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Nutritional evaluation and oil blending studies of different oils

[1] K Peeter Simon, [2] M Aruna, [3] Juliana Mandha, [4] DS Rao

[1, 2] Department of Food Technology, JNTUA, Anantapur, Andhra Pradesh, India
[2] Department of Home Science, Sri Padmavathi Mahila Visvavidyalayam, Tirupathi, Andhra Pradesh, India
[4] Department of Chemical Engineering, JNTUA, Anantapur, Andhra Pradesh, India

Abstract

Taking into consideration the regional preferences of the local population to sunflower oil, soybean oil and rice bran oil, the present study of nutritional evaluation of three different oil blends was conducted using sunflower oil, soybean oil, rice bran oilas controls. The oil blends selected were sunflower oil, soybean oil, rice bran oil in the ratios of 50:50 with other oils. These oil blends were used for making a ready to eat (RTE) extruded snack. Shelf life studies during storage for two months were examined for changes in chemical and sensory characteristics. Near significant changes were observed in the oil extracted from the fried product in comparison to control. Sensory evaluation of the ready to eat (RTE) extruded snack indicated that it was chemically acceptable up to two months of storage.

Keywords: sunflower oil, oil blending, shelf life studies, sensory characteristics

Introduction

Deep fried food items comprise a major portion of the diet and hence the thermal stability of frying oils assumes much importance as toxic products are formed on its degradation at high temperatures [1-3]. However during frying, oil is continuously exposed to the air at high temperature and contact with moisture, which accelerates the oxidation of the oil [4-7]. The rate of formation of decomposition products varies with the nature of oil used, foods fried, and temperature during frying [8]. By blending different types of oils, the consumer can be offered a better quality product with respect to flavour, frying quality and nutritive value [9-11]. The oil used for frying must have good flavor and oxidative stability in order to achieve good shelf life for the products fried. To meet today's consumer demands the frying oil must be low in saturated fat, linolenic acid, and have good flavor, high oxidative stability and should be trans-fat free [12-15].

The acceptability of a food product depends on the extent to which deterioration has occurred and oxidative rancidity is a major cause of food deterioration This in turn represents a major cause of loss of nutritional quality as well as cause of concern for food safety, as the oxidized fats in a very high dosage have been shown to have toxic effects [16-18]. Therefore, studies in which degradation of frying oils is measured in combination with sensory evaluation of the fried products, and analysis of rancidity volatiles are valuable in understanding the oil oxidation state and such products are the fried foods. The sensory parameters such as colour, flavour, texture, taste, and overall acceptability of any food product depends on the extent of oxidation of fats and oils in the food due to the formation of peroxides, aldehydes and ketones [19, 20]. Although sensory evaluation of foods is the most important quality assessment, taste evaluations are not practical for routine quality control. It is always preferable to have a quantitative method for which rejection points may be established by sensory means. Hence in the present study, the changes in the chemical and sensory parameters of a RTE extruded product during storage prepared with the various oil blends was thus analysed.

Materials and Methods

Study design

All oils were available locally and have been purchased in bulk from the Oil Millers Association of Tirupathi, Andhra Pradesh, India. Sunflower oil, soybean oil, rice bran oil have been used as control and also were used as experimental oils. These were blended in the ratios of 50:50 in the laboratory using a blender cum mixer and 12 blends were prepared and stored in PET bottles. Deep fat frying of the RTE extruded snack was conducted in each oil blend while maintaining frying temperatures at 180°C±5ºC. Identical frying experiments were also conducted with control oils. The RTE extruded snack was stored at room temperature in polythene bags in the same way as they are stored under normal marketing conditions. These were stored for 60 days and were opened periodically (0, 30, and 60 days) for sensory evaluation followed by chemical analysis to conduct a comparison of oil quality, and taste of the product prepared in different blends of oil.

Sensory evaluation

The samples stored in polythene bags were evaluated by panel members for their perceivable sensory attributes, like colour, flavour, texture, taste, and finally the overall acceptability initially at 0 day, after 30 days, and after 60 days using 5 point hedonic scale (Ranganna, 1992). A schedule was developed for sensory evaluation i.e. for assessment of colour, flavour, texture, taste and overall acceptability of the product. In order to eliminate bias, the products were undisclosed as to the fact to the type of oil that was used, and were assigned codes as blend 1, blend 2 and so on till blend 12. The intent of the study was to determine how well the oil blends performed nutritionally, in sensory evaluation and oil stability and usage though a controlled 60 day storage.

