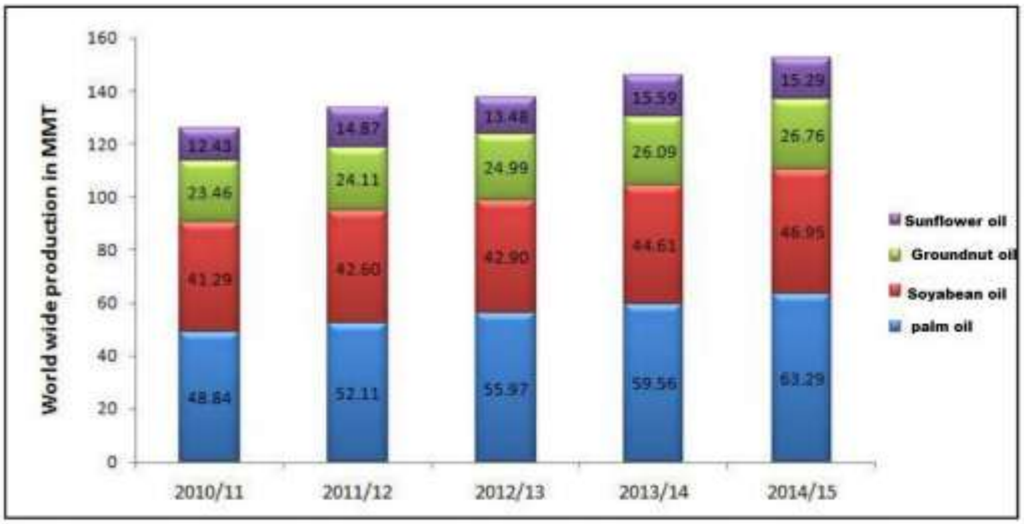

Figure 1.1: World production of edible oils from 2010/11 to 2014/15 by oil type

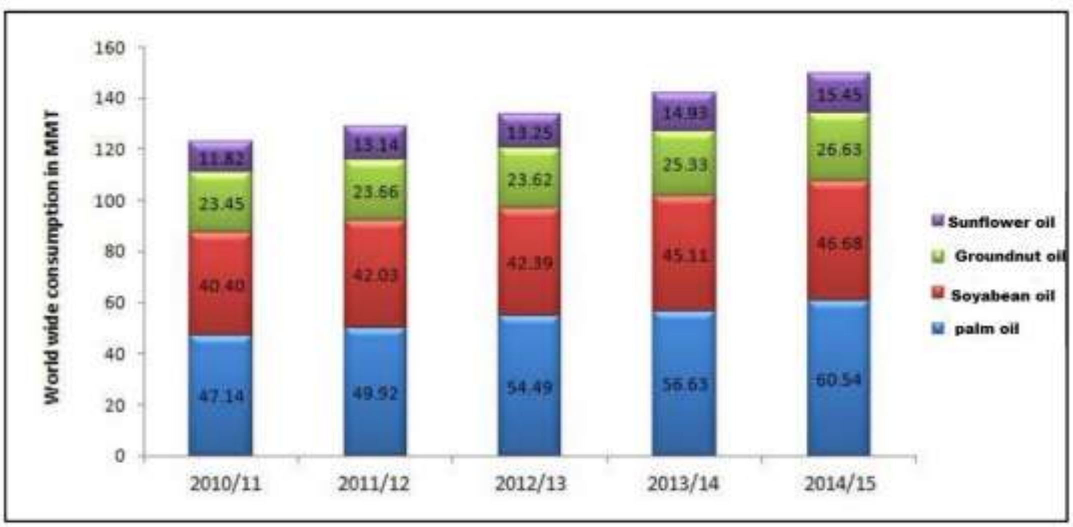

Figure 1.2: World consumption of edible oils from 2010/11 to 2014/15 by oil type

Similarly, from 2010/11 to 2014/15, Figure 1.2 showed the worldwide consumption of edible oils by form of oil. The comparison trend also indicates that the main oils consumed are palm oil (from 47.14 to 60.54 MMT) and soybean oil (40.40 to 46.58 MMT), followed by groundnut oil (23.45 to 26.63 MMT). With the drastic change in the consumption pattern, the Indian edible oil industry is highly fragmented. After China, the USA and Brazil, the Indian edible oil market is the world's fourth biggest. India's increasing population, income levels, and various patterns of consumption cause the consumption of edible oil to increase by 10 percent per year. Edible oil use, however, is highly diversified in India from region to region. More palm oil, rice bran oil, and coconut oil are consumed in the southern part of India, while Mustard oil, Groundnut oil, and Sunflower oils depend heavily on the northern part of India. In addition, more than 60 percent of India's demand for vegetable oil is only met by imports.

