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Comparative Study of Acid Value and Rancidity in commonly used Oils and Fats

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Abstract: Fats are highly susceptible to degradation due to their chemical nature. Their long carbon chains and variable degree of unsaturation leave them vulnerable to a variety of breakdown pathways. Aside from microbial degradation, the two chemical pathways for fat rancidification are Oxidative rancidity and Hydrolytic rancidity. Using any rancid oil can lead to serious health hazards. In addition to having strange flavors and odors, it contains carcinogenic free radicals. These pesky molecules are then absorbed into the foods the oil is added to. And we all know avoiding free radicals is just good health sense. The present paper focuses on acid value and rancidity of the commonly used oils and fats in our daily life

Keywords: Oil, rancidity, acid value, health, quality

I. INTRODUCTION

Oils and fats form an important part of a healthy diet. Structurally they are esters of glycerol with three fatty acids (called either triacylglycerols or triglycerides). It is these fatty acids that give the functionality to fats. Acid value and rancidity are among the important parameters to judge the quality of oils and fats. Experiments have been carried out to test the acid value and rancidity of commonly available edible oils

A. Acid Value

The acid value of oils is defined as the mass [no of mg] of Potassium Hydroxide [KOH] required to neutralise the Free Fatty Acids [FFA's] in one gram of fat. FFA's are formed during decomposition of oil glycerides. Hence, it is a relative measure of Rancidity.

B. Rancidity

It is the decomposition and degradation of fats and oils naturally. It is a naturally occurring process in which either by oxidation or by hydrolysis or by both, an oil/fat gets spoilt often resulting in an unpleasant taste and odor [formation of aldehydes and ketones], formation of toxins, alteration in nutritional value etc. Using any rancid oil can lead to serious health hazards. In addition to having strange flavors and odors, it contains carcinogenic free radicals. These pesky molecules are then absorbed into the foods the oil is added to. And we all know avoiding free radicals is just good health sense.

II. METHODOLOGY

The safety of edible oils both saturated and unsaturated had been tested for acid value and rancidity in the following oil samples:-

- 1) Extra Virgin Olive Oil
- 2) Sunflower Oil
- 3) Almond Oil
- 4) Sesame Oil
- 5) Groundnut Oil
- 6) Vanaspathi
- 7) Pure Desi Ghee

III. DETERMINATION OF ACID VALUE

The acid value is determined by directly titrating the oil/fat in an alcoholic medium against standard potassium hydroxide/sodium hydroxide solution.

A. Materials Used

- 1) Ethyl alcohol
- 2) Phenolphthalein indicator solution
- 3) Sodium hydroxide solution 0.1 N
- 4) Conical flasks
- 5) Measuring cylinders

B. Procedure

Mix the oil or melted fat thoroughly before weighing. The mass of the test sample shall be taken based on the colour. Weigh accurately appropriate amount of the cooled oil sample in a conical flask and add hot ethyl alcohol and phenolphthalein indicator solution. Boil the mixture for about five minutes and titrate while hot against standard alkali solution shaking vigorously during the titration.

Formula :

$$\text{Acid Value} = \frac{56.1VN}{\text{Weight of the sample}} = \dots\dots\dots \text{KOH/g}$$

Where N=Normality of KOH

V = Volume of standard KOH

1) Results



Oil Obtained Acidic Value Expected Range

a) Extra Virgin Olive Oil.....	3.816%.....	0.8%--2%
b) Sunflower Oil.....	0.8979%.....	<1.1%
c) Almond Oil	2.2447%.....	<0.5%
d) Sesame Oil.....	3.9283%.....	1.0%--1.4%
e) Groundnut Oil.....	2.244%.....	<4.49%
f) Vanaspathi.....	0.6734%.....	0.6
g) Pure Desi Ghee.....	3.2548%.....	< 3%

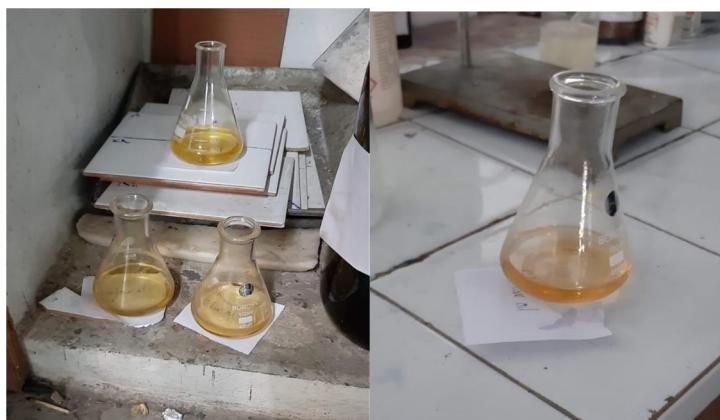
2) *Test for presence of Rancidity:* The analysis includes the determination of peroxide value. As an indication of the extent of oxidation suffered by an oil.

