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Chemical characteristics and fatty acid composition on oils and fats stored in different packaging materials

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RESUMEN

Características químicas y composición en ácidos grasos de aceite y grasas almacenadas en diferentes materiales de envase.

Aceite de semilla de algodón decolorado, aceite de palma parcialmente hidrogenado y margarina fueron almacenados en latas metálicas (estaño) y en botellas de plástico blanco (polietileno) con aire en el espacio de cabeza y a temperatura ambiente durante todo el período de investigación.

Las técnicas analíticas usadas para analizar estos materiales fueron ensayados a tiempo cero de almacenamiento (control), y después de cuatro y siete meses de almacenamiento.

Este estudio mostró que los aceites almacenados en latas metálicas tienen mejores resultados que los envases de plástico, especialmente para los aceites hidrogenados y de semilla de algodón decolorado.

PALABRAS-CLAVE: Aceite – Acidos grasos (composición en) – Almacenamiento – Característica química – Envase – Grasa.

SUMMARY

Chemical characteristics and fatty acid composition of oils and fats stored in different packaging materials.

Bleached cottonseed oil, partially hydrogenated palm oil and margarine were stored in metal (tin) cans and white plastic (polyethylene) bottles with air in head space and served at room temperature during the whole period of investigation. The analytical techniques used to analyse these materials has been done at zero time storing (control), after four and seven months of storage. This study showed that storing oils in metal cans have better results than plastic packages specially for bleached cottonseed and hydrogenated oils.

KEY-WORDS: Container – Chemical characteristic – Fat – Fatty acid (composition in) – Oil – Storage.

1. INTRODUCTION

Light, oxygen, moisture and heat are some environmental factors that adversely affect the quality of fats and oils both during and after the processing. Light is an initiator and a cause of reactions that ultimately result in the deterioration of fats and oils (1). Although fats do not absorb visible light, photosensitized oxidation can be induced by light-absorbing impurities, such as chlorophyll (2-5). It is generally accepted that autoxidation of lipids involves a free radical addition (6-8). The effect of heat, moisture, metals and enzymes on the stability and deterioration of lipid have been reviewed by Billek (9). Atmospheric oxygen may be entrapped in the oil. Oxygen can also be available in the head space of the container, and oxygen can permeat the walls of the container. Oxygen causes the formation of hydroperoxide, the components normally associated with rancid oil. Although heat can also affect the stability of oils, the package can usually afford only minor protection in the form of insulation (10). Cucurachi (11) noted that peroxide formation in oils stored in closed tins is generally insufficient to lead to development of the typical rancid odour because of the limited amount of oxygen in the head space.

2. MATERIALS AND METHODS

Bleached cottonseed oil, partially hydrogenated palm oil and margarine were supplied by the Alexandria for Oil & Soap Company and stored in metal cans (tin) and white plastic (polyethylene) bottles with air in head space and served at room temperature during the whole period of investigation. Samples under-test were taken, from the surface and under-surface of the fats and mixed throughly to get homogenized samples.

– Acid value and peroxide value were determined according to the method AOCS (12-13).

– Fatty acid composition is determined by gas liquid chromatographic analysis according to (14).

3. RESULTS AND DISCUSSION

The results are shown in Figures (1-8) where drown using Star LC 20 Computer. The initial acid value was for cottonseed oil of metal can, this value become 1.0 and 1.8 after four and seven months, respectively. 1.2, and 2,0 after the same period, respectively for white plastic package.

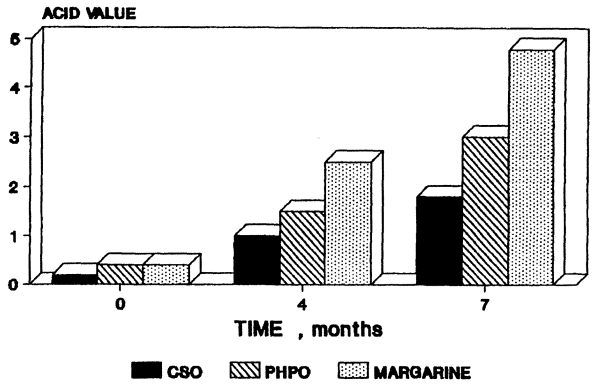

Figure 1
Acid value of cottonseed oil, partially hydrogenated palm oil and margarine stored in metal cans