OBJECTIVES

1. To study the Physic-chemical parameters and Nutritional characteristics of selected edible oils.

2. To develop blended oils using different combinations and to study the Physicochemical parameters and Nutritional characteristics of blended oils.

Deep fat frying process

Deep fat frying is one of the oldest cooking methods in which water containing food is submerged at temperatures between 140 ° C and 180 ° C in edible oils or fats. The general benefits of deep fat frying are that heat kills bacteria and toxins and the frying medium also provides some essential nutritional elements and gives an appealing texture and taste that makes fried food more palatable and thus easily embraced by the customer. For optimal fried food production, more than 20 million tonnes of edible oil consumed for industrial frying in a year requires a better understanding of the deep frying process. Simultaneous heat and mass transfer processes include deep fat frying, where oil transfers heat to the food content and loss of moisture, starch, protein and other fried material components into frying oil. Heat transfer is initially due to combined conduction and convection in this process. Free water boiling at the surface also plays a major role in this process after immersion of the moist food in hot oil. During this process, the escape of moisture by vaporization from the centre of the food material to the crust portion results in the formation of capillary pores through which hot oil enters the food. In this process, with numerous chemical reactions, both fried material and frying oil impact on each other, eventually leading to deterioration of the quality of cooking oil that makes oil unhealthy for consumption.

Potatoes, the popular snack food for frying, are low in protein and high in starch. Chicken, fish, and chicken nuggets, on the other hand, are different in structure, consisting mostly of protein. The complete process of thermal degradation of frying oil is referred to as thermal-oxidative decomposition, which requires a series of physicochemical reactions such as oxidation, hydrolysis and polymerization. There is an immense difference in the progression of frying from one substance to another. These degenerative reactions increase the viscosity of prolonged use of frying oils and their by-products are potential risk factors for health due to their association with cardiovascular diseases, obesity, diabetes, etc. The creation of new compounds depends on the oil type, frying temperature, and oxygen accessibility as well. Inevitably, due to intensive mass transfer, these degradation products are transformed into fried food, which decreases the nutritional content of both. For a better understanding of the creation of new compounds during the frying process and the absorption of frying oils into foods, this entire decomposition phenomenon must be observed in detail.

Fats and Oils in human health

Phospholipids, glycerol glycolipids, sphingolipids, fatty acids, acylglycerols, sterol esters, wax, etc. Lipids are one of the main classes of naturally occurring molecules[27]. In polar solvents such as water and methanol, lipids are insoluble, but soluble in non-polar solvents such as chloroform and ether. Fats are esterifies by triglycerides, a major lipid subset. To refer to fats, where oils are liquids and fats at room temperature are solids, the terms oils and fats are used. Fats perform many important roles, including providing high energy content, imparting palatability and taste to food, serving as precursors to many biologically active compounds, requiring fat-soluble vitamins such as A, D, E & K to be absorbed, supporting body fluids and cell membranes, and isolating the body via the skin's subcutaneous layer[29]. Fats are broadly classified into saturated fat and unsaturated fat, respectively, based on the presence of saturated and unsaturated fatty acids. In the carbon atoms of the fatty acid chain, saturated fatty acids (SFA) do not have double bonds, while monounsaturated fatty acids (MUFA) have at least one double bond, and polyunsaturated fatty acids (PUFA) have multiple double bonds in the triglyceride fatty acid chain between carbon atoms. Several recent studies have shown that higher SFA (lauric, palmitic and stearic acid) dietary intake increases total cholesterol and low-density lipoprotein (LDL) cholesterol and further accelerate the risk of developing coronary heart disease (CHD).

In addition, there are commonly studied effects of SFA on cancer, insulin sensitivity, obesity and other disorders. In India, ghee, vanaspati (hydrogenated fat), cheese and cooking oils such as coconut oil and palm kernel oils are the main sources of SFA. Consumption of dietary sources rich in MUFA (oleic acid) and PUFA (linoleic and linolenic acids), on the other hand, decreases LDL cholesterol and raises high-density lipoprotein (HDL) cholesterol, thereby decreasing the risk of CHD . The cooking oils are rich in MUFA, including groundnut, rice bran, mustard, olive and canola oils. Similarly, the rich dietary sources of PUFA are sunflower, maize, soybean, and linseed oils. During the processing of partially hydrogenated vegetable oils, another class of fatty acids known as Tran's fatty acids (TFA) are produced and also occur naturally in ruminant fats. In the Trans geometric structure, trans fat contains unsaturated fatty acids having one or more isolated double bonds.

