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Quantitative and Qualitative Analysis of Different Edible Oil by Using Different Parameters

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Abstract: The current study aims to analyze the qualitative and quantitative aspects of edible oils. Moisture content of different edible oil in the range of 0.05 to 0.3%, Acid value range 1.0 to 0.4% and free fatty acid value range is less than 0.05% helps to analyze the oxidation of oil reactivity, toxicity and rancidity etc. The detection of Heavy metal in edible oil gives us the idea about freshness, helping properties (crystalline and amorphous), storage and their influence on human health. Heavy metals like Ni are very high in soybean oil and comparatively lower in coconut oil. Similarly, heavy metal Pb is very high in mustard oil. FTIR spectroscopy was used to evaluate the functional group present in edible oil and AAS is used for the detection of heavy metals.

Keywords: Edible oils, Moisture content, Fatty acid, Heavy Metals, AAS and FTIR.

I. INTRODUCTION

The word “Edible” represents the food that we eat. In the same phase “Edible oil” (Ramadhas et.al. 2004) represents those oils that are used for domestic purpose like cooking, hair growth and needed for our body. Edible oil consists of about 96% triacyl glycerides and some other component such as free fatty acids, phospholipids, phytosterols, antioxidants etc. and melt over a wide range of temperature (19-44°C) along with enthalpy requirement is 241.1 and 325.7kJ/kg. It is commonly known as simple lipid and is extracted from different plants and seeds (Chew and Karl 2020). Edible oil requires temperature ranging between the range of 15°C to 30°C (59°F to 86°F) and also require considerable rainfall of about 1500-3000 mm per annum. All edible oil contains tocopherols in different amount and different ratios of α , β , γ and d-tocopherols (Matthaus, 2010). It is the source of essential fatty acids which is mainly used in frying, baking and other types of cooking preparation. The amount of oil that we need each day is different for everybody. The need of average adult is about 2,000 calorie per day. For women, it is about 5 to 6 teaspoon of oil per day and for men it is about 6 to 7 teaspoons of oil.

II. MATERIALS AND METHODS

Three samples were collected from local market in Patna. Samples were labelled with their brand names such as

- (1) Mustard oil (Natural oil)
- (2) Soybean oil (Nature Fit)
- (3) Coconut oil (Parachute)

Figure of oil samples are mentioned in figure no.1.

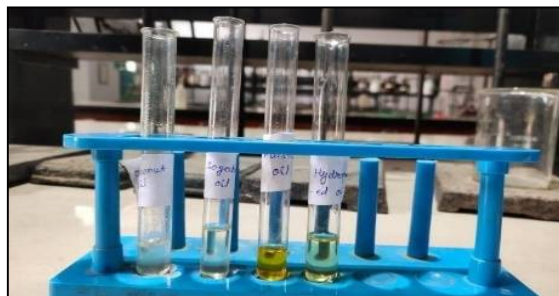


Fig 1: Oil Samples

Process involved in calculation of Acid value of an oil samples-

- Chemical preparation
- Sample preparation
- Titration and
- Calculation

After acid value determination we calculate the free fatty acid (FFA) of given oil samples by following formula

$$\bullet \text{ FFA\%} = \text{Acid Value}/2$$

$$\text{i.e., FFA\%} = \frac{\text{Mol.wt. (NaOH)} \times N \times V}{\text{Wt. of sample in gram}} \times 100$$

Process involved in the determination of heavy metals: Oil samples were taken in a beaker and digested with a mixture of 5 ml of conc. HNO_3 and Conc. HCl . The digestion process was continued until the result came clear. The cooled samples were filtered and then analyzed for estimation of heavy metals by “Atomic Absorption Spectroscopy” (Mendil et.al, 2009).

Fourier-Transformation Infrared Spectroscopy (FTIR): Functional group present in the sample was detected by FTIR. The IR spectra of the mustard oil, soybean oil, coconut oil and used soybean oil was recorded in a FTIR spectroscopy.

III. RESULTS AND DISCUSSION

The results shows that acid value detection helps to determine the oil quality of oil samples (Bello, 2011). A high Acid value indicates the deterioration of oil, which affects its nutritive value. The permissible level of acid value for all edible oil should be below 0.6 mg NaOH/g. Table 1 shows that mustard oil has higher acid value than soybean and Coconut oil.

Table 1. Acid Value measurement of different edible oil

Samples	Range (Amount of NaOH (in mg))
Mustard oil	0.864
Soybean oil	0.194
Coconut oil	0.297

This table shows that Mustard oil is not deteriorated oil than Coconut oil and Soybean oil.

