International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 4 Issue 04, April-2015

Chemical Characteristics of Different Brands of Soybean Oil Available in Bangladesh

U K Prodhan[1] *,
[1]Assistant Professor,
Dept. of Food Technology and Nutritional Science,
Mawlana Bhashani Science and Technology University,
Tangail, Bangladesh

M Ariful Islam[2]
MS Thesis student,
Dept. of Food Technology and Nutritional Science,
Mawlana Bhashani Science and Technology University,
Tangail, Bangladesh

Jannatul Quoser[3]
Assistant Family Planning Officer,
Kushtia, Bangladesh

M R Linkon[4]
[4]Lecturer,
Dept. of Food Technology and Nutritional Science,
Mawlana Bhashani Science and Technology University,
Tangail, Bangladesh

Md. Sidur Rahman[5]
[5]Nutritionist,
BIRDEM General Hospital Shabagh,
Dhaka.

M Nazibur Rahman[6]
Professor,
Dept. of Biochemistry and Molecular Biology,
Jahangirnagar University,
Savar, Bangladesh

Abstract: **Soybean is the world's leading source of edible oil. Edible oil is an important element in the diet of most transitional countries; nevertheless, little is known about the chemical characteristics of these oils. In this Study the author investigated the chemical characteristics of six brand soybean oil such as Mustafa, Muskan, Pusti, Teer, Fresh and Rupchanda collected from retail market. The studied parameters were iodine value, saponification value, acid value and Reichert-Meissl number and unsaponifiable matter. The acid value, saponification value, Reichert-Meissl number, unsaponifiable matters were determined by the standard methods. Hanus method was followed to determine the iodine value of the oil. Saponification values of Mustafa, Muskan, Pusti, Teer, Fresh and Rupchanda were (202, 208, 224, 213, 210 and 237 respectively). Acid values of Mustafa, Muskan, Pusti, Teer, Fresh and Rupchanda soyabean oils were (0.374, 0.748, 0.561, 0.374, 0.374 and 0.423 respectively). Iodine values of Mustafa, Muskan, Pusti, Teer, Fresh and Rupchanda soyabean oils were (85.45, 105.70, 89.64, 90, 105.26 and 110 respectively). Reichert-Meissl number of the Mustafa, Muskan, Pusti, Teer, Fresh and Rupchanda soyabean oils were (2.42, 2.8, 2.805, 2.97, 2.805 and 2.7 respectively). Unsaponifiable matter of the Mustafa, Muskan, Pusti, Teer, Fresh and Rupchanda soybean oils were 0.05, 0.06, 0.07, 0.04, 0.06 and 0.05 percent respectively. Considering the significance of above parameters of soybean oil, Rupchanda posses the highest position in nutritional quality and better than other soybean oils for human health.**

Keywords: Soybean oil, Iodine value, Saponification value, Acid value and Reichert-Meissl number, Unsaponifiable matter.

I. INTRODUCTION

The soybean (U.S.) or soya bean (UK) (*Glycine max*) is a species of legume native to East Asia. Soybean oil is obtained from soybeans (Glycine max) grown in some several countries of the world. Soybean oil, high in Polyunsaturated Fatty Acids (PUFAs), both linoleic and linolenic, has become a popular vegetable oil for use in foodstuffs due to its nutritional qualities, abundance, economy, and desirable functionality [1]. Soybean oil accounts for about 75 percent of vegetable oil used in commercial and consumer cooking and are the primary ingredient in many processed food Such as salad dressings, sandwich spreads, margarine, bread, mayonnaise, non-dairy coffee creamers and snack foods, including dairy product substitutes. Soybeans are higher in both protein and fat than other beans and are relatively low in carbohydrate and Oil is an emollient, solvent, moisturizer, inexpensive oil that is nutritious and has a high smoke point. The composition of soybean oil in terms of fatty acids content are as follows: lauric acid 0.2%, myristic acid 0.1%, palmitic acid 9.8%, stearic acid 2.4%, arachidic acid 0.9%, oleic acid 28.9%, linoleic acid 50.7%, linolenic acid 6.5% and hexadecenoic acid 0.4% [2]. Commodity soybean oils composed of five fatty acids: palmitic acid (16:0), stearic acid (18:0), oleic acid (18:1), linoleic acid (18:2), and linolenic acid (18:3). The percentage of these five fatty acids in soybean oil averages 10%, 4%, 18%, 55%, and 13%, respectively. Refinery processing affects the components of oil. Means; fatty acid composition, free fatty acid value, peroxide value, soap value e.g. are depend on criteria of refining process. During refining, under some circumstances fishy odor, trans fatty acid formation and many contaminations may occur. To prevent those issues, refining process has to be performed professionally and attentively [3].

