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A Review on the Frying Stability of Vegetable Oil Blends

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ABSTRACT

Deep-fat frying is widely used in food industries because of its low cost, demand and nutritional value. For the production of oil, the demand of seed crop is growing rapidly. During deep frying some of the most important quality control parameters include the iodine value, peroxide value, moisture content, specific gravity and acid of blends have been monitored. The purpose of this review is to understand the changes caused in food as toxic compounds are developed in the oxidized oil by the deep fat frying process. During this process the temperature rises ranging from 170°C to 200°C.

***KEYWORDS**: deep fat frying, oil stability, oxidative degradation, oil blends, fatty acid composition, frying oil quality*

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INTRODUCTION

Oils and fats are glyceryl ester of glycerides of higher fatty acids[1-3]. Those which are liquids at ordinary temperatures are called oils. The largest source of the oil seeds produced by the annual plants in our country are linseed oil, soybean oil, cotton seed oil, groundnut oil, sunflower oil, safflower oil, mustard oil, castor oil, and sesame oil etc. Hence, oil seeds play an important role in planning the development of the country.

The trend of consumption of oils and fats is shifting from saturated fats to fatty oil rich in polyunsaturated fatty acid (PUFAs) because of more nutritional value they are receiving increasing attention.[7] It is becoming important to formulate new vegetable oil composition of improve stability and nutritional value. The nutritive value of edible value of edible oil depends on the fatty acid profile, degree of unsaturation, arrangement of fatty acid in triglycerides structure.[8] According to World Health Organization[6] healthy oil should have three characteristics:

A. The ratio of saturated, mono and polyunsaturated should be 1:1.5:1
B. Ratio of essential fatty acid linoleic acid: linolenic should be 5:10:1.
C. Presence of oxidants

To alter the physicochemical and nutritional property of oil, one of the simple feasible and economical method is oil blending. Storage materials and environmental factors like oxygen, moisture, heat and light have a significant impact on the chemical quality of oil, and shelf life of edible oil.[9-10] Thermal oxidation or deep fat frying changes the flavor stability, quality, color, texture and nutritional quality of food due to the chemical reactions like hydrolysis, oxidation and polymerization[11] taking place in the oil. The discarded oil obtained after deep fat frying constitute a high volume, low cost and environmentally base material for the production of candles, liquid detergent and dish washing soap. The used cooking oil can be utilized as a supportive source of energy in many countries with minimum environmental impact[9]. Regarding the reconversion of WCO's they be used as main raw materials in many industrial processes such as bio lubricant or fuel

LITERATURE REVIEW

Various Scientists have worked on the studies on the changes taking place in pure oil and in the blends of oils during deep fat frying[15]. A brief review of that is mentioned following.

H. Akhtar, I. Tariq et al[16] observed that shelf-life oil was increased both during storage and in frying process at elevated temperature by the addition of synthetic antioxidants such TBHQ (Tertiary butyl hydroquinone), BHT (Butylated hydroxyl toluene), BHA (Butylated hydroxyl amine). The stored oils [treated and untreated] when underwent in the process of frying at the temperature of 180°c further detrition of oils happened. The antioxidant activities and protective effects in stabilization of sunflower oils during storage and in frying process measured in term of PV [peroxide] FFA [free fatty acid] and color Index fatty acid profile RI [Refractive Index].

Abdelmonem M. Abdellah et. al[17] studied stored seeds and oils and tested for oil oxidative Stability like color, refractive index Viscosity and value peroxide value and Iodine value.

Akriti Dhyani, Priyanka Kumari Singh[18] presented the study aimed to formulate a stable oil blend using Perilla seed oil with selected vegetable oil of higher stability characteristics and balance the ratio the fatty acids. Hence, improving the nutritional and functional value of the blended oil Perilla seed oil was blended with different edible oil (Palmolein, coconut oil and groundnut oil) in ratios blended oils were 20:80 and 30:70. All the blended oils were studied for their fatty acid composition, physicochemical properties, oxidative stability and nutritional quality index. It was found that perilla seed oil blended with saturated oil like palmolein had improved physicochemical properties and oxidative stability (0.5h to 6.5h).

