RESEARCH PAPER | International Journal of Agricultural Engineering | Volume 12 | Issue 1 | April, 2019 | 129-135
ISSN–0974–2662 ■ Visit us : *www.researchjournal.co.in* ■ **DOI: 10.15740/HAS/IJAE/12.1/129-135**

Physico-chemical study of edible and composite edible oil

■ **Ratnesh Kumar, Suresh Chandra, Samsher, Vikrant Kumar, Sunil and Vipul Chaudhary**

Received : 17.01.2019; **Revised :** 23.02.2019; **Accepted :** 14.03.2019

See end of the Paper for authors' affiliation

Correspondence to :

Ratnesh Kumar
Department of Agricultural Engineering, Sardar Vallabh Bhai Patel University of Agriculture and Technology, **Meerut (U.P.) India**
Email : rkindian563@gmail.com

■ **ABSTRACT :** Edible oil, being obtained from vegetable sources, is primarily composed of fatty acids and used for cooking, medicinal and cosmetic purposes. It is estimated that about 90 per cent of vegetable oils are used for edible purposes. The sunflower oil used as based oil for replacement. The sunflower oil was replaced by (40-85), mustard, soybean and groundnut are each (5-20%). During the storage of individual and blended oil, pH, density and specific gravity value was decreased with increasing the storage period and types of storage condition. During the storage of individual and blended oil, free fatty acid was increase with increasing the storage period and types of storage condition. During the storage of individual and blended oil, iodine value was decrease with decreasing the storage period and types of storage condition. Peroxide value was increased with increasing the storage period and types of storage condition. Edible oils processing poses challenges due to its high content of polyunsaturated fatty acids and bioactive compounds. The oils refining objective is to remove completely all the minor compounds which are present in the crude oil: free fatty acids, peroxides, phospholipides, pigments, water, heavy metals and all the insoluble impurities which affect both the commercial quality and the shelf-life.

■ **KEY WORDS :** Edible oil, Free fatty acid, Peroxide value, Iodine value, pH

■ **HOW TO CITE THIS PAPER :** Kumar, Ratnesh, Chandra, Suresh, Samsher, Kumar, Vikrant, Sunil and Chaudhary, Vipul (2019). Physico-chemical study of edible and composite edible oil. *Internat. J. Agric. Engg.*, **12**(1) : 129-135, **DOI: 10.15740/HAS/IJAE/12.1/129-135.**

Vegetable oils are produced from plant seeds, commonly used for frying, baking and other types of cooking. Edible oils and fats are biological mixtures. They contain essential fatty acids which play an important role in nutrition and are also carriers of fat soluble vitamins. It is estimated that about 90 per cent of vegetable oils are used for edible purposes, while the remaining part finds industrial applications. Edible oils processing poses challenges due to its high content of polyunsaturated fatty acids and bioactive compounds. Stability of cooking oil can be defined as resistance of cooking oil to changes caused due to oxidation, heating, frying, hydrolysis and enzymatic action. Mustard oil, used as traditional edible oil in most parts of India for centuries, is well known for its medicinal utilities (Rastogi *et al.*, 2004 and Dasgupta and Bhattacharyya, 2007). Glucosinolate, the pungent principle in mustard oil, has anti-bacterial, anti-fungal and anti-carcinogenic properties, which account for many medicinal utilities of the oil (Duke, 2008). It still has and will have a special place in future for cooking purpose in kitchens of North India. Many people in developing countries, especially children under five years of age suffer from acute or chronic protein and energy shortages. There is definitely a need for food production to keep pace with the increase in the number of the world's population. In order to achieve these national development strategies in many based economy tropical countries on agriculture and

