APPLICATION NOTE

F&F-O-001-2021/A1

Oxidation Stability of various types of Oils – Evaluation of a new Antioxidant effectiveness

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

Tested with **VELP Scientifica OXITEST Oxidation Stability Reactor**

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OXIDATION STABILITY OF OILS

Introduction

Various types of **edible oils** are available for cooking and for use in the kitchen.
These products range from **plant oils**, such as sunflower, soy, peanut, palm, coconut, olive oils, mixture of oils **to animal fats**, such as salmon oil.
Antioxidants are typically used to enhance shelf life and preserve the quality of edible oils and fats. They suppress oxidation reactions by participating in or interfering with the lipid autoxidation reaction cascade through various mechanisms. Antioxidants used in oils and fats must be cost-effective, safe, easy to handle and use, readily available, stable, effective at low concentrations, and devoid of any undesirable flavor, odor, or color attributes.

Oxidation Stability of Food

One of the most important quality alterations 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.

Samples

ID 067 Sunflower oil without antioxidant
ID 068 Soy oil without antioxidant
ID 069 Salmon oil without antioxidant
ID 070 Oils mixture without antioxidant
ID 075 Oils mixture with antioxidant B
ID 071 Sunflower oil with antioxidant C
ID 072 Soy oil with antioxidant C
ID 073 Salmon oil with antioxidant C
ID 074 Oils mixture with antioxidant A
ID 076 Oils mixture with antioxidant C

Equipment and Chemicals

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

Sample Preparation

Keep the samples at room temperature 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 holder (containing the sample) and 2 spacers.

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Analysis Procedure

Grease the O-rings with silicon grease and place 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: 90 °C
Oxygen Pressure: 6 bars

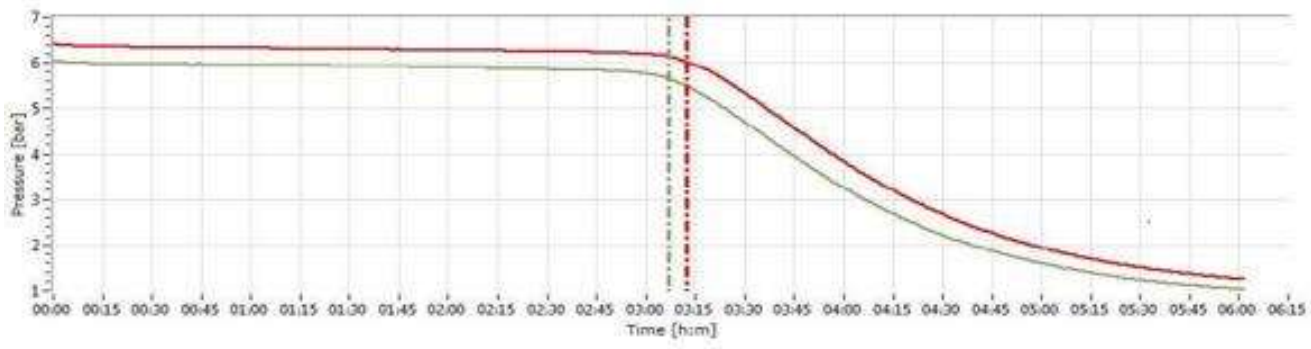
When the temperature set is reached inside the chambers, close the discharge valves and start loading oxygen.
Data acquisition is automatically started by the software.

Typical Results on Oils

Each sample has been analyzed in duplicate. All the samples have been analyzed at 100°C in order to compare the Induction Periods (IP) obtained.
At the end of the oxidation tests, the IP of every run is calculated by the software OXISoft™.

The table below refers to the IP obtained on the **Oil mixture without antioxidant sample** analyzed at 100°C.

Sample	Weight (g)	Set Point (bars)	Set Point (°C)	IP (hh:mm)	Line
Oil mixture without antioxidant	10	6.0	100.0	03:12	
Oil mixture without antioxidant	10	6.0	100.0	03:06	



Formula Comparison

Using the IP values obtained it is possible to make a comparison of the samples thanks to the **OxiSoft™** software option **"Formulas Comparison"**.

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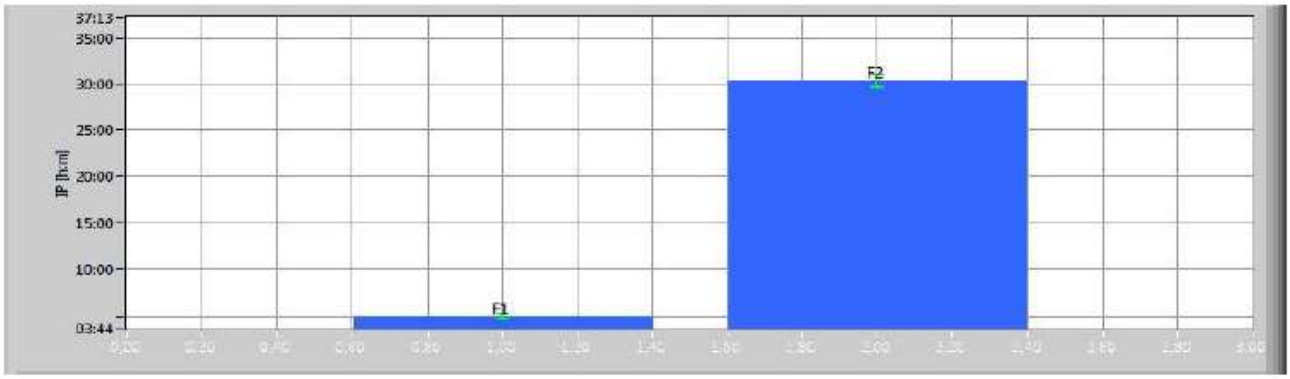
The graph below refers to the **Formulas Comparison** report of **Sunflower oil samples with and without antioxidant.**

