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Analysis of the physical and chemical characteristics of edible vegetable blended oil

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Abstract
Oils constitute one of the essential components of balanced diet as good source of energy. The chemical and physical properties of oils are amongst the most important properties that determine the quality and help to describe the present condition of oils. 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. 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% of vegetable oils are used for edible purposes.

Keywords: Mustard oil, free fatty acid, peroxide value, iodine value

Introduction
Vegetable oil is an important and widely used lipid source for our everyday (diet products). Its application is increasing day by day for food purposes and for the manufacturing of a number of toiletry products. However, some vegetable oils are not up to standards to meet consumer satisfaction in terms of their physico-chemical properties or for the texture and stability of the food products (Reyes- Hernandez *et al.*, 2007) [6]. Oil has been a vital part of people's regular dietary consumption all over the world and its usage has been found to increase several folds over the decades. The importance of using the appropriate oil for cooking goes a long way in affecting the consumer's health. Improper methods of oil-aided cooking can lead to cardiovascular diseases and increased cholesterol in the blood. They have also been found to be cancer-inducing. Hence, it is highly essential to use the right oil for cooking. Oils exhibit various physicochemical properties depending upon the amount of heating they are exposed to while cooking. These properties in turn determine the quality of the oil (Valantina *et al.*, 2016) [8]. 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) [7]. Mustard seed contain about 24 – 40% oil, 17 – 26% protein and 19% hull. Mustard seeds are processed for oil extraction and the residue obtained is called mustard cake. Mustard oil accounts for 18% of Indian edible oil consumption and has characteristic pungent taste. The proportionate increase in per-capita edible oil consumption and awareness on health benefits of mustard oil has lead to increase in demand of later. Groundnut (*Arachis hypogeal* L.) is an important oilseed crop as it contains 44-56% oil and 22-30% protein on a dry seed basis (Reddy *et al.*, 2003) [5]. Groundnut is grown on 19.3 million ha of land in about 82 countries. More than half of the production area is in arid and semi-arid regions. Groundnut otherwise called peanut, monkey nut, gobber pea and arachide belongs to the family leguminosae. Peanuts vary in color from red to brown and are usually coarse in their appearance. Raw peanuts and peanuts prepared without salt are naturally low in sodium, having 18 mg of sodium per 100 g. This equates to only 5.4 mg of salt in a 30 g serving. The nutritional importance of peanuts is due to the energy and growth supplementing constituents present in them. These include carbohydrates, lipids, proteins, vitamins, minerals, some organic acids and purines. It is estimated that as much as 30% of the population from many countries in the world are suffering from malnutrition.

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. The seed itself is edible and its oil is used throughout the world for frying and cooking. Sunflower oil composition consists of 90% oleic and 10% linoleic acids or vice versa. Protein contents of the seed ranged from 20-30%. Sunflower is the fourth biggest source of vegetable oil after soybean, palm and rapeseed. In Europe, Sunflower oil is the second most widely used oil after rapeseed. Around the world, sunflower production is 31.1 m tonnes, with more than 26 Mha under sunflower cultivation. Major sunflower growing countries in the world are Russia, Ukraine, United States, France, Canada, Hungary, Romania, CIS, Argentina, Bulgaria Europe, Turkey, Serbia, South Africa, China and India (FAO, 2005) [1].

Martials 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 analyzed 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_3 COOH: $CHCl_3$ i.e. 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 (Meyer, 2000) [2].

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

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) [5].

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

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) [5].

Carry out a blank determination alongside without the fat.