biased now towards increasing diversity of food products and consumer in order to alleviate malnutrition and pressure to strengthen and expand based industries on agriculture to ensure that their products are both healthy and safe. Soybean consumption is associated with reduced risk of cancer of the breast and prostate and may enhance survival (Zhu *et al.,* 2011; Kang *et al.,* 2012; Zhang *et al.,* 2012 and Sugiyama *et al.,* 2013). Soybean is a major source of high quality protein and Oil, and soybean seed quality is often determined by seed protein, oil, fatty acid, and mineral content. Environmental factors, such as air, light and temperature, accelerate oxidative reactions which might end in the production of off-flavors and odors associated with low molecular weight volatiles, discoloration (Navarro *et al.,* 2012). Also, oxidation induce important chemical changes of the oils that may affect directly the quality of the edible oil, generates radical oxygen species that may cause irreversible damages when reacting with biological molecules such as DNA, proteins or lipids (Bansal *et al.,* 2010 and Cabiscol *et al.,* 2010). Lipid oxidation has harmful effects on both food quality and human health. Then efforts must be made to minimize oxidation and improve oxidative stability of lipid products. The reactions during the frying/cooking process and storage conditions depend on factors such as the original quality of the oil, type of oil, concentration of antioxidants and oxygen. Other factors such as the initial content of the free fatty acids, temperature, moisture content, presence of polyvalent metal ions and unsaturated fatty acid content also affect the oxidative stability and overall quality of oil during food preparation process and storage time (List *et al.,* 2005). Peanuts, which are a rich source of Protein and essential amino acids, can help in preventing malnutrition. Moreover, peanuts contain lipids and carbohydrates which are energy rich compounds, capable of complementing the basic energy demands of the human body (Kumar *et al.,* 2018).

METHODOLOGY

All oils (Mustard oil, soybean oil, sun flower oil and groundnut oil) were purchases from Shive Sales Corporation, 252, Kotla, Mayur Vihar Phase-1 Delhi-110091 and packaging materials (PET Bottles) were purchases from local market of Meerut. Experiments were carried out to assessment of crude oil and blended oil in process and Food Engineering Laboratory of the Department of Agricultural Engineering, Sardar Vallabhbhai Patel university of Agriculture and Technology, Modipuram, Meerut. Studies were also carried out to evaluate the physico-chemical property of crude and blended oil filled in PET bottle under different storage condition. The physico-chemical and sensory attributes were analysed just after preparation and during storage of 0 and 210 days under ambient condition packaging in pet bottle.

Density:

The density of edible was calculated by mass of the sample per unit volume.

$$\text{Density} = \frac{\text{Mass of the oil (g)}}{\text{Volume of the oil (cm}^3\text{)}}$$

Specific gravity:

Specific gravity of oil is determined as the ratio of the density of oil in to the density of water at same temperature.

$$\text{Specific gravity} = \frac{\text{Density of oil}}{\text{Density of water}}$$

Peroxide value:

Weight 2 g of the oil sample a 25-ml test tube. Add 2 g of potassium iodide and 20 ml of solvent mixture ($CH_3COOH : CHCl_3 : : 2 : 1$). Loosely stopper test tube. Boil the contents of the tube within 30 seconds by placing the test tube in a boiling water bath. Boil for another 30 seconds. Cool the test tube immediately under tap water and transfer the contents of the tube into a conical flask. Add 20 ml of 5 per cent potassium iodide and 50 ml of distilled water to the flask and titrate against 0.002 N sodium thiosulphate using starch indicator towards the end (Shukla, 2003).

Peroxide value = $\frac{V}{W}$ (ml of 0.002 N. Sodium thiosulphate per g)

where,

V = ml of 0.002N. $Na_2S_2O_3$ used.

W = Weight of the sample taken in g.

Free fatty acid (Acid value):

Weigh 10 g of oil or melted fat. Dissolve the sample

in hot 100 ml of neutralized ethanol and titrate using 0.01 or 0.1 N alkali using phenolphthalein as indicator. Shake vigorously during titration and keep the solution warm. When testing oils and fats which give dark coloured solution, use the indicators as stated under determination of saponification value (Ranganna, 2005).

$$\text{Acid value as oleic acid} = \frac{\text{ml of alkali x N of alkali x 56.1}}{\text{wt of sample (g)}}$$

Iodine value:

The weight of to the sample required is 2.5 - 3.0g in the case of coconut oil and 0.15 to 0.6 g in the case of other oils depending upon the iodine value. Weigh accurately by difference, an appropriate quantity of the oil or fat (previously melted) into a clean dry 250-ml glass-stoppered conical flask, and add 10 ml of carbon tetrachloride. Add 25 ml of Wijs solution, replace the stopper after moistening with potassium iodide solution, mix and store in a dark cupboard for 30 min in the case of non-drying and semi-drying oils and 60 min in the case of drying oils. Add 15 ml of 10 per cent potassium iodide solution and 100 ml of distilled water. Titrate with 0.1 N $Na_2S_2O_3$ solution using starch as an indicator near the end point (Ranganna, 2005).

