The rice bran oil (RBO) contains high levels of phytosterols, gamma-oryzanol, tocotrienols as well as tocopherols and it extends the shelf-life of snack foods. The high oxidative stability of RBO makes it preferred oil for frying and baking applications. The saturated, monounsaturated and polyunsaturated fatty acids in RBO are in the ratio of approximately 1:2.2:1.5 and the major fatty acid compositions are not influenced by storage temperature, although linolenic acid level decrease by approximately 50% during storage. The oils are stabilized by addition of approximately 2-5% by weight of RBO, which is processed to retain unsaponifiable matter. The stabilized oil may be useful as a spray oil for crackers, nuts, chips and other snack foods. Blending of one oil with another oil (especially RBO) has also been found to improve the stability of the blend during frying and storage. The improved frying stability of low linolenic acid soybean oil compared to normal soybean oil has also been reported.

RBO is a nutritionally superior oil compared to other common vegetable oils. The oil has minor components such as oryzanol, phytosterols, tocotrienols, tocopherols and squalane which show cholesterol-lowering and skin-improving effects in addition to antioxidant effects. Presence of oryzanol and higher amounts of unsaponifiable matter (such as phytosterols) are unique to RBO. Produced in India, RBO is available in two types – chemically refined RBO (cRBO) and physically refined RBO (pRBO).

The scientists at Department of Lipid Science and Traditional Foods, Central Food Technological Research Institute, Mysore investigated the frying performance of the RBOs compared to sunflower oil. During experiment RBO of three brands – two physically refined oils (pRBO1 and pRBO2) and one cRBO – were used in this study. A market sample of sunflower oil was also used side by side as a control for deep-fat frying. Bhujia (a traditional snack in India) was prepared in the oils specified at 18°C of three batches (100 g wet raw material/batch) each using 500 g of the oil for frying. The stainless steel pan used for frying had an area of 121m² and a depth of 12.5 cm.

Oils after frying had deeper colour (23.9-137.5% increase) and higher peroxide (101.4-274.3% increase) and free fatty acid values (−4.7 to +27.3% change) compared to the starting oils, but the RBOs studied showed lesser changes compared to the control. Oil in the Bhujia was slightly lower (−7.9%) for a low-oryzanol cRBO while it was slightly higher (+7.0%) for a high-oryzanol pRBO. Both showed mild foaming compared to the control sunflower oil when partial acylglycerols caused some foaming. The bhujia retained the RBO’s healthy oryzanol [Gopala Krishna AG, Khatoon S and Babylatha R. Frying performance of processed rice bran oils, J Food Lipids, 2005, 12, 1-11].

The scientists at Turkey have evaluated the effect of packaging materials and storage conditions on sunflower (Helianthus annuus Linn.) oil quality. During experiment glass and polyethylenterephthalate (PET) bottles filled with sunflower oil were stored under both light and dark and with/without headspace to determine the effects of light, air, packaging materials and storage time on the stability of sunflower oil. Peroxide value (PV), free fatty acids, soap content and iodine number were measured to determine stability of sunflower oil every 3 months until 9 months. Glass bottles recorded lower oxidation values than oils packaged in PET. The oxidation proceeded faster in packages stored in light than in darkness, and in those with headspace. The best quality oil was found stored in the dark, free of air and packed in glass and then in PET. Even though glass gave the best protection against oxidation, PET bottles offer adequate protection (especially in the dark). This study showed that air, packaging and storage time all have an effect on the stability of sunflower oil [Kucuk M and Caner C, Effect of packaging materials and storage conditions on sunflower oil quality, J Food Lipids, 2005, 12(3), 222-231].
Deterioration of oils due to air, light, heat and deep-frying may be reduced with antioxidants

It is obvious that prolong exposure of oil to air and light initiates deteriorative changes in the oil owing to oxidation even at close to room temperature (30°C). Deterioration rate becomes very fast in frying oil not only owing to oxidation but also due to hydrolysis, as evidenced by increased free fatty acid (FFA) with frying time. Deteriorative changes in frying oil not only depend upon the percentage moisture and thermal conductivity of fried food, but also upon the fat content of that food.

