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Determination and Study of Acid Value in Edible Oils by Titrimetric Method

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ABSTRACT: Safety and quality of edible oils are paramount for human health, as they play a crucial role in nutrition and culinary practices worldwide. Edible oils, however, are susceptible to oxidation and hydrolysis, which can lead to the formation of harmful compounds and affect their nutritional value, flavour, and overall quality. Two critical parameters for assessing the quality and stability of edible oils are peroxide value (PV) and acidity, measured as free fatty acids (FFA). These tests are essential for determining the oxidative state and hydrolytic rancidity of oils, which directly impact their shelf life, safety, and suitability for consumption. Edible oils are a vital component of food manufacturing and home cooking, providing essential nutrients and influencing the flavour, texture, and nutritional quality of food products. They are a primary source of unsaturated fats and vitamin E in human diets. Edible oils play a crucial role.

KEYWORDS: Acid value, Oxidation, Hydrolysis, Titration

I. INTRODUCTION

Intentionally addition of lower-grade oils for economic gain, known as economically motivated adulteration (EMA), is a significant concern. EMA can lead to toxic contaminants, EMA can result in the introduction of toxic substances, posing health risks to humans and EMA can compromise the quality of edible oils, affecting their nutritional value and safety, heating and frying in food processing cause chemical changes in edible oils, resulting in in formation of toxic compounds such as acrylamide and polycyclic aromatic hydrocarbons. Objectives of this study are to investigate the impact of EMA on edible oil quality, consumer health, chemical changes that occur in edible oils during heating and frying, emphasize the importance of quality control measures in ensuring edible oil safety and nutritional quality and explore the role of acid value and peroxide value in monitoring oil quality.

This study focuses on the chemical changes in edible oils during heating and frying, EMA, and their impact on consumer health. The scope includes: Investigation of chemical changes in edible oils during heating and frying, including: Hydrolysis: Breakdown of triglycerides. Polymerization: Formation of polymers and dimers thermo-oxidation: Formation of peroxides and hydro peroxides. examination of the impact of EMA on edible oil quality and consumer health

Some potential limitations of this study include:

The study may not cover all types of edible oils and their specific characteristics. The scope may be limited to specific aspects of oil quality and adulteration.

The study may not provide an exhaustive review of all quality control measures, but rather focus on key indicators and strategies.

Importance:

Increasing in global demand for edible oils, raises concerns over food safety and quality, underscores the importance of rigorous testing and quality control measures in the edible oil industry. Peroxide and acidity tests are fundamental in this regard, serving as indicators of oil quality and potential spoilage. Despite their importance, there is a need for a

comprehensive review of existing literature on these tests to identify current gaps, challenges, and future research directions Peroxide and acidity tests are essential for evaluating oil quality and ensuring compliance with regulatory standards. Consuming oils with high peroxide or acidity levels can pose health risks. Peroxide and acidity tests help predict the shelf life of oils and ensure their stability during storage and transportation. Edible oils undergo chemical changes during heating and frying, including breakdown of triglycerides into free fatty acids and glycerol. Polymerization, formation of polymers and dimers, leading to changes in oil viscosity and texture. Thermo-oxidation: formation of peroxides and hydro peroxides, leading to changes in oil flavour and deuterate nutritional quality. Global demand for edible oils is increasing, driven by population growth, urbanization, and changing dietary preferences with increases of paying capacity of developing countries. Edible oil industry is a significant contributor to many economies, and ensuring oil quality can help reduce economic losses due to spoilage and degradation of end use oil production.

II. LITERATURE REVIEW

The quality and safety of edible oils are paramount for human health, as they play a crucial role in nutrition and culinary practices worldwide. Edible oils, however, are susceptible to oxidation and hydrolysis, which can lead to the formation of harmful compounds and affect their nutritional value, flavour, and overall quality. Two critical parameters for assessing the quality and stability of edible oils are peroxide value (PV) and acidity, measured as free fatty acids (FFA). These tests are essential for determining the oxidative state and hydrolytic rancidity of oils, which directly impact their shelf life, safety, and suitability for consumption.

