Rapid evaluation of frying oil degradation using ultrasonic technology

In the last few years, several methods have been evaluated in order to achieve a rapid assessment of the quality of frying oils and these have suggested the need for new systems to increase the quality of frying fats and fried foods. These studies include the use of FTIR spectroscopy, electronic noses, chromametric methods or the measurement of the dielectric capacitance of the frying oils. In this respect, ultrasonic techniques are robust, inexpensive and meet the characteristics needed for frying oil quality assessment. The quality of frying oils covering a wide range of oil degradation and degree of unsaturation was analyzed by using ultrasonic techniques by researchers at Spain. Ultrasonic velocity and attenuation decreased with temperature, and the average velocity temperature coefficients were \(-3.59\) and \(-3.51\) m/s/°C for monounsaturated (MUO) and polyunsaturated (PUO) oils, respectively. Velocity was linearly related to viscosity, showing higher values for PUO than for MUO. Velocity was also related to the percentage of polar compounds \((R^2 = 0.77\) and 0.86 for PUO and MUO, respectively\) and polymers \((R^2 = 0.86\) for PUO and MUO together\). The use of velocity and viscosity in a single prediction model allowed to classify 97.5% of the samples correctly, according to the 25% polar compounds limit. Therefore, ultrasonic techniques can be used to characterize thermal degradation of oils when subjected to different frying conditions, which could be useful for frying operators or inspection services [Benedito Jose, García-Pérez Jose V, Dobarganes M Carmen and Mulet Antonio, Rapid evaluation of frying oil degradation using ultrasonic technology, *Food Res Int*, 2007, 40(3), 406-414].

Storage stability of butter oils produced from sheep’s milk

Butter oil is the anhydrous form of milk fat and is defined as a product exclusively obtained from milk, cream or butter from various animal species. A major portion of butter oil is utilized for culinary cooking and frying of different foods. In deep-frying butter oil has the advantage over vegetable oils in that it has superior flavour and oxidative stability.

The physical and chemical characteristics and thermal stability of butter oil produced from non-pasteurized and pasteurized sheep’s milk were studied by researchers at Food Engineering Department, Faculty of Engineering, University of Gaziantep, Gaziantep, Turkey. Thermal stability of samples was estimated by using the accelerated shelf-life testing method. Samples were stored at 60, 70 and 80°C in the dark and the reaction was monitored by measuring peroxide, thiobarbituric acid and free fatty acid values. The peroxide and thiobarbituric acid values increased as the temperature increased. The increase of acid values of the two samples was not significant. A slight increase in free fatty acid value showed that hydrolytic reactions were not responsible for the deterioration of butter oil samples in thermal stability studies. When compared, butter oil produced from pasteurized sheep’s milk has higher thermal stability than butter oil produced from non-pasteurized sheep’s milk. Although butter oil produced from non-pasteurized milk was not exposed to any heat treatment, the shelf-life of this product was lower than the shelf-life of butter oil produced from pasteurized sheep’s milk. Therefore, heat treatment for pasteurization did not affect the thermal stability of butter oil [Özkanlı Oya and Kaya Ahmet, Storage stability of butter oils produced from sheep’s non-pasteurized and pasteurized milk, *Food Chem*, 2007, 100 (3), 1026-1031].
Tocopherols and tocotrienols as free radical-scavengers in refined vegetable oils and their stability during deep-fat frying

Researchers at Italy conducted studies to assess the effect of total tocopherols and tocotrienols of refined vegetable oils on oil radical-scavenging activity and to investigate the stability of the various homologues during the deep-fat frying of French fries. Eight different refined vegetable oils were investigated, having variable levels of natural tocopherols and tocotrienols. A direct correlation between the radical-scavenging capacity of the oils, measured by the DPPH test, and the total content of natural tocopherols and tocotrienols was found. Frying experiments showed that the stability of different tocopherols and tocotrienols present in the refined vegetable oils basically depend on two factors: the fatty acid composition of the oil, in particular polyunsaturated fatty acid (PUFA) content, and the kind of tocopherol and tocotrienol homologues present. The more oxidizable the oil, on the basis of fatty acid composition, the more stable were the tocopherolic antioxidants. Among the different homologues, γ-tocotrienol in palm super olein proved to be the least stable during the deep-fat frying, thus preserving the other homologues [Rossi Margherita, Alamprese Cristina and Ratti Simona, Tocopherols and tocotrienols as free radical-scavengers in refined vegetable oils and their stability during deep-fat frying, Food Chem, 2007, 102 (3), 812-817].