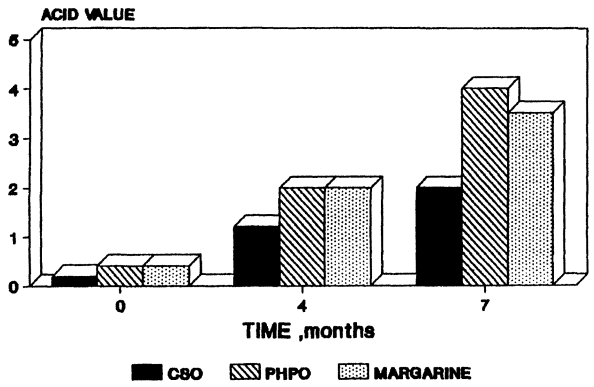

Figure 2
Acid value of cottonseed oil, partially hydrogenated palm oil and margarine stored in white plastic bottles

The acid value of partially hydrogenated palm oil reached its maximum value after the total storage period. Also the acid value of margarine increased directly with storage period (seven months).

The peroxide value of control sample (zero time storage) was 0.4 milliequivalents of oxygen per kilogram of oil became 16.3 and 35.1 for oil of metal can and 19,0 and 42,0 for that of white plastic package at the four and seven months respectively. It is known that peroxide value may be a good guide to the quality of an oil (15,16). The peroxide value of partially hydrogenated palm oil increased gradually to reach 45.5 and 53.0 for that of metal can and white plastic package, respectively, at the end of storage period (fig. 3).

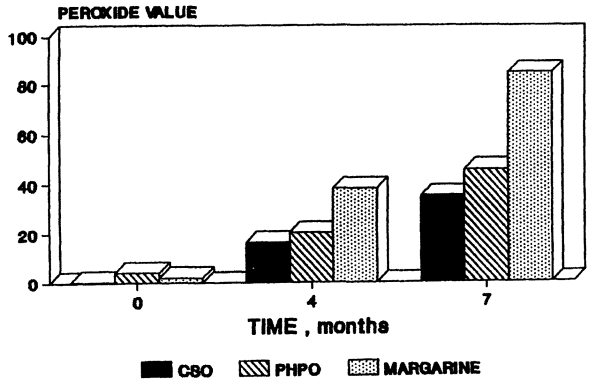

Figure 3
Peroxide value of cottonseed oil, partially hydrogenated palm oil and margarine stored in metal cans

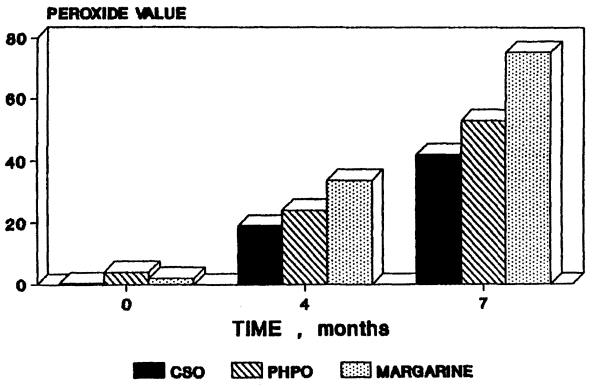

Figure 4
Peroxide value of cottonseed oil, partially hydrogenated palm oil and margarine stored in white plastic bottles

The peroxide value of margarine increased during the seven months, reached 84.6 and 75.4 in metal can and plastic package at the end of storage period.

The fatty acid composition of bleached cottonseed oil, showed a remarkable decrease in oleic and linoleic acid percentages after storing for seven months reaching 22,3 and 35,0% respectively, in metal can while they decreased to 21.1 and 32.0 respectively, for that in white plastic packages. Also palmitic acid recorded gradual increase in both kinds of containers after the same period of storage reaching 37.6 and 41,7% for that in metal can and white plastic package respectively.

In case of partially hydrogenated palm oil reported and obvious decrease in both oleic and linoleic acid percentages after storage for seven months. The palmitic acid showed gradual increase in both kings of packaging materials after the same period.

The fatty acid composition of margarine showed a notable drop in oleic and linoleic acid percentage in particular after storage for seven months. On the other hand, palmitic acid percentage increased to reach a maximum value at the seventh month of storage.