Chemical analysis
The RTE extruded snack was stored for a period of 60 days and the oil was extracted from the product using soxhlet apparatus at 0, 30, 60 days. The extracted oil samples were analysed for various rancidity parameters such as acid value, peroxide value, free fatty acids (% oleic acid), para anisidine value, totox value, thio-barbituric acid value and kreis test by standardized methods. The data was tabulated and subjected to analysis of variance, tests of significance, means and standard deviation. The package used for the analysis was SPSS 15.0, Windows version.

Results and Discussion
In India, oils and fats are extensively used for the preparation of deep fat fried products. Substantial part of dietary fat is derived from such products. Assessment of quality of frying oil used for considerable period is necessity to provide a limit for judging its suitability from stand point of health and nutrition.

Fatty acid Composition
Oils and fats form an integral part of the dietaries all over the world. Chemically they are complex mixtures of esters of fatty acids and glycerol. Fat in the liquid state is known as oil. There are various types of fatty acids present, which may be saturated and unsaturated in nature. Hence, the composition of the different fats/oils depend upon the types of fatty acids present namely stearic, oleic, palmitic, recinolic etc. Fatty acid composition of some edible fats and oils are tabulated in table 1.

Table 1: Fatty acid composition of different oils

Oils/ fats	Unsaturated / saturated ratio	Saturate					Mono unsaturated	Poly unsaturated	
		Capric acid	Lauric acid	Myristic acid	Palmitic acid	Steric acid	Oleic acid	Linoleic acid	Alpha linoleic acid
Soybean oil	5.5	-	-	-	14	6	28	58	6
Sunflower oil	7.6	-	-	-	8	7	16	64	2
Ricebran oil	4.8	-	-	-	6	6	16	52	4

Quality characteristics of individual oils
The quality characteristics of individual oil selected in the experiment is discussed under the following two sub-heads to study physic-chemical characteristics of the oils.

Physical characteristics
In this section, the most important parameters of colour and spread ability of individual oils are

a) Colour
The sunflower oil is of light amber in colour when it is crude on refining the oils the colour changes to pale yellow in colour. Rice bran oil changes to dark yellow to yellow in colour it is taken from the brown rice or rice bran. Palm oil is red in colour or orange red in colour when it is crude because of the carotenoids present when it is refined it undergoes golden yellow in colour. Soybean oil is dark brown colour when it is refined it is changed to clear light yellow in colour.

b) Spread ability
The main purpose of testing spread ability of oil is mainly to predict the different oil. The spread ability test is carried out using line spread chart. Spread ability of individual oil Sunflower oil is very high (11cm), rice bran oil is (8 cm), Soybean oil (6 cm) and Palm oil has very low spread ability. The results are

Chemical parameters
The important chemical parameters to assess the quality and shelf life stability of any oil are free fatty acid value, Peroxide value, Iodine number and saponification number. Hence in the present study these quality parameters are tested at the laboratory using standard procedures and presented in the table 2 for convenience, each parameter is depicted graphically and discussed separately in the section.

Table 2: Chemical quality analytical tests of different oils

S. No.	Individual oils	FFA value (Mg KOH/g oil)	Peroxide value (Meq)	Iodine number (Mg12/g oil)	SPN number (Mg KOH/g oil)
1	Soybean oil	0.6	0.4	0.7	0.7
2	Sunflower oil	0.4	0.3	0.6	0.14
3	Rice bran oil	0.5	0.2	0.6	0.16

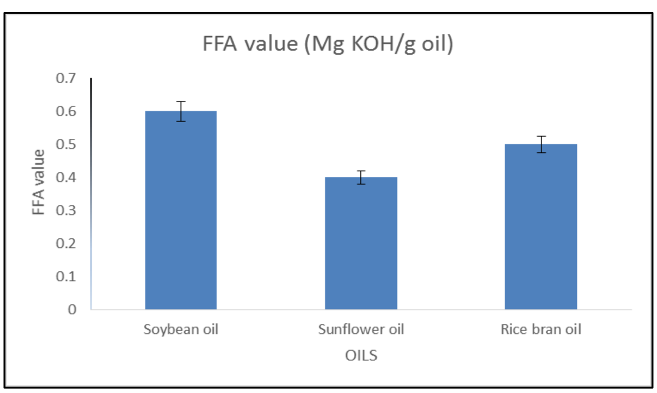

Fig 1: Free fatty acid values for individual oils

The free fatty acid values of different individual oils are plotted in figure1. Free fatty acid values helps to estimate the quantity of palmitic, leuric and oleic acid content in different oils. The values of the oils are soybean oil (0.6mg), sunflower oil (0.4mg) and rice bran oil (0.5 mg).

