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Effect of Selected Storage Conditions and Packaging Materials on Olive Oil Quality

A.K. KIRITSAKIS, Department of Food Science, Higher Technical Educational School, Thessaloniki, Greece, and **L.R. DUGAN,** Department of Food Science and Human Nutrition, Michigan State University, East Lansing, MI, U.S.A.

ABSTRACT

Transparent glass and polyethylene plastic bottles filled with virgin olive oil were stored in diffused room light and direct sunlight (ca 4 hrs a day in sunlight and the remainder of the day in diffused light). In each case one-half of the containers were covered completely with aluminum foil. The oxidation of all oil samples proceeded slowly in darkness, faster in diffused light and even faster in direct sunlight. Glass packaging materials gave better protection against oxidation than polyethylene plastic bottles. Significant destruction of the color of oil was observed under different light conditions.

INTRODUCTION

Light causes significant deterioration of olive oil quality in the presence of air (1-6). In the absence of air, however, direct sunlight causes a decrease in peroxide and Kreis values of the oil (7). Further, Cucurachi (1) noted that peroxide formation in olive oil stored in closed tins is generally insufficient to lead to development of the typical rancid odor because of the limited amount of oxygen in the headspace.

One study with olive oil stored in different types of containers revealed similar results in glass and PVC containers (8,9) each of which were better than other types of plastic containers (8).

Unal (5) reported that the peroxide value of olive oil stored in cans or glass bottles decreased during storage, whereas peroxide values of samples stored in PVC bottles increased. This effect was attributed to the O_2 permeability of PVC (5). In addition, an increase in the free fatty acids and decreases in the β-carotene and chlorophyll contents were observed. The destruction of these two pigments was greater in illuminated samples than in those stored in darkness (5).

The purpose of this work was to study the effect of some storage conditions involving light and of different packaging materials (glass and polyethylene plastic) on olive oil quality.

MATERIALS AND METHODS

Six samples of oil from olive fruits of the cultivar "Koro-

neiki" were obtained during a collection season. They were numbered as olive oils 1-6. Oils 1-4 were extracted by the Pieralisi system, while No. 5 and No. 6 were obtained by the Rapanelli-sinolea and Rapanelli-decanter systems, respectively. Pieralisi and Rapanelli are companies making centrifugal extraction systems which are described by Petruccioli (12). Both the Pieralisi and the Rapanelli systems involve centrifugal separation of oil after milling of fruits and malaxation of paste. The Rapanelli-sinolea oil is that oil separated after a primary treatment, while the Rapanelli-decanter oil is separated after additional malaxation of residue from the primary treatment and agitation with water.

The oils (No. 1-3) were placed in glass and in polyethylene plastic bottles and stored in diffused light and in direct sunlight (ca 4 hrs. a day in sunlight and the rest of the day in diffused room light). About 5 cm head space was left in each bottle, and one-half of the containers were covered with aluminum foil to prevent passage of light through the transparent bottles.

The oils (No. 4-6) were placed in glass bottles and stored in darkness for two yrs. No head space was left in these samples.

Oxidation of the oil samples was followed by measuring the peroxide value (10).

RESULTS AND DISCUSSION

Figures 1 and 2 present data obtained from olive oil No. 1 in plastic bottles and stored in diffused light or direct sunlight. After five months of storage, the peroxide values were 65 and 75 milli-equivalents/kilogram (meq/kg) for samples stored in diffused and direct sunlight, respectively. Only 15-20 meq/kg peroxide values were developed in foil covered samples, whereas 70-80 meq/kg peroxide values were developed in samples without a foil cover. These results agree with other findings (2).

While the difference in peroxide value between samples exposed to light and those protected from light is large, the difference between samples exposed to diffused versus direct (only 4 hrs/day) light is not great. Thus, the presence of any light is unfavorable and the exposure to direct sunlight serves to enhance the effect only to the small degree shown.

Figure 3 presents data concerning the relative effect of glass and polyethylene plastic bottles on the oxidation of olive oil No. 2, which was exposed to diffused light. Samples in polyethylene bottles developed higher peroxide values than those in glass bottles. When samples were covered with aluminum foil, lower peroxide values were recorded. Oil in covered glass bottles had lower peroxide values than that in covered plastic bottles after five months of storage. These results are consistent with other findings (5,8) and point to the probable intrusion of oxygen as a consequence of plastic permeability.

Table 1 contains data for olive oil No. 3 stored in polyethylene bottles and exposed to diffused light for 3 months. Although the initial peroxide value of the oil was relatively low (8.7), in a period of one month the value was higher than 20 (Table 1). This value was higher than that

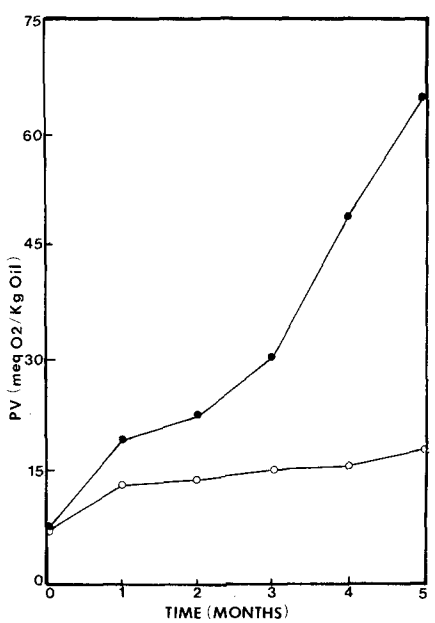

FIG. 1. Effect of diffused light on peroxide formation in olive oil No. 1 stored in plastic bottles (●: plastic bottles; ○: plastic bottles covered with aluminum foil).