Carry out a blank determination alongside without the fat.

$$\text{Iodine value} = \frac{\text{(Blank titre – Sample titre) x N of } Na_2S_2O_3}{\text{Wt of sample (g)}} 12.69$$

Refractive index:

Refractive index was determined using a mathematical expression derived by Perkins.

RI = 1.45765 + 0.0001164 IV

where,

RI is the refractive index and IV is the iodine value

pH value:

The digital pH meter is kept at stand by position firstly then calibrating the pH 7 and pH 4 standard buffer solutions. The electrode of pH meter is dipped in test solution and the temperature knob is placed at 0°C control to the temperature of test solution. The function selector switch is set to pH and reading of digital display is allowed to stabilize, before it sample is mix or grind with 100 ml water and filtered through what man filter paper number l. The filtered sample is used for pH measurement.

■ RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

pH content:

From the data it was found of individual oil ranged between 4.3 to 5.4. While in blended oil were 4.2 to 4.6 as fresh. The constant pH was observed 4.3 in T_1 (mustard oil) and highest 5.4 in T_2 (Soybean oil) where as in case of blended oil, lowest was found in 4.3 in T_7 (SF_{55}+GN_{15}+SB_{15}+MS_{15}) and highest *i.e.* 5.2 in T_5 Sample (SF_{85}+GN_5+MS_5+SB_5). It is blended that the ratio of sunflower oil affects the pH of fresh blended oil in different concentrations. As per data, the pH was observed highest in soybean oil as compared to sunflower oil. The present studs, the sunflower oil used as based oil for replacement. The sunflower oil was replaced with soybean, mustard and groundnut combined in the ratio of 5, 10, 15 and 20 per cent each blend oil of T_5 single was observed highest than the other combination but lowest in T_7 and followed by method in ascending affected by ratio of soybean oil (5 to 20%), because the individually soybean has highest pH than the others. During the storage of individual and blended oil, pH was decreased with increasing the storage period and types of storage condition. During refrigeration of oils, the pH was observed higher followed BOD (35°C) and room storage at 210 days. In refrigeration condition, pH was found highest for T_5 and lowest T_7, in BOD pH observed highest

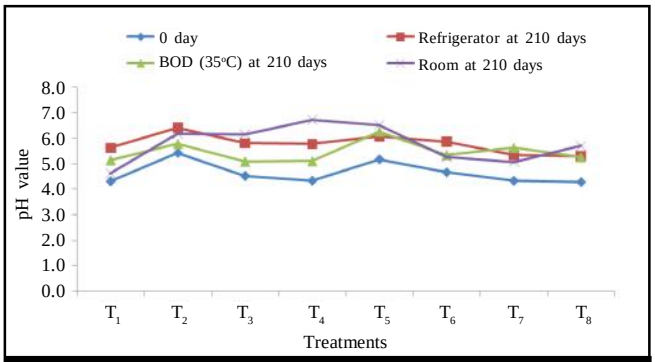

Fig. 1 : Effect of storage condition on pH of crude oil and blended oils

Description : (T_1) - MS: Mustard oil, (T_2) - SB: Soybean oil, (T_3) - SF: Sunflower oil, (T_4) - GN: Groundnut oil, (T_5) - SF (85%) + MS (5%)+ SB (5%) + GN (5%), (T_6) - SF (70%) + MS (10%) +SB (10%) + GN (10%), (T_7) - SF (55%) + MS (15%) + SB (15%) + GN (15%), (T_8) – SF (40%) + MS (20%) + SB (20%) + GN (20%)

in T_5 and lowest T_6. In room storage pH was assessed highest T_5 and lowest T_7 during storage of 210 days. From the Fig. 1, it seems that the highest pH of blended oil (T_5) was observed in room storage and lowest 5.1 for T_5 and T_7 in room temperature after 210 days of storage. The stagnant temperature of storage for 210 day can be affecting the pH of the fresh as well blended oil. The result of study also revealed that the pH increased upto 22.16 per cent in refrigerator followed by 22.16 per cent in room and lowest 21.08 per cent in BOD in storage at 210 days.