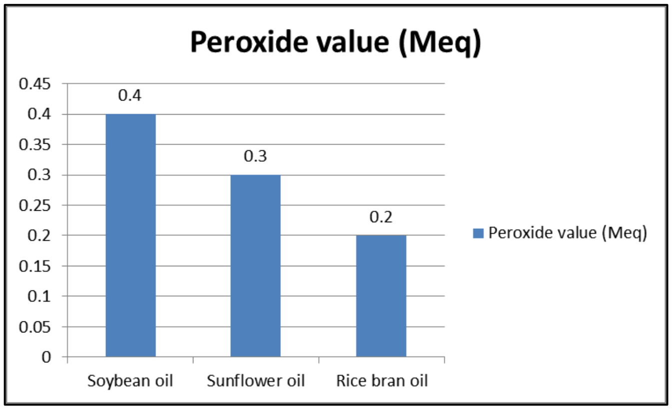

Fig 2: Peroxide values for individual oils

Detection of peroxide value gives the initial evidence of rancidity in unsaturated fats and oils. Other methods are available, but peroxide value is most widely used. It gives measure of the extent that which oil sample has undergone primary oxidation, extent of secondary oxidation and further rancid values. The peroxide values for sunflower oil is high (0.3meq) and next to the soyabeanoil is (0.24meq), and rice bran oil contain same amounts (0.20meq) of peroxide value.
The sensory parameters such as colour, flavor, texture, taste and overall acceptability of any food product depends on the extent of oxidation of fats and oils in the food due to the formation of peroxides, aldehydes and ketones.

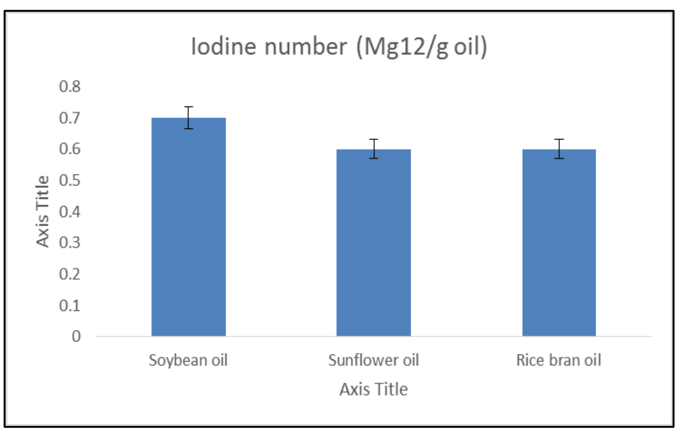

Fig 3: Iodine number for individual oils

Iodine number in chemistry is the mass of iodine in grams that is consumed by 10 grams of a chemical substance. Iodine numbers are often used to determine the amount of unsaturation in fatty acids. This unsaturation is in the form of double bonds, which react with iodine compounds. Higher the iodine number, more C=C bonds are present in the fat. On the other hand rice bran oil and sunflower oils are highly unsaturated which makes it a drying oil, well suited for making an oil plant. Iodine number for palm oil contains high amount (0.9 mg) of iodine number and next to soybean oil (0.7mg) when compared with sunflower oil and rice bran oil (0.6 mg).