Due to high amounts of polyunsaturated fatty acids, these oils have favorable nutritional status and beneficial physiological effects towards prevention of coronary heart

disease and cancer [4]. During frying oils with much higher oxidation occurs that causes the production of hydroperoxides and volatile compounds such as aldehydes, ketones and other chemicals are undesirable [5]. It should be noted that the oils are exposed to excess heat effects are harmful and those that are commonly used on medium heat significant changes in terms of nutrition do not show.

The dietary fat consumption for about 70% of the population averages 62.5% of the recommended amount for good health. Soybean seed oil is the one of the most preferred oil for a healthy life. The reasons that people's choice are quality, functionality, being precursors of Omega-3, Omega-6 and Vitamin E, having a low price of soybean oil [6].

The physico-chemical properties of fried soybean oil are directly related to their glyceride, fatty acid composition and chemical constitution. So, knowledge of these compositional factors is important in connection with research aimed at improvement of fat and fat products for specific uses. Some research works have been carried out on the characterization of soybean oil and nutritional compositions of its various parts but till now no detailed studies were made. The intention for the present study is to simulate the condition when we consume it with processed cooked food. Hence the present investigations were carried out to find out the chemical characteristics of Mustafa, Muskan, Rupchanda, Teer, Pusti and Fresh soybean oil which were collected from retail market.

II. METHODS AND MATERIALS

2.1 Sample Collection

Mustafa, Muskan, Rupchanda, Teer, Pusti and Fresh soybean oil were collected from retail market. All samples were preserved in dry, brown bottles. The bottles were covered with carbon papers to prevent photo oxidation. All reagents used were of analytical grade unless otherwise specified and the results were depicted as the mean value of three replicates.

2.2 Chemical characteristics

The acid value, saponification value, Reichert-Meissl number, unsaponifiable matters were determined by the standard methods. Hanus method was followed to determine the iodine value of the oil. The chemical characteristics of these soyabean oils were investigated in BCSIR and Food Technology & Nutritional Science laboratory of Mawlana Bhashani Science and Technology University, Tangail.

2.3 Determination of Saponification value

The sample of oil about 5gms was weighted accurately into 250ml conical flask. Then 50ml of 0.5N alcoholic KOH solution in the flask was Pipetted out and also an equal volume into a similar flask containing no sample (blank titration). The solutions in the flask were added with constant stirring and stirring time was same for each operation. The flask was connected to air condensers and then reflux the change by boiling at least for half an hour or more to saponify the sample completely. After the period of a refluxing was over, the charge and the blank were cooled and then titrated with 0.5 N HCl using phenolphthalein as an indicator.

2.4 Determination of Acid value

First of all 20 gm of oil was weighted into a 250 ml conical flask and add 50 ml of 95% alcohol that has been neutralized with 0.1 N alkali solution using phenolphthalein indicator. Then the contents were heated to boiling and the flask was shaken thoroughly, in order to dissolve the free fatty acids as completely as possible. The solution was cooled and then titrated against 0.1 N alcoholic caustic potash solution with constant shaking (using phenolphthalein as indicator) until the pink color persisted after vigorous shaking. Heating made the soap soluble so that titration was completed. End point was reached when the pink color persisted for 30 seconds in the hot solution after vigorously shaking.