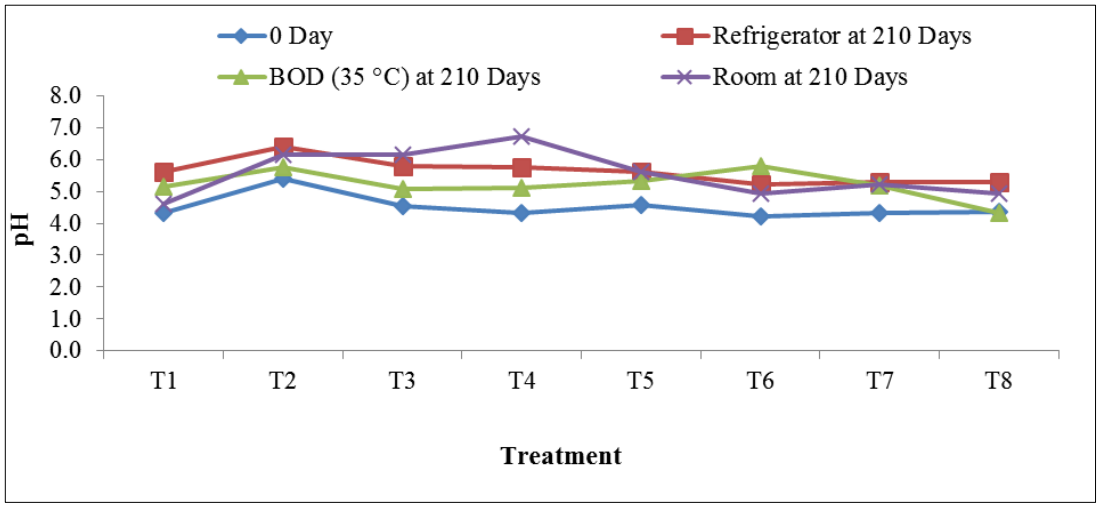
$$\text{Iodine Value} = \frac{(\text{Blank titre} - \text{Sample titre}) \times \text{N of Na2S2O3}}{\text{Wt of sample (g)}} \times 12.69$$

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 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) & highest 5.4 in T_2 (Soybean oil) where as in case of blended oil, lowest was found in 4.2 in T_6 (GN_{70}+SB_{10}+MS_{10}+SF_{10}) and highest i.e. 4.6 in T_5 Sample (GN_{85}+MS_5+SB_5+SF_5). It is blended that the ratio of groundnut 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 groundnut oil. The present studs, the groundnut oil used as based oil for replacement. The groundnut oil was replaced with soybean, sunflower and mustard 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_6 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 (35ºC) and room storage at 210 days. In refrigeration condition, pH was found highest for T_5 and lowest T_6; In BOD pH observed highest in T_6 and lowest T_7. In room storage pH was assessed highest T_6 and lowest T_8 during storage of 210 days. From the Fig. 1, it seems that the highest pH of blended oil (T_6) was observed in

BOD storage and lowest 4.9 for T_6 & T_8 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 up to 22.28% in refrigerator followed by 17.71% in BOD and lowest in 14.28% in room storage at 210 days.



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

Fig 1: Effect of storage on pH of vegetable crude and blended oils

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 0.893 to 0.896. 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 0.893 in T_6 (GN_{70}+SB_{10}+MS_{10}+SF_{10}) and highest i.e. 0.896 in T_5 Sample (GN_{85}+MS_5+SB_5+SF_5). As per data, the density was observed highest in soybean oil as compared to groundnut oil. It is blended oil that the ratio of ground nut oil affects the fresh blended oil in different ratio. The groundnut oil was replaced with soybean, sunflower and mustard 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. Refrigeration of oils, the density was reported higher followed room and BOD (35 ºC) at 210 days. In refrigeration storage, density was found highest for T_2 and lowest T_7; In BOD density was recorded highest in T_2 and lowest T_5; 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.