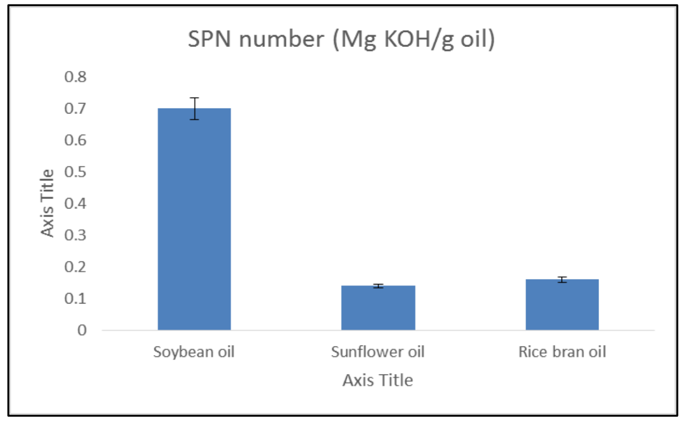

Fig 4: Saponification number for individual oils

It is a measure of the average molecular weight of all the fatty acids present. As most of the mass of a fat/tri ester is in the 3 fatty acids, it allows for comparison of the average fatty acid chain length. Long chain fatty acids found in the fats have a low saponification values because they have a relatively fewer number of carboxylic functional groups per unit mass of the fat as compared to short chain fatty acids. Figure 4 denotes that maximum of saponification number is observed in soy bean oil (0.7 mg) followed by sunflower oil, rice bran oil (0.14 mg, 0.16 mg) respectively.

Quality characteristics of blended oils
Physical characteristics

a) Colour
The colour of the blended oils is different from the individual oils. It shows slight variance.
In the blended oils, when the soybean oil blended with sunflower oil it shows pale yellow colour, soybean oil with rice bran oil shows yellow colour, soybean oil with palm oil gives golden yellow colour. Sunflower oil with rice bran oil gives light yellow colour, sunflower oil with palm oil gives golden yellow colour and the palm oil combines with the rice bran oil shows yellow colour. These are the different variations of colour in the blended oils.

b) Spreadability
The main purpose of testing spreadability of oils is mainly to know the viscosity of different oils. Spreadability is the test which is also used mainly for the baking and gel formation of oils in commercial purpose. It is mainly used for the post-baking spreading in industries. Spreadability is tested by using the line spread test. The spreadability of the blended oil combination of soy bean oil and the sunflower is very high (12 cm). Spreadability of the combination of soy bean oil and rice bran oil contains (9 cm). Spreadability of the combination of sunflower oil with rice bran oil (8cm) and the sunflower oil with palm oil (7 cm). The blended oils with soybean oil and palm oil are very low (5 cm). Because of thickness the spreadability time is more for these oils. So, the spreadability is very poor in the oil of palm mixed with other individual oils.
Miller *et al*., (2000) studied on viscosity and heat transfer coefficients for canola, corn, palm and soybean oil and concluded that the frying time and oil temperature significantly affected viscosity and also showed greatest increase in corn oil viscosity over 36 hr.

Chemical characteristics

The chemical parameters of the blended oils are very important to assess their shelf life, quality of the combination of oils.

Table 3: Chemical quality analytical tests of blended oils

S. No	Mixed oils	FFA value (Mg KOH/g oil	Peroxide value (Meq)	Iodine number (Mg 12/ g oil)	SPN value (Mg KOH/ g oil)
1	SB+SF	0.6	0.4	0.6	0.28
2	SB+RB	0.5	0.2	0.4	0.25
3	SF+RB	0.5	0.2	0.5	0.4

According to the figure the free fatty acid values are very high (0.3 mg) in combination of soya bean oil mixed with sunflower oil (0.5 mg), soya bean oil mixed with rice bran oil (0.5 mg), sunflower oil mixed with rice bran oil (0.5 mg) and sunflower oil mixed with palm oil (0.3 mg). It reflects the freshness and the deterioration of the materials and also the quantity of glycerol to be released as a result of neutralization of oils. High acidity oils or fats produce excess smoke during heating.

If the fat frying oil is over used in frying process, the triglycerides may produce thermal oxidative materials. The differences in stability of various oils are due to the other natural antioxidants quoted by Stephen *et al*., (1978).

Peroxide vale for different combinations of oils

According to the graph the saturated fat palm oil shows high rancidity. When palm oil mixed with soybean oil, sunflower oil and rice bran oil these combinations show high points peak points of (0.4meq) in peroxide estimation. It is less in combinations of rice bran oil mixes with soybean oil and sunflower oil which is only 0.2 meq. The peroxide value is 0.2neq in the blending sample of soybean and rice bran oil.