Reference material:

ID	Date [dd/mm/yy]	File Name	Set point T [°C]	Set point P [bar]	IP [h:m]	SD [h:m]	RSD [%]
F1	12/02/19	IDO67 Sunflower oil without antioxidant	100,0	6,00	4:56	0:16	5,5

Results:

ID	Date [dd/mm/yy]	File Name	Set point T [°C]	Set point P [bar]	IP [h:m]	SD [h:m]	RSD [%]	Delta IP [h:m]	Delta IP [%]
F2	10/02/19	IDO71 Sunflower oil with antioxidant	100,0	6,00	30:19	0:42	2,3	25:23:00	514,5



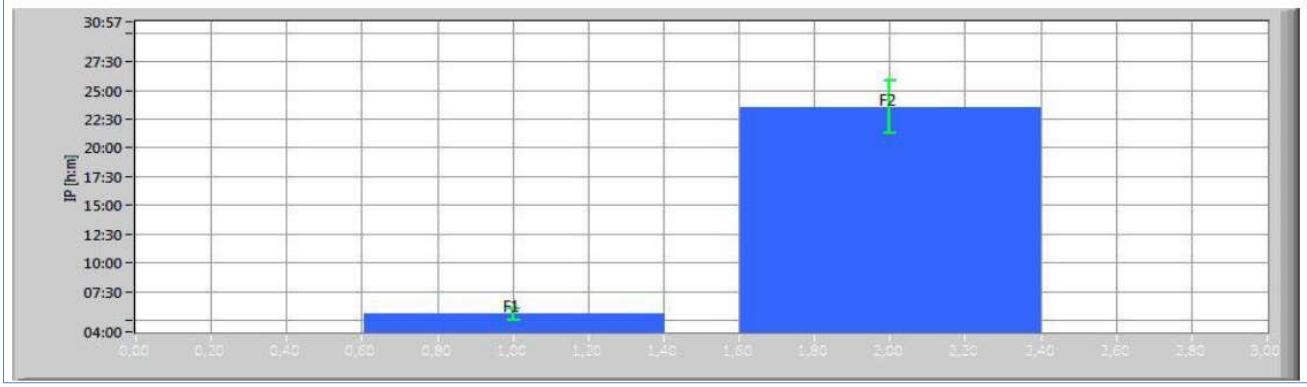
The graph below refers to the **Formulas Comparison** report of **Soy oil samples with and without antioxidant.**

Reference material:

ID	Date [dd/mm/yy]	File Name	Set point T [°C]	Set point P [bar]	IP [h:m]	SD [h:m]	RSD [%]
F1	12/02/19	IDO68 Soy oil without antioxidant	100,0	6,00	5:32	0:31	9,4

Results:

ID	Date [dd/mm/yy]	File Name	Set point T [°C]	Set point P [bar]	IP [h:m]	SD [h:m]	RSD [%]	Delta IP [h:m]	Delta IP [%]
F2	09/02/19	IDO72 Soy oil with antioxidant	100,0	6,00	23:31	2:17	9,7	17:59	325



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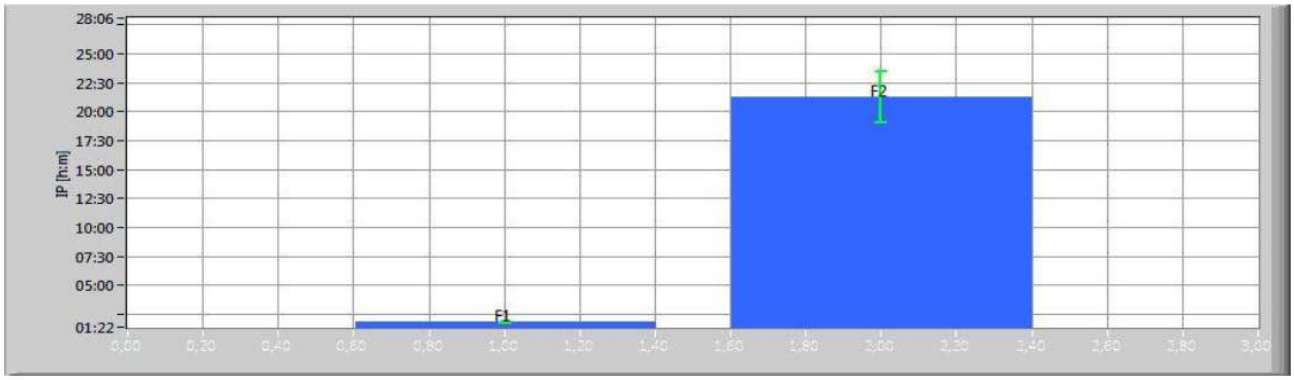
The graph below refers to the **Formulas Comparison** report of **Salmon oil samples with and without antioxidant**.