Several clinical trials have shown a strong association between the high intake of TFA and the risk of developing cardiovascular disease (CVD) and the rise in serum LDL cholesterol compared to SFA. U.S. because of their greater adverse health consequences, Effective January 1, 2006, the Food and Drug Administration (FDA) passed a labelling provision for TFA in packaged food items, requiring it to be recorded on the nutrition label if 0.5g/serving is present. The American Heart Association (AHA) proposed that the overall fat intake limit should be less than 30-35% of total calories, with SFA consumption restricted to 10%, MUFA to 15%, and PUFA to 10% of total calories. Similarly, intake of TFA is limited to 1% of total energy . Therefore, if the maximum total fat consumption is taken into account, the SFA: MUFA: PUFA ratio is estimated to be 1:1.5:1. Since the intake of single edible oil alone can not comply with the guidelines proposed, it is practiced to combine two or more oils to provide health benefits.

One of the most frequently taken after cooking rehearsals in the world is the Profound Fat Searing Technique. Cooking oils fill in to share warmth as a tool for singing nourishment and makes seared sustenance perfect and fun. The Browning process is the most complicated process, requiring numerous physicochemical adjustments that are complicated to achieve it. Via thermo-oxidation, hydrolysis, and polymerization, broiling incites hot oil corruption. Hydrolysis creates free unsaturated fats while hydro peroxides and small sub-atomic carbonyl mixes are formed by the oxidation handle. The arrangement of polar mixes and deterioration of cell reinforcements that further damage broiling oil are triggered by this whole process. In the end, these debasement products are gathered into singed nourishment by mass trade and decrease the balanced quality of both oil and sustenance. Therefore, the search procedure is of study intrigue calls for unique precise investigation that is determined for the present analysis.

The main objective of this analysis is to explain the corruption mechanism and the depiction of debased objects, which helps to hit the base as far as the amount of fricasseeing cycles at the cut-off points for searing oil use. The unthinking examinations and learning on the debased objects help to understand the best approach to prevent the protection and improvement of singing cycles from disintegrating oil. The analysis also explores the creation by mass spectrometry of the overwhelming polar mixes and their auxiliary clarification. Oxidation of oil is another imperative aspect that illuminates the wonders of corruption. Expansion of effective cancer prevention agents is one of the most ideal approaches to expanding any oil's warm ability. Be that as it may, at searing temperatures, the majority of normal and manufactured cancer prevention agents are shaky and incapable. It is important to screen elective cell reinforcements along these lines for their action in the refined oils that are without any additional cancer prevention agents. This research investigated the adequacy of a few characteristic and engineered cancer prevention agents to prevent the production of polar mixes and thermo oxidation in the midst of delayed fricasseeing conditions in this specific situation. In addition, the advantage of combining two unique oils was explored to increase the warm reliability. The present analysis draws the overall picture on the form of debasement items formed in the middle of broiling and the techniques for preventing the assurance of improving the soundness of the oil and improving fricasseeing cycles.

Major reactions and degraded products formed during deep fat frying

Several reviews discussed the reactions in edible oils while frying process. Choe et al., (2007) described the major chemical alterations that take place while frying in depth. They include Hydrolysis, Thermo-oxidation, and Polymerization.

Hydrolysis

Fats and oils consist of triglyceride esters. These triglycerides are very susceptible to glycerol backbone hydrolysis in the presence of moisture. When hydrolyzed, triacylglycerols (TAG) contain free fatty acids (FFA), diacylglycerols (DAG) and monoacylglycerols (MAG). So, the amount of FFA, DAG and MAG content in oils is increased by hydrolysis. FFA generation and its oxidized compounds contribute to the rancid taste and the inappropriateness of frying oil for consumption. Water in food materials during frying is the main cause of hydrolysis. In the presence of water, the decomposition of the ester linkage is possible when heating. While water evaporation will delay the rate of hydrolysis with the rise in temperature, the volatilization of formed glycerol above 150 C would accelerate the hydrolysis. During the frying process, replenishment of fresh oil could reduce the formation of DAGs or MAGs and slow down the hydrolytic changes. Both enzymes are unstable in the frying phase at a higher frying temperature. There is no enzymatic activity reported during oil degradation. At lower temperature levels, however, hydrolytic rancidity may be possible in oils. Several factors affect the breakage site of the ester bond on the glycerol backbone, including the location and number of carbons, length of the carbon chain, satiric hindrance of the aliphatic chains, moisture content, and temperature.