Monika Choudhary, Kiran Grover[19] designed to develop a healthier and stable blend of Rice bran oil (RBO) and MO (mustard oil). Therefore, RBO was blended with MO in two ratios i.e., 80:20 and 70:30. These blends were analyzed for fatty acid composition, physiochemical properties oxidative. stability and antioxidant activity.

In a recent seminar organized by Nutrition Quest under the aegis of wellness Quotient various benefits of rice bran oil and why it is known as an Indian version of olive oil was discussed by Meena Mehta. She said that the ratio of SFA: MUFA; PUFA is important.

Vikas Pali[20] presented that ROS is an excellent cooking and salad oil due to its high smoke point and delicate flavor. The nutritional quantities and health effects of rice bran oil are also established. RBO is rich in unsaponifiable fraction which Contains the micronutrients like vitamin E complexes, Y oryzanol, Phytosterol, Polyphenols and Squalene. It is high in antioxidants namely oryzanol, tocotrienol, tocopherol and squalene with some amount of omega 3 fats.

K. Chaudhury et. al [21] presented fatty acid analysis wherein the five types of locally consumed edible oil [n=22] was carried out using a GC. The results showed that Sunflower oil contained the highest percentage of long chain mono or polyunsaturated fatty acid (91.42+ 1.91%) compared to soybean oil (81.14+ 1.49%), mustard oil (86.80+ 3.071%) Palm oil (53.30 + 0.351%) and coconut oil (11270g) sunflower oil with highest percentage of mono and polyunsaturated fatty acid especially the high linoleic low oleic variety appeared to be superior and most suitable edible oil for mass consumption.

Pranjali Shinde, Shelly Gupta[22] studied the oxidative degradation of refined sunflower soybean, groundnut oil and pure mustard oil during deep frying at 180°C. The oxidative degradation of the oil was evaluated by peroxide value (PV), p anisidine value (p - AV), totox value (TV) and regression coefficient of oils for four consecutive days. The result shows that the oil rich in monounsaturated fatty acids has higher oxidative stability than all containing polyunsaturated fatty acids during deep frying. Soybean oil shows lowest oxidative stability and mustard oil shows highest oxidative stability during deep frying other oils as compared to other oils

Prakash Kumar Nayak, Uma Dash et.al[23] observed that during deep frying of food at high temperature enhances the sensorial properties such as unique fried flavor, golden brown color and crispy texture. At the same time, so many chemical reactions like oxidation, polymerization, hydrolysis etc., take place in the food system, which ultimately alters the physical and chemical properties of fat. The parameters like free fatty acid (FFA), peroxide value (PV), p-anisidine value (p- AY), TOTOX value, iodine value (IV).

Jacek Namietnik et.al[24] aimed the study to examine and compare oxidative stability of refined (peanut, corn rice bran grape seed and rapeseed) oils. The oils were subjected school oven test [temperature 63 ± 1°C] and a Rancimat test [temperature 120°C] and their stability was compared at the 1st and 12th month of storage. Changes in the peroxide (PV) and anisidine. (AV) values in the thermostat test were the fastest in rapeseed ail and grapeseed oil. The best quality was preserved by peanut and corn oils both in the first and the twelfth month of storage.

Ratnesh Kumar, Suresh Chandra et. Al[25] presented the groundnut oil used as based oil for replacement.

The ground nut oil was replaced by soybean, sunflower and mustard combined in the ratio 5, 10, 15 and 20%. During the storage of individual and blended oil, free fat and was increased with increasing the storage period and type of storage conditions.

Akriti Dhyani, Rajni Chopra et.al[26] stated that blended oil has shown blending balances to fatty acid composition with good functional and nutritional value. Studies related to the blending of oils and functional and nutritional benefits of blended oil were also reviewed.

Hanafy A. Hashem, Rabie Farag[27] reviewed number of formulas that have been formulated that can be used for either healthy purposes or better oxidative stability. This review can help to find out the most economically viable oil blends for cooking purposes, with maximum nutrition as well as desirable physicochemical properties.