From the above quoted data, it can be discussed that palm oil as it exhibits high oleic acid performs much greater stability against oxidative deterioration than the normal seed oil supported by Sharon *et al*., (1969). Due to this lesser increase in the free fatty acid and peroxide value is observed in palm oil.

Iodine number for combination of oils

Rice bran oil and sunflower oils are good cooking oils because of the drying. According to the graph, when soybean oil mixes with sunflower oil it contains (0.6 mg) high iodine number. When sunflower oil mixes with rice bran oil (0.5 mg) low iodine number for soybean oil mixed with rice bran oil (0.4 mg). These combinations are good for cooking.

Saponification number for combination of different oils

According to the plotted graph soybean oil when mixed with rice bran oil shows saponification number of 0.25 mg. At the same time soy bean oil mixes with sunflower oil (0.18mg) and sunflower oil mixes with rice bran oil shows medium range (0.4mg) of saponification.

Comparison of blended oil products

Soft, hard and crisp texture of the product shows a great impact on consumption rate of the product. Texture doesn't give any significant variance with the blended oils. Sunflower and soya bean oil combination shows good texture (7.35%). Remaining all the combinations soybean oil mixed with rice bran oil (7.28%), soybean oil mixed with rice bran oil, (7.16%) shows almost similar texture of the product. According to the data available from the table, when blended oils are compared with each other in their appearance, texture, taste, color, flavor and overall acceptability there is a 5 percent significant difference between appearance and one percent significant difference (P<1%) in color are observed. Texture, taste, flavor and overall acceptability didn't show any significant difference.

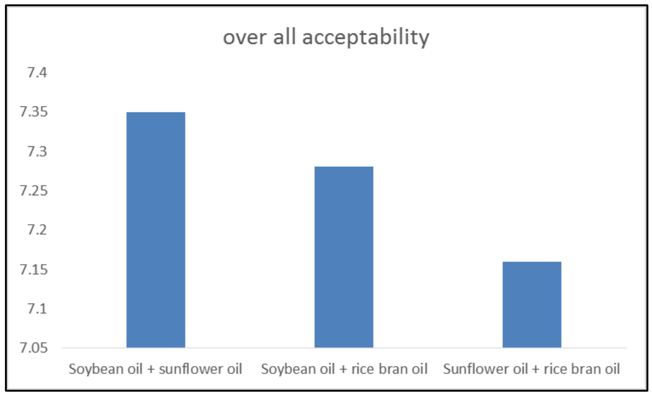

Fig 5: over all acceptability of blended oils

The cooking quality characteristics of all blended oils clearly demonstrated well acceptance score of all the five sensory characteristics and thus including good overall acceptability. The present experimental research is much interesting and helpful to promote blending of different oils for the better wellbeing instead of adhering to the common usage of any single oil individually. Texture and flavor shows the significant difference of five percent (p>5%). The combination of sunflower oil, soybean oil and the rice bran oil gives good texture and appearance because of their dry nature.

Conclusion

The present study "deep fat frying factors of selected oils and oil blends'' is carried out to find out the "quality parameters of blended oils''. In the deep fat fried products by taking into consideration the factors like temperature and acceptability studies etc. The oils selected for this present study are 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 acceptability in the selected product "snack". The effect of temperature on the acceptability of oil by the product is observed. The acceptability studies of the product fried in selected oils and oil blends and the variations in snacks has been conducted. The proportions selected for the blended oils are 50:50 percent because of their higher acceptability. This was because of the toxics present in the some oils like ground nut oil and soybean oil etc.

From the above results, it can be discussed that the snacks fried in soybean oil gained maximum acceptability of oil in almost all the variations. Acceptability scores attained "maximum" by the product fried in the soybean medium as well as prepared with other variations. But other oils did not reach the score equivalent to soybean oil. The "excellent'' scores are attained to product fried in soybean and Soybean + Sunflower oils blend. Among the high linoleic acid oils, soybean oil is considered best and among the blends, soybean sunflower oil is found to give beneficial results next to palm oil with minimum increases in the peroxide values free fatty acid, iodine and saponification values. It is statically proved that the effect of type of the oil with appearance of the product is highly significant at 1 percent level. The colour of the product also found to be highly significant at five percent level.

