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Storage stability of crips measured by headspace and peroxide value analyses «Short communication»

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SUMMARY

Storage stability of crisps measured by headspace and peroxide value analyses

Normal sunflower oil and high oleic acid sunflower oil were tested in industrial frying of crisps against the reference oil palm olein. A protective agent, dimethyl polysiloxane (DMPS), was also tested in crisp frying. Peroxide values and volatile contents of the crisps stored in normal storage conditions (room temperature) were measured during storage.

From the peroxide values it could be seen that crisps fried in normal sunflower oil were the most unstable during storage. Crisps fried in high oleic sunflower oil proved to be almost as stable towards oxidation as crisps fried in reference oil palm olein.

Volatile contents, measured by a static headspace - gas chromatograph - mass spectrometry system, confirmed the conclusions of peroxide analysis.

Neither of the methods could find any difference between the samples which had been fried with and without DMPS.

KEY-WORDS: Crisps - Headspace analysis - High oleic sunflower oil - Industrial frying - Peroxide value – Storage – Sunflower oil

1. INTRODUCTION

Oxidative deterioration of triglycerides takes place during deep-fat frying and storage of fried foods. Rancidity in fat-containing foods is measured by sensory evaluation or chemical methods. Peroxide value and hexanal content are normally used to evaluate deterioration of oils and storage stability of foods such as potato crisps (Warner et al., 1974, Snyder et al., 1986, Robards et al. 1988 and Hawrysh et al., 1995).

In this work, normal sunflower oil and high oleic acid sunflower oil were tested in industrial frying of crisps against the reference oil palm olein. The volatile decomposition products, such as hexanal, were studied with a static headspace gas chromatographic method. Hexanal content and peroxide value were measured during the storage test of potato crisps.

2. STORAGE STABILITY OF CRISPS MEASURED BY PEROXIDE VALUE

2.1. Method

The fat was extracted with a mixture of hexane and isopropanol. All used glassware was rinsed with hexane before use. About 20 g crisps were crushed with a Waring blender homogeniser. An amount of sample containing 5 g fat (calculated from the fat contents of the crisps) was weighed into an extraction funnel. 90 mL of hexane : isopropanol mixture (3:2) and 60 mL of 0.45 M sodium sulphate solution (in water) were added and the mixture was shaken. Layers were allowed to separate and the solvent fraction (upper layer) was transferred moved to a round bottomed flask. The extraction was repeated and the extracts were combined.

Extractions were done out of direct light. At the end, solvents were evaporated under vacuum at 30°C and the peroxide value was immediately determined in the same flask.

Peroxide value was measured according to the A.O.C.S. Cd 8b-90 standard method.

2.2. Results

Results from the peroxide value determinations of stored crisps are shown in Figures 1, 2 and 3.

2.3. Conclusions

Results from the first group of oils showed that crisps fried in normal sunflower oil (SO1) were the most unstable during storage (Figure 1). The reference oil palm olein (PO1) was the most stable oil but high oleic sunflower oil (HOSO1) was almost as good.

Results from the second group showed that there was practically no differences between the crisps fried in sunflower oil with (SO2A) and without (SO2) DMPS (Figure 2).

The third group confirmed the earlier results about DMPS (Figure 3). Additionally, there could be seen a small difference between palm olein (PO3) and high oleic sunflower oil (HOSO3), the latter being more unstable to some extent.

3. STORAGE STABILITY OF CRISPS MEASURED BY HEADSPACE ANALYSIS OF VOLATILES

3.1. Method

3g of crushed potato crisps were weighed induplicate into 22 mL headspace vials (Tekmar Co.). Vials were purged with helium and sealed with silicone rubber Teflon caps by using a crimper. Internal standard, 4-heptanone in rapeseed oil, was added. Samples were equilibrated for 50 min at 90°C, followed by pulsed mixing for 30 seconds and re-equilibration for 30 min at the same temperature with a Tekmar 7000 headspace autosampler. After equilibration, 2 mL of headspace gas was transferred twice with a 2 mL sample loop to the capillary interface cooled to -120°C. The interface was flash heated to 200°C and volatile compounds were flushed to the capillary column with helium (0.5 mL/min).

Volatiles were determined by using a Hewlett Packard 5890 gas chromatograph (GC) equipped with a capillary column and a mass selective detector (70 eV). The GC column used was NB-30, 25 m * 0.20 mm * 1.0 µm (HNU Nordion). The oven was programmed with an initial hold of 5 min at 33°C, risen to 162°C at the rate of 4°C /min, hold 0 min and risen to 250°C at the rate of 15°C /min, with a final hold of 1 min.