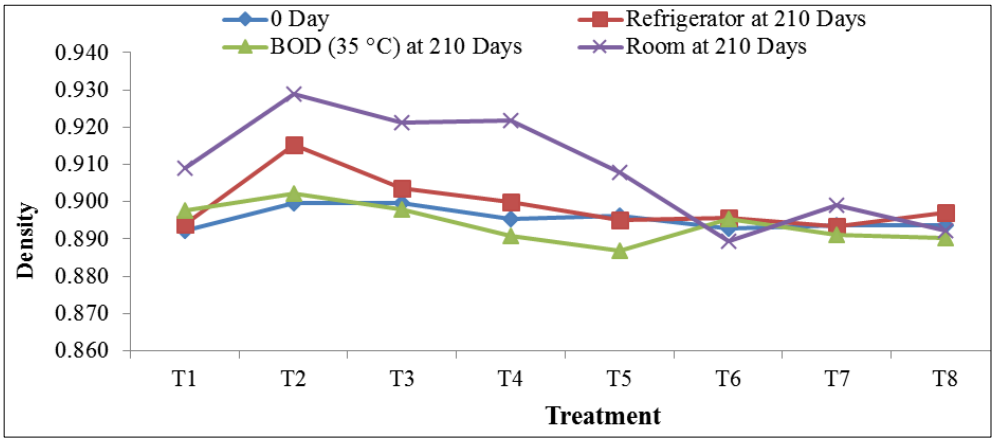


Fig 2: Effect of storage on density of vegetable crude and blended oils

Specific gravity: The specific gravity of individual oil ranged from 0.8363 to 0.8432. While in blended oil was observed from 0.8366 to 0.8400. 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 0.8366 in T_6 (GN_{70}+SB_{10}+MS_{10}+SF_{10}) and highest i.e. 0.8400 in T_5 Sample (GN_{85}+MS_5+SB_5+SF_5). As per data, the specific gravity was observed highest in soybean oil as compared to groundnut oil. It is blended oil that the ratio of ground nut oil affects the fresh blended oil in different ratio. The groundnut oil was replaced with soybean, sunflower and mustard 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. Refrigeration of oils, the specific gravity was reported higher followed room and BOD (35 ºC) at 210 days. In refrigeration storage, specific gravity was found highest for T_2 and lowest T_7; In BOD specific gravity was recorded highest in T_2 and lowest T_5; 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.

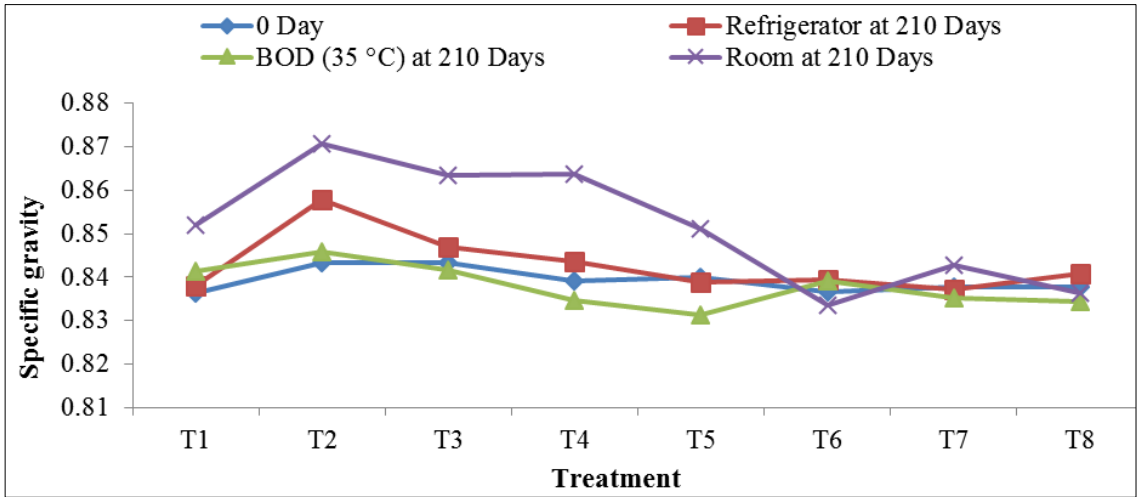


Fig 3: Effect of storage on specific gravity of vegetable crude and blended oils

Free Fatty Acid: The free fatty acid of individual oil ranged between 0.18 to 0.19. While in blended oil were 0.16 to 0.18 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 in 0.16 in T_8 (GN_{40}+SB_{20}+MS_{20}+SF_{20}) and highest i.e. 0.18 in T_5 Sample (GN_{85}+MS_5+SB_5+SF_5). It is blended that the ratio of groundnut 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 groundnut oil. The present studs, the groundnut oil used as based oil for replacement. The groundnut oil was replaced with soybean, sunflower and mustard 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 BOD (35 ºC) and refrigerator storage at 210 days. In refrigeration condition, free fatty acid was found highest for T_7 and lowest T_5; 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_5 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_6 & T_5 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.