The above data can be collected that on the whole, rice bran oil and among blends soybean sunflower is found to exhibit positive results. Thus it can be suggested that soybean oil should be used as a good frying media oil by the product from the health point of view and the blending of oils should be done attain better results as revealed from this study. These practices can be applied in the households levels easily but commercially also, it should be checked that such practices are followed well by fast food outlets, hotels, industries etc. for better and beneficial results. Thus products as such prepared attain good flavor, aroma and crisp appearance which will have immense popularity among all classes of people.

References

1. Chu Y H, Kung YL. A study on vegetable oil blends. Food Chemistry. 1998; 62:191-195.
2. Siddique BM, Anees A, Ibrahim MH, Sufia H, Rafatullah M *et al*. Physico-chemical properties of blends of palm olein with other vegetable oils. Grasas y Aceites. 2010; 61:423-429.
3. Rotondi A, Bendini A, Cerretani L, Mari M, Lercker G *et al*. Effect of olive ripening degree on the oxidative stability and organoleptic properties of cv. Nostrana di Brisighella extra virgin olive oil. J Agric Food Chem. 2004; 52:3649-3654.
4. Henna Lu FS, Tan PP. A Comparative study of storage stability in virgin coconut oil and extra virgin Olive oil upon thermal treatment. International Food Research Journal. 2009; 16:343-354
5. Sidwell CG, Harold S, Milado B, Mitchell JH. The use of thiobarbituric acid as a measure of fat oxidation. J Am Oil Chem Soc. 1954; 31:603-606.
6. Waltking AE, Wessels H. Chromatographic separation of polar and nonpolar components of frying oils. Journal of the Association of Official Analytical Chemistry. 1981; 64:1329-1330.
7. Saguy IS, Shani A, Weinberg P, Garti N. Utilization of jojoba oil for deep-fat frying of foods. LWT Food Sci Tech. 1996; 29:573-557.
8. Gomez KA, Gomez AA. Statistical procedures for agricultural 446 researches. Wiley, New York, 1984.
9. Cheikh-Rouhou S, Hentati B, Besbes S, Blecker C, Deroanne C *et al*. Chemical Composition and Lipid Fraction Characteristics of Aleppo Pine (Pinushalepensis Mill.) Seeds Cultivated in Tunisia. Food Sci Tech Int. 2006; 12:407-415.
10. Okafor JNC, Mordi JI, Ozumba AU, Solomon HM, Olatunji O. Preliminary studies on the characterization of contaminants in tigernut (Yellow variety). In Proceedings of 27th annual Nigerian Institute of Food Science and Technology (NIFST) conference. 2003, 210-211.
11. Belewu MA, Abodunrin OA. Preparation of Kunnu from Unexploited Rich Food Source: Tiger Nut (Cyperusesculentus). Pakistan Journal of Nutrition 2008; 7:109-111.
12. Adekanmi OK, Oluwatooyin OF, Yemisi AA. Influence of Processing Techniques on the Nutrients and Antinutrients of Tigernut (Cyperusesculentus L.). World J Dairy & Food Sci. 2009; 4:88-93.
13. Fritch CW. Measurements of frying fat deterioration: A brief review. J Am Oil Chem Soc. 1981; 58:272- 274.
14. Codex Alimentariu S. Codex standard for named vegetable oils, CODEX STAN 210-1999, Page 1 of 16 Adopted 1999. Revisions 2001, 2003, 2009. Amendment 2005, 2011, 1999.
15. Peled M, Gutfinger T, Letan A. Effect of water and BHT on stability of cottonseed oil during frying. J Food Sci Agric. 1975; 26:1655-1666.
16. Abdel-Aal MH, Karara HA. Changes in corn oil during deep-fat frying of foods. Lebensm.-Wiss. Technol. 1968; 19:323-327.
17. Nawar WW. Thermal degradation of lipids. J Agric Food Chem. 1969; 17:18-21.
18. Perkins EG. Formation of non-volatile decomposition products in heated fats and oils. Food Technol. 1967; 21:125-130.
19. Shahidi F, Wanasundara UN. Methods for measuring oxidative rancidity in fats and oils. In Akon, C. C. and Min, D. B. (Eds). Food Lipids: Chemistry, Nutrition and Biotechnology, New York: Marcel Dekker, 2002, 387-403.
20. Marina AM, Che Man YB, Nazimah SAH, Amin I. Chemical properties of coconut oil. Journal of the American Oil Chemists' Society. 2009; 86:301-307.