South Asian J. Food Technol. Environ., 5(2): 864-873 (2019)
ISSN 2394-5168 (Print), 2454- 6445(online)
www.sweft.in

Quality evaluation of blended edible oils

Ratnesh Kumar*, Suresh Chandra, Samsher, Vikrant Kumar, Sunil and Pinkoo Singh

Deptt. of Agricultural Engineering, SVPUAT, Meerut (UP)
*Email: rkindian563@gmail.com

Abstract

The effect of storage conditions on the quality of mustard, soybean, sunflower and groundnut oils were analysed under storage upto 210 days in Room temperature, BOD incubator and Refrigerated condition. The mustard oil used as based oil for replacement. The mustard oil was replaced by (40-85), soybean, sunflower and groundnut are each (5-20%). During the storage of individual and blended oil, pH was increase with increasing the storage period and types of storage condition. Density, specific gravity and iodine value was reduced with raising the storage period. Free fatty acid and peroxide value was increase with increasing the storage period and types of storage condition. Vegetable oils have wide application in foods where they are used in frying, cooking etc. Vegetable oils are produced from plant seeds, commonly used for frying, baking and other types of cooking. Edible oils and fats are biological mixtures.

Keyword: Crude oil, peroxide value, iodine value, pH, room temperature
Paper cited: Kumar, R., Chandra, S., Samsher; Kumar, V., Sunil and Singh, P. (2019). Quality evaluation of blended edible oils. *South Asian Journal of Food Technology and Environment*, 5(2): 864-873.

Introduction

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% of vegetable oils are used for edible purposes, while the remaining part finds industrial applications. Fats and oils are one of the five essential ingredients of human diet and the others are protein, carbohydrates, minerals and vitamins (Shukla *et al.*, 1992). The oil seeds are major source of edible in world. Vegetable oils are extremely damaging to the reproductive system and the developing bodies of unborn babies and children. Because the reproductive system in both men and women is constantly producing and dividing new cells, there is potential for mutation and problems when these cells are made of the wrong kind of fats and are oxidized. Because vegetable oils oxidize easily, they deplete the body of antioxidants since the body must use these to attempt to neutralize the oxidation. People with high consumption of vegetable oils and their products are at risk for Vitamin E deficiency and other deficiencies. Rapeseed *(Brassica napus L.)* is now the second most important source of vegetable oil in the world. Canola oil is also considered healthy for human nutrition due to its lowest content of saturated fatty acids among vegetable oils and moderate content of polyunsaturated fatty acids (Stamer *et al*., 1999). 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; Dasgupta and Bhattacharyya, 2007). *Brassica juncea L.* is also known as Indian mustard or mustard greens or leaf mustard, is perennial herb, usually grown as annual or biennial mustard. The use of Indian mustard oil is discouraged in the International market due to its high erucic acid and glucosinolate content. It is being used in India past so many years and also has a niche in rich

Indian culture. But its side effects have not been observed yet in India (Batra, 2003). 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. 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. Therefore, improving soybean seed quality is key to improving human and animal nutrition (Bellaloui *et al.,* 2010). The use of soybean products in the feed and food industry has increased steadily. The world soybean production is currently 219.8 million metric tons out of which India produced 9.3 million metric tons constituting about 4% of the total world production. Out of this production, less than 10% is directly used for human consumption (Gandhi, 2006). Sunflower oil is a high-quality edible oil. It is used in cooking, frying, and in the manufacture of margarine and shortening and considered by some as desirable as olive oil. Sunflower oil was selected in this study due to its high use in food as it is a rich source of linoleic acid. Furthermore, it is light in taste and appearance and has a toxic at low concentrations may be generated after destruction of the linoleic acid (Min and Boff, 2001). At high temperature and in the presence of air, many chemical reactions can be observed in oil: hydrolysis, polymerization, oxidation and isomerization (Rossell, 2001). The most common commercial products of groundnut are: groundnut oil, groundnut cake and fried peanuts which are sold at markets places or hawked on the streets (Hussaini *et al.,* 2010; Salami, 2013). They are usually consumed after roasting or boiling, and also processed into different forms such as peanut butter, candy, chocolates, cakes, and others. Peanut butter and jelly sandwiches are popular in the American culture, with raw, roasted, shelled or unshelled forms of peanuts being available in United States throughout the year. Peanut oil is characterized by 45.2% oleic acid (18:1) and 32.4% linoleic acid (18:2), palmitic (C16:0), and a trace amount of linolenic fatty acid (C18:3), (Carrin and Carelli, 2010; Mzimbiri *et al.,* 2014).

