APPLICATION NOTE

F&F-O-001-2014/A1

Oxidation Stability of Butter

Reference: **International Standard Procedure AOCS Cd 12c-16**

Tested with **VELP Scientifica OXITEST Oxidation Stability Reactor** (Code F30900248)

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OXIDATION STABILITY OF BUTTER

Introduction

Butter is an emulsion of water in oil, approximately composed by 80% of fat. In good butter the moisture is evenly dispersed throughout the butter in tiny droplets. Butter can be made from either whole milk or cream; however, it is more efficient to make butter from cream.
Traditionally, it can be fermented or, in Anglo-Saxon countries, salted before trading. It is used as a condiment and in cooking, similar to vegetable oils and lard.

The sensorial quality of butter can be described as the customer's reaction to its color, texture and flavor. It has been said that the consumer tastes with his/her eyes, and it is true that a person's initial impression of a food will often be determinant.

Apart from food, it can be found as an ingredient of cosmetics, medicines and lubricants.

Oxidation Stability of Food

One of the most important quality alteration of food is due to oxygen absorption by the unsaturated fatty acids, free or esterified. The auto-oxidation of fats is a chemical reaction promoted by light, high temperatures, metal traces and, sometimes enzymes.
OXITEST can determine the oxidation stability of various sample types, without the need for preliminary fat separation.

OXITEST Principle

OXITEST speeds up the oxidation process because of the two accelerating factors, temperature and oxygen pressure, according to the most common applications.
The instrument measures the absolute pressure change inside the two chambers, monitoring the oxygen uptake by reactive components in the sample and automatically generates an IP value.

IP Definition: IP stands for Induction Period and it is the time required to reach the starting point of oxidation, corresponding to either a level of detectable rancidity or a sudden change in the rate of oxidation. The longer the Induction Period, the higher the stability against oxidation over time.

Sample

Butter formula F1
Fat labeled value: 81.0 g / 100 g
Butter formula F2
Fat labeled value: 82.0 g / 100 g

Equipment and Chemicals

- Analytical balance, 3 decimals
- Silicone grease
- Oxygen, purity grade 5.0

Sample Preparation

Keep the samples refrigerated during the storage.
Put 10 grams of homogeneous sample directly on the surface of the titanium sample holder, by using a spatula.
In each reaction chamber (A and B), place 1 sample holders (containing the sample) and 2 spacers.

Analysis Procedure

Grease the O-rings with silicon grease and set them in their position. Close the chambers with the titanium covers and turn the discharge valves in open position. Set the following conditions on the OXISoft™ software:
Temperature: 80 °C
Oxygen Pressure: 6 bars

When the temperature set is reached inside the chambers, close the discharge valves and start loading oxygen.
Data acquisition is automatically started by the software.

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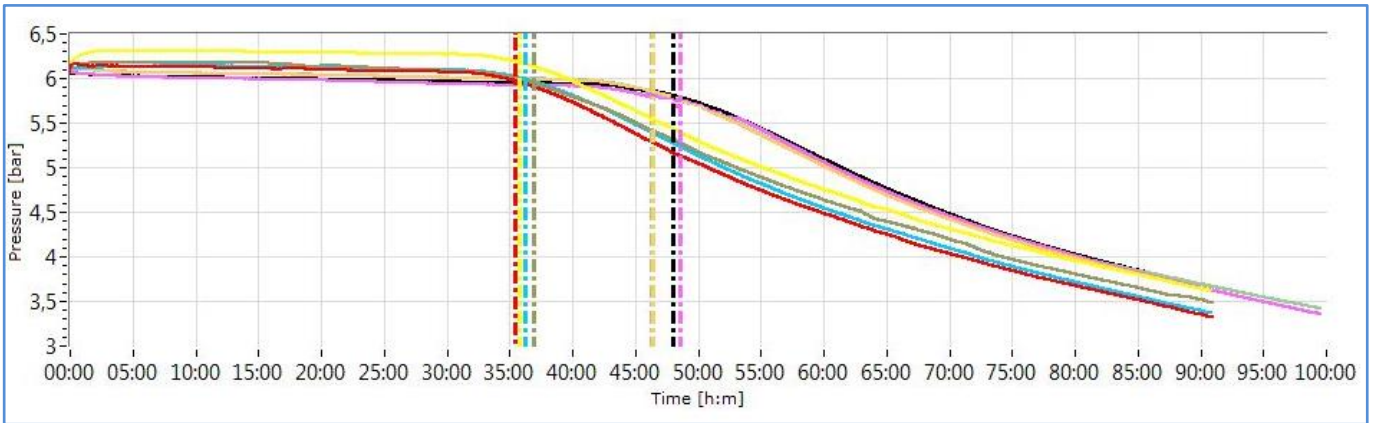
Typical Results on Butter

Each sample has been monitored four times. At the end of the oxidation tests, the IP of every run is calculated by the software OXISoft™.