Density:

The density was found of individual oil ranged from 0.892 to 0.900 (Fig. 2). While in blended oil was observed from 0.891 to 0.898. The density was reported that 0.892 in T_1 (mustard oil) and highest in T_2 (Soybean oil) where as in case of blended oil, lowest was found in 0.891 in T_8 (SF_{40}+GN_{20}+SB_{20}+MS_{20}) and highest *i.e.* 0.898 in T_7 Sample (SF_{55}+GN_{15}+MS_{15}+SB_{15}). As per data, the density was observed highest in soybean oil as compared to sunflower oil. It is blended oil that the ratio of sunflower oil affects the fresh blended oil in different ratio. The sunflower oil was replaced with soybean, groundnut and mustard combined in the ratio of 5, 10, 15 and 20 per cent. During the storage of individual and blended oil, density was reduced with raising the storage period and different storage condition, such as refrigeration, BOD and room. Room of oils, the density was reported higher followed refrigeration and BOD (35°C) at 210 days. In refrigeration storage, density was found highest for T_2 and lowest T_8, In BOD density was recorded highest in T_2 and lowest T_6, In room storage density was observed highest T_2 and lowest T_6 during storage of 210 days can be affected the density of fresh as well as blended oil.

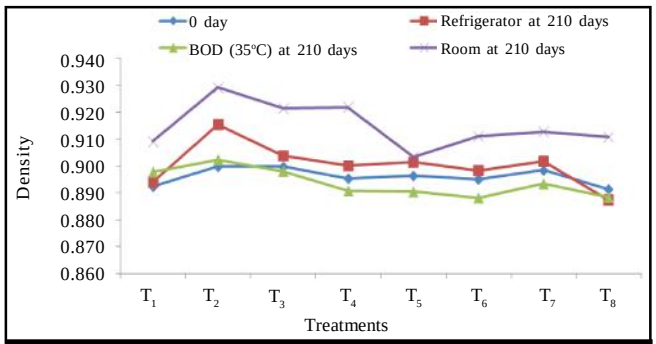

Fig. 2 : Effect of storage condition on density of crude oil and blended oils

Specific gravity:

From the data it was found that specific gravity of individual oil ranged from 0.8363 to 0.8432 (Fig. 3). While in blended oil was observed from 0.8354 to 0.8419. The specific gravity was reported that 0.8363 in T_1 (mustard oil) and highest in T_2 (Soybean oil) where as in case of blended oil, lowest was found in 0.8354 in T_8 (SF_{40}+ GN_{20}+ SB_{20}+ MS_{20}) and highest *i.e.* 0.8419 in T_7 sample (SF_{55}+GN_{15}+MS_{15}+SB_{15}). As per data, the specific gravity was observed highest in soybean oil as compared to sunflower oil. It is blended oil that the ratio of sunflower oil affects the fresh blended oil in different ratio. The sunflower oil was replaced with soybean, groundnut and mustard combined in the ratio of 5, 10, 15 and 20 per cent. During the storage of individual and blended oil, specific gravity was reduced with raising the storage period and different storage condition, such as refrigeration, BOD and room. Room of oils, the specific gravity was reported higher followed refrigeration and BOD (35°C) at 210 days. In refrigeration storage, specific gravity was found highest for T_2 and lowest T_8 ; In BOD specific gravity was recorded highest in T_2 and lowest T_6 ; In room storage specific gravity was observed highest T_2 and lowest T_6 during storage of 210 days can be affected the specific gravity of fresh as well as blended oil.