Materials and methods

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 – 250110. 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.

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

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 gms of the oil sample a 25-ml test tube. Add 2 gms 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% 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).

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

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).

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

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% 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.

$$\text{Iodine Value} = \frac{(\text{Blank titre} - \text{Sample titre}) \times \text{N of } Na_2S_2O_3}{\text{Wt of sample (g)}} \times 12.69$$

Refractive Index: Refractive Index was determined using a mathematical expression derived by Perkins (1995).

$$RI = 1.45765 + 0.0001164\ IV$$

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 No. l. The filtered sample is used for pH measurement.

Results and Discussion

pH content: The pH data was found of individual oil ranged from 4.3 to 5.4. While in blended oil were 3.2 to 5.4 as fresh. The constant pH was observed 4.3 in T_1 (mustard oil) & highest 5.4 in T_2 (Soybean oil) where as in case of blended oil, lowest was found in 4.2 in T_8 (MS_{40}+SF_{20}+GN_{20}+SB_{20}) and highest i.e. 4.5 in T_5 Sample (MS_{85}+SB_5+GN_5+SF_5). It is blended that the ratio of mustard oil affects the pH of fresh blended oil in different concentrations. As per data, the pH was observed highest in soybean oil. The present studs, the mustard oil used as based oil for replacement. The mustard oil was replaced with sunflower, soybean and groundnut combined in the ratio of 5, 10, 15 and 20% each blend oil of T_5 single was observed highest than the other combination but lowest in T_8 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 increase with increasing the storage period and types of storage condition. During room of oils, the pH was observed higher

followed BOD (35°C) and refrigeration storage at 210 days. In refrigeration condition, pH was found highest for T_5 and lowest T_8; In BOD pH observed highest in T_7 and lowest T_5. In room storage pH was assessed highest T_5 and lowest T_8 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 4.9 for T_7 & T_5 in BOD (35°C) 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 up to 22.24% in refrigerator followed by 21.81% in room and lowest 31.51% in BOD in storage at 210 days.

Density: From the data it was found that density of individual oil ranged from 0.892 to 0.900 (Fig.-2). While in blended oil was observed from 0.894 to 0.897. The density was reported that 0.892 in T_1 (mustard oil) & highest in T_2 (Soybean oil) where as in case of blended oil, lowest was found in 0.894 in T_5 ($MS_{85}+SF_5+GN_5+SB_5$) and highest i.e. 0.897 in T_8 Sample ($MS_{40}+SB_{20}+GN_{20}+SF_{20}$). As per data, the density was observed highest in soybean oil compared to the mustard oil. It is blended oil that the ratio of mustard oil affects the fresh blended oil in different ratio. The mustard oil was replaced with sunflower, groundnut and soybean combined in the ratio of 5, 10, 15 and 20%. 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_8 and lowest T_5 ; In BOD density was recorded highest in T_5 and lowest T_6 ; In room storage density was observed highest T_8 and lowest T_6 during storage of 210 days can be affected the density of fresh as well as blended oil.