Azam et. Al[28] observed that to consume variety of edible oils in a proper proportion as their fatty acid composition is an integral part of balanced diet and thereby influencing human health.

Addisu Alemayhu et al[29] defined the purpose of the study to determine the qualities of edible peanut and soybean seed and predict their shelf stability using accelerated Shelf-life testing method. Fatty acid profiles were determined by GCMS as methyl esters and result revealed that the predominant fatty and in edible soybean and cottonseed oil were linoleic acid 42.8%, and 41.6% respectively while oleic and 46:3%. is the major fatty and edible peanut ail. Combining the Kinetic model identified and the rate constant model equation that could help to predict the shelf life of domestic edible oils were determined at room temperature and amount 36.9, 42.1 and 37.8 weeks for soybean, peanut and cottonseed oils respectively.

Sarmina Yeasmin, G. M. Masud Rana et.al[30] formulated blended edible oils which were enrich fatty acid profile with balance fatty acid ratio. Indigenous Rice Bran oil (RBO) and mustard ail (MO) were mixed in the ratio of 60:40, 70:30 and 90:10 (RBO:MO). Moisture content, density specific gravity refractive index, viscosity, free fatty acid, and peroxide value and their blends, viscosity acid value, iodine value of the single vegetable oil were determined. Fatty acid composition such as saturated fatty and (SFA), monounsaturated Fatty Acid (MUFA), Poly-unsaturated Fatty And (PUFA) of all oils were analyzed by GEMS.

Tafadzwa Kaseke, Umezuruike Linus apara[31] evaluated the effect of blending sunflower with pomegranate seed Oil (BPSO) from blanched seeds (95° C / 3 min) on oxidative stability and antioxidant properties of the oil blends. Sunflower and pomegranate seed oil from unbleached seed (PSO) were used as controls. Blending SO with BPSO and PSO was assessed in 90:10, 85:15 and 80:20 ratio (w/w) with respect to total phenolic content, total carotenoids content, tocophenol content and fatty acid composition to establish the best blending ratio.

Meenakshi Garg et al[32] described this study claims to determine the effect of frying properties of sesame and soybean oil blends on the physicochemical soybean oil (SO) when blended with sesame seed oil (SSO) in the ratio of 40:60, 60:40 and 50:50 so as to enhance its market acceptability.

S. Sahin[33] observed the mechanism and structure of lipid oxidation process and significance of prediction of shelf life has been explained.

Ratnesh Kumar et.al.[34] showed that the groundnut used as based oil for replacement by soybean, sunflower and mustard in the ratio 5,10,15 and 20%. During the storage of individual and blended oil, fatty acid was increased with increasing the storage period and type of storage condition.

El. Reffaei et.al[35] defined the study was performed to investigate performance of canola oil and its blends with either sunflower or palmolien blended at 1:1 (w:w) by using different frying cycles of potatoes chips up to consecutive 10 frying cycle /3 days for each oil /day. Significant chemical changes in the frying oil quality have occurred during frying process.

Elina Hishamuddin et.al[36] studied to evaluate the effects of blending winged bean seed oil (WBSO) and palmolein on the physicochemical properties of the blends. They were prepared by changes in fatty acid and triglycerol composition, iodine value cloud point and thermal behavior were studied.

M.Roiaini, T. Ardiannie et.al[37] conducted the study to identify the best oil blends in term of physicochemical properties between canola, olive and palmolien oil canola and olive oils were blended at different ratios of 80:20, 60:40, 50:50, 40:60, and 20:80. The study reflected that the palmolein is stable against rancidity and oxidations.

Hina Menon et.al[38] defined the quality band thermo oxidative stability of soybean oil, palmolien oil, canola oil and their blends were evaluated. The binary blends of SO:PO and CO:PO were formulated in the ratio (75:25) and ternary blends were prepared by blending CO:PO:SO, in the ratio of 35:30:35. To monitor the thermal stability of pure oils and their blends, they are subjected to temperature 180 C at different time intervals.