The literature reviews aim to provide a comprehensive overview of oil peroxide and acidity tests in edible oils, focusing on their significance, methodologies, factors influencing oil quality, and the implications for health, safety, and industry practices. By synthesizing existing research, this review seeks to identify gaps in knowledge and practice, propose future research directions, and contribute to the enhancement of quality control measures in the edible oil industry.

The review will cover the principles and methodologies of peroxide and acidity tests, the impact of processing and storage conditions on oil quality, and the health and economic implications of consuming oxidized or degraded oils. It will also explore the challenges and limitations of current testing methods and discuss potential strategies for improving oil quality and safety.

By reviewing the topic of oil peroxide and acidity tests in edible oils, researchers contribute to improved quality control, enhanced food safety, and better industry practices, ultimately benefiting both consumers and the edible oil industry.

III. MATERIALS AND METHODS

Oil samples

1. Rice bran Oil
2. Castor Oil
3. Sunflower Oil
4. Olive Oil
5. Soyabean Oil
6. Badam Oil
7. Dalda Oil
8. Mustard Oil
9. Coconut Oil
10. deep fry Rice bran Oil
11. deep fry Soyabean Oil

Required Materials

- | | |
|-----------------------|--------------------|
| 1. Sample tubes | 12. Test Tube |
| 2. Weight Machine | 13. Reagent Bottle |
| 3. Measuring Cylinder | 14. Falcon Tube |
| 4. Burette and stand | |
| 5. Conical Flask | |
| 6. Beaker | |
| 7. Hot Plate | |
| 8. Glass Rod | |
| 9. Pipette | |
| 10. Funnel | |
| 11. Filter Paper | |

Required Chemicals-

1. Sodium Hydroxide (NaOH)
2. Ethanol
3. Phenolphthalein

In design for food oil samples, the purpose is to systematically control and modify factors to examine how they affect the quality, characteristics, or processing of the oil. This can involve investigating things like frying conditions, storage conditions, temperature, time, or the presence of particular additives or extraction processes.

Experimental designs play a vital role in analyzing food oil samples, enabling researchers to manage variables and assess their interconnections. Prominent design types include full factorial designs, which examine all possible combinations of factors, and fractional factorial designs, which evaluate a limited selection of these combinations to cut down on experimental costs. These designs facilitate robust statistical conclusions regarding how various parameters influence oil characteristics such as oxidation rates, purity, and yield. .

Independent Variables:

the temperature at which they fry.

1. Time to fry.
2. Oil kind.
3. Storage circumstances (light, temperature).
4. Techniques for extraction (solvent, pressure, temperature).

2. Significance of Experimental Design:

- **Statistical Validity:** Ensures reliable and statistically significant experimental results.
- **Resource Efficiency:** Maximizes information gained while minimizing the number of experiments, leading to more efficient resource usage.
- **Process Optimization:** Establishes a framework for identifying the best combination of factors to achieve desired outcomes in food oil production and processing.
- **Knowledge Expansion:** Contributes to understanding the factors that dictate the properties and behaviour of food oils.

By employing suitable experimental designs, researchers can derive crucial insights into the determinants of food oil properties, ultimately enhancing quality, safety, and efficiency within the food sector.

Objectives of Experiment

The quality of food oil samples assessed by analyzing their chemical, physical, and sensory properties.

Evaluate the safety of food oil samples, focusing on potential health risks and contamination.

Innovate new food oil products or improve existing ones by optimizing processing methods and formulations.

Experimental Process

1. Sample Collection: Food oil samples are collected from various sources, including different types of oils, processing methods, and storage conditions.

2. Sample Preparation: Prepare samples for analysis through techniques such as filtering, degassing, and other necessary processes.

3. Treatment Application: Apply various treatments to the samples, modifying factors like temperature, pressure, and other processing conditions.

4. Data Collection : Document key parameters, such as:

Acidity : Acidity levels were measured using titration.

5. Data Analysis: The collected data were analyzed using statistical methods.

Methods for Measuring Acidity

Phenolphthalein Indicator Solution Preparation – Dissolve 2g Phenolphthalein Indicator powder into 100 ml of Ethanol and mix well by shaking.