2.5 Determination of Iodine value

Wijs reagent was first prepared by dissolving 8.5 gms of iodine and 7.5 gms of iodine monocholoride in worm glacial acetic acid and then took up to 1000 cc by cold glacial acetic acid. Then accurately 0.1 gms of the sample in a 250-300 ml glass stopper flask was weighted. The sample was dissolved in 10 ml of chloroform or carbon tetrachloride, wormed slightly. In the next step the solution was cooled well, and then added similar volume of $CHCl_3$ or CCl_4 to a similar flask containing no sample (blank). 25 ml of the wijs solution was added into the flask containing the sample and an equal volume (25 ml) into the blank. By shaking each flask were diluted with 50-100 ml of water and 15 cc of 10% KOH solution was added to the solution in each flask. The stopper and side of the beaker were rinsed with the water. Then titrated the solution with standard 0.1 N sodium thiosulphate solution (standardized with standard $K_2\ Cr_2\ O_7$ solution). Starch solution was added when yellow color nearly disappeared by the addition of the sulphate. Finally the solution was titrated up to end point, when blue color formed by the addition of starch was suddenly discharged.

2.6 Determination of Reichert–Meissl value

5 gms of the sample was weighted accurately in a 300 ml conical flask and added 10 cc. of 95% ethyl alcohol and 2 cc. of 50 % caustic soda solution. The mixture was boiled for about one hour under reflux to saponify the material. After saponification alcohol was removed by heating the solution on a water bath and the dry soap thus formed was dissolved in 100 cc of distilled water. The soap was then acidified with 50 cc of N H_2SO_4 as a result of which the soap was converted into sodium sulphate and the fatty acids. The aqueous mixture was then distilled and the distillate was collected (110 cc.) and filtered. The filtered distillate was titrated against N/10 caustic soda, using phenolphthalein as an indicator.

2.7 Determination of unsaponifiable Matter

Accurately 5 gm of well mixed oil sample was taken into a 250ml conical flask. 50ml of alcoholic potassium

hydroxide solution was added. The content was boiled under reflux air condenser for one hour or until die saponification was completed. The condenser was vasted with about 10 ml of ethyl alcohol. Triesapooified mixture was transferred and washed the saponification flask. 50 ml of petroleum ether was added, shaken vigorously, and allow the layers to separate. Then the lower soap layer was transferred into another separating funnel and repeated the ether extraction for another 3 times using 50 ml portions of petroleum ether. Washed the combined ether extract three times with 25 ml portions of aqueous alcohol followed by washing with 25 ml portions of distilled water to ensure ether extract is free of alkali. Then ether solution was transferred to 50 ml beaker, rinse separator with ether, rinsing was added to main solution. The solution was evaporated to about 5ml and transferred quantitatively using several portions of ether to 50ml Erlenmeyer flask previously dried and weighed. Ether was evaporated. When all ether had been removed added 2-3 ml of acetone. Last traces of ether were removed by drying at 100'C for 30 minutes. Residue was dissolved in 50 ml of warm ethanol which had been neutralized to 3 phenolpthahen end points. The solution was titrated with 0.02N NaOH.

III. RESULTS AND DISCUSSION

Studies were conducted on the detection of chemical characteristics of six different brands of soybean oil and the results are presented in Figures 1, 2, 3, 4 and 5 respectively. It was found that Saponification values of Mustafa, Muskan, Pusti, Teer, Fresh and Rupchanda were 202, 208, 224, 213, 210 and 237 respectively. Bangladesh Standard & Testing Instiute (BSTI) standard for saponification value is 189-195. Rupchanda possessed the highest saponification value among all the oils investigated (Figure 1).

Acid values of Mustafa, Muskan, Pusti, Teer, Fresh and Rupchanda soyabean oils were 0.374, 0.748, 0.561, 0.374, 0.374 and 0.423 respectively. BSTI standard for acid value is 0.6 mg/g max. Muskan possessed the highest acid values among all the oils investigated (Figure 2).

