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RESEARCH ARTICLE

PHYSICO-CHEMICAL AND SENSORY EVALUATION OF DIFFERENT VANASPATI GHEE AVAILABLE IN PAKISTAN

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Abstract

The purpose of the present work was to access the physic-chemical and sensory quality of 40 brands of Vanaspati ghee commercially available in Pakistan. The quality of Vanaspati ghee is determined in term of different physicochemical tests such as free fatty acid value, rancidity, color, smell, physical appearance, refractive index, and presence of vitamins. Analysis results showed that Free Fatty Acid value and rancidity value significantly deviate from the standards set by Pakistan Standard and Quality Control Authority (PSQCA). While color, refractive index, appearance and smell values are in compliance with the standards set by PSQCA. Analysis results also disclose that only 52.5% brands contain vitamins and only 3 brands were found to meet with all major national and international specifications. The above results showed severe deviation of product development from the standards of PSQCA.

Keywords: vanaspati ghee, quality evaluation, brands, PSQCA, food safety

Introduction

Vanaspati ghee is a cheaper substitute of animal fat. It is manufactured by fully or partially hydrogenation of cooking oils of plant source by applying low medium pressure and in the presence of nickel catalyst (Che Man and Tan, 1999). Mostly palm oil and cotton seed oil are used in the manufacturing of Vanaspati ghee. In Pakistan it is also known as banaspati ghee. During the manufacturing of Vanaspati ghee Tran's fats are produced which are dangerous for human health and cause numerous diseases in human such as cardiovascular diseases, cancer and obesity (Gebauer, 2011).

Oils and fats play a vital role in the economy of a country such as Pakistan where a huge amount of foreign exchange is spent on import of raw cooking oils especially palm oil.

In recent years there is a rapid increase in cooking oil refining industry in Pakistan due to rapid increase in the demand but it is observed that mostly industries fail to compliance with the standard set by Pakistan Standard Quality Authority (PSQCA). The quality of Vanaspati ghee can be judged by performing different physicochemical tests. Free fatty acid analysis provides useful informations about the raw cooking oil quality, effectiveness of neutralization

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process and storage condition (Mehmood *et al.*, 2012). Increased level of free fatty acid may cause many metabolic defects in humans including insulin resistance and other health defects (Karpe *et al.*, 2011). Peroxide value is also an important indicator of quality of oils and fats. Peroxide value is also used to measure the oxidative rancidity (Rossel, 1986).

Oxidation of oils and fats is one of the important quality parameter commonly used to evaluate their quality. During oxidation processes many the odorous compounds are produced. Their presence is able to decrease the nutritional quality of product and produce such compounds which are dangerous for health (Addis and Park, 1989). Color indicate whether the product is proper bleached or not and presence of coloring pigments. Sunlight play very important pole in development of rancidity. To avoid such type of rancidity protection of oils and fats against light is needed. Fluorescent light also can affect the stability of oils and fats (Sohail *et al.*, 2010; Ahmed, 2011).

The main purpose of present study was to asess the quality of Vanaspati ghee manufactured and marketed by different companies in Pakistan, as there were a limited number of surveys conducted to assess the quality of commercially available ghee in Pakistan. Recently, we have published quality evaluation of commercially available vegetable oils in Pakistan and the results shows severe deviation of standards set by PSQCA (Mehmood, 2012).

Materials and Methods

Vanaspati ghee samples were collected from different local markets of Pakistan. A total of 40 different brands having packaging of (250 g to 16 kg) were studied. These samples were brought to laboratory in original packaging through transportation. Before analysis the samples have been stored for five hours at room temperature (~25^{o}C) to avoid the temperature effects on different parameter of Vanaspati ghee.

Physico-chemical analysis

Vanaspati ghee samples were analyzed for free fatty acid (FFA) value by using AOAC method no. 41.1.21 (AOAC, 2000). Rancidity, weight, refractive index, color and presence or absence of vitamins was analyzed by using PSQCA method. No. PS-2858-2003 (R) (PSQCA, 2003).

Sensory evaluation

Six trained and experienced food technologists (judges) have been used to evaluate the organoleptic characteristics of Vanaspati ghee samples by using the method of Larmond (Larmond, 1977). The sensory testing was made in the panel room where the temperature and relative humidity was controlled. Judges were provided with prescribed questionnaire to record their sensory observations. The information contained on the sensory Performa was indicated as 9-Like extremely, 8-Like very much, 7- Like, 6-Like slightly, 5-Neither like or nor dislike, 4- Dislike slightly, 3-Dislike moderately, 2-Dislike, 1-Dislike extremely.

