Application Note AN-T-112

Acid value and free fatty acids in edible oils

Fully automated determination according to the current EN ISO, Ph. Eur, and USP standards

The acid value (or acid number), together with the free fatty acid value, are important parameters used for the characterization and quality assessment of edible fats and oils. These parameters are also used to monitor the production process of fats and oils.

By definition, the acid value in oils and fats refers to the weight in milligrams of the amount of potassium hydroxide (KOH) or sodium hydroxide (NaOH) required to neutralize one gram of this sample. Acid value and free fatty acid determination by titration are among the best-known analysis methods.

This Application Note describes both the acid value titration as well as the free fatty acid titration in different edible oils. The method is based on the standards EN ISO 660, USP<401>, and Ph.Eur. 2.5.1.

Find more information in the video:

INTRODUCTION

Free fatty acids (FFAs) are triglyceride-free fatty acids. They are only found in very small quantities in virgin (native) vegetable oils. The more refined or processed the oil is, the higher the free fatty acid content. The acid value and free fatty acid value may only be present up to a certain level in edible oils; therefore, both values are used for quality classification purposes. In general, the acid value increases with the age of an oil as triglycerides decompose into smaller fatty acids and glycerol as an effect of time.

In short, FFAs are caused by the hydrolysis of long chain oils into shorter fatty acid chains. The higher the acid value and FFA content, the lower the quality and stability of the oil against oxidation.

FFA analysis is used for purity testing. In certain cases, it allows conclusions to be drawn about the pretreatment or ongoing decomposition reactions—in particular for saturated fatty acids and unsaturated fatty acids in fat or oil samples.

Using the acid value titration method or the free fatty acid titration method by potentiometric indication, very accurate results can be achieved for a wide range of edible oils, animal fats, or waxes, up to products with high saponification.

SAMPLE AND SAMPLE PREPARATION

The analysis is demonstrated on canola oil (rapeseed oil), palm oil, sunflower oil, and olive oil.

No sample preparation is required.

EXPERIMENTAL

This analysis is performed on an automated system consisting of an OMNIS Advanced Titrator and an OMNIS Sample Robot S with Dis-Cover equipped with a dSolvotrode (**Figure 1**).

To a reasonable amount of sample, a solvent mixture consisting of ethanol and diethyl ether is automatically added, and the solution is stirred for one minute to dissolve the sample. Afterwards, the sample is titrated with standardized ethanolic potassium hydroxide (KOH) until after the equivalence point is reached.

Figure 1. OMNIS Sample Robot S with Dis-Cover functionality, Dosing module, and OMNIS Advanced Titrator equipped with dSolvotrode for the determination of acid value and free fatty acids.

RESULTS

This method demonstrates acceptable results and well-defined titration curves for acid value and free fatty acids displayed in **Table 1** and **Figure 2**. The SD(rel) is apparently high with max. 5.3%, however, this corresponds to a SD(abs) of approx. 8.5 g KOH/g sunflower oil or 4.4 g KOH/g rapeseed oil, respectively.

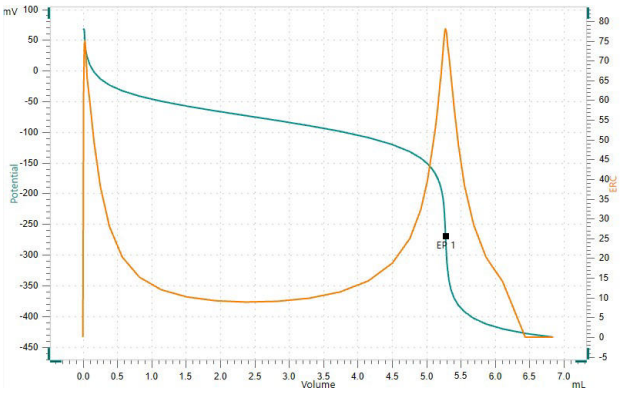

Figure 2. Titration curve of the determination of the acid value of palm oil.

Table 1. Results for acid value (AV) and free fatty acids (FFA) expressed as oleic acid (canola oil, olive oil, sunflower oil) or palmitic acid (palm oil) for different edible oils.

Sample (n = 5)	Acid value in mg KOH/g	Free fatty acids in %	SD(rel) in %
Canola oil	0.11	0.05	4.0
Olive oil	0.41	0.21	2.0
Palm oil	11.6	5.3	0.2
Sunflower oil	0.16	0.08	5.3

CONCLUSION

Acid and free fatty acid titration with NaOH or KOH is a precise and reliable method to determine these values in various edible oils according to several international standards.

Using an OMNIS Sample Robot with Dis-Cover functionality allows the fully automated determination of up to four samples in parallel, freeing up valuable time of the operator and thus increasing the productivity in the lab. The OMNIS system offers the opportunity to customize the system according to your needs and expand it for other required titration applications on edible oils, such as the peroxide value or iodine value.

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