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Comparing oxidative stability of two margarines with vegetable oils of equal composition in fatty acids.

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Graphical Abstract

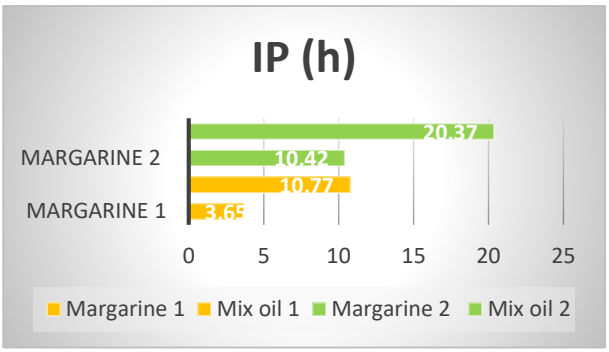

Figure 1. Induction periods of margarines and vegetable oils of equal composition in fatty acids

Abstract.

This work compares the oxidative stability of two margarines with vegetable oils of equal composition in both saturated and unsaturated fatty acids. For this purpose, weighted averages of the composition of the oils are calculated and their induction times at 120^0C were previously computed by QSPR. The results obtained from this calculation are compared to those obtained for equal weight of margarine in Rancimat at the same temperature. These results show that margarines have lower oxidative stability than oils with the same composition in fatty acids,

	which is explained by the fact that the presence of water in margarines generates hydrolysis reactions that speed up the oxidative process.

Introduction

Oxidative stability is an important parameter for evaluating the quality of edible oils and fats; it refers to the ability of oils and fats to resist oxidative rancidity (or deterioration) over processing and storage periods (1).

Lipid oxidation has been identified as the major deterioration process of vegetable oils affecting both the sensory and the nutritional quality of foods. Frying is one of the most common cooking techniques used in domestic and industrial food preparation. Flavor, shelf-life and nutrient composition of fried food and vegetable oils are altered by this process, and some of the formed compounds may have undesirable consequences on consumer's health (2,3).

Margarine is a water-in-oil (W/O) emulsion, solid at 20°C, derived from vegetable and animal oils. Other W/O emulsions with a fat content of 39–41%wt. may be designated as minarine or halvarine, according to the Codex Stan 256-2007. Moreover, depending on their composition and texture, they have been described as hard, soft, and semisoft margarines.

Previous studies in our group elucidated the complex relationship between composition and oxidative stability of vegetable oils and fats (4,5). To meet this objective, 22 types of oils and fats were analyzed for fatty acid composition, tocopherols, β-carotene, chlorophyll, total phenolic content (TPC) and oxidative stability. A multiple linear regression model approach showed a higher coefficient in the equation for saturated fatty acids (SFA), monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA). Taking into account these compounds, the equation turned out to be in the form below:

$IP = -904 + 9.49\,[SFA] + 9.16\,[MUFA] + 8.94\,[PUFA]$; $r^2 = 0.670$ (1)

The present work compares the oxidative stability of margarines with vegetable oils of equal composition in saturated and unsaturated fatty acids. For this purpose, weighted averages of the composition of the oils are calculated, and their induction times at 120^0C were previously computed by QSPR. The results obtained from this calculation are compared to those achieved for equal weight of margarine in Rancimat at the same temperature.

Materials and Methods

Margarine Samples

Margarines of different composition are detailed in Table 1.

Table 1. Fatty acid composition (expressed %wt. of total fatty acids)

Margarine	MUFA	PUFA	UFA	SFA
1	26.9	46.43	73.22	26.79
2	36.62	46.48	63.38	36.62

Margarine 1 contains a greater amount in weight in unsaturated fatty acids (UFA) but minor amount of %wt. in MUFA than margarine 2.

Rancimat analysis – Induction period (IP)

Oxidative stability of margarines was determined by the oxidation induction period (IP) in a 743 Rancimat apparatus (Metrohm Ltd., Herisau, Switzerland) according to the AOCS Official Method Cd 12b-92 (AOCS,1998). Margarine samples (3 g) were heated at 120 °C with a constant airflow of 20 L/h. The times required for a sharp increase in water conductivity are calculated automatically by the software and correspond to the IP in h. Measurements were taken in quadruplicate.

Results and Discussion

Oils selected for calculated weighted averages of the composition characteristics are defined in Table 2.

Table 2. Composition unsaturated fatty acids of oils and induction period at 120°C

Oil	UFA	IP (h)
1	82.8	9.99
2	51.5	12.75

Source: Ref.4

The weights of the oils for margarine 1 in the weighted averages are 0.69 (oil 1) and 0.31 (oil 2) and, for margarine 2, 0.38 (oil 1) and 0.62 (oil 2).

The induction periods for the combinations of these oils (mix oil 1 and mix oil 2), with equal composition in fatty acids to the margarines, are calculated by Equation 1, resulting 10,77 and 20.37 h, respectively.

Induction periods at 120°C of margarines 1 and 2 measured with Rancimat resulted in 3.650±0.200 h and 10.415±0.450 h, respectively.

The results of the comparing oxidative stability of the two margarines with vegetable oils of equal composition in fatty acids are shown in Figure 1:

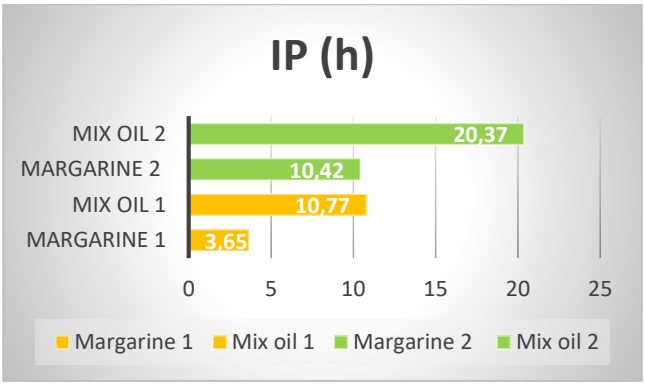

Figure 1. Induction periods of margarines and vegetable oils of equal composition in fatty acids

The difference between the induction periods of margarine 1 and the combination of oils with the same composition in unsaturated and saturated fatty acids is 7.12 and, similarly, for margarine 2 the difference between induction periods is 9.95 h.

Conclusions

- The oxidative stability of margarines decreases with the increase of unsaturated fatty acids in their composition.
- Margarines have less oxidative stability than oils of equal composition in fatty acids, because the presence of water in margarines favors the hydrolysis of unsaturated fatty acids, especially in frying or cooking processes.
- The difference between the induction periods of margarines and oils is greater in those margarines which contain higher amount of monounsaturated fatty acids (Table 1), since these acids are hydrolyzed more easily than the rest.

References

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