Application Note AN-R-033

Determination of antioxidant content with PEG as carrier material

Reliable and accurate equivalent of the α-tocopherol content with the polyethylene glycol method

The shelf life of many products must be checked regularly to ensure that they are still fit for use. These include various food and cosmetic products, as well as petroleum products used in industry. The antioxidant content of a product is a key indicator of its shelf life. Essentially, the higher the antioxidant content in the product, the longer its shelf life and the younger the product is.

This Application Note demonstrates the feasibility of determining antioxidant content with the Rancimat method. A calibration with a known antioxidant, α-tocopherol (vitamin E), was carried out using PEG as a carrier material – and then the antioxidant content of an already measured sample was calculated with linear regression. Using the 892 Professional Rancimat, reproducible and accurate determination of the oxidation stability of different products is possible.

INTRODUCTION

When measuring stability with the Rancimat, the PEG method has proven to be the most effective method in addition to direct measurement. It is particularly suitable for products with a complex matrix or when time-consuming sample preparation should be avoided.

However, like direct measurement, the PEG method cannot reflect the antioxidant content of the product exactly. Comparison with a second method such as titration, HPLC, or a long-term test is always necessary [1].

In this Application Note, calibration with α-tocopherol was carried out using PEG as a carrier material. Afterward, the antioxidant content of a previously measured sample was calculated using linear regression. The calibration was performed using a dilution series from a stock solution. Standards between w(tocopherol) = 25 mg/kg and 250 mg/kg were used for the calibration.

It has been shown that this calibration method can be used to make a reliable statement about the antioxidant content—expressed as α-tocopherol— of various products. This antioxidant content can be easily compared at any time. As many products contain different antioxidants, it is easier to focus on a single substance for comparison. In addition, it is not possible to distinguish between different antioxidants in the same product using the Rancimat – this requires a chromatographic method.

SAMPLE AND SAMPLE PREPARATION

This application is demonstrated on various samples (Table 1).

No sample preparation is required.

EXPERIMENTAL

The determinations are carried out using an 892 Professional Rancimat (Figure 1).

An appropriate amount of sample (or standard solution) and PEG are weighed into the reaction vessel, and then the analysis is started.

With the Rancimat method, the sample is exposed to an airflow at a constant temperature of 100–180 °C. Highly volatile secondary oxidation products are transferred into the measuring vessel along with the airflow where they are absorbed in the measuring solution.

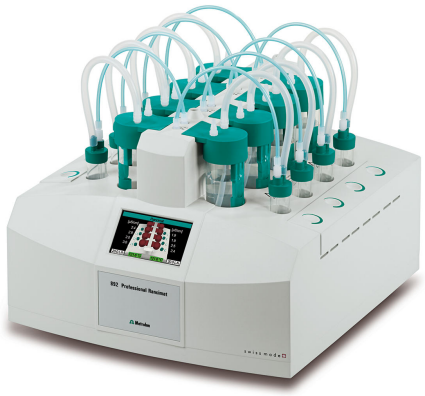

Figure 1. 892 Professional Rancimat equipped with measuring and reaction vessels for the determination of oxidation stability

The conductivity of the measuring solution is continuously registered. The formation of secondary oxidation products leads to an increase in the conductivity. The time until occurrence of this marked conductivity increase is referred to as the «induction time», which is a good indicator for the oxidation stability (Figure 2).

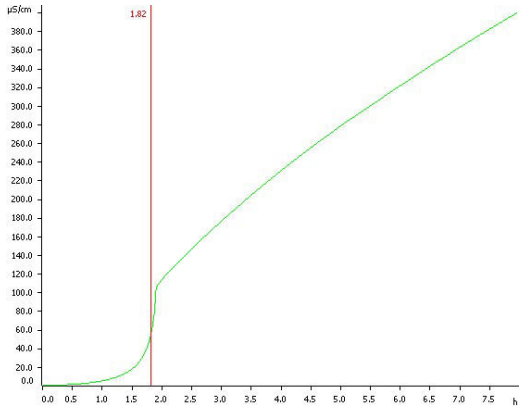

Figure 2. Determination of the oxidation stability of a bratwurst sausage. Induction time is determined at 1.82 h.

Using linear regression, it is shown that the α-tocopherol standards with the corresponding induction time achieved a coefficient of determination of 0.998 (Figure 3). This demonstrates the accuracy of the 892 Professional Rancimat.

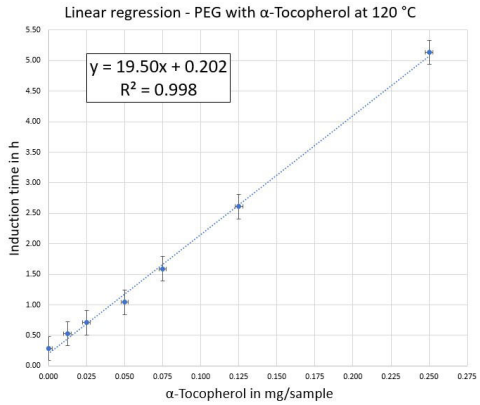

Figure 3. Linear regression of α-tocopherol with PEG as a carrier material at 120 °C.

Table 1. Results of the equivalent of α-tocopherol with the 892 Professional Rancimat as measured at 120 °C.

Sample (n = 4)	Mean value α-tocopherol (mg/kg)	SD(rel) in %
Cervelat	86.8	5.5
Bratwurst	84.0	1.1
Moisturizer	65.1	8.9
Body lotion	58.1	6.1
Dark chocolate	68.2	4.7
Coffee powder	1590.1	7.5
Green tea	7423.7	7.8

CONCLUSION

Thanks to the PEG method, conclusions can be drawn about the antioxidants expressed as α-tocopherol in the processed end product. Since there is no sample preparation required, the direct influence of the complete matrix of the sample is seen, and not just individual components.

With the Rancimat, this quality parameter can easily and simultaneously be determined for eight different samples at a time, increasing quality control laboratory throughput.

REFERENCES

1. Pokhrel, K.; Kourimská, L.; Rudolf, O.; et al. Oxidative Stability of Crude Oils Relative to Tocol Content from Eight Oat Cultivars: Comparing the Schaal Oven and Rancimat Tests. *Journal of Food Composition and Analysis* 2024, *126*, 105918. https://doi.org/10.1016/j.jfca.2023.105918.

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CONFIGURATION

892 Professional Rancimat

The 892 Professional Rancimat is an analysis system for the simple and safe determination of the oxidation stability of natural fats and oils with the well-established Rancimat method. With eight measuring positions in two heating blocks. The built-in display shows the status of the instrument and each individual measuring position. Start buttons for every measuring position enable the measurement start on the instrument. Cleaning effort can be reduced to a minimum through the use of practical disposable reaction vessels and dishwasher-safe accessories. This saves time and costs and significantly improves accuracy and reproducibility.

All accessories necessary for carrying out determinations are included in the scope of delivery. The StabNet software is required for instrument control, data recording and evaluation and for data storage.