Statistical analysis

Frequency distribution along with standard deviation and Z-test was carried out. Each sample was subjected to analysis in triplicate and mean values were calculated. The significance level was established at $P<0.05$ (Steel *et al.*, 1997).

Results and Discussion

Free fatty acid value (FFA)

The results of free fatty acid value of Vanaspati ghee samples were shown in Fig 1. The data revealed a significant deviation ($P<0.05$) of FFA value from the standard value (≤0.2%) set by PSQCA for Vanaspati ghee. The FFA value of Vanaspati ghee recorded in samples was in the range of 0.33 ± 0.004 and 0.08 ± 0.002. From all 40 samples studied only 30 samples were in compliance with standards set by PSQCA while remaining 10 samples did not fulfill the required criteria (Table 1).

Analysis revealed that 27.5% of samples were found in good quality (0.068-0.13%), 47.5% samples were of acceptable quality (0.14-0.20), 12.5% samples were of low quality (0.21-0.27).

Rancidity

Rancid Vanaspati ghee samples present undesirable flavor and color (Karpe *et al.*, 2011). The mean rancidity values of different Vanaspati ghee brands are shown in Figure 2.

These values significantly deviate ($P<0.05$) from standard value (≤ 3r). Rancidity values obtained from the analysis ranged from 0 to 15r.

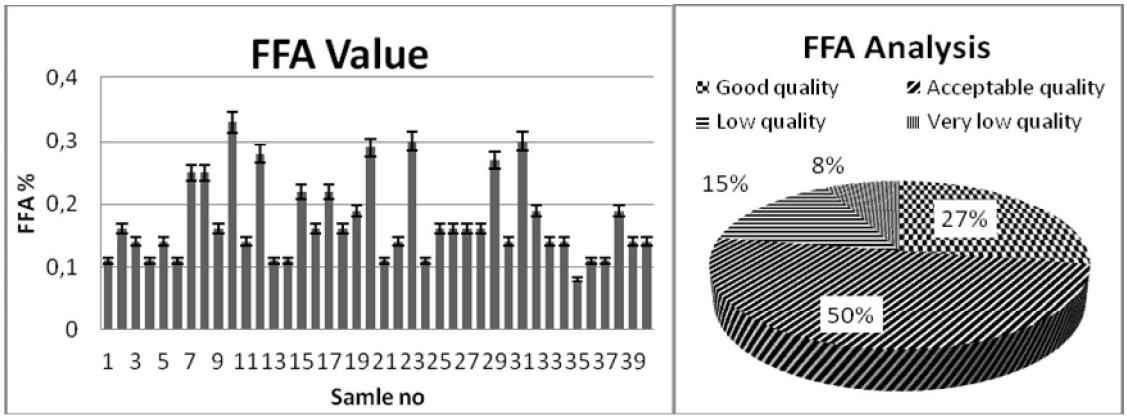

Figure1. *Free fatty acid variation in 40 Vanaspati ghee samples*

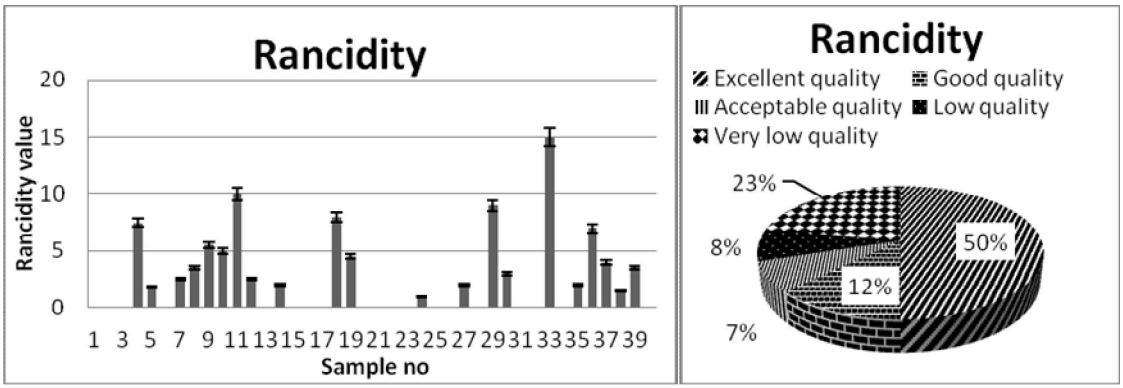

Figure2. *Rancidity variation in 40 Vanaspati ghee samples*

Analysis results showed that 28 samples were incompliance with value set by PAQCA and 12 samples shows deviation form prescribed value set by PSQCA (Table 1).