Specific gravity: From the data it was found that specific gravity of individual oil ranged from 0.8363 to 0.8432 (Fig.-2). While in blended oil was observed from 0.8379 to 0.8410. The specific gravity was reported that 0.8363 in T_1 (mustard oil) & highest in T_2 (Soybean oil) where as in case of blended oil, lowest was found in 0.8379 in T_7 ($MS_{55}+SF_{15}+GN_{15}+SB_{15}$) and highest i.e. 0.8410 in T_8 Sample ($MS_{40}+SB_{20}+GN_{20}+SF_{20}$). As per data, the specific gravity was observed highest in soybean oil compared to the mustard oil. It is blended oil that the ratio of mustard oil affects the fresh blended oil in different ratio. The mustard oil was replaced with sunflower, groundnut and soybean combined in the ratio of 5, 10, 15 and 20%. 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_8 and lowest T_5 ; In BOD specific gravity was recorded highest in T_5 and lowest T_6; In room storage specific gravity was observed highest T_8 and lowest T_6 during storage of 210 days can be affected the specific gravity of fresh as well as blended oil.

Free fatty acid: The free fatty acid of individual oil ranged from 0.18 to 0.19. While in blended oil were ranged from 0.14 to 0.19 as fresh. The constant free fatty acid was observed 0.18 in T_2 (soybean oil) & highest 0.19 in T_1 (mustard oil) where as in case of blended oil, lowest was found 0.14 in T_6 ($MS_{70}+SF_{10}+GN_{10}+SB_{10}$) and highest i.e. 0.19 in T_5 Sample ($MS_{85}+SF_5+SB_5+GN_5$). It is blended that the ratio of mustard 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. The present studs, the mustard oil used as based oil for replacement. The mustard oil was replaced with

sunflower, groundnut and soybean combined in the ratio of 5, 10, 15 and 20%, 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^{o}C) storage at 210 days. In refrigeration condition, free fatty acid was found highest for T_6 and lowest T_8 ; In BOD free fatty acid observed highest in T_5 and lowest T_8 ; In room storage free fatty acid was assessed highest T_7 and lowest T_6 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 0.73 for T_1 & 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.

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) & highest 2.22 in T_1 (mustard oil) where as in case of blended oil, lowest was found in 2.16 in T_8 (MS_{40}+SF_{20}+GN_{20}+SB_{20}) and highest i.e. 2.20 in T_5 Sample (MS_{85}+SB_5+GN_5+SF_5). It is blended that the ratio of mustard oil affects the iodine value of fresh blended oil in different concentrations. As per data, the iodine value was observed highest in mustard oil. The present studs, the mustard oil used as based oil for replacement. The mustard oil was replaced with sunflower, soybean and groundnut combined in the ratio of 5, 10, 15 and 20%. During the storage of individual and blended oil, iodine value was decrease with increasing the storage period and types of storage condition. During room of oils, the iodine value was observed higher followed BOD (35^{o}C) and refrigeration 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_8 and lowest T_5 ; 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_6) was observed in room storage and lowest 1.27 for T_8 & T_5 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.

Peroxide value: The peroxide value of individual oil ranged from 0.16 to 0.34. While in blended oil were 0.26 to 0.29 as fresh. The constant peroxide value was observed 0.16 in T_3 (sunflower oil) & highest 0.34 in T_1 (mustard oil) where as in case of blended oil, lowest was found in 0.26 in T_8 (MS_{40}+SB_{20}+SF_{20}+GN_{20}) and highest i.e. 0.29 in T_5 Sample (MS_{85}+SF_5+GN_5+SB_5). It is blended that the ratio of mustard oil affects the peroxide value of fresh blended oil in different concentrations. As per data, the peroxide was observed highest in mustard oil. The present studs, the mustard oil used as based oil for replacement. The mustard oil was replaced with sunflower, soybean and groundnut combined in the ratio of 5, 10, 15 and 20%. During the storage of individual and blended oil, peroxide value was increased with increasing the storage period and types of storage condition. During refrigeration of oils, the peroxide value was observed higher followed room and BOD (35^{o}C) storage at 210 days. In refrigeration condition, the peroxide value of blended oil highest T_6 and lowest T_8 ; In BOD peroxide value recorded highest in T_5 and lowest T_8; In room storage peroxide value was assessed highest T_5 and lowest T_8 during storage of 210 days. From the Fig. 6, It seems that the highest pH of blended oil (T_5) was observed in room storage and lowest 0.90 for T_5 & T_8 in BOD (35^{o}C) 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.