Iodine values of Mustafa, Muskan, Pusti, Teer Fresh and Rupchanda soyabean oils were 85.45, 105.70, 89.64, 90, 105.26 and 110 respectively. BSTI standard for iodine value is 120-143. Rupchanda possessed the highest iodine value among all the oils investigated (Figure 3).

Figure 4 shows that Reichert-Meissl number of the Mustafa, Muskan, Pusti, Teer Fresh and Rupchanda soyabean oils were 2.42, 2.8, 2.805, 2.97, 2.805 and 2.7 respectively, whereas Figure 5 depicts that Unsaponifiable matter of the Mustafa, Muskan, Pusti, Teer, Fresh and Rupchanda soybean oils were 0.05, 0.06, 0.07, 0.04, 0.06 and 0.05 percent respectively. BSTI standard for unsaponifiable matter is 1.5% max. Teer possessed highest Reichert-Meissl number on the other hand Pusti possessed highest amount of Unsaponifiable matter.

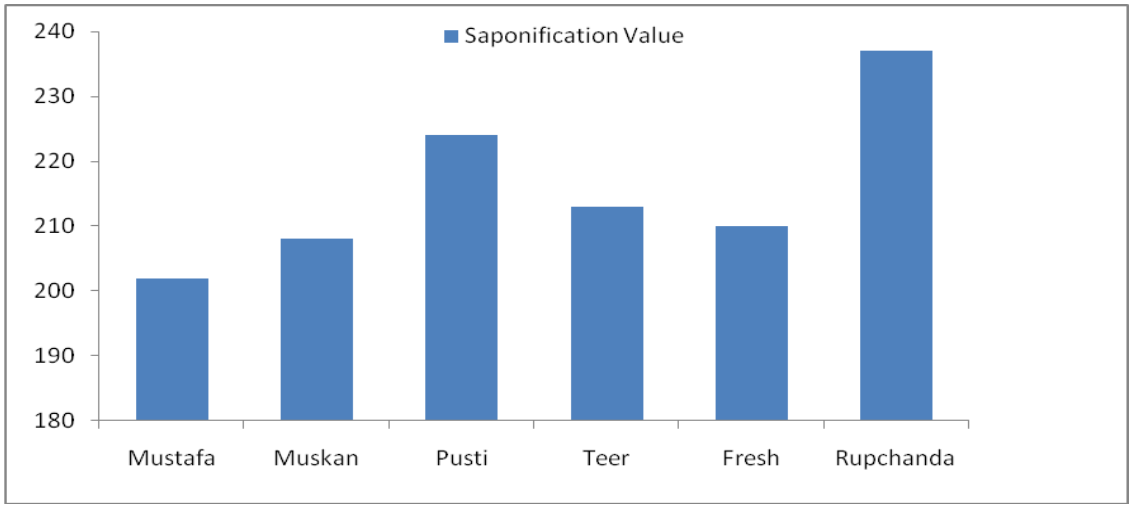

Figure1: Saponification value of six different brands of soybean oil.

