EASTMAN

Schaal Oven Storage Stability Test

Evaluating antioxidant effectiveness in fats, oils, and fat-containing foods

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Tests for determining oxidative stability

Oxidative stability, or storage life until development of rancidity, is an important factor in the processing and marketing of fats, oils, and fat-containing foods. Methods for determining oxidative stability are therefore essential, particularly where antioxidants are being evaluated for effectiveness in retarding rancidity in these products. One widely used method involves storage tests in which oil, fat, or food products are stored under controlled conditions and evaluated periodically for organoleptic (odor and flavor) changes.

Storage tests conducted under normal conditions of product use provide the most realistic determination of stability. However, these tests are usually too time consuming to be practical. For laboratory evaluations, a method of accelerated storage-testing has been developed.

The simplest accelerated method utilizes oven storage.[1–3] The Schaal Oven Test, 62.8°C (145°F), is often used for evaluating fats, oils, and baked goods such as crackers and pie crusts. Oven tests at lower temperatures are used for such products as essential oils and cheese spreads where elevated temperatures tend to distill volatile ingredients, break emulsions, or otherwise destroy original physical characteristics of the product. Shelf tests at ambient temperature are sometimes used for the latter product group and follow the same procedure, except for oven use.

The complex compositions of food products and certain uncontrollable factors in conducting storage tests preclude strict comparisons or projections of test data. In reporting test results, it is common practice to describe the test used and to give time values for control (untreated) versus antioxidant-treated samples.

Numerous papers describing the use of storage tests for evaluating oxidative stability and carry-through properties of antioxidant-treated products have been published.[4–12] Data comparing results from storage stability tests and various methods of oxygen-absorption measurement are also available.[13–15]

Accelerated storage-testing of fats, oils and fat-containing foods

Equipment

1. Thermostatically controlled gravity convection oven capable of maintaining temperature range of 62.8° ± 2.8°C to 23.9° ± 1.2°C (145° ± 5°F to 75° ± 2°F)
2. Glass jars (4-oz, wide mouth, with screw caps)

Procedure

1. Set oven for desired storage temperature.
2. Label a sufficient number of the 4-oz jars with proper identification to provide 3–5 jars for each sample to be tested. For valid comparative results, control (no antioxidant) samples must be included in this test. Code the samples to eliminate any bias on the part of the organoleptic panel members. (Caution: Make certain that the labels used will adhere to the jars and remain legible during extended storage at elevated temperatures.)
3. Record in a laboratory notebook the sample identification and the date of the beginning of the storage test.
4. Fill the labeled jars one-third to one-half full with the desired test samples and cap the jars.
5. Place the jars in the oven in a manner to allow free circulation of the heated air in the closed oven.
6. Evaluate the odors and/or flavors of the samples at appropriate intervals, using a trained organoleptic panel consisting of at least three members. The length of the interval between evaluations will depend on the nature of the individual sample. However, samples having relatively short Schaal Oven life (1 week or less) should be evaluated at 24-hour intervals, while samples having longer oven life may be evaluated twice a week. A sample is removed from the oven when a rancid odor or flavor has been detected by a majority of the panel members.
7. Record in the laboratory notebook the date each sample is removed from the oven.
8. Calculate for each sample the average days to rancidity (by odor or flavor) when all the replicates have been removed from the oven.
9. Report results as "Storage Stability, as Days to Develop Rancid Odor (or Flavor) at _____°C (____°F)."

Additional information

Tables 1 and 2 give typical results obtained in the Eastman laboratories from storage stability tests on fats, oils, and food products treated with Eastman Tenox™ antioxidants. These data are provided to give an indication of the overall time involved and comparative values obtained when these tests are run. For more information on specific applications and to determine which antioxidants may be most effective in certain applications, refer to appropriate references cited in the bibliography or contact your Eastman representative.

Table 1 Examples of stabilities of Eastman Tenox™ antioxidant-treated food products determined by oven storage tests

Food product	Antioxidant[a] treatment, % by wt of food product	Storage stability as days to develop rancid odor @ 62.8°C (145°F)
	None (control)	10
Oat cereal	0.005 Eastman Tenox™ BHA	34
	None (control)	12
Corn cereal	0.005 Eastman Tenox™ TBHQ	56
	None (control)	9
	0.02 Eastman Tenox™ BHA	9
Cottonseed oil	0.02 Eastman Tenox™ TBHQ	23
	None (control)	6
Soybean oil	0.02 Eastman Tenox™ BHA	8
Butter mints	None (control)	27

[a]*Antioxidants used:*
Eastman Tenox™ BHA — butylated hydroxyanisole
Eastman Tenox™ TBHQ — tert-butylhydroquinone

Table 2 Examples of carry-through of Eastman Tenox™ antioxidants into food products with antioxidant-treated fats or oils as determined by oven storage tests

		Storage stability as days[b] to develop rancid odor @ 62.8°C (145°F)		
Fat or oil	Antioxidant treatment, wt %[a]	Pastry	Crackers	Potato chips
	None (control)	2	3	—[c]
Lard	0.01 Eastman Tenox™ BHA	21	22	—
	None (control)	—[c]	—[c]	12
	0.02 Eastman Tenox™ BHA	—	—	13
Cottonseed oil	0.02 Eastman Tenox™ TBHQ	—	—	20

[a]*Based on weight of fat or oil.*
[b]*Averages of quadruplicate determinations.*
[c]*Dash indicates test was not conducted.*

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