Rancidity values obtained from analysis also revealed that 50% samples was of excellent quality (<1.1), 12.5% was of good quality (1.1-2), 7.5% has acceptable quality (2.1-3), 7.5% lies in low quality (3.1- 4), while remaining 22.5% samples were of very low quality (>4) (Fig.3).

Good manufacturing practices (GMP) and proper storage conditions can control rancidity problem in fat and oil industry.

The rancidity problem can be solved by the addition of suitable antioxidants to the product (Che Man and Tan, 1999).

Color

Color of the Vanaspati ghee is due to the presence of some coloring pigments. Figure 3 and 4 presents color values for different cooking oil brands.

Highest value of color was recorded in sample 7 (Brand name not disclosed) (Y: 52-R5.2), followed by sample 28 (Brand name not disclosed). Minimum value (Y: 27-R: 2.7) was recorded in sample 3.

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Table 1. *Frequencies distribution of 40 Vanaspati ghee samples in term of FFA, Rancidity, and Color*

Frequency distribution of color			Frequency distribution of color y		
No	**Ranges of values**	**No of samples**	**No**	**Ranges of values**	**No of samples**
1	< 1.67	0	1	< 16.67	0
2	1.67 – 3.33	17	2	16.67 – 33.33	17
3	3.33 – 5.00	22	3	33.34 – 50.00	22
4	> 5.00	1	4	> 50.00	1
Frequency distribution of free fatty acid values			Frequency distribution of rancidity		
No	**Ranges of values**	**No of samples**	**No**	**Ranges of values**	**No of samples**
1	< 0.068	0	1	< 1.1	20
2	0.068 – 0.13	11	2	1.1 – 2.0	5
3	0.14 – 0.20	20	3	2.1 – 3.0	3
4	0.21 – 0.27	6	4	3.1 – 4.0	3
5	> 0.27	3	5	> 4.0	9

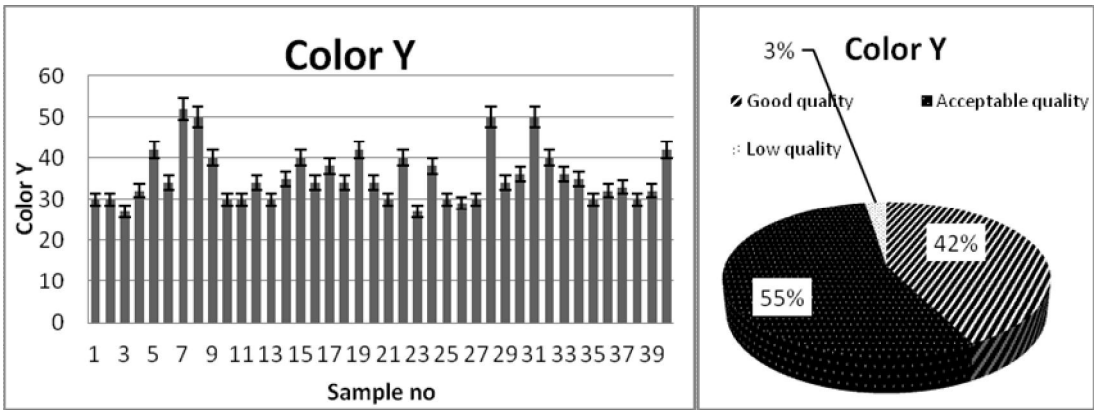

Figure 3. *Color Y variation in Vanaspati ghee samples of different brands of Pakistan*

Color values are satisfactory in most of the Vanaspati brands except the sample 7 (Table. 1). Analysis showed that 42.5% of samples lie in good quality range (16.67-33.33y-67-4.33r), 55% of samples was of good quality (33.34-50y and 3.33-5r) and only 1 sample was of low quality (›50y and ›5r) (Figure 4 and 5).

High color values are probably due to poor bleaching process that was performed during processing of raw oil.

Vitamin addition

There is a deficiency of vitamin A in a considerable segment of Pakistani population (GOP, 2011).