Boskou[39] observed that oxidative stability is affected negatively by other factors such as free fatty acids, unsaturated hydrocarbon, enzyme, and trace metals. Pigments have negative effect on oxidative stability. Storage of olive oil under nitrogen pressure in a dark place at room temperature (25-300 C) increases shelf life.

Alirena Sejouie et.al[40] studied frying performance of palmolien, sesame oil and canola oil and their blends by assessing the physicochemical changes in color, viscosity, free fatty acid, peroxide value, anisidine value, polymer content of oil during deep fat frying of potato chips.

Hyesook Chai et.al[41] prepared noble blended oils and their frying qualities were evaluated such as fatty acid composition, acid value, peroxide value, smoke point and sensory evaluation were measured to elucidate the optimum blend ratio of canola and palm oil.

K. Sharanke et al[42] evaluated the stability of three oils widely used namely coconut oil, sunflower and palm oil during continuous deep frying. The experiment was conducted by frying potato slices at 175+ 5 C frying was done for 15 min. This process was conducted over a period of 12 hours using the same oil with replenishment.

Fereshteh[43] studied the antioxidant activity and physicochemical properties of oils. Sunflower and corn oil and their combinations with sesame oil were prepared. The analysis of fatty acid composition, oxidative stability index, smoke point and antioxidant activity were done on oil sample.

R. Ravi et.al[44] observed edible oil blends containing 80 parts of mustard oil or groundnut oil or sunflower oil and 20 parts of sesame oil or refined red palm oil or rice bran oil were studied to determine the changes in their physical and sensory characteristics during deep fat frying. Odor evaluation by the trained sensory panel revealed that successive frying subdued the intensity of typical odor notes of the oil blends.

M. Fawzy Ramdan[45] formulated blends (10% and 20% w/w) of cold pressed oils including black cumin oil, cumin oil, coriander oil and clove oil with high linoleic sunflower oil. Oxidative stability and radical scavenging of sunflower and blends stored under oxidative condition (600 C) for 8 days were studied by increasing the proportion of cold pressed oil in sunflower oil. The study shows that the linoleic acid level decreased while tocols level increased.

Farooq Anwar et.al[46] prepared blends (20%, 40%, 60%, 80% w/w) of Moringa oleifera with sunflower oil and soybean oil and evaluated the changes in fatty acid composition oxidative and thermal stability of soybean oil and sunflower oil.

Kanika Sharma et. Al[47] described that the review paper covered the literature related to blending of vegetable oil with a focus on effect of vegetable oils blending on their physicochemical and nutritional properties, health benefits and utility in food industries.

Antonella De Leonardis et.al[48] investigated composition and oxidative stability of palm oil/extra virgin olive oil blends. Analytical composition and oxidative stability of the blends were found to be linear combination of the oil partners, fatty acid composition of oils and blends was the major deciding factor on oxidation stability.

F. Hashempour et.al[49] stated the main goal of the study was to evaluate the physical, chemical and nutritional properties of oil obtained by blending flaxseed oil as a rich source of omega 3 fatty acid has an important role in maintaining good health. There is no pure oil with an ideal fatty acid composition and oxidative stability.

A. Joshi et.al.[50] stated that the objective of the study was to develop the blend with improved omega -6 to omega-3 fatty acid ratio (w-6: w-3) with good oxidative and thermal stability.

Haridas et. al[51] studied blending of oil combines the potency of two edible oils and offers a balance of fatty acid. In order to prevent the oxidative damage of unsaturated fatty acid a blend of rice bran oil and safflower oil (70:30) with an antioxidant technology was designed. In recent recommendations NIN state that a correct combination or blend of two or more oil should be used to achieve all kinds of fatty acids in the diet.

Pandurangan M.K[52] studied blended ground nut oil with other edible oil such as palm oil and rice bran oil for the enhancement of its market acceptability and the physicochemical properties like viscosity, density, specific gravity, refractive index, conductivity, optical rotation, acid value, saponification value, iodine value and peroxide value of vegetable oils and their blends in 95:5 to 85:15 proportions were evaluated.The result obtained helped the oil producing industry to find out the most economically viable oil blends for cooking purposes with maximum nutrition as well as desirable physicochemical properties.