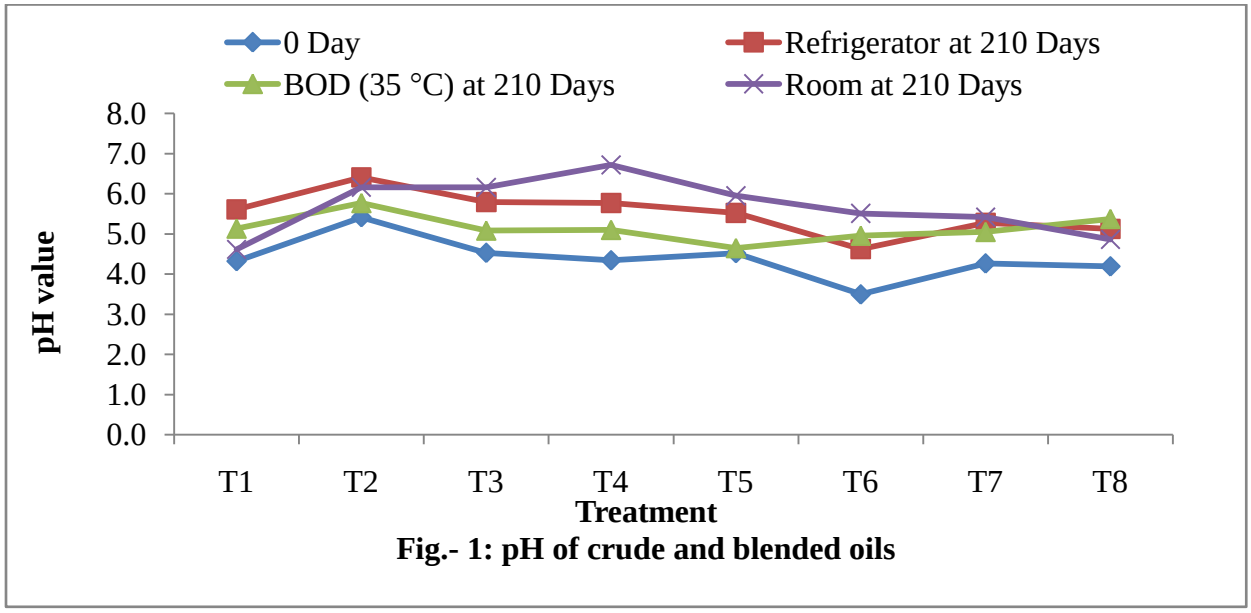

Fig.- 1: pH of crude and blended oils

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

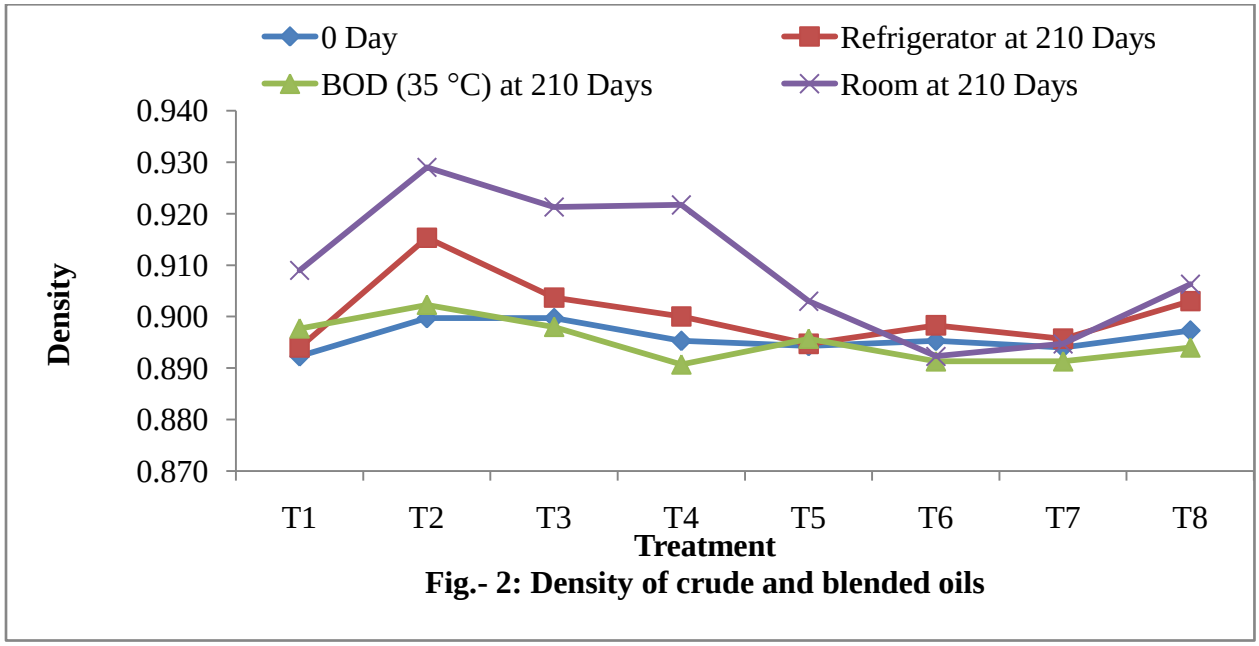

Fig.- 2: Density of crude and blended oils

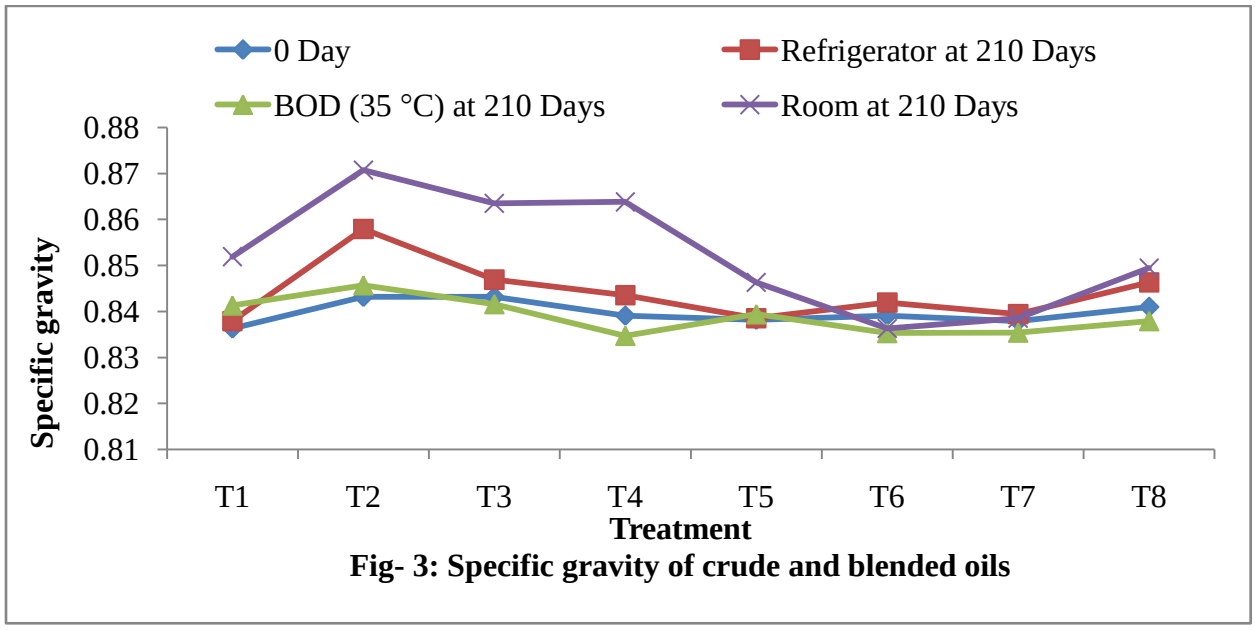

Fig- 3: Specific gravity of crude and blended oils

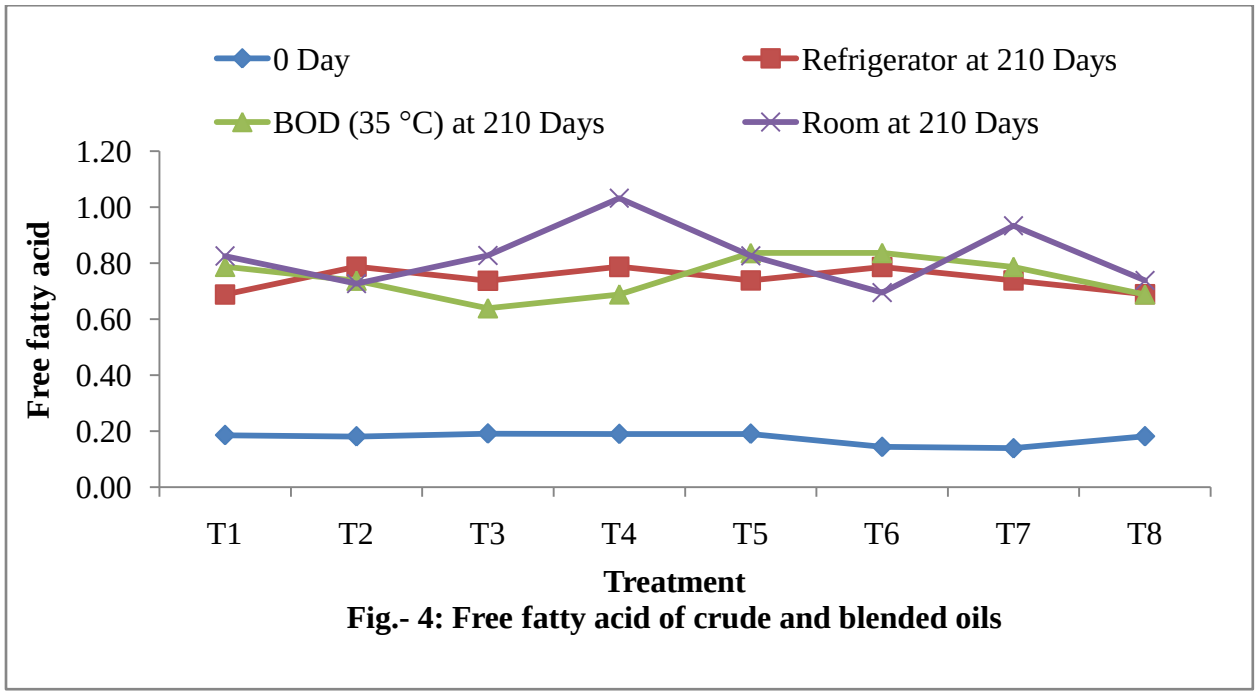

Fig.- 4: Free fatty acid of crude and blended oils

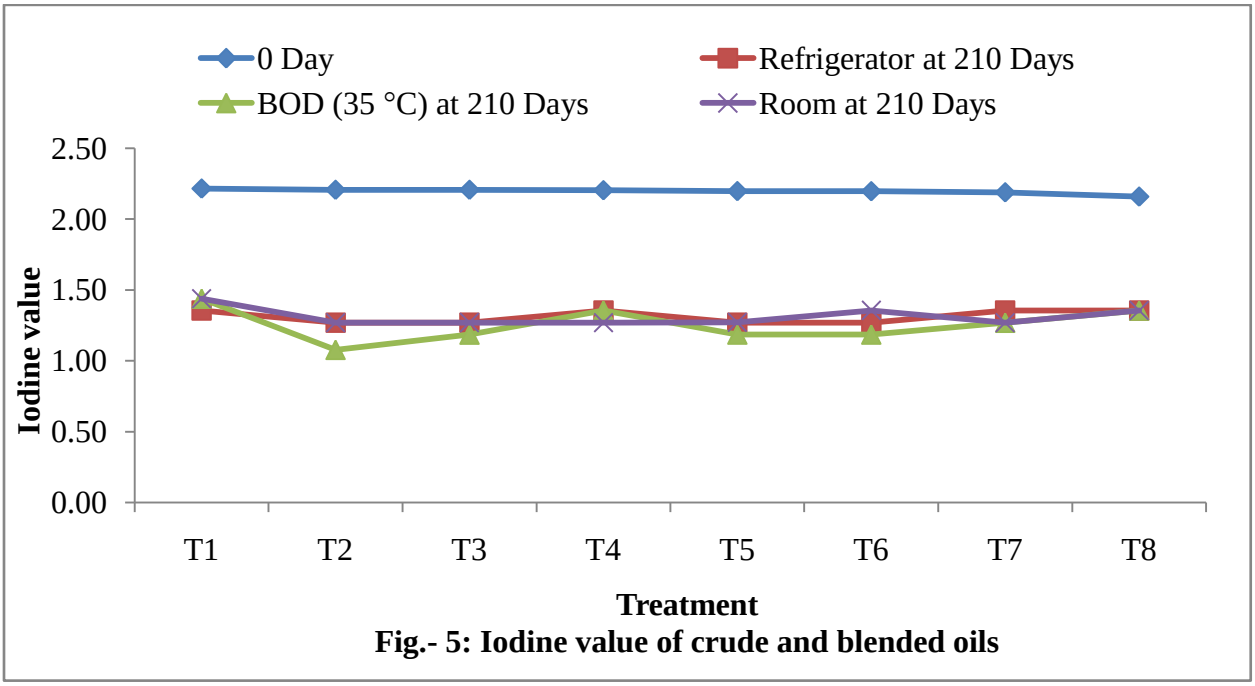

Fig.- 5: Iodine value of crude and blended oils

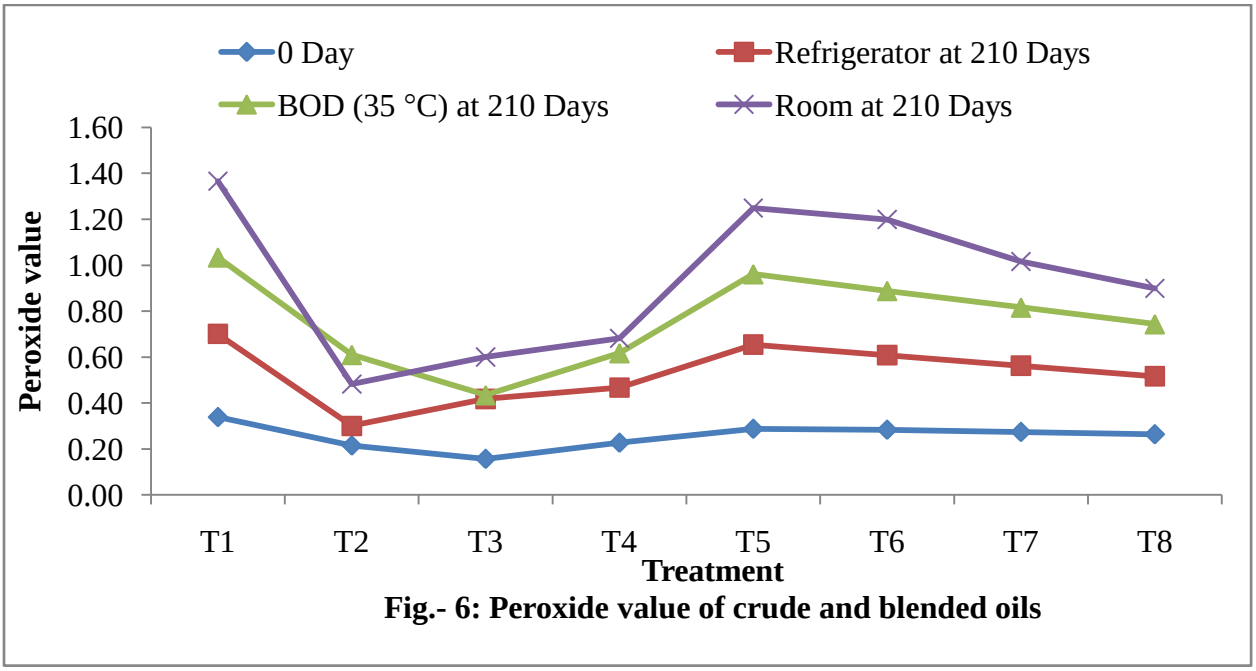

Fig.- 6: Peroxide value of crude and blended oils

Conclusions

The experimental results show that pH was increase with increasing the storage period and types of storage condition. As per data, the density was observed highest in soybean oil compared to the mustard oil. 