Improvement of meat oxidation stability by addition of natural products

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

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

Introduction

Meat and fish are the main proteic food products consumed in the human diet. Their shelf-life is quite limited due to the easy attack from bacteria, also the presence of a consistent amount of fat that is easily subjected to an oxidation process, thus producing molecules responsible for off-flavour development.

Fat oxidation is a complex chemical reaction stimulated by oxygen and light exposure, and is accelerated by high temperatures and presence of metal traces.

Aromatic plants such as rosemary, oregano, and several spices such as red chili pepper powder are rich in compounds showing strong antioxidant properties. The addition of such natural ingredients, or their extracts, to food products, has been proposed in order to increase food storage, in particular thanks to their activity against fat oxidation.

The context of sustainability, and the circular economy project, the extraction of active compounds from agro-industrial byproducts is gaining growing interest for their high content of phenolic and antioxidant active molecules.

The use of natural additives to preserve meat and fish stability is strongly encouraged, and in the late years has been proposed as substitute of common synthetic preservatives.

Oxidation Stability in 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 oxygen, 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

Meat samples: sausage
Natural extract: basil
Fat labelled value: 25g / 100g of meat

Equipment and Chemicals

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

Sample Preparation

Mix the sausage with natural extract of basil (5 % w/w). Store both the sausage as is and the sausage with the addition of basil at room temperature. Put 30 grams of homogeneous sample directly on the surface of the titanium sample holders, by using a spatula.

In each reaction chamber (A and B), place 3 sample holders containing 10 grams of the sample each, for a total of 30 g of sausage in each oxidation chamber.

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: 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 Sausage

Each measure has been performed in duplicate.
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.
The Figure 1 shows the oxidation graphs obtained and the IP values of sausage samples with and without the addition of the natural extract, basil at T0 (as soon as It is produced).

Sample	Weight (g)	Set Point (bars)	Set Point (°C)	IP (hh:mm)	Line
Sausage with basil T0	30.000	6.00	90.0	7:13	
Sausage with basil T0	30.000	6.00	90.0	8:50	
Sausage T0	30.000	6.00	90.0	3:09	
SausageT0	30.000	6.00	90.0	3:09	
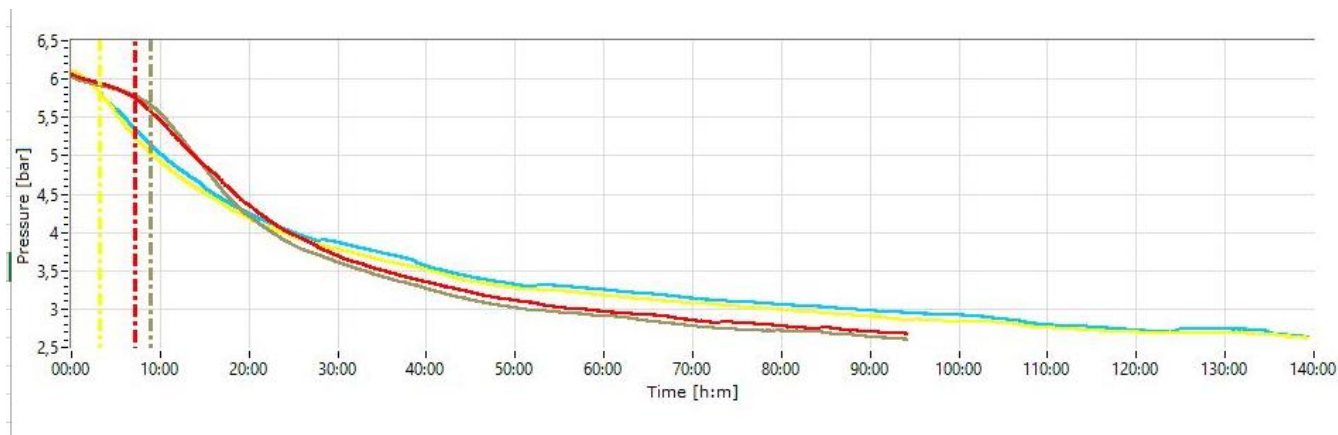
Formula Comparison

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.