0.1 N Sodium Hydroxide Solution Preparation- Dissolve 4gm Sodium Hydroxide into 900 ml of distilled water, cool and make a final volume of 1000 ml standardize the solution before use.

Sample Preparation and Titration

10 gm of oil sample is taken in a conical flask. 50 ml ethanol (99%) is measured and poured into a conical flask. 2-3 drops of phenolphthalein indicator was added in solution and shaken. 1N NaOH is added dropwise until the light pink colour solution is formed. Now the neutralized ethanol is added to the flask containing sample. The flask is shaken to mix the solution. The mixture is boiled by placing the flask on hot plate. After 10 minutes the boiling was continued until the sample is dissolved completely. Shaking with hand should be continued periodically. Continue the boiling until the sample dissolved completely. Then the sample was titrated and the end point was read.

CALCULATION

Sample weight (W_s) = 10.8445 gm

Normality of NaOH (N) = 0.1N

Volume of NaOH solution (V) = Final burette reading – Initial burette reading

Molecular weight NaOH (MW_{NaOH}) = 40.001

$$\text{ACID VALUE} = \frac{MW_{NaOH} \times N \times V}{W_s}$$

Where,

MW_{NaOH} = Molecular weight of NaOH

N = Normality of NaOH; V = Volume of NaOH

STATISTICAL ANALYSIS

There is a clear relationship between healthy food and the well-being of individuals, which are vital components of any society or nation. Historically, there has always been a mismatch between people's food needs and the available supply, often caused by either a lack of resources or mismanagement. Today, this issue has become more complex and troubling.

In various regions afflicted by poverty and conflict, many individuals consume less than the necessary amount of healthy food, with some even resorting to scavenging for scraps in garbage bins.

This study aims to address a crucial aspect of healthy eating, specifically focusing on the oils used for deep frying in fast food establishments. These oils are prevalent due to the fast pace of modern life and the lack of time to prepare meals at home, making fast-food outlets popular among students and professionals alike. Fried food is popular globally, and its quality is influenced by the type of oil or fat used for frying.

The range of different types of oil acid value should be the table with the table below.

S.No.	Oil sample	Acid Value Range
1	Mustard oil	1- 6 mg
2	Coconut oil	0.37 - 6 mg
3	Rice bran oil	0.5 – 5 mg
4	Soyabean oil	0.6 – 3 mg
5	Castor oil	0.14 – 4.7 mg
6	Olive oil	0 – 2 mg
7	Sunflower oil	0.5 – 2.5 mg
8	Badam oil	0.2 – 2 mg
9	Dalda	0 – 0.6 mg
10	Deep fry Rice bran oil	0.5 – 5 mg

11	Deep fry Soyabean oil	0.6 – 3 mg
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CALCULATION:

Acid Value – Calculated by using the formula

$$\text{Acid Value} = \frac{MW_{\text{NaOH}} \times N \times V}{W_s}$$

Where, MW_{NaOH} = Molecular weight of NaOH; N = Normality of NaOH;
V= Volume of NaOH

IV. RESULTS & DISCUSSION

The experimental result (Acid value) of different oils:

S.No.	Oil sample	Acid Value Range	Experimental Result
1	Soyabean oil	0.6 – 3 mg	0.680017 mg
2	Olive oil	0- 2 mg	0.120003 mg
3	Rice bran oil	0.5 – 5 mg	1.32003 mg
4	Mustard oil	01 – 6 mg	3.040076 mg
5	Castor oil	0.14 – 4.7 mg	2.00005 mg
6	Coconut oil	0.37- 6 mg	0.8002 mg
7	Sunflower oil	0.5 – 2.5 mg	0.5000125 mg
8	Badam oil	0.2 – 2 mg	0.720018 mg
9	Dalda	0 – 0.6 mg	0.200005 mg
10	Deep fry Rice bran oil	0.5 – 5 mg	1.320033 mg
11	Deep fry Soyabean oil	0.6 – 3 mg	0.280007 mg

Acidity: - Free fatty acids are produced as oil oxidizes and add to the oils' total acidity. Larger level of free fatty acids signifies greater rancidity and deterioration. The acid value for an oil sample is indicative of the age of the oil and can be used to determine when the oil must be changed.

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