3.2. Results

The hexanal contents are summarised in Figure 4. Aldehydes were not found in freshly fried crisps. Pentane was only found in crisps fried in normal sunflower oil.

3.3. Discussion

The equilibrium conditions, sample and standard amounts were selected according to previous works of Warner et al. (1974) and Robards et al. (1988). The equilibrium could not be reached in the system because of additional formation of volatile oxidation products during heating with increasing time and temperature. The time and temperature selected were a compromise between the sensitivity and the formation of oxidation products during the analysis.

Very volatile compounds, i.e. methyl pentanes, 2-propanone and 2-butanone, were difficult to separate from the water and air peaks with mass spectrometry so quantitation of these compounds was not accurate. Helium atmosphere reduced the interference of air but water was coming from the sample during equilibration and could not be avoided.

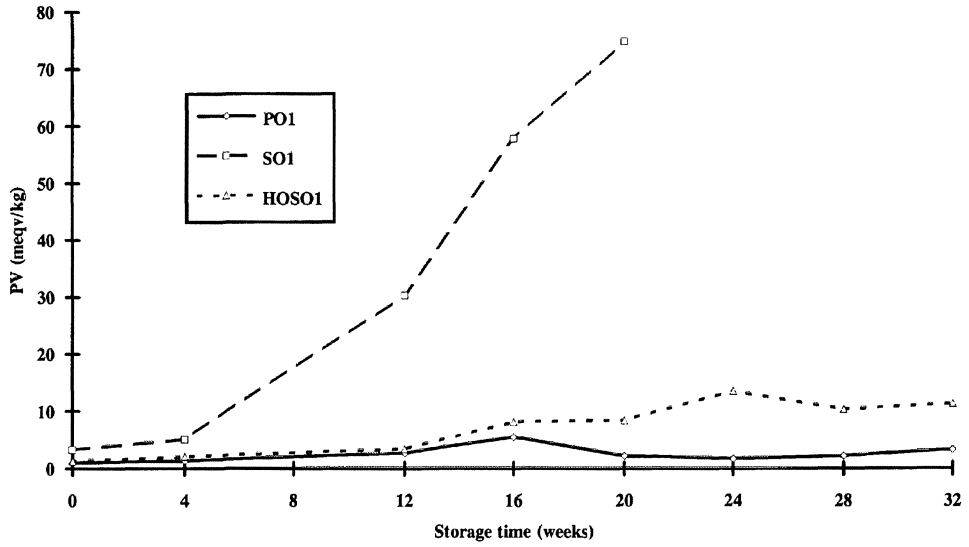

Figure 1
Effect of storage time on the peroxide values of crips from group 1

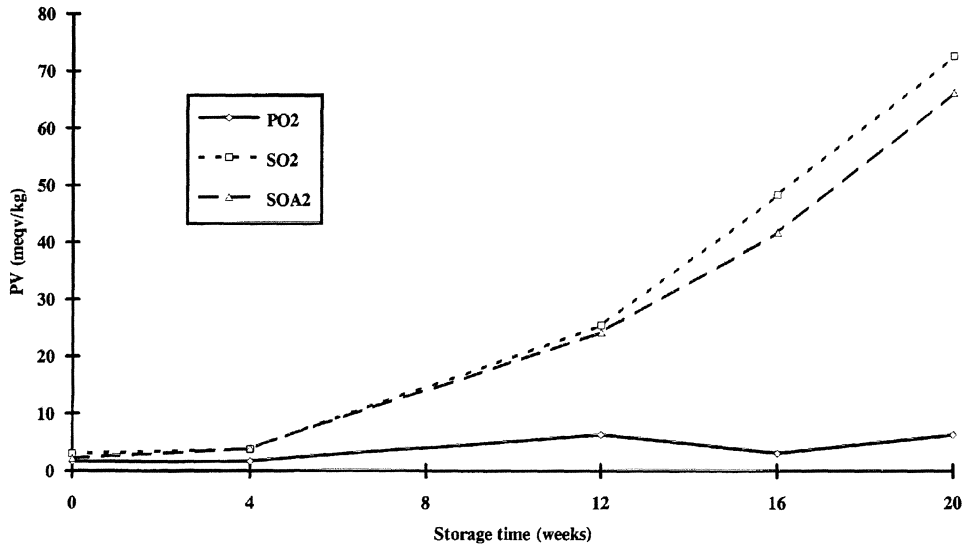

Figure 2