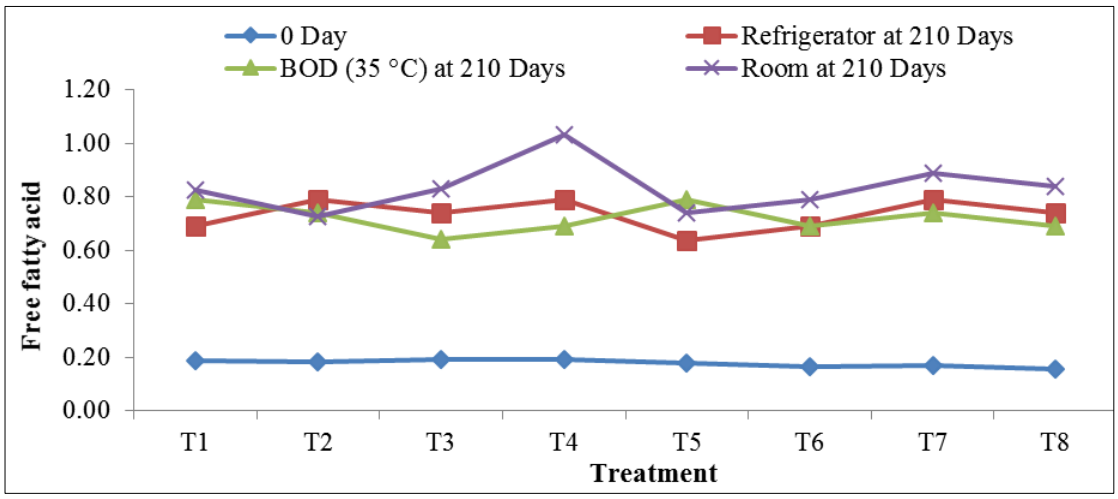


Fig 4: Effect of storage condition on free fatty acid of vegetable crude and blended oils

Iodine Value: From the data it was found that iodine value of individual oil ranged from 2.20 to 2.22 (Fig.-2). 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 2.18 in T_6 (GN_{70}+SB_{10}+MS_{10}+SF_{10}) and highest i.e. 2.19 in T_8 Sample (GN_{40}+MS_{20}+SB_{20}+SF_{20}). It is blended that the ratio of groundnut oil affects the iodine value of fresh blended oil in different concentrations. As per data, the free fatty acid was observed highest in mustard oil as compared to groundnut oil. The present studs, the groundnut oil used as based oil for replacement. The groundnut oil was replaced with soybean, sunflower and mustard combined in the ratio of 5, 10, 15 and 20%. During the storage of individual and blended oil, free fatty acid was decrease with decreasing the storage period and types of storage condition. During room of oils, the iodine value was observed higher followed BOD (35ºC) and refrigerator storage at 210 days. In refrigeration condition, iodine value was found highest for T_7 and lowest T_5; In BOD free fatty acid observed highest in T_7 and lowest T_6; In room storage iodine value was assessed highest T_7 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 room storage and lowest 1.27 for T_6 & T_7 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.