C. Materials Required

- 1) Acetic acid - chloroform solvent mixture
- 2) Freshly prepared saturated potassium iodide solution
- 3) 0.1 N sodium thiosulphate solution
- 4) Conical flasks
- 5) Measuring cylinders

D. Procedure

Weigh sample into stoppered conical flask. Add acetic acid chloroform solvent mixture and swirl to dissolve. Add saturated potassium iodide solution with a mohr pipette. Stand for 1 min in dark with occasional shaking, then add water. Slowly titrate the liberated iodine with 0.1 N sodium thiosulphate solution, with vigorous shaking until yellow colour is almost gone. Add starch solution as indicator and continue titration shaking vigorously to release all I₂ from CHCl₃ layer until blue colour disappears.



After keeping in dark to obtain yellow

Formula:

$$\text{Rancidity} = \frac{\text{Titre} \times N \times 100}{\text{Weight of sample}} = \dots \text{meq/kg}$$

Where N=Normality of KOH

IV. RESULT

Fresh oils usually have peroxide values well below 10 meq/kg. A rancid taste often begins to be noticeable when the peroxide value is above 20 meq/kg.

In the samples we tested we got:-

- 1) Extra Virgin Olive Oil..... 2.0 meq/kg
- 2) Sunflower Oil..... 0.8 meq/kg
- 3) Almond Oil..... 1.6 meq/kg
- 4) Sesame Oil..... 2.0 meq/kg
- 5) Groundnut Oil..... 1.4 meq/kg
- 6) Vanaspathi..... 0.8 meq/kg
- 7) Pure Desi Ghee..... 4.6 meq/kg



Yellow colour disappeared after titration

For acid value; olive oil, sesame oil and ghee had more acidic content than required. As mentioned above, acid value is relative to rancidity.

Factors affecting an oil to spoil may vary from one situation to another

Fats are highly susceptible to degradation due to their chemical nature. Their long carbon chains and variable degree of unsaturation leave them vulnerable to a variety of breakdown pathways.

Using any rancid oil can lead to serious health hazards. In addition to having strange flavors and odors, it contains carcinogenic free radicals. These pesky molecules are then absorbed into the foods the oil is added to. And we all know avoiding free radicals is just good health sense.

V. DISCUSSION

Using fresh oil is always the healthiest cooking habit. And there are specific things you can do to prolong your oil's freshness, according to recent research from columbia university:

- A. Don't mix different types of oils.
- B. Avoid iron or copper pots or pans for frying oil that is to be reused. These metals also accelerate rancidity.
- C. Turn off the heat after you are done cooking. Exposing oil to prolonged heat accelerates rancidity.
- D. Store all cooking oils in a cool, dark place.

Yet if your oils get rancid and you don't want to throw it away, you can always use it as

- 1) Use it as a lubricant and rust preventative on everything from squeaky hinges to tools.
- 2) Use it as lamp oil. Cooking oil puts out about the same amount of light as a candle.
- 3) Use it for conditioning and polishing furniture. Combine equal parts oil with vinegar for an amazing mixture that can make old, scratched furniture look almost new. Butcher blocks and cutting boards benefit from it also.
- 4) Use rancid olive oil to soften and preserve leather (shoes, purses, furniture, etc.). It restores suppleness and adds a layer of protection. A drop or two of citrus or lavender to your bottle adds a nice touch to the results.
- 5) Use it to get paint off your hands. Just rub some into your skin, let it absorb for 5 minutes, and then wash thoroughly with soap.
- 6) Use it to protect rattan and wicker furniture and baskets. It prevents cracking and splitting. Gently rub warm oil into your furniture with a soft cloth.
- 7) Use it in soap-making.

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