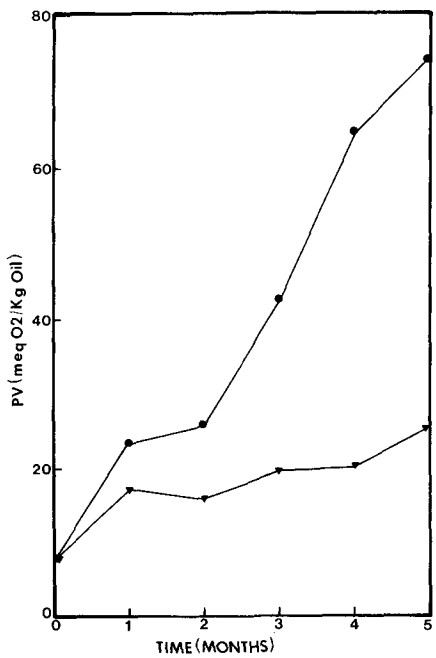

FIG. 2. Effect of direct sunlight on peroxide formation in olive oil No. 1 stored in plastic bottles (●: plastic bottles; △: plastic bottles covered with aluminum foil).

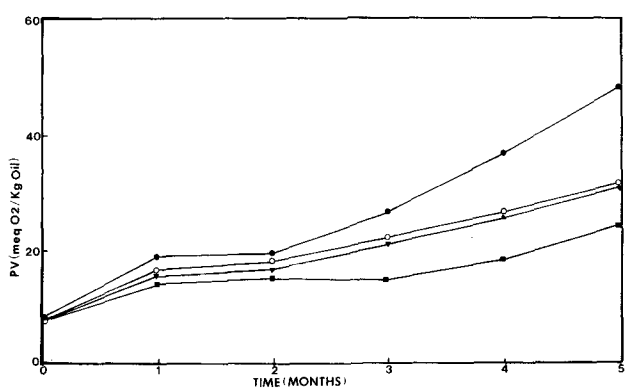

FIG. 3. Effect of diffused light on peroxide formation in olive oil No. 2 stored in plastic or glass bottles (●: plastic bottles; △: plastic bottles covered with aluminum foil; ○: glass bottles; ■: glass bottles covered with aluminum foil).

established by The Council for International Olive Oil (COI) (10) in order for an oil to be considered a virgin oil. The peroxides continued to increase and reached a value of 52.5 at the end of 3 months. The oil had an off taste at that time and had lost most of its original color. Loss of color also was observed by Ramunni (11). He noticed that olive oil, stored in colorless glass bottles in the presence of light, quickly lost all of the chlorophyll and about 70% of the carotene present. Results of this study suggest that commercial bottling of olive oil in transparent plastic containers is undesirable. The oil can be oxidized easily when it is displayed in stores in diffused light. During that time, oxygen may enter into the plastic containers due to the O_2 permeability of some plastic bottles (5) and initiate the oxidation mechanism. In addition, the presence of light will facilitate oxidation (1-3).

Table 2 presents data from 3 samples of olive oil in hermetically closed glass bottles stored in darkness. After 2 yrs of storage at room temperature, the peroxide value had not changed, which indicates that there was not a sufficient amount of dissolved oxygen to cause oxidation. Gutierrez (8) demonstrated that oxygen and light should be excluded during olive oil storage. However, he stated that the elimination of these 2 factors is not always sufficient to maintain the quality of olive oil during storage.

This study has reaffirmed that glass bottles provide better protection from oxidation for olive oil than do polyethylene plastic bottles. Exclusion of light with aluminum foil resulted in lower peroxide values and in color protection. Thus olive oil should be stored in bottles which are not transparent to light or permeable to oxygen in order for oxidative deterioration to be minimized during storage.

TABLE I

Peroxide Value of No. 3 Olive Oil (F.F.A. 0.9%) Stored for 3 Months in Diffused Light in Polyethylene Bottles

Storage time (months)	Peroxide value (meq O_2/kg oil)
0	8.7
1	24.6
2	39.5
3	52.5

TABLE II

Peroxide Value of Olive Oil Samples Stored for 2 Years in Darkness in Glass Bottles

		Peroxide value (meq O_2/kg oil)	
No. of oil	Extraction system	Initial value	Final value
4	Pieralisi	7.8	8.4
5	Rapanelli-sinolea	5.9	6.8
6	Rapanelli-decanter	4.2	5.2

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