A study was conducted by researchers at Department of Food Science and Technology, University of Karachi, Karachi, Pakistan to follow the oxidative deterioration of oils exposed to air, air-light and deteriorative changes subsequent to deep-frying. Furthermore, decline in the rate of oxidation was noted following addition of plant extracts, such as tea [Camellia sinensis (Linn.) O. Kuntze], and different purified phenolic acids, viz. ferulic, caffeic, vanillic and gallic as antioxidants.

To follow the relative rate of oxidative deterioration of edible oils, refined olive, corn and soybean oils were analyzed periodically for their peroxide value (PV), $p$-anisidine value ($p$-AV) and iodine value (IV) following exposure to air and air-light for 30 days. Changes in the above values of the oils were also examined and after being used for deep frying of French fries at 180°C for varying periods of time i.e. 30, 60 and 90 minutes PV and $p$-AV values increased in the order, deep frying>air-light exposure>air exposure, while the values with respect to the oils increased as soybean>corn>olive. Decreases in IV followed the same pattern, i.e. deep frying>air-light>air and soybean>corn>olive. Percentage of free fatty acid increased with increase in time of deep-frying. Deep-frying of French fries in corn oil was also carried out in presence of caffeic, ferulic, vanillic acid and crude tea extract as antioxidants. All antioxidants effectively reduced the oxidation rate in the oil as detected by decreases in PVs and $p$-AVs and relatively low reduction rates in IVs for all the frying times. The order of antioxidative activity was caffeic acid >vanillic acid >ferulic acid >tea extract. Variation in percentage of FFA of corn oil due to variation in nature of fried food was also analyzed. Percentage of FFA of the oil used for deep frying of chicken drum sticks were higher than the values of the oil used for deep-frying of French fries [Naz Shahina, Siddiqi Rahmanullah, Sheikh Hina and Sayeed Syed Asad, Deterioration of olive, corn and soybean oils due to air, light, heat and deep-frying, Food Res Int, 2005, 38(2), 127-134].

Electrolyte degumming of non-hydratable gums from selected vegetable oils

The scientist at Department of Lipid Science and Traditional Foods Central Food Technological Research Institute, Mysore has developed a new degumming protocol by employing electrolyte solutions to remove non-hydratable gums from soybean, rice bran and mustard oils. It removes non-hydratable gums, mostly phosphatidic acid (PA) and phosphatidyl ethanolamine (PE), which is left out after water degumming and could not be removed without the use of phosphoric or citric acid. Acid degumming is associated with oil loss (~10%) due to the emulsifying nature and subsequent washings. However, physical degumming with electrolyte solutions, when combined with water degumming, removes nonhydratable gums with much less oil loss (~4%). The water-degummed vegetable oils, when treated with 2% of electrolyte solution, prepared by mixing aqueous solution of 1.5% of potassium chloride and 0.5% of sodium chloride in a ratio of 95:5 (v/v), yielded degummed soybean, rice-bran and mustard oils with phospholipid contents as low a 0.05, 0.06 and 0.02%, respectively. Gums recovered through this technique can easily be regenerated and used for commercial purposes [Nasirullah, Physical refining: Electrolyte degumming of non-hydratable gums from selected vegetable oils, J Food Lipids, 2005, 12(2),103-111].
Preparation of canola protein materials using membrane technology

Rapeseed is an important oilseed crop and ranks second in the world production of oil bearing seeds. The usefulness of rapeseed/canola as a source of food proteins is severely restricted by the presence of undesirable components such as glucosinolates, phytates and fibre (hull). These toxic and antinutritional compounds in rapeseed/canola must be removed as completely as possible, before it can be used as a protein source for human consumption.

