Comparative study of physio-chemical properties oils and fats

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Abstract:

India is one of the largest producers of oil seeds in the world. Comparative study of composition and physio-chemical properties of Soya bean oil, Rice Bran oil, Karanj seed oil, Mahua seed oil, Orange seed oil was carried out. Results showed that Soya bean oil has highest Iodine value that is 130 fallowed by orange seed oil. Mahua seed oil has highest Saponification value of 192 and soya bean oil has lowest. Specific gravity of orange seed oil is highest 0.937. Soya bean oil has highest Flash point 328^0C and orange seed oil has lowest. Rice bran oil has highest Cetane no of 55 while soya bean oil has lowest.

Key words: Soya bean oil, Rice bran oil, Karanj seed oil, Mahua seed oil, Orange seed oil, Iodine value, Saponification value, Specific gravity, Flash point, Cetane no,

INTRODUCTION

India is one of the largest producers of oilseeds in world. Annual production and consumption of oils and fats is about 119 million tonnes and rising steadily at a rate of 2-6 million tones per year. In India 70 percent area of total oilseed crops is covered by soya bean. Among non conventional oils rice bran oil, Mahua seed oil, Karanj seed oil and orange seed oil are the most important. The environmental conditions are good for growth of oilseeds so in India large no of oilseed processing plants are present.

Soyabean is dominant oilseed produced in the world, due to its favorable agro economic characteristics, its high quality protein and its valuable edible oil. The rice bran is the by-product of rice milling and bran layer contains 18-22 percent oil. The rice bran oil is having high medicinal value and therapeutical applications. The oryzanol present in rice bran oil is effective

for lowering blood cholesterol. Rice bran oil also acts as anticancer and anti-infection agent in humans.

Karanj seed oil is used for healing, antiseptic and homeostatic effect by ayurvedic practitioners. It also used for skin diseases and rheumatic part. The Mahua seed oil is edible and also used as a laxative for treating habitual constipation, piles and haemorrhoids and also as emetic. The orange seed has therapeutic properties are antiseptic, anti depressant, antispasmodic, anti-inflammatory, carminative and tonic.

This section includes the fallowing activities

- Study of different oils produced in India like conventional as well as non conventional oils. The study is focused on the total area of cultivation, annual production, oil extraction plants, per capita consumption and environmental conditions.
- Soyabean oil: The area of cultivation is determined and total annual production with per capita consumption was studied with respect to its description of tree, habitat and occurrence. Comparative study of soya oil is carried with composition and physic-chemical properties.
- Rice bran oil: It is non conventional oil produced from rice bran. Utilization of rice bran by-product is carried for production of oil. Evolution of compositional and physic-chemical properties, health benefits with medicinal uses were determined.
- Orange seed oil: Evolution of importance of environmental conditions with tree description, habitat and occurrence was identified. The composition and properties were determined and comparative study was carried with its properties. Use of orange seed oil in pharmaceuticals was determined.
- Mahua seed oil: The standard method of oil extraction, its utilization, nutritional properties and health benefits were determined.
- Karanj seed oil: Karanj seed oil is commonly used for meditational purpose. It is having health benefits. Chemical composition and all properties were determined.

MATERIALS AND METHOD

Determination of Iodine Value

Procedure:

The weight of the sample required is 0.15-0.6 g in case of oil depending upon the iodine value. Weight accurately by difference, an appropriate quantity of oil or fat in to dean dry 250 ml glass-stopered 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 oil 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 indicator near the end point.

Carry out a blank determination alongside without the oil.

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

Determination of Saponification Value

Procedure:

Melt the sample if it is not already liquid and filter through a filter paper to remove any impurities and the last traces of moisture. Make sure that the sample is completely dry. Mix the sample thoroughly and weigh about 1.5 to 2.0 g of dry sample into a 250 ml Erlenmeyer flask. Pipette 25 ml of the alcoholic potassium hydroxide solution into the flask. Conduct a blank determination along with the sample. Connect the sample flasks and the blank flask with air condensers, keep on the water bath, boil gently but steadily until saponification is complete, as indicated by absence of any oily matter and appearance of clear solution. Clarity may be achieved within one hour of boiling. After the flask and condenser have cooled somewhat wash down the inside of the condenser with about 10 ml of hot ethyl alcohol neutral to phenolphthalein. Titrate the excess potassium hydroxide with 0.5N hydrochloric acid, using about 1.0 ml phenolphthalein indicator.