Evaluation of Mangosteen seeds and seed oil for edible purpose

Conventional edible oils are becoming very scarce and there is a need to establish alternative oil-bearing seeds as substitutes. Preliminary compositional studies carried out on seeds of *Garcinia mangostana* Linn. showed that they deserve to be investigated as promising sources of fat and carbohydrate for possible use as food or feed to bridge the gap of oil deficiency.

Therefore, chemical analysis and preliminary toxicological evaluation of *G. mangostana* seeds and seed oil was done by researchers at Nigeria in order to determine the possibility of using them for human and/or animal consumption. Proximate analysis showed that the seeds have high amount of carbohydrate and are rich in oil (21.68 ± 6.18%) but have a low protein content. The physical properties of the oil extracts showed the state to be liquid at room temperature (25 ± 1°C) and the colour of the oil golden-orange. The specific gravity of the oil was 0.98 ± 0.01. Among the chemical properties of the oil extracts, acid value, saponification number, iodine value, per cent free fatty acid and peroxide value compared well with those of conventional edible oils. The seed flour was found to be a good source of minerals. It contained considerable amounts of potassium (7071 mg/kg), magnesium (865 mg/kg) and calcium (454 mg/kg). Fatty acid composition of the seed oil indicated that the oil contains one essential fatty acid in small proportion: linoleic acid (1.30%) and most prevalent fatty acids are palmitic acid (49.5%) and oleic acid (34.0%). Weanling albino rats appeared to suffer no toxicological effects when fed with *G. mangostana* seed oil for 8 weeks. Weekly monitoring of the rats showed good physical appearance and steady weight increase. Histological examination of sections of the heart, liver, kidney, spleen and lung revealed that the kidney of some of the rats had some degrees of pathology and no lesion was found in the heart and liver of the rats. However, the seed oil could be useful as an edible oil and for industrial applications [Ajayi IA, Oderinde RA, Ogunkoya BO, Egunyomi A and Taiwo VO, Chemical analysis and preliminary toxicological evaluation of *Garcinia mangostana* seeds and seed oil, Food Chem, 2007, 101 (3), 999-1004].
Garlic is indigenous to Asia and is cultivated worldwide for the fleshy segments of its bulbs, which are used as a condiment, especially in Asian cuisine. It has antioxidant, antimicrobial, antibacterial, antiviral, antifungal, antiprotozoal properties and beneficial effects on the cardiovascular and immune systems. Garlic is rich in selenium and organosulphur compounds, which have pronounced antioxidant activity. Thus, researchers at Pakistan studied efficacy of garlic extract in stabilizing sunflower oil during accelerated storage. Extracts of garlic were prepared in different solvents; extract yield was in the range of 6.24-23.2% and antioxidant activity range in the linoleic acid system was 14.1-93.2%. Being highest in yield and antioxidant potential, methanolic extract was thermally evaluated by heating the extract at 185°C for different intervals, i.e. 0-80 minutes and evaluating antioxidant activity of the heated extract in the linoleic acid system (71.6% inhibition).

Methanolic extract of garlic at three different concentrations, i.e. 250 (SFO-250), 500 (SFO-500) and 1000 ppm (SFO-1000) were added to preheated RBD (Refined, bleached and deodorized) sunflower oil. BHA (SFO-BHA) and BHT (SFO-BHT) at 200 ppm served as standards besides the control. Weight gain, antioxidant activity index, free fatty acid content, peroxide value, conjugated dienes, conjugated trienes and thiobarbituric acid-reactive substances were taken as parameters for evaluation of effectiveness of garlic in stabilization of sunflower oil. Results from different parameters were in agreement with each other, suggesting the highest efficiency of SFO-1000, followed by SFO-BHT, SFO-BHA, SFO-500, SFO-250 and Control.

