Determination of the oxidation stability of fat-containing solid foodstuffs

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Stability

Summary

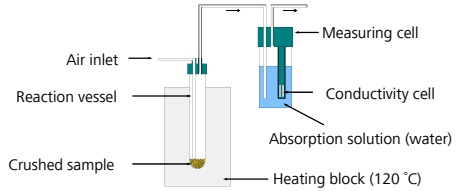
The Rancimat method is a widely accepted method for the determination of the oxidation stability of natural fats and oils. Its main application is quality control in oil mills and the oil processing industry. At elevated temperatures and under the exposure of air, fatty acids are oxidized. The reaction products are absorbed in ultrapure water that is continually monitored for conductivity. After an induction period with slow reaction, the formation of volatile carboxylic acids is accelerated. At that time the conductivity begins to increase rapidly. Instead of investing weeks or months, the sample can be oxidized within a few hours.

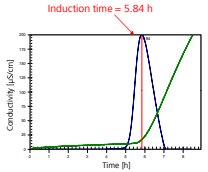
The method can also be used to determine the oxidation stability of solid foodstuffs that contain natural fats or oils. Frequently, a direct determination without extraction of the fat is possible, if the fat content exceeds a minimum level. In these cases, a simple and reliable assessment of the quality of the produced foodstuff is possible.

A number of fat-containing solid foodstuffs such as almonds, peanuts, peanut-flavored puffs, potato chips, muffins, butter cookies, French fries, and instant noodles were successfully tested with the Rancimat method. The experiments revealed that the comminution of the sample is one of the most important steps. The grinding procedure of the tested samples was kept as simple as possible to avoid the use of expensive milling instrumentation.

Rancimat method

In the Rancimat method, a stream of purified air passes through the fat-containing sample, which is held at a specified temperature in a thermostatted aluminum block. The effluent air from the oil or fat sample is then bubbled through a vessel containing deionized water. The conductivity of the water is continually monitored and stored by the software on the attached PC. The end of the induction period corresponds to the appearance of the secondary oxidation products – volatile organic acids, predominantly formic acid – which are blown out of the sample and absorbed in the water. At that time the conductivity begins to increase rapidly.

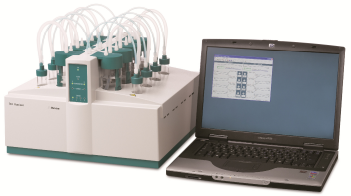




The PC software derives the induction time automatically from the maximum of the **second derivative** of the **conductivity-time** plot.

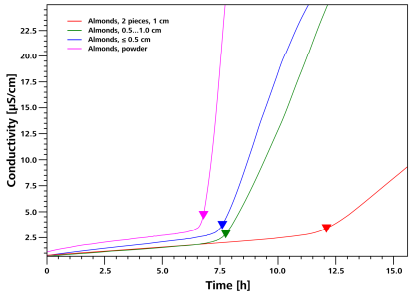
743 Rancimat

The oxidation stability characterizes the resistance of oils and fats as well as fat-containing foods to oxidation and is thus an estimate of how quickly a fat or oil will become rancid. The 743 Rancimat permits the determination of the oxidation stability in up to eight samples in accordance with international standards.



Influence of particle size

The oxidative stability is expressed as induction time. It strongly depends on the particle size of the sample: the smaller the particles, the lower the induction time. Medium hard samples such as almonds can be easily comminuted in a re-sealable plastic bag by using a hammer.



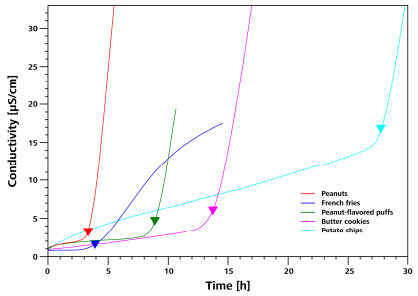
Almond samples	Almond size [cm]	Induction time [h]
	1.0	12.1
	0.5...1.0	7.7
	≤ 0.5	7.6
	powder	6.8

For most food samples, powdering is recommended, because the more homogeneous the sample, the better (steeper) the obtained measuring curve. In cases where the sample cannot be powdered, the crushed sample should be homogeneous with a maximum particle size of approximately 5 mm.

When the use of a hammer is not applicable, for example for French fries, a knife and a cutting board can be used instead. Soft samples are manually crushed.

Oxidation stability of fat-containing foodstuffs

Foods containing fat suffer from oxidative rancidity. In the following, the oxidation stability of several well-milled, fat-containing foodstuff samples was determined. During processing, naturally fat-rich nuts loose their protective microstructure and become prone to oxidative spoilage. Other foods, which are naturally low in fat, commonly become fused with fat during manufacturing: instant noodles, for example, absorb large fat quantities (up to 22%) in the deep-frying step. Similarly, baked goods contain significant fat contents.



Sample		Induction time [h]
	Almonds	6.9
	Peanuts	3.4
	Peanut-flavored puffs	8.9
	Potato chips	27.7
	Muffin	10.7
	Butter cookies	13.7
	French fries	3.9
	Instant noodles	14.8

Conclusion

Fat oxidation results in rancidity and is the major cause of food deterioration. The Rancimat method is a straightforward means for determining the oxidation stability of fat-containing foodstuffs. Sample size is a key parameter: the smaller the sample size, the lower the induction time.

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