Calculation:

$$\text{Saponification Value} = \frac{56.1\ (B-S)\ N}{W}$$

Determination of Specific Gravity Procedure:

Fill the dry pycnometer with the prepared sample in such a manner to prevent entrapment of air bubbles after removing the cap of the side arm. Insert the stopper, immerse in water bath at 300 C 0.20 C and hold for 30 minutes. Carefully wipe off any oil that has come out of the capillary opening. Remove the bottle from the bath, clean and dry it thoroughly. Remove the cap of the side arm and quickly weigh ensuring that the temperature does not fall below 30^0C.

$$\text{Specific Gravity at } 30^0\text{C} = \frac{A - B}{C - B}$$

Where,

A = weight in gm of specific gravity bottle with oil at 30^0C

B = weight in gm of specific gravity bottle at 30^0C

C = weight in gm of specific gravity bottle with water at 30^0C

Determination of Flash point

Procedure:

Thoroughly clean and dry all parts of the cup and its accessories before starting the test, being sure to remove any solvent which had been used to clean the apparatus. Support the tester on a level steady table Fill the cup with the oil to be tested up to the level indicated by the filling mark .Place the lid on the cup and properly engage the heating devices. Insert the thermometer, light the test flame and adjust it to 4.0 mm in diameter. Heat the sample so that the temperature increase is about 5 to 6ºC per min. During the heating, turn the stirring device from one to two revolutions per second. Apply the test flame when the temperature of the sample is a whole number not higher than 17^0C below the flash point At every 5ºC rise in temperature, discontinue stirring and apply the test flame by opening the device which controls the shutter and lowers the test flame into the shutter opening. Lower the test flame in for 0.5 second and quickly return to the raised position. Do not stir the sample while applying the test flame. As soon as the test flame has been returned to the raised position, resume stirring. The flash point is the temperature indicated by the thermometer at the time of the flame application that causes a distinct flash in the interior of the cup.

Determination of Cetane number of oil

This instrument applies a simpler, more robust approach to CN measurement than the CFR. Fuel is injected into a constant volume combustion chamber in which the ambient temperature is approximately 575 °C. The fuel combusts, and the high rate of pressure change within the chamber defines the start of combustion. The ignition delay of the fuel can then be calculated as the time different between the start of fuel injection and the start of combustion. The fuel's derived cetane number can then be calculated using an empirical inverse relationship to ignition delay.

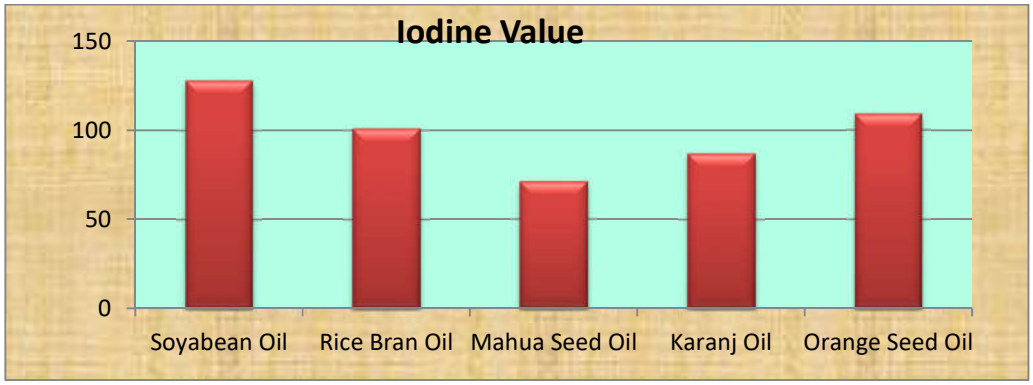
RESULTS AND DISCUSSTI0NS

Iodine value of oils

The Iodine value of different vegetable oils as determined is shown below:

Oil	Iodine Value
Soyabean Oil	130
Rice Bran Oil	101
Mahua Seed Oil	70
Karanj Oil	87
Orange Seed Oil	109

Iodine value of Rice bran oil, Orange seed oil and Soyabean oil is 101,109 and 130 respectively. Mahua seed oil has lowest Iodine value (70) amongst all oils studied indicating the increased presence of saturated acids. Karanj oil has Iodine value (87) which is slightly higher than Mahua seed oil.