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. 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^{o}C) storage at 210 days. During the storage of individual and blended oil, iodine value was decrease with increasing the storage period and types of storage condition. During refrigeration of oils, the peroxide value was observed higher followed room and BOD (35^{o}C) storage at 210 days.

Acknowledgements

This work was supported by the department of Agricultural Engineering laboratory in Sardar Vallbhbhai Patel University of Agriculture and Technology, Meerut, Uttar Pradesh, INDIAN, under the thesis work of Post Graduate Studies in 2018.

References

Batra, P. (2003). Evaluation Of Mustard Oil As A Health Oil In Rat Model,Department of Medical Elementology and Toxicology,Faculty of Science.

Bellaloui, N., Bellaloui, H.A., Gillen, A.M., Abbas, H.K., Zablotowicz, R.M., Mengistu, A. and Paris, R.L. (2010). Soybean seed protein, oil, fatty acids, and mineral composition as influenced by soybean-corn rotation. Agricultural Sciences, 1(3):102-109.

Carrin, M.E. and Carelli, A.A. (2010). Peanut Oil Composition data. European Journal of Lipid Science and Technology. Vol 112, Issue 7, Pages 693–818. Wiley Online Library. KGaA, Weinheim.

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.

Gandhi, A. P. (2006). Soybean-the greater bean, World Grain (USA), February issue, p 59-62.

Hussaini, Y.I., Napoleon, D.S. and Hassan, I.I. (2010). An Evaluation of Groundnut Processing by Women in a Rural Area of North Central Nigeria. Journal of Agricultural Science, 2 (1):206-210.