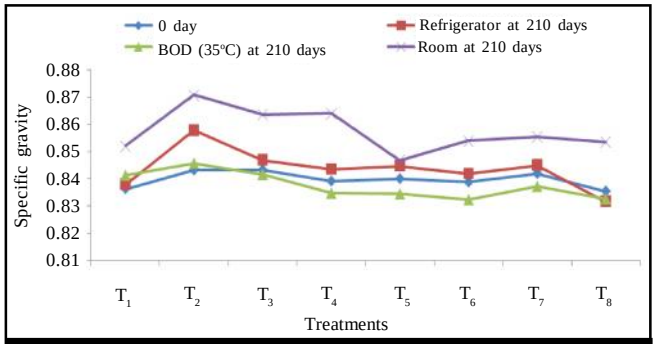

Fig. 3 : Effect of storage condition on specific gravity of crude oil and blended oils

Free fatty acid:

The free fatty acid of individual oil ranged between 0.18 to 0.19. While in blended oil were 0.15 to 0.16 as fresh. The constant free fatty acid was observed 0.18 in T_2 (soybean oil) and highest 0.19 in T_1 (mustard oil) where as in case of blended oil, lowest was found in 0.15 in T_6 (SF_{70}+GN_{10}+SB_{10}+MS_{10}) and highest *i.e.* 0.16 in T_5

Sample (SF_{85}+MS_5+SB_5+GN_5). It is blended that the ratio of sunflower oil affects the free fatty acid of fresh blended oil in different concentrations. As per data, the free fatty acid was observed highest in mustard oil as compared to sunflower oil. The present studs, the sunflower oil used as based oil for replacement. The sunflower oil was replaced with soybean, groundnut and mustard combined in the ratio of 5, 10, 15 and 20 per cent. During the storage of individual and blended oil, free fatty acid was increase with increasing the storage period and types of storage condition. During room of oils, the free fatty acid was observed higher followed refrigerator and BOD (35°C) storage at 210 days. In refrigeration condition, free fatty acid was found highest for T_6 and lowest T_7 ; In BOD free fatty acid observed highest in T_7 and lowest T_5 ; In room storage free fatty acid was assessed highest T_5 and lowest T_7 during storage of 210 days. From the Fig. 4, It seems that the highest free fatty acid of fresh oil (T_4) was observed in room storage and lowest T_2 for T_1 and T_3 in BOD temperature after 210 days of storage. The stagnant temperature of storage for 210 day can be affecting the free fatty acid of the fresh as well blended oil.

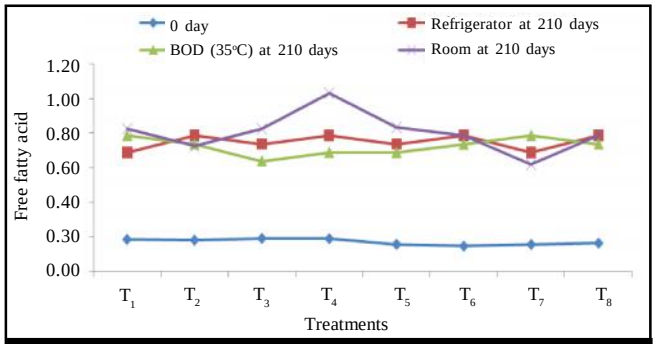

Fig. 4 : Effect of storage condition on free fatty acid of crude oil and blended oils

Iodine value:

From the data it was found that iodine value of individual oil ranged from 2.20 to 2.22. The constant iodine value was recorded 2.20 in T_4 (sunflower oil) and highest 2.22 in T_1 (mustard oil) where as in case of blended oil, lowest was found in 2.16 in T_8 (SF_{40}+GN_{20}+SB_{20}+MS_{20}) and highest *i.e.* 2.20 in T_5 sample (SF_{85}+GN_5+MS_5+SB_5). It is blended that the ratio of sunflower oil affects the iodine value of fresh blended oil in different concentrations. As per data, the iodine value was observed highest in mustard oil as compared to sunflower oil. The present studs, the sunflower oil used as based oil for replacement. The sunflower oil was replaced with soybean, mustard and groundnut combined in the ratio of 5, 10, 15 and 20 per cent. During the storage of individual and blended oil, iodine value was decrease with decreasing the storage period and types of storage condition. During refrigeration of oils, the iodine value was observed higher followed BOD (35°C) and room storage at 210 days. In refrigeration condition, iodine value was found highest for T_7 and lowest T_5 , In BOD iodine value observed highest in T_5 and lowest T_8, In room storage iodine value was assessed highest T_6 and lowest T_5 during storage of 210 days. From the Fig. 5, It seems that the highest iodine value of blended oil (T_7) was observed in refrigeration storage and lowest 1.27 for T_5 and T_8 in BOD temperature after 210 days of storage. The stagnant temperature of storage for 210 day can be affecting the iodine value of the fresh as well blended oil.