It is concluded that garlic can stabilize sunflower oil up to a greater extent than commonly employed synthetic antioxidants. It inhibits thermal deterioration of oil by improving its hydrolytic stability, inhibiting double bond conjugation and reducing the losses of polyunsaturated fatty acids. Appreciably high thermal stability of garlic extract shows an added advantage at high processing temperatures, contrary to synthetic antioxidants. Therefore, garlic can be considered as a potential antioxidant source of natural origin [Iqbal Shahid and Bhanger MI, Stabilization of sunflower oil by garlic extract during accelerated storage, Food Chem, 2007, 100 (1), 246-254].

Extending the frying life of oil is of commercial and economic importance. Therefore, improving the thermal stability of cooking oils could provide considerable savings to the food processors. Sunflower (*Helianthus annuus* Linn.) oil is among the healthiest vegetable oils available. It ranks high in percentage of PUFA, which can be of benefit in lowering cholesterol level. Therefore, a study was conducted by researchers at School of Food Science and Technology, Southern Yangtze University, Wuxi, Jiangsu, China to evaluate the thermal resistance of sunflower seed oil before and after treatment with two kinds of aromatic plants which are used in different processes of the food industry. Three different frying temperatures i.e., 150, 180 and 200°C, were applied to refined sunflower seed oil before and after addition of lavender and thyme (dried...
aerial parts). A number of official methods were used to evaluate chemical and physical changes in all samples during heating.

Quality parameters of sunflower seed oil were improved by treatment with either lavender or thyme. In fact, the statistical analysis of results proved the existence of a significant difference between untreated and treated oil samples. However, no difference was found between sunflower oil with lavender and sunflower oil with thyme, whenever the same temperatures were applied. Thyme and lavender exhibited a high ability in reducing free fatty acids content (FFA), peroxide value (PV) and viscosity. The incorporation of Lavender and/or Thyme in sunflower seed oil helped to improve its thermal stability and, consequently, to extend it’s frying life [Bensmira Meriem, Jiang Bo, Nsabimana Consolate and Jian Tang, Effect of Lavender and Thyme incorporation in sunflower seed oil on its resistance to frying temperatures, Food Res Int, 2007, 40(3), 341-346].

Enhancement of the oxidative stability of some vegetable oils by blending with Moringa oleifera oil

Moringa oleifera Lam. is the most widely known and utilized species, belonging to the family Moringaceae. M. oleifera oil (MOO) is reported to have a high level of oleic acid and different tocopherol isomers; and has excellent oxidative stability during frying. So, great potential exists for blending of MOO with other high-linoleic oils. Thus, researchers at Pakistan prepared blends (20, 40, 60 and 80% w/w) of MOO with sunflower oil (SFO) and soybean oil (SBO) to evaluate the changes in fatty acid (FA) composition, oxidative and thermal stability of SFO and SBO. The blending of MOO with SFO and SBO in proportions of 0-80% resulted in the reduction of linoleic acid (C18:2) content of SFO and SBO from 67.0 to 17.2% and 56.2 to 14.6% and increase in the contents of oleic acid (C18:1) from 26.2 to 68.3% and 21.4 to 65.9%, factors of 0.72, 0.72 and 1.27, 1.33, respectively. A storage ability test (180 days; ambient conditions) showed an appreciable improvement in the oxidative stability of substrate oils with increase of MOO concentration, as depicted by the least oxidative alterations in PV, IV and highest increase in induction period, IP, of the MOO:SBO (80: 20 w/w) blend. Each 20% addition of MOO resulted in decreases of PV and IV by factors of 0.84, 0.85 and 0.89, 0.88, respectively, and increases in IP by factors of 1.45 and 1.37 of SFO and SBO, respectively.