It is possible to elaborate the oxidation curves obtained for each kind of butter.

Sample	Weight (g)	Set Point (bars)	Set Point (°C)	IP (hh:mm)	Line
Butter F1	10,000	6,00	80,0	35:28	
Butter F1	10,000	6,00	80,0	36:54	
Butter F1	10,000	6,00	80,0	35:44	
Butter F1	10,000	6,00	80,0	36:14	
Butter F2	10,000	6,00	80,0	46:24	
Butter F2	10,000	6,00	80,0	48:35	
Butter F2	10,000	6,00	80,0	46:17	
Butter F2	10,000	6,00	80,0	48:00	



Repeatability Test

With OXISoft™, it is possible to create a repeatability test for each analysis, in order to obtain the average, standard deviation and relative standard deviation of the results.

For repeatability test, it is necessary to analyze the same quantity of the sample in duplicate or more, at the same values of temperature and pressure. In the table below the results are summarized:

Sample	IP average (hh:mm)	SD (hh:mm)	RSD %
Butter F1	36:05	0:37	1.7
Butter F2	47:19	1:09	2.4

RSD value must be < 5% in order to obtain good results.

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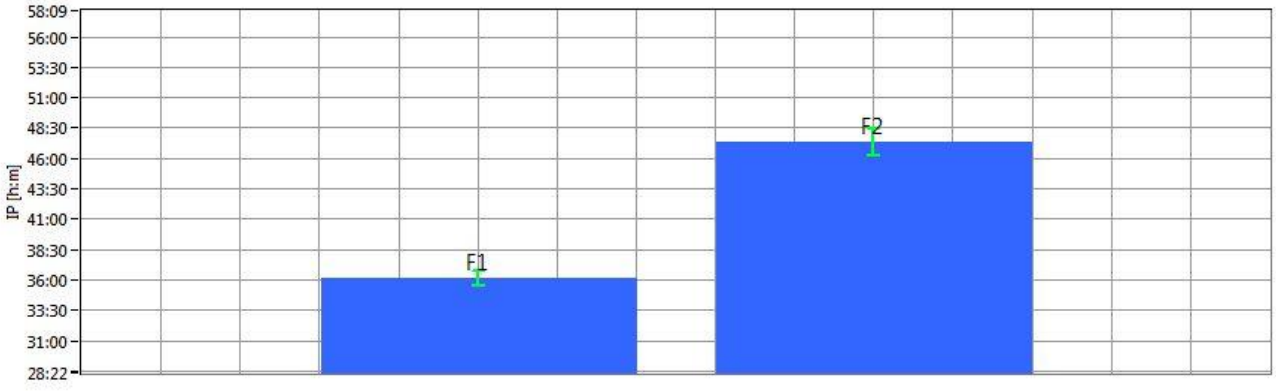
Formula Comparison

With OXISoft™, it is also possible to easily compare the obtained IP values, of different formulations but tested at the same condition, and identify the most stable one.



Butter F1 Butter F2

Conclusion

The results obtained by OXISoft™ and the formula comparison function, clearly discriminate the butter's resistance to oxidation. Butter F2 results significantly more stable against oxidation
Although the total fats percentage is very similar, Butter F1 has a shorter IP value, hence a lower oxidation stability. This is probably related to their fat composition: higher content of unsaturated fatty acids has a higher oxidation kinetic compared to saturated fatty acids as shown in table below.

Comparison between the rate of oxygen absorption by saturated and unsaturated fatty acids	
Stearic acid	1
Oleic acid	11
Linoleic acid	114
Arachidonic acid	179

Table bibliography: *"Food Chemistry" - page 166 - Cappelli, Vannucchi*

Butter is an important ingredient in food industry and, knowing its stability, can help to choose it in making end product's formulation.

Benefits of OXITEST are:

- Test is made directly on the whole sample
- No need for preliminary fat separation of the sample
- Resistant titanium chamber
- Time saving analysis, if compared to the traditional methods
- Especially designed for R&D, Product Development and Quality Control labs
- Many investigations available through the software OXISoft™:
  1. Repeatability test: a series of tests run on the same sample or standard to verify its IP period, to calculate accuracy and repeatability of the data
  2. Freshness test: to verify the quality of different lots, for example of the same raw material, and compare them
  3. Formula comparison: to identify the most stable formula of a finished product, under the same conditions
  4. Packaging comparison: for testing which packaging maintains the product in the freshest condition
  5. IP during ageing: to obtain a graph of the decrease of the product IP during the shelf-life period
  6. Estimated shelf life: to have a prediction of oxidation stability during the shelf life.

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