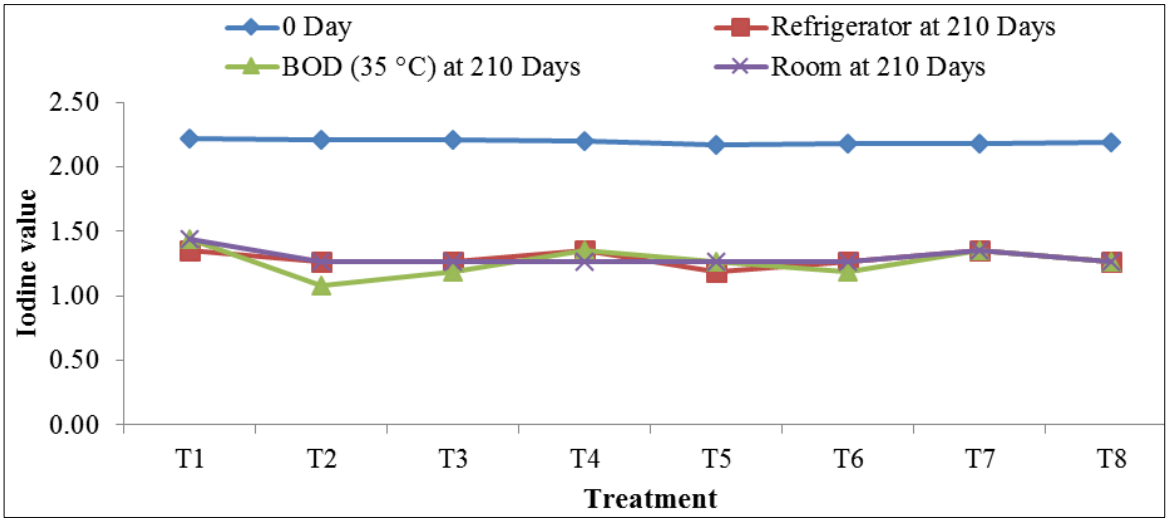


Fig 5: Effect of storage on Iodine value of vegetable crude and blended oils

Peroxide value: The peroxide value of individual oil ranged between 0.16 to 0.34. While in blended oil were 0.20 to 0.21 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 0.20 in T_5 (GN_{85}+SB_5+MS_5+SF_5) and highest i.e. 0.21 in T_6 Sample (GN_{70}+MS_{10}+SB_{10}+SF_{10}). It is blended that the ratio of groundnut 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 groundnut oil. The present studs, the groundnut oil used as based oil for replacement. The groundnut oil was replaced with soybean, sunflower and mustard combined in the ratio of 5, 10, 15 and 20%.

During the storage of individual and blended oil, peroxide value was decreased with increasing the storage period and types of storage condition. During room of oils, the peroxide value was observed higher followed BOD (35ºC) and refrigerator storage at 210 days. In refrigeration condition, the peroxide value is no changing in blended oil; 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 0.70 for T_5 & 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.

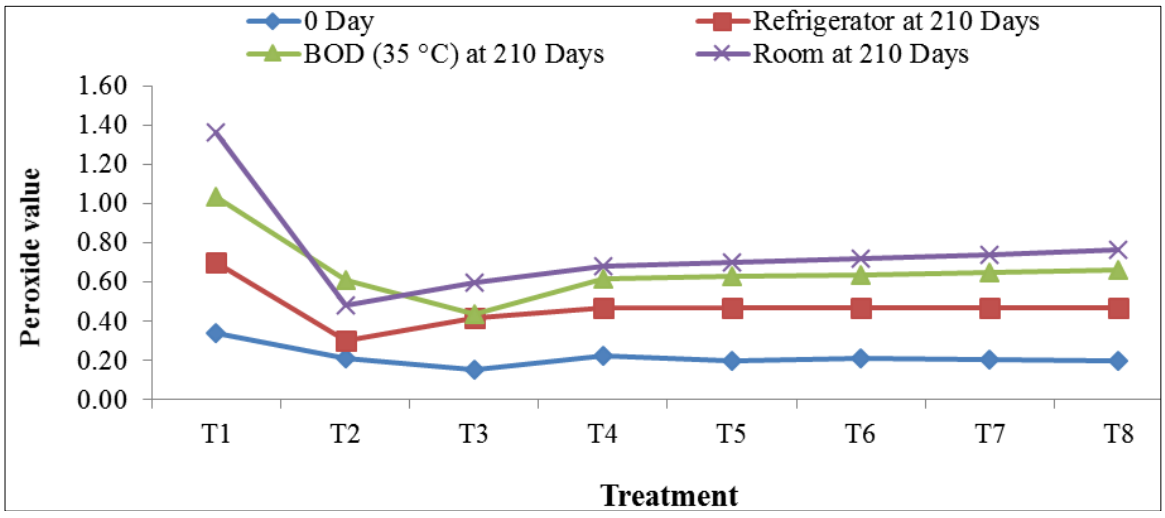


Fig 6: Effect of storage on peroxide value of vegetable crude and blended oils

Conclusions

The present studs showed that the groundnut oil used as based oil for replacement. The groundnut oil was replaced with soybean, sunflower and mustard combined in the ratio of 5, 10, 15 and 20%. The ratio of groundnut 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 groundnut oil. As per data, the density was observed highest in soybean oil as compared to groundnut oil. It is blended oil that the ratio of ground nut oil affects the fresh blended oil in different ratio. The storage of individual and blended oil, specific gravity was reduced with raising the storage period and different storage condition. The present studs, the groundnut oil used as based oil for replacement. The groundnut oil was replaced with soybean, sunflower and mustard 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 conditions. The constant temperature (35ºC) of storage for 210 day can be affecting the iodine value of the fresh as well blended oil. The individual and blended oil, peroxide value was decreased with increasing the storage period and types of storage condition.

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