

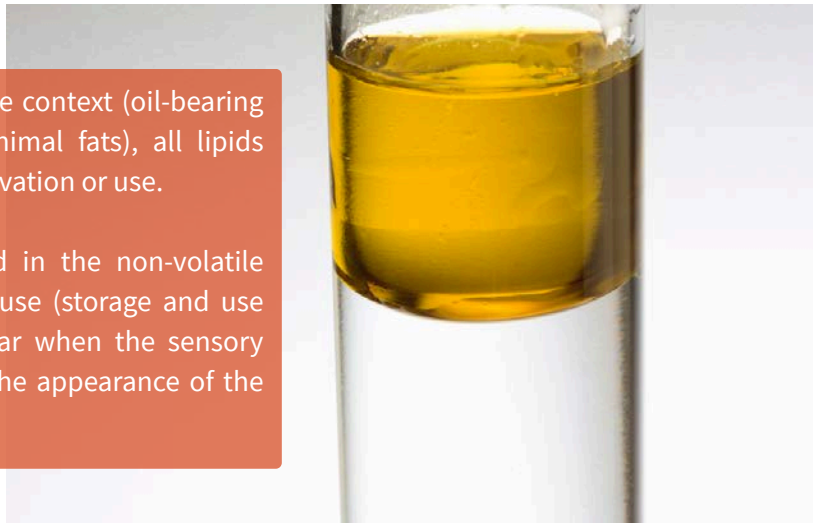
OXIDATION OF FATS & OILS

Fact sheet : N°3

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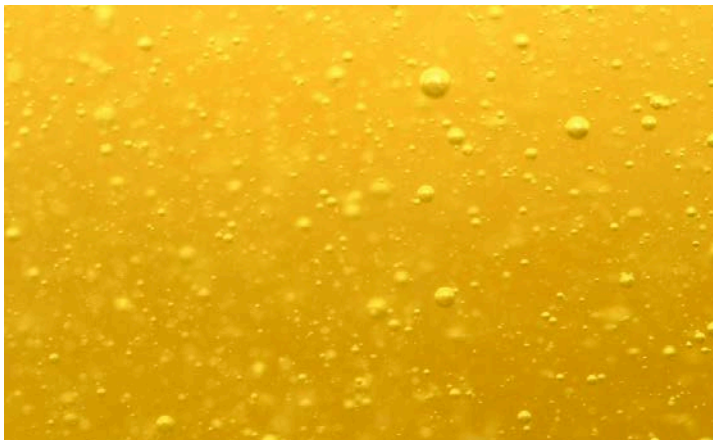
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OXIDATION



When they are extracted from their natural protective context (oil-bearing cells for vegetable fats and oils, adipocytes for animal fats), all lipids undergo autooxidative alterations during their conservation or use.

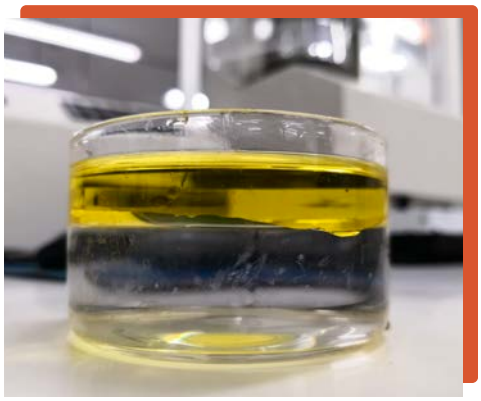
These alterations, which are more or less marked in the non-volatile compounds formed according to the conditions of use (storage and use cold or hot – cooking, frying, etc.), are always clear when the sensory aspect is taken into consideration, in particular by the appearance of the rancid defect .



This results in a direct implication of the oxidation phenomenon on the market value of oils and fats and therefore on their use-by date (Best before date).

The autooxidation of a fatty substance is a purely chemical phenomenon that is very complex and involves radical reactions able from Self-care and who require only the presence of atmospheric oxygen (biradical activated oxygen).

FORMED COMPOUNDS



The first products formed by the attack of activated oxygen on the double bonds of the fatty acid chains are unstable peroxide compounds, hydroperoxides, whose structure will depend on the nature of the fatty acids attacked (mono-, di-, tri- or polyunsaturated acids).

The alkoxyl radicals that derive from it by splitting lead to multiple secondary products whose nature and proportions depend on different parameters. Among these products, volatile molecules appear (mainly aldehydes, hydrocarbons, alcohols, acids, etc.) that modify the original flavour of fats. The largest group of volatile products in terms of quantity (a few hundred ppb or g/kg) is that of aldehydes (from C5 to C12), hence the notion of "aldehyde rancidity" (as opposed to the butyric rancidity of fermented dairy products). The threshold for the perception of these products in fats is very low.

Non-volatile secondary oxidation compounds are mainly monomeric oxidized triglycerides containing at least one altered fatty acid carrying a functional group such as hydroxyl, carbonyl or epoxide.

WHAT INFLUENCES

Oxidation is a spontaneous phenomenon but whose kinetics can be accelerated or slowed down under the effect of different parameters:

- the temperature,
- the nature of lipids and in particular fatty acids,
- the presence of light, especially UV,
- the content of pro-oxidant trace elements (metals),
- the hydrolysis state of glycerides, the activity of certain initiating enzymes (lipoxidases and lipoxygenases)
- the presence of so-called "antioxidant" molecules (or antioxidants),
- the presence of other products with eff and retarder (metal chelators, oxygen absorbers, etc.) or accelerators (pigments).

Other possibilities of damage

In addition to oxidative deterioration, edible fats can be damaged by chemical and/or enzymatic hydrolysis, polymerization (in the case of frying oils) and more rarely by isomerization or cyclization.

How to control the evolution of these phenomena

The analytical methods used to monitor these reactions are generally physico-chemical and make it possible to measure the degradation products formed.

In the case of autooxidation, the peroxide value is a sensitive measure, useful for evaluating the oxidation state (in the initiation phase) of a refined oil (customer/supplier specifications on receipt, for example), or for monitoring the behaviour of a fat stored at a low temperature (propagation phase), but it cannot account for the oxidative history of the fat.

A freshly refined fat has a peroxide value of less than 1 milliequivalent of O_2 per kg, can reach 2 or 3 meq/kg after packaging and transport, 5 or 10 meq/kg in

end of 12-month storage (shelf life of commercial oils) in its original packaging, without presenting any unacceptable sensory defects. It should be noted here that hydroperoxides are present at levels of the order of ppm and that they do not present any toxic character at this level.

As far as secondary oxidation compounds are concerned, many chemical indices make it possible to measure aldehydes (paranisidine index, TBA test, carbonyl number, etc.) but with a sensitivity and a range of application that are sometimes reduced.