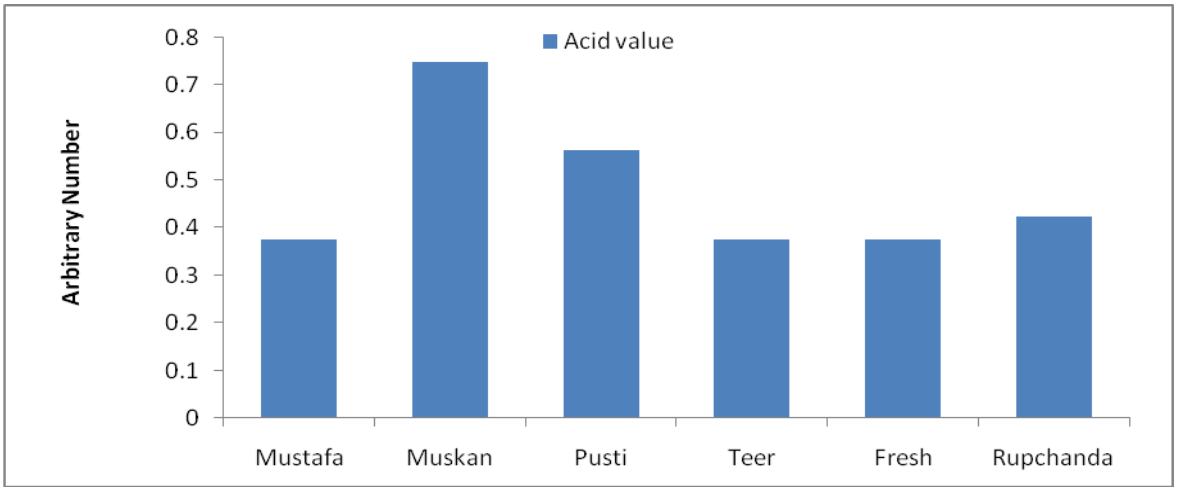

Figure 2: Acid value of six different brands of soybean oil.

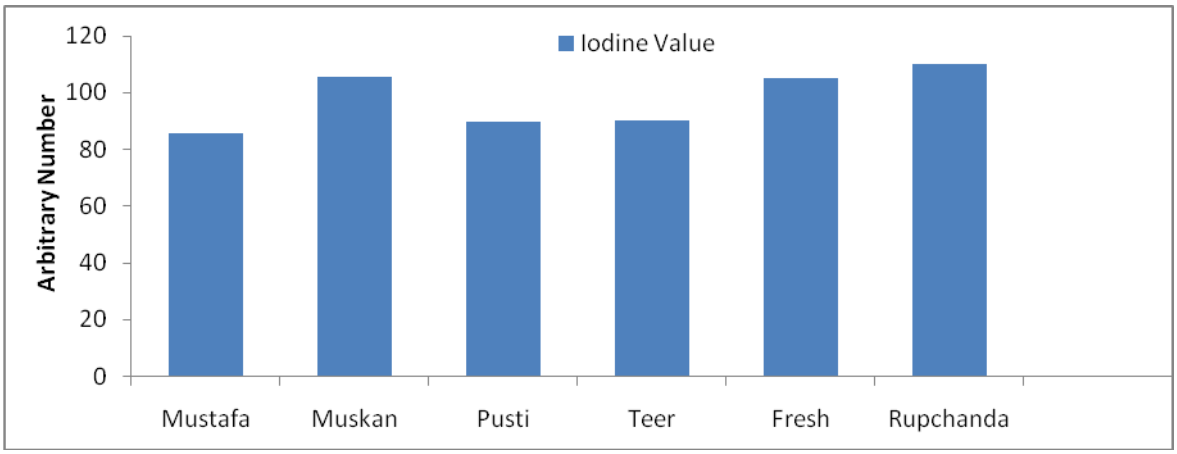

Figure 3: Iodine value of six different brands of soybean oil.