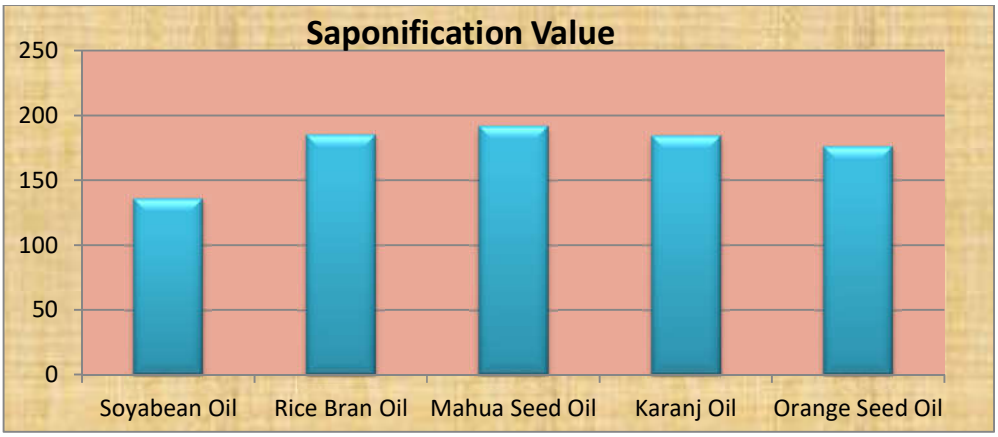
Saponification value of oils

The saponification value of oils as determined is shown below:

Saponification value of oils

Oil	Saponification Value
Soyabean Oil	193
Rice Bran Oil	190
Mahua Seed Oil	192
Karanj Oil	184
Orange Seed Oil	198

It is observed that Saponification value of orange seed oil, Karanj oil and Rice bran oil is 198,184 and 190 respectively. Table-15 indicates that Mahua seed oil has highest Saponification value than other oils that is 192. Mahua seed oil shows more Saponification value followed by Rice bran oil, Karanj oil, Orange seed oil and Soyabean oil.



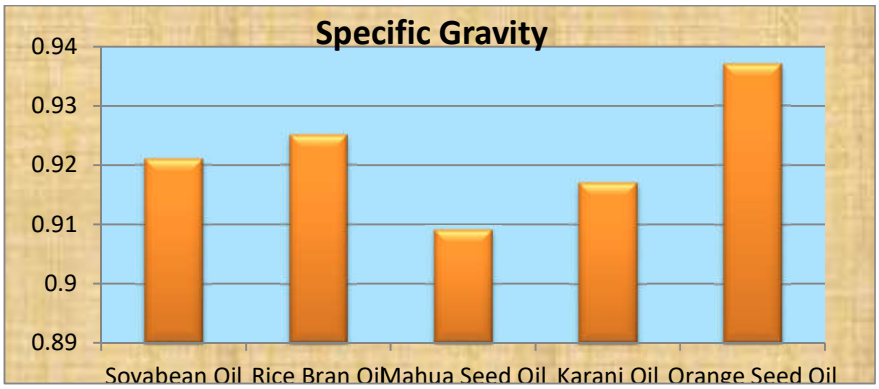
Specific Gravity of oils

The Specific Gravity of oils is determined and shown below:

Specific Gravity of oils

Oil	Specific Gravity
Soyabean Oil	0.921
Rice Bran Oil	0.925
Mahua Seed Oil	0.909
Karanj Oil	0.917
Orange Seed Oil	0.937

The Orange seed has highest Specific Gravity that is 0.937. The Specific Gravity of Rice bran oil and Soyabean oil is 0.925 and 0.921 respectively. Mahua seed oil has lower Specific Gravity than other oils. Specific gravity of Karanj oil is 0.917 which is more than Mahua seed oil but less than other oils.