Uma Maheshwari et al[53] observed when groundnut oil was blended with cotton seed oil for the enhancement of its physicochemical properties and sensory characteristic. The physicochemical properties like color, specific gravity, smoke point, moisture content, peroxide value acid value free fatty acid and oil retention capacity of groundnut and cotton oil blends in ratio 80:20 to 20:80 proportions were evaluated along with the sensory attributes. The results showed decline in acid value and improvement in sensory characteristics of groundnut and cotton seed oil blends when compared to the unblended groundnut oil making it more preferable for consumption.

Ali Motamedzadegn et.al[54] studied physical blending of virgin coconut oil with palmolein and chemical interesterification were conducted in order to improve the functional characteristics of VCO. Likewise, the alterations in chemical composition, solid fat content, slip melting point and rheological attributes (flow behavior, strain sweep, frequency sweep and temperature sweep) of fat blends prior and interesterification were investigated.

Sumit Grover et.al[55-56] describes aim of the study was to drive on ail composition with a balanced ratio of unsaturated monounsaturated and polyunsaturated fatty acids (SEA, MUFA PUFA) along with improved properties and shelf life.

CONCLUSION

In conclusion, the literature review highlights various studies conducted on the changes occurring in pure oils and oil blends during deep fat frying. Researchers have investigated the physicochemical changes, fatty acid composition, oxidative stability, and nutritional evaluation of different oil blends to understand their properties and potential benefits. Antioxidants including TBHQ, BHT, and BHA have been proven to extend the shelf life of oils while storage and frying at high temperatures. These antioxidants provide protection and aid in the stabilization of oils by lowering peroxide values (PV), free fatty acids (FFA), and color index. Synthetic antioxidants have showed potential in preserving oil quality.

The nutritional and functional benefit of blended oils has been investigated by blending various oils. Blending perilla seed oil with saturated oils like palm olein, for example, has been proven to improve physicochemical qualities and oxidative stability. Rice bran oil (RBO) has also been

utilized in the development of healthier and more stable mixes with mustard oil (MO) or other oils. The proportion of saturated fatty acids (SFA), monounsaturated fatty acids (MUFA), and polyunsaturated fatty acids (PUFA) in oil blends is critical for obtaining acceptable characteristics.

Studies have shown that oils high in monounsaturated fatty acids (MUFA) have superior oxidative stability during deep frying than oils high in polyunsaturated fatty acids (PUFA). Because of its high percentage of mono and polyunsaturated fatty acids, sunflower oil, particularly the high linoleic form, has been recognized as a good oil for mass consumption. Peroxide value (PV), p-anisidine value (p-AV), totox value (TV), and regression coefficient have all been used to test the oxidative stability of oils. The rate of oxidative destruction and variations in these values vary based on the kind of oil and antioxidant content.

Furthermore, the literature study underlines the significance of preserving oil quality and stability throughout deep frying procedures. Chemical events such oxidation, polymerization, and hydrolysis take place, causing changes in the physical and chemical characteristics of the lipids. These changes are monitored using parameters such as free fatty acid (FFA), peroxide value (PV), p-anisidine value (p-AV), TOTOX value, and iodine value (IV).

Also, investigations have been conducted to compare the oxidative stability and shelf life of various oils by comparing their peroxide (PV) and anisidine (AV) values. Peanut and corn oils were found to be more stable than rapeseed and grapeseed oils. To preserve the quality of oils and extend their shelf life, their oxidative stability must be considered. Oils can be blended to improve their physicochemical qualities, antioxidant activity, and nutritional profiles. To increase market acceptability and frying qualities, sesame oil blends with soybean oil or other vegetable oils have been produced. To get the required properties in the blended oils, the ideal blend ratio must be determined.

In conclusion, the assessment of the literature gives useful information about the physicochemical changes, oxidative stability, fatty acid composition, and nutritional evaluation of oils and oil blends during deep fat frying. The research examined contribute to a better knowledge of the elements that influence oil quality and stability, assisting in the creation of healthier and more stable oil blends for a variety of culinary applications.

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