As it is a fat soluble vitamin, PSQCA recommended the addition of vitamin A in a range of 33000 IU ± 10% in Vanaspati ghee. But the existing practical situation is totally different.

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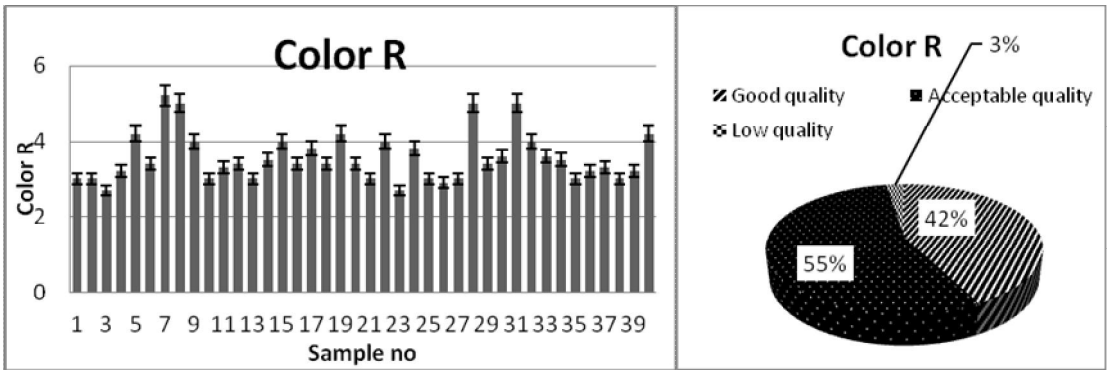

Figure 4. *Color R variation in Vanaspati ghee samples of different brands of Pakistan*

From 40 samples which were subjected to analysis for presence of vitamin only 47.5% samples showed presence of vitamin and more than half (52.5%) samples contain no vitamin addition (Figure 5).

Above results confirms that most of the Vanaspati ghee industry does not follow the standard set by PSQCA.

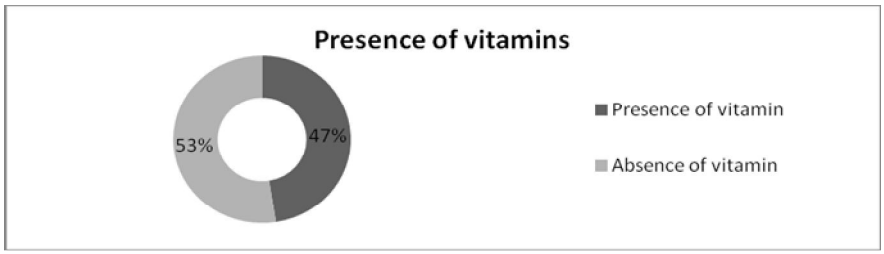

Figure 5. *Presence of vitamin in Vanaspati ghee samples*

Smell/Odor

Smell score of different Vanaspati ghee brands were given in Fig.6. Smell score range from 2 to 8.5. 75% samples have smell score according to standard (Table 2). Organoleptic evaluation results also showed that 5% samples was of excellent quality (>8.1), 17.5% was of good quality (6.6-8.1), 52.5% had acceptable quality, (5-6.5), 17.5% samples was of low quality (3.4-4.9) and remaining 7.5% samples was of very low quality (<3.4).

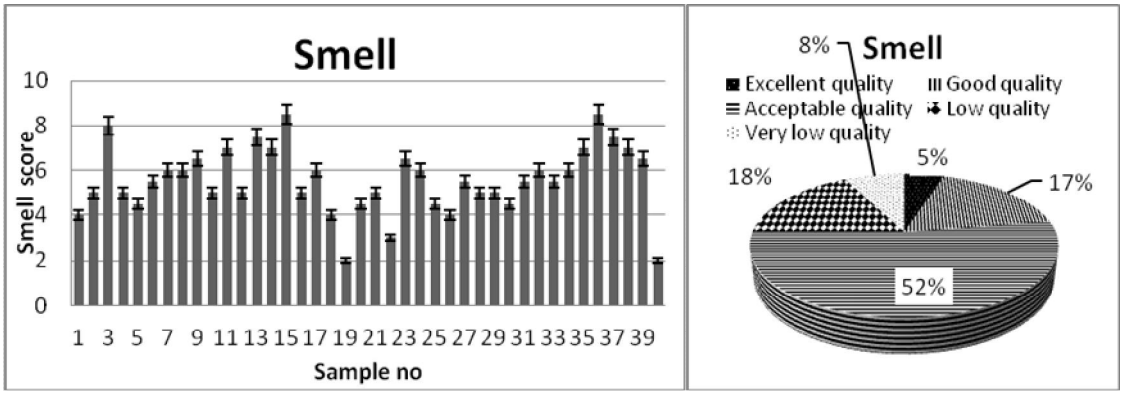

Figure6. *Smell variation in Vanaspati ghee samples of different brands*

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Table 2. *Frequencies distribution of 40 Vanaspati ghee samples in term of Weight, Smell, Foreign matter, appearance and refractive index*