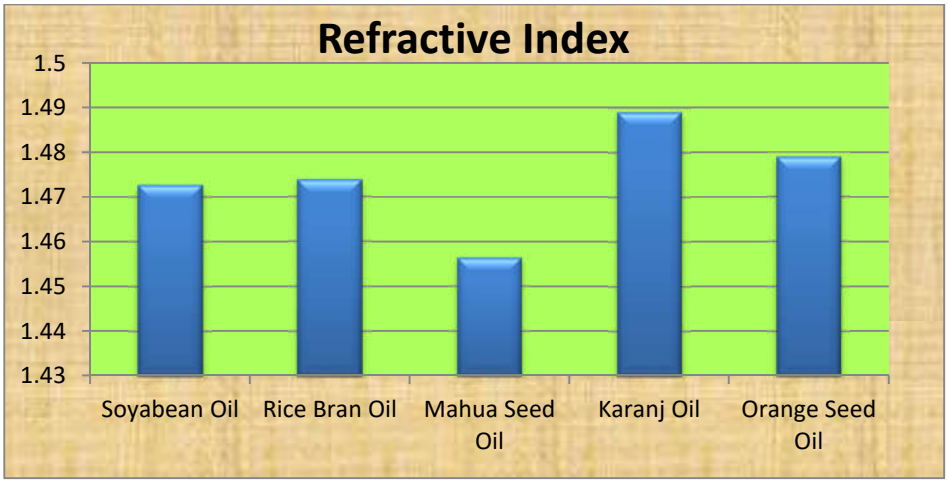
Refractive Index of oils

The Refractive Index of different vegetable shown below:

Refractive Index of oils

Name of Oil	Refractive Index
Soyabean Oil	1.4727
Rice Bran Oil	1.4738
Mahua Seed Oil	1.4523
Karanj Oil	1.4890
Orange Seed Oil	1.4789

Refractive Index of Soyabean oil, Rice bran oil and Orange seed oil is 1.4727, 1.4738 and 1.4789. It was observed that there is no remarkable difference in Refractive Index of these three oils. Karanj oil shows high Refractive Index that is 1.4890 than other oils taken for study. The lowest Refractive Index was shown by Mahua seed oil.

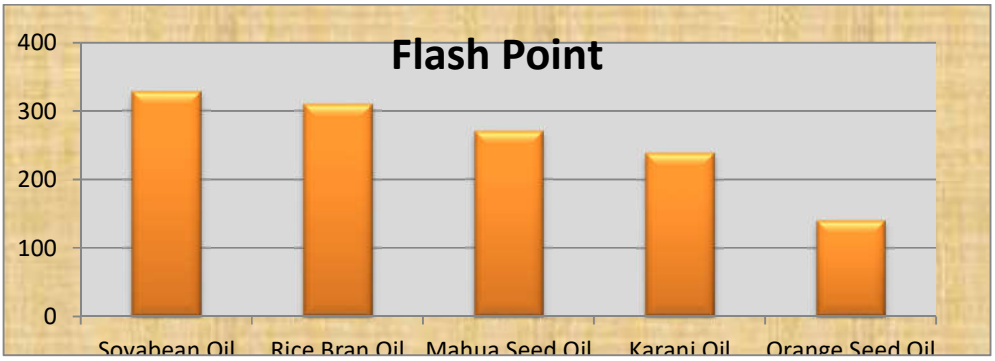


Flash Point of oils

The flash Point of vegetable oils were shown below:

Flash point of oil

Oil	Flash Point
Soyabean Oil	328^0C
Rice Bran Oil	310^0C
Mahua Seed Oil	270^0C
Karanj Oil	239^0C
Orange Seed Oil	140^0C