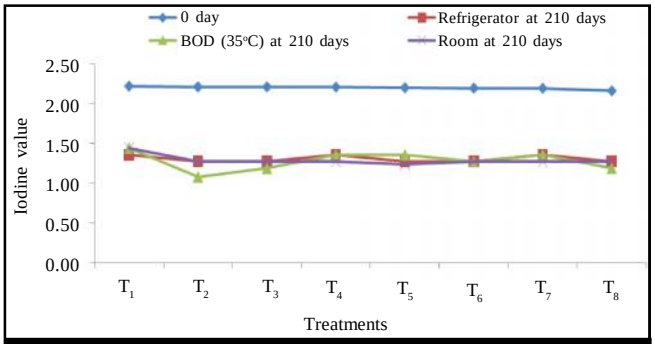

Fig. 5 : Effect of storage condition on Iodine value of crude oil and blended oils

Peroxide value:

The peroxide value of individual oil ranged between 0.16 to 0.34. While in blended oil were 0.15 to 0.21 as fresh. The constant peroxide value was observed 0.16 in T_3 (sunflower oil) and highest 0.34 in T_1 (mustard oil) whereas in case of blended oil, lowest was found in 0.15 in T_5 (SF_{85}+SB_5+MS_5+GN_5) and highest *i.e.* 0.21 in T_8 sample (SF_{40}+GN_{10}+MS_{10}+SB_{10}). It is blended that the ratio of sunflower oil affects the peroxide value of fresh blended oil in different concentrations. As per data, the peroxide was observed highest in mustard oil as compared to sunflower oil. The present studs, the sunflower oil used as based oil for replacement. The sunflower oil was replaced with soybean, mustard and

groundnut combined in the ratio of 5, 10, 15 and 20 per cent. During the storage of individual and blended oil, peroxide value was increased with increasing the storage period and types of storage condition. During room of oils, the peroxide value was observed higher followed BOD (35°C) and refrigerator storage at 210 days. In refrigeration condition, the peroxide value of blended oil highest T_8 lowest T_5; In BOD peroxide value recorded highest in T_8 and lowest T_5; In room storage peroxide value was assessed highest T_8 and lowest T_5 during storage of 210 days. From the Fig. 6, It seems that the highest pH of blended oil (T_8) was observed in room storage and lowest 0.64 for T_5 and T_8 in room temperature after 210 days of storage. The stagnant temperature of storage for 210 day can be affecting the peroxide value of the fresh as well blended oil.

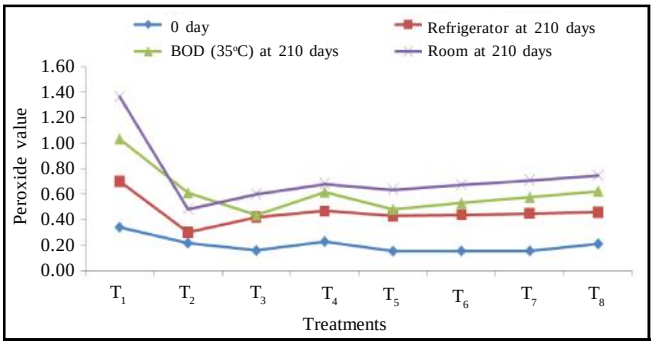

Fig. 6 : Effect of storage condition on peroxide value of crude oil and blended oils

Conclusion:

The results showed that the sunflower oil used as based oil for replacement. The sunflower oil was replaced with soybean, groundnut and mustard combined in the ratio of 5, 10, 15 and 20 per cent. The pH was observed highest in soybean oil as compared to sunflower oil. The result of study also revealed that the pH increased upto 22.16 per cent in refrigerator followed by 22.16 per cent in room and lowest 21.08 per cent in BOD in storage at 210 days. During the storage of individual and blended oil, density was reduced with raising the storage period and different storage condition, such as refrigeration, BOD and room. During the storage of individual and blended oil, specific gravity was reduced with raising the storage period and different storage condition, such as refrigeration, BOD and room. It is blended that the ratio of sunflower oil affects the free fatty acid of fresh blended oil in different concentrations. The stagnant temperature of storage for 210 day can be affecting the iodine value of the fresh as well blended oil. During the storage of individual and blended oil, peroxide value was increased with increasing the storage period and types of storage condition.