The heating performance test (180°C for 42 hours; 6 hours heating cycle per day), as followed by the measurement of polymer contents and total polar contents (TPC), also revealed the MOO:SBO (80:20 w/w) blend to be the most stable. Every 20% addition of MOO in SFO and SBO resulted in reduction of the polymer contents and TPC of SFO and SBO by factors of 0.91, 0.92 and 0.94, 0.94, respectively. On the basis of the present findings, it appears that proper blending of high linoleic oils with MOO can result in oil blends which could meet nutritional needs with improved stability for domestic cooking and deep-frying.

Potential multipurpose *Nigella sativa* Linn. seed oil

*Nigella, Nigella sativa* Linn. (Black Cumin, Hindi — Kalonji, Kalajira) is an annual herbaceous plant belonging to the Ranunculaceae family. Nigella seeds are used for edible and medicinal purposes in many countries. They are used as a condiment in bread and other dishes and in the preparation of a traditional sweet dish, composed of black cumin paste, which is sweetened with honey or syrup and in flavouring of foods, especially bakery products and cheese. Nigella seed oil or extract has protective and curative actions and is considered as one among newer sources of edible oils. This seed oil has been reported to possess antitumor activity, antioxidant activity, anti-inflammatory activity, antibacterial activity and a stimulatory effect on the immune system. The researchers of Tunisia and Belgium undertook investigations to obtain information about the chemical composition of Nigella seeds cultivated in Tunisia and Iran and to determine fatty acid profiles, thermal profiles and sensorial profiles of their lipid fraction obtained by cold solvent extraction.

Physico-chemical properties of two Nigella seed varieties were determined. Physical and chemical analyses of crude oil extracted from the seeds by a cold solvent method were also performed. The following results (on a dry-weight basis) were obtained for Tunisian and Iranian varieties, respectively: protein 26.7 and 22.6, oil 28.48 and 40.35, ash 4.86 and 4.41, and total carbohydrate 40.0 and 32.7 per cent. The major unsaturated fatty acids were linoleic acid (50.3-49.2%), followed by oleic acid (25.0-23.7%), while the main saturated fatty acid was palmitic acid (17.2-18.4%). Myristic, myristoleic, palmitoleic, margaric, margaroleic, stearic, linolenic, arachidic, eicosenoic, behenic and lignoceric acids were also detected. Thermal profiles of both Nigella seed varieties, determined by their DSC melting curves, revealed different thermograms. Sensorial profiles of Tunisian and Iranian seed oils were defined through the GeLab ($L^*$, $a^*$, $b^*$) colour, oxidative stability by Rancimat test and viscosity. Physico-chemical properties of the oils for Tunisian and Iranian varieties, respectively, include: saponification number 211 and 217, peroxide value 5.65 and 4.35, iodine index 120 and 101, and an acidity of 22.7 and 18.6 per cent.

The study revealed that Nigella seeds are a rich source of many important nutrients that appear to have a very positive effect on human health. It constitute a good alternative source of essential fatty acids compared with common vegetable oils and could contribute to the overall dietary intake of the mineral elements. However, further investigations may be done to establish this oil as a potential new multi-purpose product for industrial, cosmetic and pharmaceutical uses [Cheikh-Rouhou Salma, Besbes Souhail, Bentati Basma, Blecker Christophe, Deroanne Claude and Attia Hamadi, *Nigella sativa* L.: Chemical composition and physicochemical characteristics of lipid fraction, *Food Chem*, 2007, **101** (2), 673-681].

**Poultry**

Physico-chemical and functional properties of dried egg white

Transport and storage of dried egg products is less costly and requires less space; at low moisture content, egg products are less susceptible to microbial growth; and the uniformity and easy dosage of dried egg products make them an ideal ingredient in the food industry. The scientists at Belgium investigated the effects of moisture content (0.8-9.9%) and dry-heating time on selected physico-chemical and functional (foaming) properties of freeze-dried egg white after dry-heating. Moisture content during dry-heating proved to be a parameter determining the functionality of the resulting egg white powder. The degree of conformational changes induced in the egg white proteins by dry-heating was