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SHIFTS IN ACID AND SAPONIFICATION VALUES OF OILS OVER TIME

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ABSTRACT

The AV and SV of oils are important metrics for assessing their quality and suitability for use in both industrial and culinary contexts. This study examines these values. While the SV assesses the molecular weight of fatty acids, which is crucial for soap creation and purity assessment, the AV counts free fatty acids, which are symptomatic of oil breakdown. This paper clarifies the relevance of AV and SV in numerous industries, such as cosmetics, medicines, food production, and biofuels, through an extensive examination of experimental methodology and theoretical foundations. Through the comprehension of the complexities involved in AV and SV determination, this study enhances quality control protocols and maximizes oil utilization in various applications. In order to determine the impact of environmental elements such as oxygen, light, and heat on these values, we have repeated the process of estimating the values for acid and saponification after seven months for the acid value and nine months for the saponification value and we found that there are some oxidative changes in oils which causes change in acid and saponification values of oils.

KEYWORDS: Acid Value (AV), Saponification value (SV), Triglycerides.

INTRODUCTON

The properties of oils are crucial in chemistry and industry because they dictate their use and functionality. The AV and SV are two essential metrics used to assess oils. These numbers offer important information on the chemical makeup and quality of oils, which affects how well-suited they are for different uses, from industrial operations to cooking projects. an oil's acid value indicates how much free fatty acid it contains and how vulnerable it is to rancidity and deterioration. The saponification value, on the other hand, provides important details about the oil's overall purity and soap-forming ability by reflecting the standard weight of molecule present in all the fatty acids. Industries that produce food items, pharmaceuticals, cosmetics, and biofuels, among others, must comprehend these principles.

This research paper delves into the complexities of determining acid value and saponification value and clarifies their importance in evaluating the quality and appropriateness of oils for different uses. This study attempts to provide a thorough grasp of these crucial factors and their influence on the more general domains of chemistry, industry, and culinary arts through an extensive analysis of experimental methodology, theoretical frameworks, and practical consequences.

ACID VALUE

The AV is the number which specifies the amount of potassium hydroxide in milligrams necessary to neutralize the free acids present in 1gm of substances.[1]

Significance

The AV indicates the degree of rancidity of a particular oil/fat. Rancid oil produces high acid. Acidification is the breakdown of fats and other lipids by hydrolysis and/or oxidation. Unsaturated fats are oxidized mainly by processes mediated by free radicals, resulting in unpleasant odors and smells.

Rancidity can be reduced but not eliminated. The content of solid and liquid oils can be reduced by storing them at low temperatures and away from light. This value is the quantification of the fatty acids released as a result of the hydrolysis of glycerides under the influence of humidity, temperature and moisture**.**

Principle

The acid value is determined by directly titrating the oil in an alcoholic medium against standard potassium hydroxide/sodium hydroxide solution.[2] The value is a measure of the number of fatty acids, which have been liberated by hydrolysis from the glycerides due to the action of moisture, temperature and/or lipolytic enzyme

lipase.[3] The value represents the quantity of free fatty acids.[4]

SAPONIFICATION VALUE

The saponification value is the number of milligrams of potassium hydroxide necessary to neutralize the free acids and to saponify the esters present in one gram of substance.[5-7]

Significance

A high SV denotes triacylglycerols with shorter fatty acyl chains and vice versa. As a result, SV becomes a simple method for determining the chain length of fatty acids in certain fats and oils.[8]

As a point of reference, the majority of popular oils and fats, whether they come from vegetables or animals (sunflower, soybean, rapeseed, swine lard, cattle tallow, chicken fat, etc.), nearly exclusively comprise long chain fatty acids (C18 and C16).[9]

SV is mostly used to indicate the molecular weight of triglycerol.[10-11] As molecular weight decreases then it denotes the decreasing length of fatty acid and vice versa.

Principle

The process of hydrolysing lipids or triglycerides with a strong alkali to produce glycerol and potassium salts is known as saponification. A known amount of fat or oil is refluxed together with an excess of alcoholic KOH. The amount of KOH left behind after saponification is measured by titrating against a standard acid. The result obtained is used to determine the number of fats or oils that undergo saponification.

MATERIALS AND METHOD

Acid Value

Reagent required

Ethanol(alcohol), diethyl ether,0.1N Sodium hydroxide, Phenolphthalein indicator, soyabean oil of different brands (sunny, star, gemini), sunflower oil of different brands (sunny, star, gemini).