Authors' affiliations:
Suresh Chandra, Samsher, Vikrant Kumar, Sunil and Vipul Chaudhary, Department of Agricultural Engineering, Sardar Vallabh Bhai Patel University of Agriculture and Technology, **Meerut (U.P.) India**

REFERENCES

Bansal, G., Zhou, W., Barlow, P.J., Joshi, P.S., Lo, H.L. and Chung, Y.K. (2010). Review of rapid tests available for measuring the quality changes in frying oils and comparison with standard methods. *Crit. Rev. Food Sci. Nutr.*, **50**:503-514.

Cabiscol, E., Tamarit, J. and Ros, J. (2010). Oxidative stress in bacteria and protein damage by reactive oxygen species. *Inter. Microbiol.*, **3** : 3-8.

Dasgupta, S. and Bhattacharyya, D.K. (2007). Dietary effect of gamma-linolenic acid on the lipid profile of rat fed erucic acid rich oil. *J. Oleo. Sci.*, **56**: 569-577.

Duke, J.A. (2008). *Duke's handbook of medicinal plants of the bible*. CRC Press, Boca Raton, ISBN-13: 978-0-8493-8202-4, pp. 65-69.

Kang, H.B., Zhang, Y.F., Yang, J.D. and Lu, K.L. (2012). Study on soy isoflavone consumption and risk of breast cancer and survival. *Asian Pac. J. Cancer Prev.*, **13** : 995-998.

Kumar, R., Chandra, S., Samsher, Kumar, K., Kumar, T. and Kumar, V. (2018). Analysis of the physical and chemical characteristics of edible vegetable blended oil. *Internat. J. Chem. Stud.*, **6** (6) : 10-15.

List, G.R., Wang, T. and Shukla, V.K.S. (2005). *Storage, handling and transport of oils and fats.* Bailey's Industrial Oil and Fat Products.

Navarro, M., Castro, W. and Biot, C. (2012). Bioorganometallic compounds with antimalarial targets: Inhibiting hemozoin formation. *Organometallics*, **31**: 5715-5727.

Ranganna, S. (2005). *Handbook of analysis and quality control for fruit and vegetable products.* Tata Mc Graw- Hill Publishing Company Limited, New Delhi, India.

Rastogi, T., Reddy, K.S., Vaz, M., Spiegelman, D. and Prabhakaran, D., Willett, W.C. and Ascheri, A. (2004). Diet and risk of ischemic heart disease in India1-3. *Am. J. Clin.*

Nutr., **79** : 582-592.

Shukla, S.G. (2003). *Dairy chemistry*. Aman Publishing House Madhu Market, Naveen Bazar, Meerut (U.P.) India.

Sugiyama, Y., Masumori, N., Fukuta, F., Yoneta, A., Hida, T., Yamashita, T., Minatoya, M., Nagata, Y., Mori, M., Tsuji, H., Akaza H. and Tsukamoto, T. (2013). Influence of isoflavone intake and equol-producing intestinal flora on prostate cancer risk. *Asian Pac. J. Cancer Prev.*, **14** :1-4.

Zhang, Y.F., Kang, H.B., Li, B.L. and Zhang, R.M. (2012). Positive effects of soy isoflavone food on survival of breast cancer patients in China. *Asian Pac. J. Cancer Prev.*, **13**:489-482.

Zhu, Y.Y., Zhou, L., Jiao, S.C. and Xu, L.Z. (2011). Relationship between soy food intake and breast cancer in China. *Asian Pac. J. Cancer Prev.,* **12** : 2837-2840.