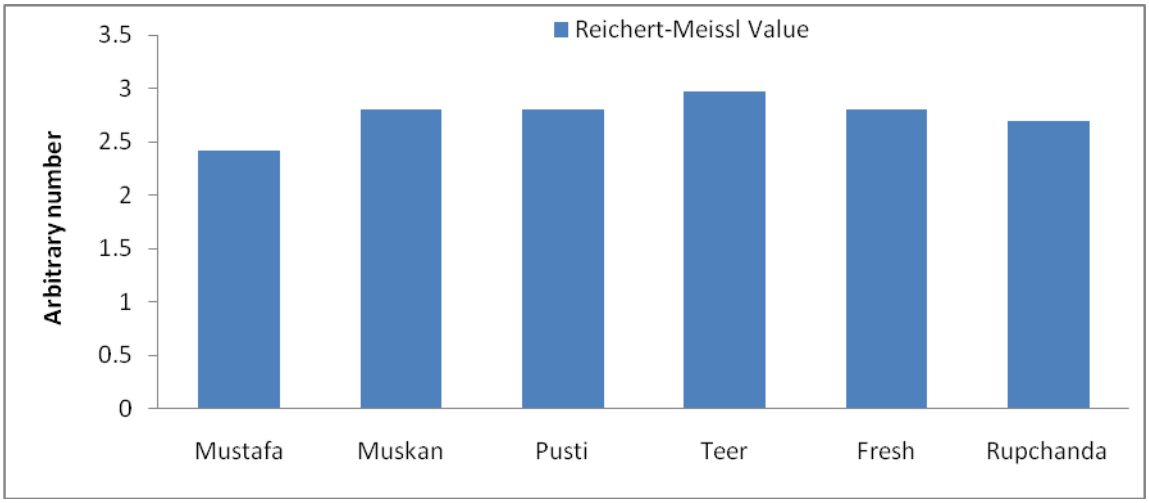

Figure 4: Reichert- Meissl number of six different brands of soybean oil.

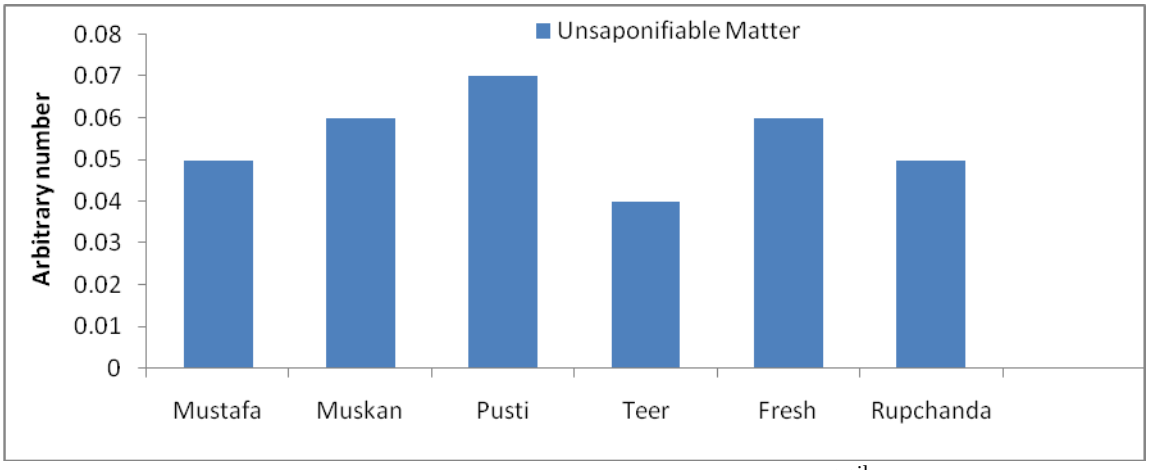

Figure 5: Unsaponifiable matter of six different brands of soybean oil.

Vegetable oils are of great importance in human life. Particularly, soybean oils act as important sources of essential fatty acids. There is strong scientific evidence, that n−3 fatty acids significantly reduce blood triglyceride levels [7] and regular intake reduces the risk of secondary and primary heart attack [8]. Some benefits have been reported in conditions such as rheumatoid arthritis [9] and cardiac arrhythmias. Soybean oil may reduce risk of heart disease [10].

Frying could change the degree of unsaturation of fatty acids along with other chemical values. As it is so important some special chemical characteristics of those oils from the nutritional point of view considering health status of the people of Bangladesh were investigated. The Iodine value is the most important factor in determining the purity of oil whereas Saponification value is related inversely to the average molecular weight of the fat. The Acid number is used to quantify the amount of acid present and Reichert-Meissl number is a useful indicator of non-fat compounds in edible fats. As the saponification and iodine value of Rupchanda soybean oil was higher than others so that the molecular weight and degree of unsaturation was high which indicate good quality for consumption.