Sausage   Sausage with
basil T0
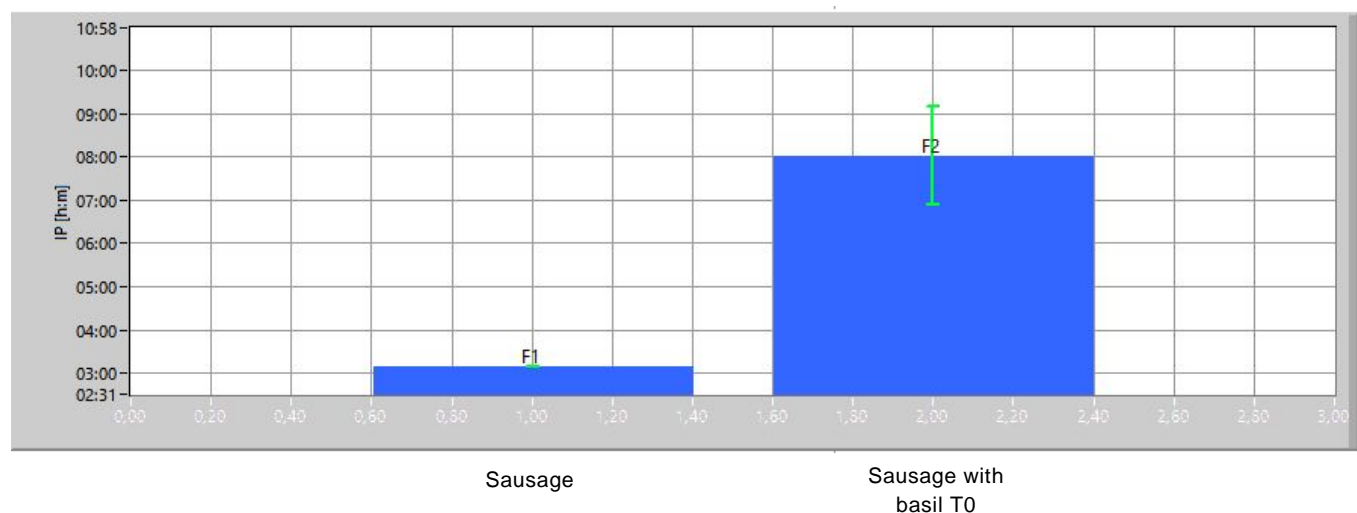
Study of enriched meat samples at different time of storage

The study has been also extended to measure the sausage stored at 4 °C, after addition of the natural extract at time T0 and after 24 and 96 hours.
In Table 1, data recorded from measures performed at T0, T24 and T96 are reported.

Storage time at 4 °C (hours)	IP (minutes)
0	481± 68
24	483 ± 35
96	505 ± 9

Table 1: IP values of sausage enriched with basil aroma and stored at 4 °C

The values reported in the table show even an increase of the oxidative stability of meat with time. On the contrary, the analysis performed on control samples recorded a progressive decrease of IP, reaching a value of about 90 minutes for the sausage as is after 96 hours, thus showing that the protective effect of basil oil is extremely strong.

Conclusion

The results obtained by OXITEST and the formula comparison function clearly discriminate the sausage as is and the sausage with basil aroma resistance to oxidation. From the IP results obtained it is very clear the effect of the natural extract to increase sausage's resistance to oxidation. Moreover, after storage at 4 °C for 24 and even 96 hours, a progressive sensible enhancement of the oxidative stability has been observed.
Therefore, Oxitest can be proposed as an easy method to assess the effect of natural extract addition to meat products, in order to test different vegetable derivatives.

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
- Connectivity to **VELP Ermes Cloud Platform** for remote Application and Service support, remote access to the instruments, alerts and notifications and much more

Acknowledgments