Table 2. Free fatty acid measurement of different edible oil

Samples	Range (NaOH in mg)
Mustard oil	0.432
Soybean oil	0.098
Coconut oil	0.148

This table shows that mustard oil is of flavor, off colour, off odour than coconut oil and soybean oil. High level of free fatty acid directly correlates to off-odors, off-colors and off-flavours in fried product (Endo, 2013). A graph is shown for comparing the acid value and free fatty acid value (Fig 2).

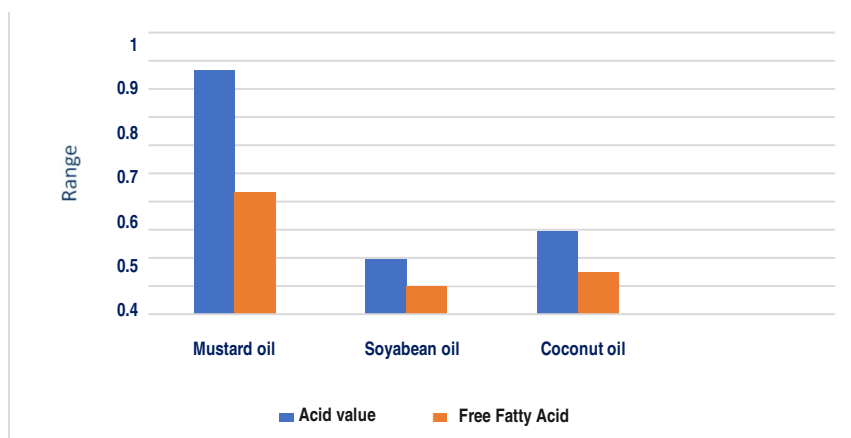


Fig 2. Graph comparing between Acid Value and Free Fatty Acid in mg

From the graph, we analyzed that mustard oil has higher acid value and free fatty acid than coconut and soyabean oil. After comparing the acid value and free fatty acid of samples, we proceed for the measurement of moisture content in samples.

Table 3. Moisture content measurement of different edible oil

Samples	Range (°C)
Coconut oil	0.03
Mustard oil	0.08
Soybean oil	0.25

This table shows that Soybean oil is higher moisture content than Mustard oil and Coconut oil. Moisture content value represent the efficiency of edible oil for domestic uses, hair growth etc.

Heavy Metals detection is carried out with the help of Atomic Absorption Spectrometer (AAS).

Table 4. For Nickel (Ni) Concentrations

Sample Label	Conc. (mg/L)	%RSD
Mustard oil	0.215	7.95
Soybean oil	0.188	1.34
Coconut oil	0.117	1.05
Used soybean oil	0.218	1.01

The amount of Nickel was found highest in used soybean oil followed by Mustard oil, Soybean oil and lowest in Coconut oil (Khan H. et. al., 2007). Hydrogenation of oils in presence of nickel catalyst to form fat is an addition reaction. During Hydrogenation, vegetable oils are reacted with hydrogen gas at 60°C.

Table 5. For Lead (Pd) Concentrations

Sample Label	Conc. (mg/L)	%RSD
Mustard oil	0.015	0.95
Soybean oil	0.088	0.34
Coconut oil	0.109	1.05
Used soybean oil	0.018	1.01

The amount of lead was found highest in Coconut oil followed by Soybean oil, used soybean oil and lowest in Mustard oil.

Next, we turn our attention to identify the functional group of active component present in edible oil. For that we performed FTIR spectroscopy. The spectrum was scanned in the range of 3500 to 1000 cm^{-1} .

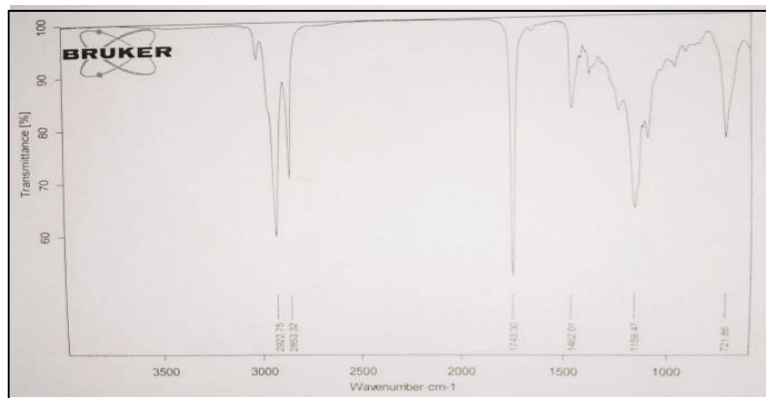


Fig 3. FTIR Spectra of Mustard Oil.