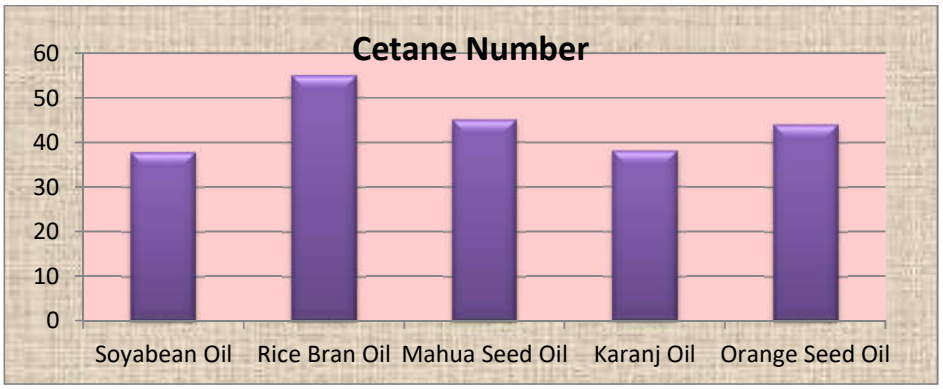
It is observed that Soyabean oil has highest flash point of 328^0C followed by Rice bran oil which also has a flash point of 310^0C. Orange seed oil, Mahua oil and Karanj oil seed oil had flash points of 140^0C, 270^0C and 239^0C respectively.

Cetane Number of oils

Cetane number of Rice bran oil, Mahua seed oil and Orange seed oil are 55, 45 and 44 respectively. Soyabean oil has lowest cetane number than other oils. Karanj oil also has lower cetane number as that of soyabean oil that is 38. That means time required for combustion after injection is less for soyabean oil and Karanj oil. Rice bran oil shows highest cetane number of 55. There is no much more difference in cetane number of Orange seed oil and Mahua seed oil. The cetane number of Mahua seed oil is 45 and Orange seed oil is 44. Table indicates that Rice bran oil required highest time for combustion in engine.

Cetane number of oils

Oil	Cetane Number
Soyabean Oil	37.8
Rice Bran Oil	55
Mahua Seed Oil	45
Karanj Oil	38
Orange Seed Oil	44



Comparative Properties of Vegetable Oils

Properties	Oils				
	Soyabean	Rice Bran	Karanja	Mahua	Orange Seed
Specific Gravity	0.921	0.925	0.917	0.909	0.937
Iodine value	130	101	87	70	109
Saponification value	193	190	184	192	198
Cetane No	37.8	55.0	38.0	45.0	44.0
Flash Point (^{0}C)	328^{0}C	310^{0}C	270^{0}C	239^{0}C	140^{0}C

CONCLUSION

India is one of the largest producer of oilseeds and it is also having large no of processing units. The environmental conditions are favourable so oilseeds production is increasing per year. All conventional and nonconventional oilseeds oil was extracted with soxlet extraction. This section has mainly focused on chemical compositional study of different extracted oil and its physic-chemical properties. The major contribution of this work are summarised as fallows:

- Mahua seed oil has lowest Iodine value amongst all oils. Its Iodine value is 71 so Soyabean oil has highest Iodine value followed by Orange seed oil and then Rice bran oil.
- Mahua seed oil has highest Saponification value than other oils that is 192. Saponification value of soyabean oil is lowest than other oils and it is 136 which is quite less.
- The Orange seed has highest Specific Gravity that is 0.937so as Mahua seed oil has lower Specific Gravity than other oils. Specific Gravity of Karanj oil is 0.917. The Karanj oil shows high Refractive Index that is 1.4890. The lowest Refractive Index was shown by Soyabean oil.
- Soyabean oil has highest flash point of 328^0C than other oils. The Orange seed oil has lower flash point of 140^0C. Fire point of Orange seed oil is lower that is of 169^0C but Soyabean oil has highest fire point of 359^0C.
- Soyabean oil has lowest pour point that is -12^0C as compared to other oils. Mahua seed oil has highest pour point of 9^0C. The Calorific value of Soyabean oil is highest of 43.7. Orange seed oil has lowest calorific value of 35.
- Soyabean oil has lowest cetane number than other oils. Rice bran oil shows highest cetane number of 55. The Soyabean oil has higher viscosity than other that is 49.99. Orange seed oil shows lowest viscosity of 21.06.

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