Thermo-oxidation:

Oxygen reacts with oil during the frying process which contributes to the oxidation of the TAG fatty acid groups. It is well known that autoxidation, due to the rancidity of oil and fat, is a major degradation reaction. It is also the main reaction, along with an increase in temperature that took place while frying. During frying, oxidation takes place at a greater rate than hydrolysis and creates hydro peroxides and then small volatile molecular compounds such as aldehydes, ketenes and short-chain alkanes. The thermal oxidation phenomenon is the same as the mechanism of autoxidation, except for the speed of reaction . Alkyl radical formation is known as the initiation stage of the primary oxidation reaction of oil by the removal of hydrogen in the oil. The initiation process includes the creation of TAG radical ions. Due to the spin barrier, oil in the non-racial state does not react with the di-radical oxygen triplet state. For the oxidation of oil, radical oxygen requires radical oil. The oxidation rate of different fatty acids during thermal oxidation or autoxidation is primarily affected by the carbon-hydrogen (C-H) bond strengths of fatty acids. The weakest fatty acid C-H bond on TAG is mainly removed to form an alkyl radical. Many variables, such as light, heat, and metal ions, catalyze the initiation stage. For saturated fatty acids and unsaturated fatty acids, such as oleic or linoleum acids, the position of radical formation is different. At the alpha position of the carboxyl group, the alkyl radical is formed from saturated fatty acids, which have electron withdrawing properties. Whereas, in the case of unsaturated fatty acids, it is formed at the double bond allelic position. These alkyl radicals make up peroxy radicals and propagate the mechanism of oxidation. These alkyl radicals can also react to yield dimers and polymerized products with other alkyl, alkoxy and peroxy radicals.

The propagation stage of the oxidation process involves the generation of peroxy radicals (ROO) which then extract hydrogen to form hydro peroxides from other organic substrates (ROOH). These hydro peroxides are very volatile and simple to build β-scission homolytic cleavages to decompose into short-chain compounds of the O-O, C-C and C-O groups around the peroxide ring.

The stage of propagation continues by hydro peroxide decomposition. With the formation of volatile and non-volatile compounds, the termination stage ends. This final step requires the combination of free radicals, thereby preventing further dissemination. A homologous sequence of small molecular alcohols, aldehydes, hydrocarbons, etc. composes these compounds. These volatile short chain compounds are odor-active, causing fried material and frying oil to become off-flavor. Most volatiles evaporate by steam from frying oil, while the concentration of these compounds in oil could be decreased by deep fat frying and moisture in the frying oil. The concentration of volatile compounds in the oil is also influenced by other factors, such as the quality of the oil, food content, and frying conditions.

Polymerization:

Polar compounds that primarily include triacylglycerol dimers and polymers are the major degradation products of frying oil. These dimers and polymers are large, high molecular weight molecules formed by the combination of bonds of -C-C-, -C-O-C, and -C-O-O-C. Different dimers, including dehydroxy dimer, ketone hydro dimer, linoleate dehydro dimer, and oleate dehydro dimer, are found during frying at 195 C in soybean oil. Therefore, two different kinds of polymeric products have been formed on the basis of the presence of oxygen. They are non-polar polymers with no oxygen and oxygen polymers with polar polymers. Continuous polymer production and accumulation leads to colour deepening and viscosity increase and further frying oil deterioration . The structure and quantity of polymers produced in frying oil are affected by other factors, including frying conditions and the nature of frying oil. Two major reactions are mainly used to interpret the formation mechanism of polymers, including the free radical chain reaction and the Diels-Alder reaction. Allyl radicals are formed through the reactions of these alkyl radicals, preferably by methylene carbons alpha to the double bonds and dimers are formed.