Apparatus Required

Conical flask, volumetric flask, burette, pipette, stand, bubbler.

Method for estimation Acid value

Weigh exactly 10g of the sample and dissolve in 50 ml of solution which containing equal amounts of alcohol and ether solvents, which have been previously neutralized with 0.1 N NaOH. If the sample does not dissolve in solvent at room temperature, reflux the sample and shake frequently and swirl gently until the oil dissolves. After adding one millilitre of phenolphthalein solution and shaking for thirty seconds, titrate the mixture with 0.1 N sodium hydroxide solution until the colour changes to pale pink.

CALCULATION

$$\text{Acid Value: } \frac{V_{KOH} \times 5.61}{W}$$

Where,

VKOH = The volume of 0.1N sodium hydroxide required

W= The weight in gram of substance

Saponofication Value

Reagent required

0.5M potassium hydroxide solution, 0.5M HCl solution, phenolphthalein indicator, soyabean oil of different brands (sunny, star, gemini), sunflower oil of different brands (sunny, star, gemini).

Apparatus required

Round bottom flask, volumetric flask, burette, beaker, pipette, stand, bubbler, water bath or heating mantle, reflex condenser.

Method for estimation of saponification value

1. Weigh approximately 2 grams of the product to be wei ghed into an iodine flask equipped with a reflux condens er. Add 25 ml of 0.5 m KOH ethanol solution, reflux and boil in a water bath for 30 minutes. Remove the condens er, add 1 ml of phenolphthalein solution and titrate imme diately with 0.5 M HCl. Do not forget to read "a"
2. Repeat this procedure, ignoring the marked items.
3. Calculate the saponification ratio by using formula given below

$$\text{Saponification ratio} = 28.05 \times \frac{(b\text{-}a)}{w}$$

Where,

b – blank titration reading

a – sample titration reading

w – weight of sample (oil)

We have repeated the same procedure of acid value estimation and saponification value estimation after 7 months for acid value and after 9 months for saponification value to check the effect of environmental factors like oxygen light and heat on these values.

Notes

1. Alcohol flames readily. Make use of electrical heating.
2. When alcohol is saponified, it shouldn't dry out. Alcohol vapor needs to be cooled down effectively.
3. The test solution's homogeneity and clarity are signs of full saponification.

Table No. 1: Initial Acid values of oils.

Oil ↓ / Brand name →	Sunny	Star	Gemini
Soyabean oil	33.66	33.66	33.66
Sunflower oil	33.66	33.66	33.66

Table No. 2: Acid Values of oils after 7 months from previous record.

Oil ↓ / Brand name →	Sunny	Star	Gemini
Soyabean oil	67.32	127.15626	41.13813
Sunflower oil	33.66	100.98	44.88

Table No. 3: Initial saponification value of oils.

Oil ↓ / Brand name →	Sunny	Star	Gemini
Soyabean oil	190.4	193.545	192.70
Sunflower oil	193.545	192.6384018	192.6384018

Table No. 4: Saponification values of oils after 9 months from previous record.

Oil ↓ / Brand name →	Sunny	Star	Gemini
Soyabean oil	203.83935	219.726887	217.855935
Sunflower oil	202.96	207.57	205.70187

CONCLUSION

At first acid and saponification value of both of oil of each brand having normal acid and saponification value but on storage both acid value and saponification value both increases of each oil. The observed increase in acid and saponification values of the oils during storage provides compelling evidence of oxidative degradation. This phenomenon is likely caused by the oils' exposure to environmental factors such as oxygen, light, and heat, which catalyse the breakdown of triglycerides into free fatty acids. The rise in acid value indicates a higher concentration of free fatty acids, whereas the rise in saponification value indicates a greater amount of alkali required to neutralize these acids. To prevent such deterioration, oils should be stored in tightly sealed, opaque containers that are protected from light and kept in cool environments. Regular monitoring of these values is an important tool for determining oil stability and ensuring a long shelf life. In case of acid value of both soyabean and sunflower oil the wide change observed in the oil from brand star and in case of saponification value also the wide change observed in the oil from the same brand star as compared to other brands of oils.

NOTE

The research reported in this paper focuses on the quantification values exceeding by matrices for Sunflower Oil and Soybean Oil belonging to three different brands. No reference control will be included in every panel because the results and interpretations presented are solely developed from our applied methods under this experimental design. No claims on the quality, safety and/or efficacy of these brands have been made. Results should be interpreted within the confines of this specific research methodology and are not meant to facilitate comparative analysis or recommendations for any potential brands.

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