Frequency distribution of smell			Frequency distribution of appearance		
No	**Ranges of values**	**No of samples**	**No**	**Ranges of values**	**No of samples**
1	< 3.4	3	1	< 3.4	3
2	3.4 – 4.9	7	2	3.4 – 4.9	10
3	5.0 – 6.5	21	3	5.0 – 6.5	13
4	6.6 – 8.1	7	4	6.6 – 8.1	11
5	> 8.1	2	5	> 8.1	3

Frequency distribution of refractive index		
No	**Ranges of values**	**No of samples**
1	< 40	3
2	40 – 48	10
3	> 48	27

Appearance

Appearance score of different Vanaspati brands were given in Fig. 7. Most of the brands presented satisfactory appearance. Appearance score ranged from 2-8.5. Appearance score of 27 samples (67.5%) was in accordance to standard i.e. 5. The remaining 13 samples (32.5%) were of unacceptable quality (Table 2). Organoleptic evaluation results revealed that 7.5% samples was of excellent quality (>8.1), 27.5% was of good quality (6.6-8.1), 32.5% has acceptable quality (5-6.5), 25% were of low quality (3.4-4.9) and remaining 7.5% samples was of very low quality (<3.4) range (Fig.7).

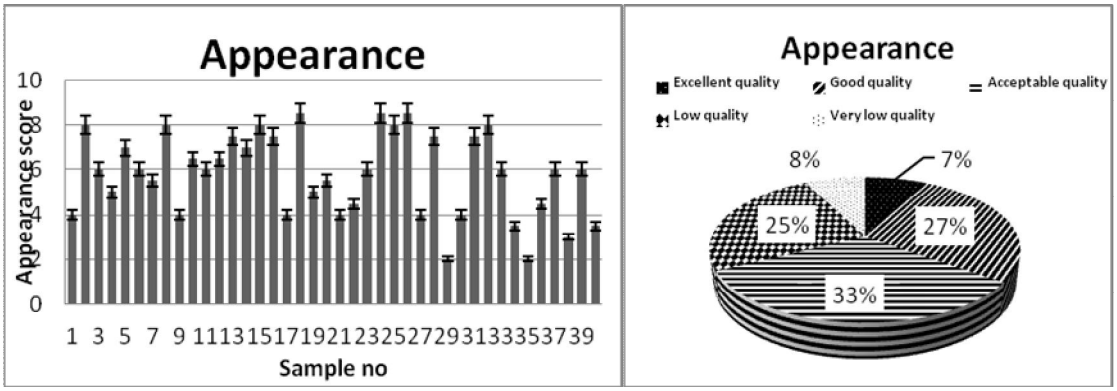

Figure 7. *Physical appearance of 40 Vanaspati ghee samples*

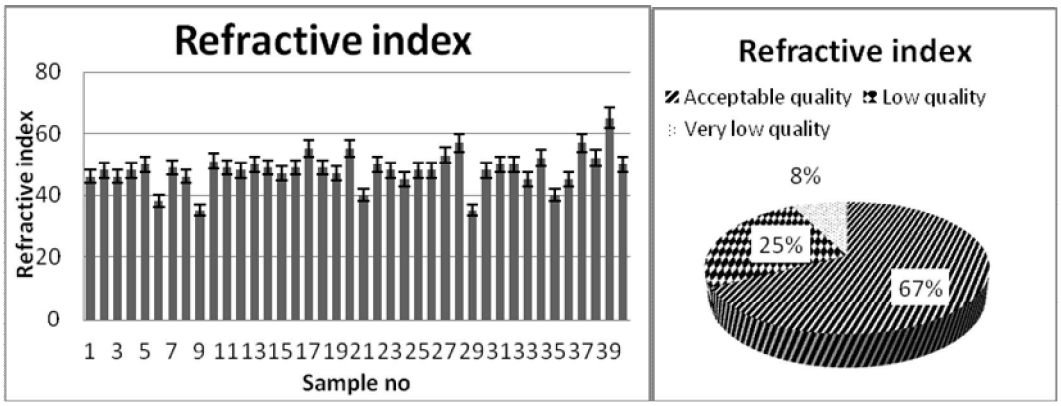

Figure 8. *Refractive index of 40 Vanaspati ghee samples of different brands*

Refractive index

Refractive index value of different Vanaspati brands was shown in Fig. 8. The values ranged between 35 and 65. Out of 40 samples only 27 samples (67.5%) were in accordance to standard set by PSQCA (Table 2).

Results also showed that 67.5% samples lie in satisfactory quality range (>48), 25% was of low quality (40-48) and remaining 7.5% samples was of very low quality (< 48) range (Fig. 8). The value of refractive index increases with the increase of unsaturation as well as increase in chain length of fatty acid (Hamilton, 2008).

Conclusions

From these results it is proved that severe deviation exists in quality of Vanaspati ghee commercially available in Pakistan from the standards set by PSQCA. The values of free fatty acids and rancidity were significantly high as compared to standard values. It is therefore necessary for the government to take immediate steps to control quality of Vanaspati ghee. By this way healthy and nutritious Vanaspati ghee will be available for consumer.

References

Addis P.B., Parks. (1989) Role of Lipid Oxidation Products in Atherscicrosis. In: Taylor S.L., Scanlan R.A., Dekker M. (ed.): Food Toxicology a perspective on the Risks, 297-330. New York, USA.