Through various positional carbons that react with allyl radicals, acyclic and cyclic polymers are formed. By reacting with another radical of unsaturated molecules, Allyl radical forms a dimeric radical and the generated dimeric radical reacts to form acyclic dimer with hydrogen radical. Usually, hydrogen radical is lost by TAGs with a polyunsaturated fatty chain and forms a radical similar to the conjugated diene. This conjugated diene can combine to form a dimeric radical intermediate with another unsaturated molecule; intramolecular additions have therefore taken place and form a cyclic dimer. Oxidized TAG monomers having one or more oxygen-containing groups are formed from extra oxygen involved in chemical reactions during deep fat frying. The remaining high-molecular polymers can be formed in the same way. Such oxygen-contained TAG monomers would be polymerized by C-C-, C-O-C- and C-O-O-C-bonds under the radical catalysis effect. In addition, in dimers, trimers or oligomers, additional oxygen atoms could be formed when the sample has been heated for a prolonged period of time at frying temperature[56]. In order to produce oxydimers, Allyl radical produced by oxidation could combine with alkoxy radical formed by breaking hydroperoxides. Similarly, two molecules of peroxyl radicals were united and a peroxy dimer was formed.

In addition, it is still important to investigate the simultaneous formation of these non-polar and polar polymers and their ease of formation. The structural complexity and lack of literature highlights the importance of studying the structural analysis of polymers produced during deep fat frying and their formation pathways. Dimers and polymers are formed depending on the nature of the oil, the temperature of the frying process, and the number of frying cycles. The amount of polymer formation increases as the number of frying cycles and temperature increases [58]. Linoleic acid-rich (PUFA) oils such as soybean oil and sunflower oil are more readily polymerized during frying than oleic acid-rich (MUFA) oils such as palmolein[59]. The development of cyclic compounds in frying oil, including polymers, depends on the degree of unsaturation and frying temperature as well.

Until the temperature in the frying oil reaches 200 C to 300 C, cyclic compounds are not created. The development of monomers of cyclic fatty acids and polymers is directly related to the increased amount of linolenic acid . The possibility of the formation of tricyclic dimers and bicyclic dimers as well as cyclic monomers during frying in soybean oil[62] has been highlighted in several studies. Oxidized polymer compounds, however, speed up oil oxidation and degrade oil quality and increase the viscosity of the oil. In addition, they minimise heat transfer, create foam during frying, and also cause food to be highly absorbed by oil. The acceptability of a food product depends on the degree to which degradation has occurred and oxidative rancidity is a major cause of food deterioration. This, in turn, is a major cause of loss of nutritional quality and a concern for food safety, since it has been shown that oxidised fats have toxic effects at a very large dose.

Therefore, studies that measure the degradation of frying oils in combination with sensory evaluation of fried products and analysis of volatile rancidity are valuable in understanding the state of oil oxidation, and fried foods are such products. The sensory parameters of any food product, such as colour, flavour, texture, taste, and overall acceptability, depend on the extent of oxidation of fats and oils in the food due to peroxide, aldehyde, and ketone formation. Although the most important quality evaluation is sensory evaluation of foods, taste evaluations are not practical for routine quality control. A quantitative method for which rejection points can be established by sensory means is always preferable. The change in the chemical and sensory parameters of snacks prepared with the various oil blends during storage was thus analysed in the present study.

CONCLUSION

In order to find out the quality parameters of blended oils, the current work is done. By taking into account the variables such as temperature and acceptability studies etc. in the deep fat fried products. Sunflower oil (SF), soybean oil (SB), rice bran oil (RB) and the selected blends are SF+SB, SB+RB, SF+RB, to observe their effect on the acceptability of snacks in the selected product. The oils selected for this current study are Acceptability of the product is observed. Studies have been conducted on the acceptability of the fried product in selected oils and oil blends and on variations in snacks. Due to their greater acceptability, the proportions selected for the blended oils are 50:50 per cent. This was due to the toxic substances found in some oils, such as ground nut oil and soybean oil, etc. From the findings, it can be concluded that in almost all the variations, the snacks fried in soybean oil gained maximum oil acceptability. The product fried in the Soybean medium as well as prepared with other variations achieved "maximum" acceptability scores. But the score equivalent to Soybean blended oil was not reached by other oils. In Soybean and Soybean + Rice bran oils blend, the "excellent" scores are reached for product fried. Soybean oil is considered best among the high linoleum acid oils, and among the blends, soybean oil is found to yield beneficial results alongside olive oil with minimum increases in the free fatty acid, iodine and saponification values of the peroxide values. The effect of the type of oil with the appearance and color of the product at five percent level is statically demonstrated to be significantly high.

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