Reference material:

ID	Date [dd/mm/yy]	File Name	Set point T [°C]	Set point P [bar]	IP [h:m]	SD [h:m]	RSD [%]
F1	12/02/19	IDO69 Salmon oil without antioxidant	100,0	6,00	1:46	0:03	3,3

Results:

ID	Date [dd/mm/yy]	File Name	Set point T [°C]	Set point P [bar]	IP [h:m]	SD [h:m]	RSD [%]	Delta IP [h:m]	Delta IP [%]
F2	13/02/19	IDO73 Salmon oil with antioxidant	100,0	6,00	21:13	2:12	10,4	19:27	1100,9



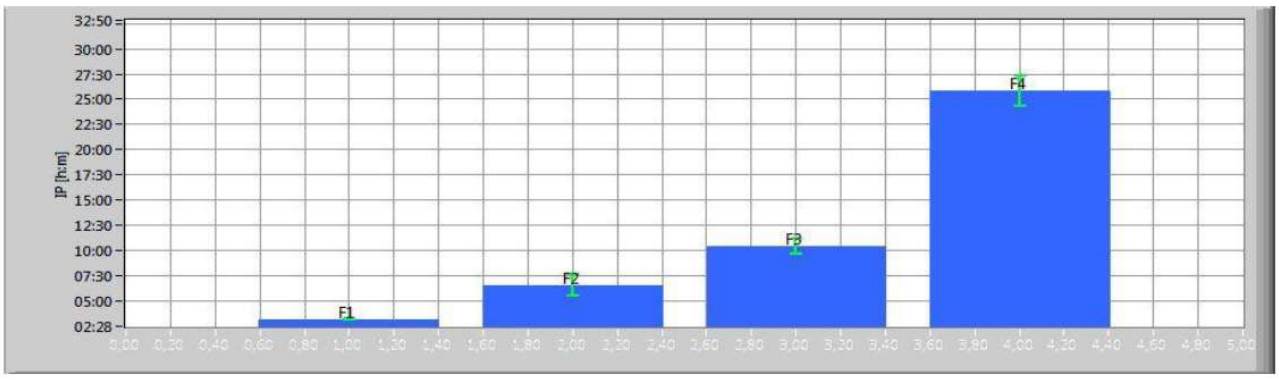
The graph below refers to the **Formulas Comparison** report of **Oils mixture samples with and without antioxidant**.

Reference material:

ID	Date [dd/mm/yy]	File Name	Set point T [°C]	Set point P [bar]	IP [h:m]	SD [h:m]	RSD [%]
F1	13/02/19	IDO70 Oils mixture without antioxidant	100,0	6,00	3:09	0:04	2,2

Results:

ID	Date [dd/mm/yy]	File Name	Set point T [°C]	Set point P [bar]	IP [h:m]	SD [h:m]	RSD [%]	Delta IP [h:m]	Delta IP [%]
F2	12/02/19	IDO74 Oils mixture with antioxidant A	100,0	6,00	6:30	1:04	16,5	03:21	106,3
F3	12/02/19	IDO75Oils mixture with antioxidant B	100,0	6,00	10:25	0:44	7,1	07:16	230,7
F4	10/02/19	IDO76 Oils mixture with antioxidant C	100,0	6,00	25:51	1:31	5,9	22:42	720,6



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Conclusion

The **OXITEST Oxidation Stability Reactor** is an innovative and reliable solution to investigate the oxidation stability of various types of oils. The longer the **Induction Period**, the higher the stability of the oil against oxidation over time.

From the graphs obtained with the option **"Formulas Comparison"** for **sunflower, soybean, salmon oils** it is evident that the **OXITEST** is able to effectively discriminate, in a very clear way, between the oil analyzed as is and the same type of oil with the addition of antioxidant and between oils of different origin.
Comparing all the oils containing the antioxidant, the Sunflower Oil with antioxidant (ID O71) has the highest resistance to oxidation with an IP value of 30:19 (hh:mm).

Benefits of the OXITEST are:

- Test is performed directly on the whole sample
- No need for preliminary fat separation from the sample
- Resistant titanium chamber
- Time saving analysis compared to the traditional methods
- Designed for R&D, Product Development and Quality Control labs
- Many parameters can be investigated with the OXISoft™ software:
  1) **Repeatability test**: a series of tests run on the same sample or standard to verify its IP period and 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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