Suitable conditions for the extraction and precipitation of proteins from Iranian canola (Brassica napus Linn. cv. ‘Quantum’, ‘PF’, and ‘Hyola’) meals were determined by researchers of Iran using a membrane-based process which consisted of extraction of hexane-defatted canola meals at pH 9.5-12.0 and precipitation, at pH values between 4.5 and 7.5, to recover a precipitated protein isolate (PPI). Acid soluble protein isolate (SPI) was then prepared by ultrafiltration (UF) followed by diafiltration (DF) and drying. The highest protein yield was obtained by alkaline extraction at pH 12.0 with all meals investigated. The maximum yield of precipitated protein was observed at pH values between 4.5 and 5.5, depending on variety and dehulling treatment. Almost 90% of the proteins were recovered in three products: PPI and SPI containing (81-98% protein, N×6.25), and the meal residue (35% protein). The glucosinolate content of all meals tested and their protein products was low, and in some cases they were below the detection limit of glucosinolates. Both isolates were low in phytic acid. Some functional properties (protein dispersibility index, water absorption, fat absorption, emulsifying activity, and foaming properties) were evaluated. Iranian canola meals were compared with soybean meal in terms of functional properties. All canola meals tested showed a high PDI and WA and were superior to soybean meal in fat absorption, emulsifying activity and foaming properties.

The program demonstrated the feasibility of producing food-grade protein isolates from Iranian rapeseed/canola varieties, by adapting the membrane-based technology developed at the University of Toronto. The optimal pH for the extraction of proteins from all meals tested was determined to be 12.0. The precipitation curves of all meals showed a broad precipitation maximum at pH values between 4.5 and 6.0. More than 60% of the protein present in the meal was recovered as protein isolate. The isolates had low phytic acid and glucosinolate content. The phytic acid level in SPI was undetectable. All rapeseed products tested were superior to soybean meal in fat absorption, emulsifying activity and foaming properties [Ghodsi A, Khodaparast MH Haddad, Vosoughi M and Diosady LL, Preparation of canola protein materials using membrane technology and evaluation of meals functional properties, Food Res Int, 2005, 38(2), 223-231].

Thermal behaviour of mango seed almond fat and its mixtures with cocoa butter

Vegetable fats and oils are widely used in the food, pharmaceutical, cosmetic and chemical industries and are normally obtained from oilseeds such as sesame seed, soy bean, cotton seed and oil. But the identification and application of new materials is important for the development of new technological approaches towards the use of traditional raw materials. Among these fat and oil sources, cocoa butter (CB) is highly appreciated because of its physical and chemical characteristics.

Some Mexican scientists evaluated the physicochemical characterization, including thermal behaviour, by differential scanning calorimetry of mango seed almond fat (MAF), alone and in mixtures with cocoa butter (CB). Results showed that mango almond seeds contain about 5.28-11.26% (dw) of fat. The refraction index is 1.466, the saponification index 189.0 and the iodine index 41.76. Fatty acids found in MAF are oleic, stearic and palmitic acids (40.81, 39.07 and 9.29% (w/w), respectively) as well as smaller amounts of linoleic, with arachidic, behenic, lignoceric and linolenic acids, among others. Calorimetric analysis showed that MAF crystallizes between 14.6 and 24.27°C with a ΔH of 56.06 J/g and melts between −17.1 and 53.8°C, with fusion maxima at 18.54°C and 40.0°C for the α and β polymorphic forms. Their fusion enthalpies are 70.12 and 115.7 J/g. The MAF solids content profile is very similar to that of CB, both in stabilized and non-stabilized samples. The mixing compatibility was analyzed using isosolids curves of mixtures of different compositions [Solís-Fuentes JA and Durán-de-Bazúa MC, Mango seed uses: thermal behaviour of mango seed almond fat and its mixtures with cocoa butter, Bioresource Technol, 2004, 92(1), 71-78].
Linseed oil may improve nutritional quality of the lipid fraction of dry-fermented sausages