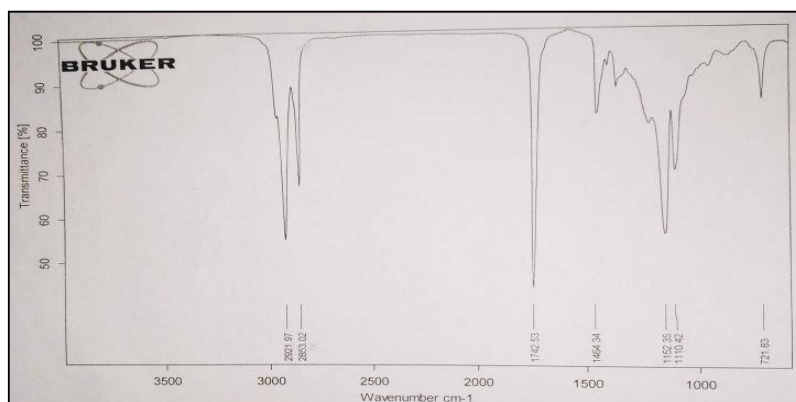


Fig 4. FTIR Spectra of Soybean oil

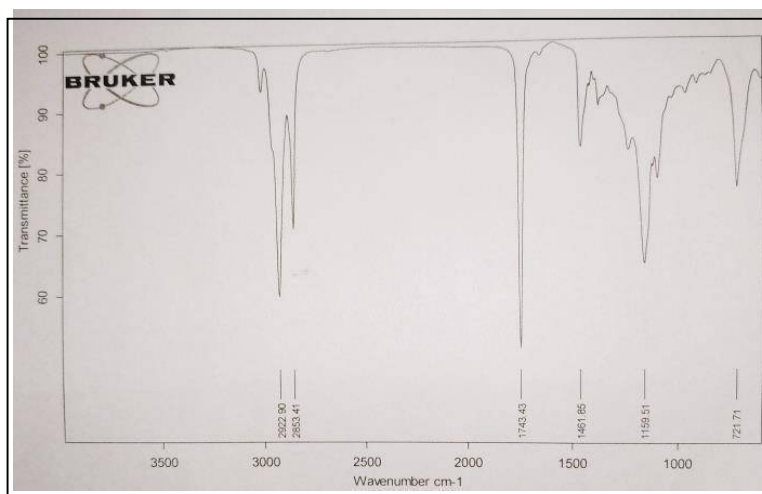


Fig 5. FTIR Spectra of Coconut oil

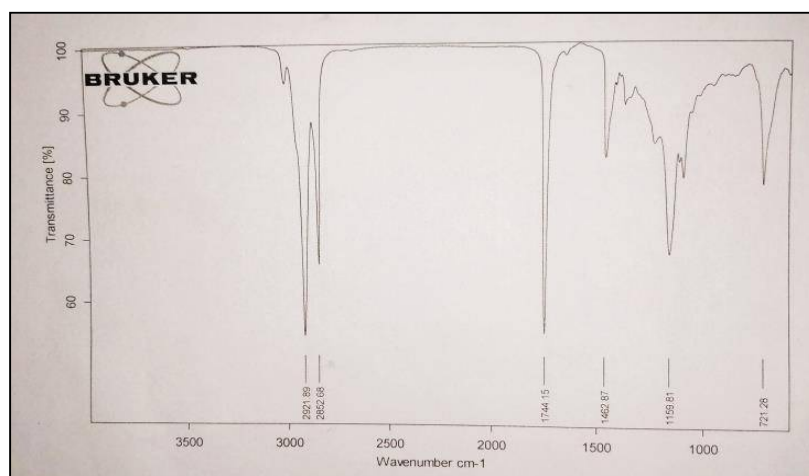


Fig 6. FTIR Spectra of Used soybean oil

Fig no. 3, 4, 5, and 6 confirmed the sharp peak around 2921cm^{-1} to 2922 cm^{-1} which indicate the presence of O-H band for acid and 1742 to 1744 cm^{-1} for carbonyl group.

Table 6. Showing FTIR detect functional group present in taken oil sample

Oil sample	Two sharp peaks(cm^{-1})	Functional group
Mustard oil	1744.15 and 2921.89	C=O and O-H(acid)
Soybean oil	1743.43 and 2922.90	C=O and O-H(acid)
Coconut oil	1742.53 and 2921.97	C=O and O-H(acid)
Used soybean oil	1743.30 and 2922.75	C=O and O-H(acid)

From analysing the table 6, we found that there are two sharp peaks for different oil sample. There is slight variation in sharp peak values for different edible oil. So, all the oil sample contain Carbonyl and Hydroxyl groups.

IV. CONCLUSION

The result showed that moisture content for Edible Oil is in the range of 0.05 to 0.3%, Acid Value range is about 1 to 4 and Free Fatty Acid Value range is about less than and equal to 0.05. Heavy Metals like Nickel (Ni) is very high in Soybean oil and comparatively lower in Coconut oil. Similarly, heavy metal Lead (Pb) is very high in Coconut oil and comparatively lower in Mustard oil.

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