Oxidative Changes During Frying of Kernel in Sunflowerseed Oil

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Abstract

Sunflowerseed oil was used for laboratory scale frying of groundnut at 160°-165°C. The oxidative changes of the frying oil were followed measuring the change of dielectric constant and the content of evaporable products. The decrease of contact oil-air surface resulted in significant slowing of oxidative changes.

Key words: frying, sunflowerseed oil, oxidation, polar components

Introduction

The frying of oilseeds kernel in the oil, a complex process in which the oil transfers the heat and mass to the kernel, also results in significant chemical changes of the kernel and the oil. The primary oxidative products (hydroperoxides) are degradated during frying and evaporable and nonevaporable substances are formed, significantly changing the frying oil characteristics (Min and Smouse, 1985).
A number of oil characteristics are changed during frying: the content of polar materials and free fatty acids, colour, viscosity, iodine number, refractive index... (Fritsch, 1981). The oxidative changes of frying oil, in such a complex system, are followed by measuring only a smaller number of parameters. The evaporable products which change the electro-conductivity of the water are registered by the Rancimat apparatus (Barrera and Estves, 1992). Another approach is the determination of pentane, hexanal etc. in the gaseous phase of the frying oil or fried kernel (Pongracz, 1986). The increase of polar substances content in the frying oil by measuring the change of dielectric constant can be used for the quick control of the frying process (Fritsch, Egberg and Magnuson, 1974). The exact determination of oxidation products content in the oil during frying is possible by chromatographic methods also (Gertz, 1986).

Materials and methods

A commercial sample of edible sunflowerseed oil and dehulled groundnut kernel were used for laboratory-scale frying in a glass vessel at 160°-165°C. The kernel sample was introduced into the oil in a glass vessel with perforated bottom. The kernel was fried for 20 min, the oil temperature was maintaned for 40 min and then again used for frying. The increase of polar oxidation products content was directly measured by following the change of dielectric constant (FOS values, Food Oil Sensor, Northern Industr. Co., USA). The content of FFA was determined by AOCS method. The evaporable oxidation products content in the frying oil was investigated using the Rancimat apparatus (Rancimat 617, Metrohm, CH). The oxidation of groundnut kernel was followed at 100°C (Oxidograph apparatus, Mikrolab Aarhus AS, Denmark). A portion of fried kernel was "washed" with fresh oil by dipping the kernel containing vessel (after oil dripping) into fresh oil, for 30 sec.

Results and discussion

The influence of oil/air contact surface decrease is presented in Figure 1. The frying was performed at 165°C, and a glass plate was placed on the oil surface when the oil was not in contact with the kernel (40 min/hour), decreasing the contact surface from 0,247 cm^2/1g to 0,113 cm^2/1g of oil. A significant decrease of oil oxidation was noticed, partly due to the decreased contact surface, and partly due to the added tocopherols.
Figure 2 presents the oxidative changes of groundnut kernel fried in sunflowerseed oil. After replacing the frying oil on the fried kernel surface with fresh oil, the reaction with oxygen is slower (curve 2 compared to curve 1). A better slowering down of oxidation can be achieved when oil with 0,02% of added tocopherols is used for the "washing" (curve 3).
The change of evaporable oxidation products content of sunflowerseed oil is presented in Figure 3. The Rancimat apparatus measures only the evaporable components which change the water conductivity. The difference in the oxidative state of initial oil (curve O) and oil after 10 and 16 hours of frying is evident. The evaporable oxidation products were detected after 8h in the initial oils, and in the frying oils they were present at the beginning of the investigations.

Conclusion

The oxidative process takes place during the frying of groundnut kernel in edible sunflowerseed oil at the start of frying. The flow rate of the oxidative changes can be followed by measuring the dielectric constant (Food Oil Sensor). After 16 hours of frying (approximately the limit for the use of oil for frying in the nutrition) changes of iodine number and viscosity take place. Measuring the content of evaporable oxidation products of the oil (Rancimat apparatus) and the oxidation rate at 100°C (Oxidograph apparatus) results in a better knowledge of frying oil and product quality. The decrease of oil/air contact surface and the addition of tocopherols contribute to slower oil oxidation during frying.