Effect of storage time on the peroxide values of crisps from group 2

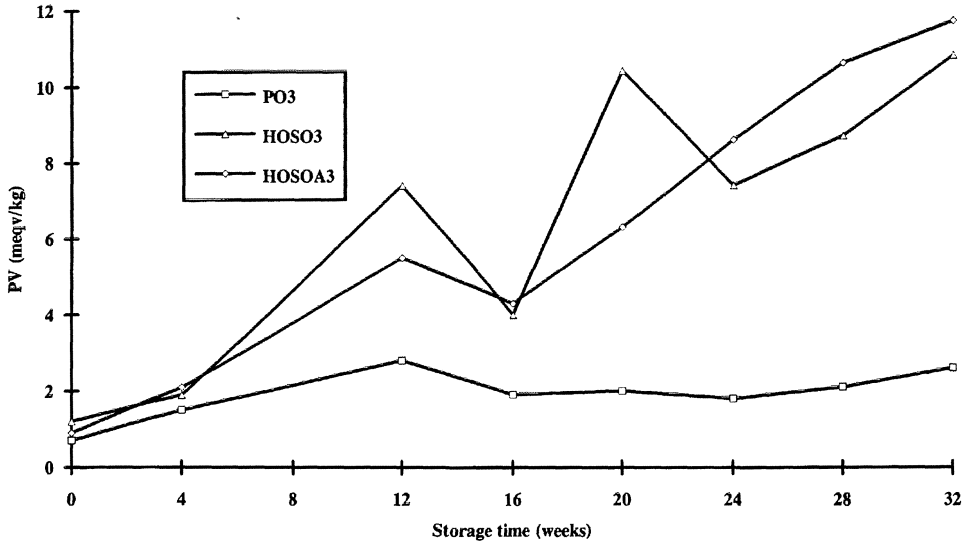

Figure 3
Effect of storage time on the peroxide values of crisps from group 3

Hexanal was chosen as an indicator of the oxidation level of crisps.

3.4. Conclusions

From the results obtained, it can be seen that hexanal contents of crisps fried in SO with or without DMPS were significantly higher than those fried in other oils tested. In all samples, it could be observed an accelerated increase in hexanal content after 24 weeks of storage.

4. SUMMARY

In summary, the reference palm olein was shown to be the best oil in terms of crisp stability during storage. However, high oleic sunflower oil was almost as good as palm olein. Crisps fried in normal sunflower oil were much more prone to oxidation than those fried in any of the other studied oils. The significance of these findings would greatly depend on the shelf life requirements but, for sunflower crisps, commercialization periods shorter than 2-3 months should be ensured.

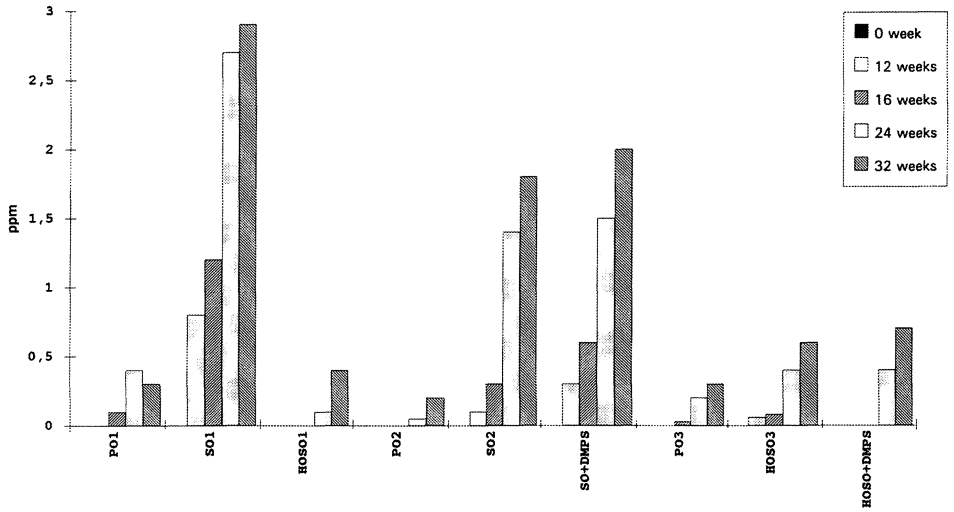

Figure 4
Hexanal content (ppm) of stored crisps

ACKNOWLEDGMENTS

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