At the high temperatures used during frying, the oil can undergo hydrolytic splitting, with the formation of partial glycerides and free fatty acids and a decrease of the smoke point; oxidation, with the formation of hydroperoxides which subsequently evolve with related cycling and rheological changes (with a negative effect on the viscosity of the oil); formation of splitting compounds such as polar compounds, compounds with a carbonyl and furan structure (responsible for the off-flavour); and formation of position isomers (conjugate acids) and structure isomers (trans acids) with suspected anti-nutritional activity. Hazards in the frying process are supposed to depend on the oils capacity to resist heat stress, environmental and technological contaminants (micotoxins, solvents, trans fatty acids, additives, etc.), nutritional value and the presence of allergens. Therefore the selection of frying oil and subesquent quality control methods should be designed to control these risks. Indeed, the characteristics of oils may be detected mainly on the basis of iodine and free fatty acids (acid value). Iodine value decreased during the frying process as a consequence of the oxidation of the double bonds because, resistance to heat stress depends on the unsaturation of fat, on the rancidity of the product and on its antioxidant properties. For determining the quality of fried oil used in various hotels and restaurants these parameters can be used.

IV. CONCLUSION

In this study the author investigated the chemical characteristics of six different brands of soybean oils in Bangladesh. It was observed that Rupchanda soybean oil was better comparing to others soybean oil. Because the saponification and iodine value of Rupchanda soybean oil was higher than others so that the molecular weight and degree of unsaturation was high that indicates good quality for consumption. Although the other brands of soybean oil were qualitatively lower than Rupchanda but depending on the significance of all physical parameter of oil, the values were between standards range. The result of this study will be able to create awareness among people to choose soybean oil whether it will be good for health or not. Among all the Soybean oils investigated Rupchanda possess the highest position in nutritional quality.

V. REFERENCES

(1) O. R. D. Brien, Fats and Oils Formulating and Processing for Application. CRC press, Boca Raton, FL, 17-30,2004.
(2) A. E. Bailey, Industrial Oil and Fat Products, Interscience Publishers, Inc., New York. British Standard, 635, 1967.
(3) R. Farhoosh, S. Einafshar, S. Sharayei, The effect of commercial refining steps on the rancidity measures of soybean and canola oils. Food Chem., 115: 933-938, 2009.
(4) S, Yehuda, S. Rabinovitz, D.I. Mostofsky, "Mixture of essential fatty acids lowers test anxiety". Nutritional Neuroscience 8 (4): 265–267. 2005.
(5) E. Choe and D. B. Min, Chemistry of deep- fat frying oils. Journal of Food Science.72(5): 77-86. 2007.
(6) T.L. Mounts, K. Warner, G. R. List, R. Kleiman, W.R. Fehr, E.G. Hammond and J.R. Wilcox, JR, Effect of fatty acid composition on soybean oil stability. Journal of the American Chemist's Society, Vol.65, No.4, (May 1986), pp.624-628. 1986.
(7) S. Harris, "n−3 fatty acids and serum ipoproteins: human studies". Am J ClinNutr 65 (5 Sup.): 1645S–1654S. 1997.
(8) H.C. Bucher, P. Hengstler, C. Schindler, G.Meier, "n−3 polyunsaturated fatty acids in coronary heart disease: a meta-analysis of randomized controlled trials". Am J Med 112 (4): 298–304. 2002.
(9) J. M. Kremer, J. Bigauoette, A.V. Michalek, M.A. Timchalk, L. Lininger, R.I. Rynes, C. Huyck, J. Zieminski, L.E. Bartholomew, "Effects of manipulation of dietary fatty acids on clinical manifestations of rheumatoid arthritis.". The Lancet (Elsevier) 1 (8422): 184–187. 1985.
(10) M. L. Burr, P.M. Sweetham,."Diet and reinfarction", European Heart Journal 15 (8): 1152–1153. PMID 7988613. August 1994.