References

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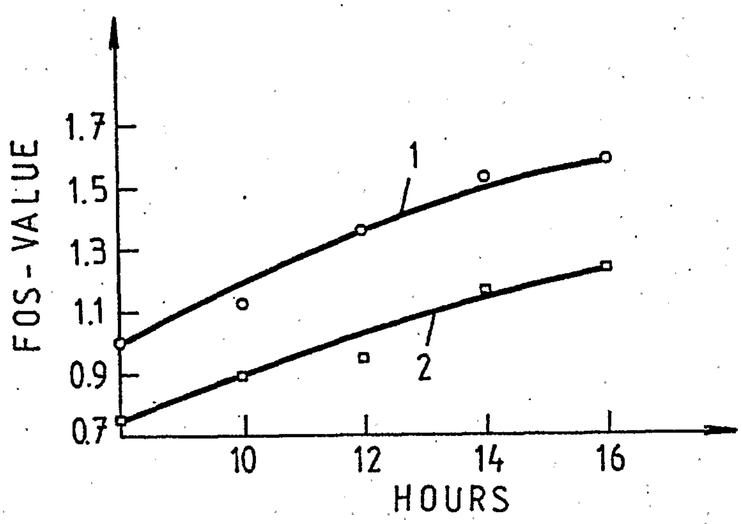

Figure 1. Frying with different ratio surface contact oil/air and influence of added antioxidant

1 - Control frying, oil/air contact surface 0,247 cm^2/1 g of oil

2 - Frying with sunflower oil containing 0,02% of tocopherol, oil/air contact surface 0,113 cm^2/1 g of oil

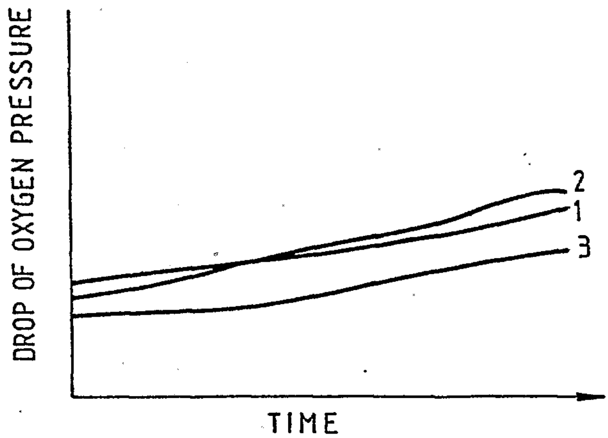

Figure 2. Oxidation of ground nut (Oxidograph, 100°C)

1 - groundnut fried in sunflowerseed used for 10 hours, at 150°C

2 - groundnut fried in sunflowerseed used for 16 hours, at 160°C, a part of the frying oil on the surface of the kernel replaced by fresh oil

3 - groundnut fried in sunflowerseed oil used for 16 hours at 160°C, a part of the frying oil on the surface of the kernel replaced by fresh oil

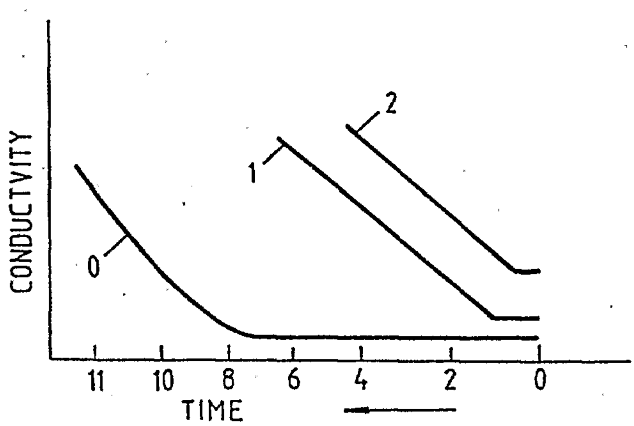

Figure 3. Influence of use of oil for frying (at 160°C) on the oxidative state (Rancimat 617, 100°C)

0 - Initial oil
1 - Oil used 10 hours for frying
2 - Oil used 16 hours for frying