Min, D.B. and Boff, J.F. (2001). Lipid oxidation of edible oil. In C. Akoh and D. B . Min edn. Food lipids. New York, Marcel Dekker. pp. 335-363.

Mzimbiri, R., Shi, A.M., Liu, H. and Wang, Q. (2014). A Review: Peanut Fatty Acids Determination Using Hyper Spectroscopy Imaging and Its Significance on Food Quality and Safety. Food Science and Quality Management, 28:90-97.

Perkins, G. (1995). Physical properties of soybeans, in Erickson (Ed.), Practical handbook of soybean processing and utilization, 3 (Champaign, IL: AOCS Press) 29-38.

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

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.

Rossell, J.B. (2001). Frying. Improving quality. In J. B. Rossell edn. Cambridge England. Woodhead Publishing Limited.

Salami, A.O. (2013). Heuristic Approach to Job Scheduling in a Small Scale Groundnut Oil Processing Firm in Nigeria. European Journal of Business and Management, 15(18):25-34.

Shukla, B.D., Srivastava, P.K. and Gupta, R.K. (1992). Oil seed Processing Technology, CIAE Bhopal (India).

Shukla, S.G. (2003). Dairy Chemistry. Aman Publishing House Madhu Market, Naveen Bazar, Meerut (UP).

Stamer, D.E., Hamama, A.A. and Bhardwaj, L. (1999). Canola oil yield and quality as affected by production practices in Virginia, In: Janick J., (ed.) Perspectives on new crops and new uses, ASHS Press, Alexandria, VA. pp. 254-256.

Received	: September, 2019
Revised	: October, 2019
Published	: December, 2019