Ahmed T., Atta S., Sohail M., Khan. A.R., Akhtar, S. (2011) Effect of fluorescent light on quality and stability of edible fats and oils, *Journal of Chemical Society of Pakistan*, 33, 233- 237.

AOAC (2000) Official Methods of Analysis. The Association of the Official Analytical Chemists, 17th ed, Arlington, USA.

Che Man Y.B., Tan C.P. (1999) Effects of natural and synthetic antioxidants on changes in refined, bleached, and deodorized palm olein during deep-fat frying of potato chips., *JAOCS*, 76, 331-339.

Gebauer S.K., Destaillats F., Mouloungui Z., Candy L., Bezelgues J.B., Dionisi F., Baer, D.J. (2011) Effect of trans fatty acid isomers from ruminant sources on risk factors of cardiovascular disease: Study design and rationale, *Contem. Clin. Trials*, 32, 569-576.

GOP (Government of Pakistan). (2011) National Nutrition Survey. Ministry of Health, Nutrition Wing, Islamabad.

Hamilton R.J. (2008) Fatty acids: structure, occurrence, nomenclature, biosynthesis and properties, In: Dijkstra A.J., Hamilton R.J., Hamm W. (ed.): Trans Fatty Acids, 1-24. Blackwell, Singapore.

Karpe F., Dickmann J.R., Fraym, K.N. (2011) Fatty acids, obesity, and insulin resistance: time for a reevaluation, *Diabetes*, 60, 2441-2449.

Larmond E. (1977) Laboratory Methods for Sensory Evaluation of Food, Research Branch Canada, Dept. Of Agric. Publication, 1637.

Let M.B., Jacobsen C., Sorensen A.N., Meyer A.S. (2007) Homogenization conditions affect the oxidative stability of fish oil enriched milk emulsions: Lipid Oxidation, *Journal of Agricultural and Food Chemistry*, 55, 1773-1780.

Mehmood T., Ahmad A., Ahmed A., Khalid K. (2012) Quality evaluation and safety assessment of different cooking oils available in Pakistan, *J. Chem. Soc. Pak.*, 34, 518-525.

PSQCA (2003) Specification for Banaspati, Pakistan standards and quality control authority: Karachi, Pakistan.

Rossel J.B. (1986) Classical analysis of Fats and Oils. In: Hamilton R., Rossel J. (ed.): Analysis of Fats and Oils, 1-90. New York, USA.

Sohail M., Ahmed T., Akhtar S. and Durrani Y. (2010) Effect of sunlight on quality and stability of dietary oils and fats, *Pakistan Journal of Biochemistry and Molecular Biology*, 43, 123-125.

Steel R.G.D., Dicky V., Torrie J.H. (1997) Principles and Procedures of statistics, McGrawHill Book co. Inc. New York, USA.