As meat and meat products, are some of the most important sources of dietary fat, modification of the lipid profile of such products, by enhancing \( n-3 \) polyunsaturated fatty acids, can help to improve the nutritional quality of the occidental diet. Research has been done on animals by feeding diets rich in polyunsaturated acids, basically \( n-3 \). Linseed (\textit{Linum usitatissimum} Linn.) has been widely used for this purpose, both as seeds and as oil. Researchers of Spain carried out studies to evaluate the lipid modifications undergone in dry-fermented sausages, during the ripening process, when pre-emulsified linseed oil was used in the formulation, mainly focusing attention on the changes in the P/S and \( n-6/n-3 \) ratios. Improvement of the nutritional quality of the lipid fraction of dry-fermented sausages was achieved by a substitution of one quarter of the amount of pork backfat present in traditional formulations by an emulsion in which linseed oil was included. This improvement was particularly noticeable when 100mg/kg of butylhydroxytoluene and 100mg/kg of butylhydroxyanisole were added. P/S ratio increased from 0.4 in the control sausages to 0.6 in the batch with 3.3% linseed oil and to 0.7 in the batch with linseed (3.3%) and antioxidants. The \( n-6/n-3 \) ratio decreased from 14.1 in control products to 7.2-7.1 in modified products as a consequence of the \( \alpha \)-linolenic acid increment. No oxidation problems were detected during the ripening process, with TBA values always lower than 0.23 ppm. Hexanal and nonanal showed the highest values in linseed oil-containing products. Addition of antioxidants avoided the formation of decadienals and other aldehydes from lipid oxidation.

In conclusion, the addition of linseed oil to the formulation of dry-fermented sausages has a relevant influence on the nutritional quality of the products, without substantially modifying the flavour and oxidation status of the ready-to-eat products. However, more research is needed to substantiate evolution of the lipid oxidation process during the shelf life of linseed-containing sausages [Ansorena D and Astiasaran I, The use of linseed oil improves nutritional quality of the lipid fraction of dry-fermented sausages, \textit{Food Chem}, 2004, \textbf{87}(1), 69-74].

Physico-chemical properties of Papaya seed oil

Papaya is important for its fruit and it is also grown for papain production. The seeds of papaya fruits are generally discarded. However, in order to make a more efficient use of papaya, it is worth investigating the use of the seeds as a source of oil. Currently, two main processes for the extraction of oil from seeds are of industrial importance: the hydraulic process and further purification and the chemical process using organic solvents. The scientists at Malaysia evaluated the physico-chemical properties of seed oil from \textit{Carica papaya} Linn. to determine and to compare the physico-chemical properties and the quality of oil extracted from papaya seeds using different enzymes with that of oil extracted using solvents.

Four commercial enzymes were used for the enzymatic extraction, namely, Termamyl 120L, Type L (\( \alpha \)-Amylase), Neutrast\textsuperscript{®}0.8L (Neutral protease), Celluclast\textsuperscript{®}1.5L FG (Cellulase) and Pectinex\textsuperscript{®}Ultra SP-L (Pectinase). The melting point of the oil was 9.7-10.5°C and showed that there was no significant difference (\( P>0.05 \)) between the oil obtained from enzyme and solvent extractions. Generally, the colour of the oil was reddish yellow. Solvent-extracted oil tended to have more yellow and red colour (24Y+4.0R) compared to enzyme-extracted oil (20Y+3.0R). The iodine and the saponification values of the solvent-extracted oil were found to be 66.0 and 154.7, respectively, while those of the enzyme extracted oil were 66.2-69.3 and 154.5-161.7, respectively. The unsaponifiable matter of the oil extracted using different enzymes ranged between 2.07 and 2.90% and were significantly different (\( P<0.05 \)) from that of the solvent-extracted oil (1.39%). The predominant fatty acid in the oil was oleic acid (72-78%), with some palmitic (12-14%), stearic (4-5%) and linoleic (2.5-3.5%) acids with no significant difference in fatty acid compositions between oil extracted using solvent and enzymes. The main triacylglycerols (TAGs) were sn-glycerol-oleate-oleate-oleate (OOO) (43.5-45.5%) and 1-palmitoyl-dioleoyl glycerol (POO)+stearoyl-dioleoyl-linoleoyl glycerol (SOL) (29.5-30.5%). Thus, papaya seed oil has the potential to become a new source of high-oleic oil. However, toxicological studies need to be carried out before considering for food applications [Puangsri T, Abdulkarim SM and Ghazali HM, Properties of \textit{Carica papaya} L. (Papaya) seed oil following extractions using solvent and aqueous enzymatic methods, \textit{J Food Lipids}, 2005, \textbf{12}(1), 62-76].