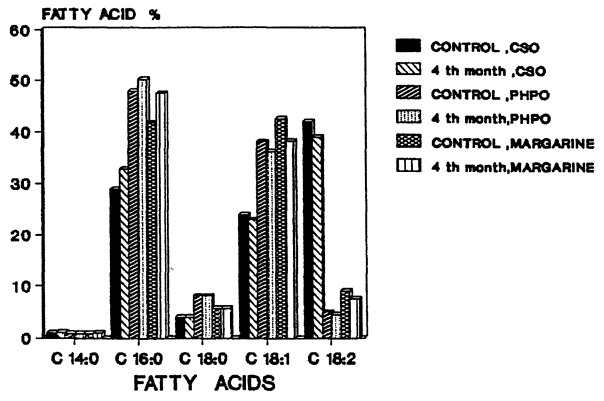

Figure 5
Fatty acid composition of cottonseed oil, partially hydrogenated palm oil and margarine stored in metal cans for four months

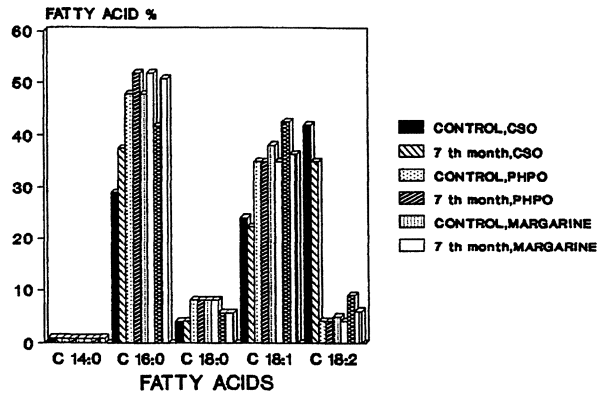

Figure 6
Fatty acid composition of cottonseed oil, partially hydrogenated palm oil and margarine stored in metal cans for seven months

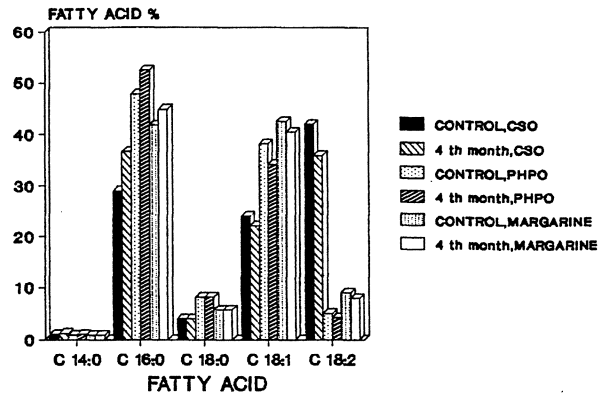

Figure 7
Fatty acid composition of cottonseed oil, partially hydrogenated palm oil and margarine stored in white plastic bottles for four months

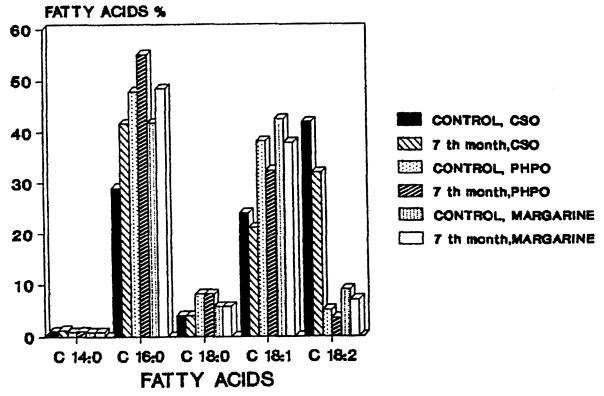

Figure 8
Fatty acid composition of cottonseed oil, partially hydrogenated palm oil and margarine stored in white plastic bottles for seven months

In addition oxygen and moisture might entrained into container during drawing the sample to be analyzed.

The peroxide value is a good guide to the quality of lipid. This parameter measures the amount of oxygen chemically bound to an oil as peroxide, particularly hydroperoxide. It is therefore used to assess the degree of oxidation. Hence, the presence of light in addition to air coming in both fat containers during taking the samples, accelerated oxidative deterioration of the stored fats. The increase in peroxide value may be attributed to the change of linoleic acid into hydroperoxide than to carbonyl compound.

A suggested oxidation mechanism for hydroperoxide formation begins with reaction of the free radical of the fatty acid moiety with singlet oxygen to form the peroxide radical which reacts readily with unsaturated sites to form the hydroperoxide and a free radical, then by prepetuating the chain (1).

It is clear from the results that metal can offered suitable and better protection against deterioration than plastic packages for storing cottonseed oil and partially hydrogenated palm oil. On the other hand, plastic container was better for storing margarine and this is due to the presence of water and salt in margarine where they compose about 16 and 2%, respectively (17).

The preceding results agreed with the findings of the other workers (10).

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