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EFFECT OF GAMMA IRRADIATION AND OTHER TECHNOLOGICAL TREATMENTS OF OLIVE FRUIT ON ITS OIL QUALITY

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Abstract

Picual olive fruits were soaked in hot water, sun-dried irradiated at 1.5KGy and the olive oil was obtained by pressing . Physical and chemical properties , stability, fatty acids compostion and unsaponifiable mater (USM) constituents were determined in all samples undertaken. The results indicated that, sun - drying treatment markdly increased the peroxide value of olive oil, while all treatments under investigation had no real effects on other oil properties and fattry acid composition. Soaking tratment caused no changes, while sun - drying and irradiation induced a remarkable changes in the USM components olive oil. Squalene increased and B-sitosterol decreased by irradiation, while the reverse trend occurred by sun- drying treatment . In addition, olive oil stability increased by irradition and decreased by sun - drying

INTRODUCTION

Olive is considered an importatnt crop of Mediterranean countries which produce about 95% of the world olive oil production Colakoglu (1972). However Egypt is one of minor producing olive oil among Mediterranean countries. Olive is well adapted to severe heat and aridity of Mediterranean summer as compared to other trees Colakoglu (1972). During the last period Egyptian Governmment gave an attention for increasing the area cultivated with olive trees and particulary at new reform desert land. The production costs of olive oil are higher than those for other vegetable oils. However , this oil is superior over other vegetable oils due to its balanced fatty acids and its flavour Colakoglu (1972) . It is therefore necessary to protect the good quality of olive oil which could be decreased during harvesting , storage and processing.

Grubby olive oil is one of many defects resulting from poor olive farming and fruit storage methods and it can be defined as characterisitc flavour of oils obtained from olive fruits that have been heavily attacked by fruit flies (*Dacus oleae*). IOOC (1987). Ionizing radiation has successfuly used for disinfesting fresh fruits (Tilton and Burditt, 1983; Burditt, 1982) . Moreover several studies (Block *et al.*, 1966; Steiner , 1966) used gamma irradiation as an effective quarantine treatment against fruit flies. In Egypt at several areas sun - drying treatmnent used for reducing olive weight before pressing fruits . In addition some studies have treated olive fruits with diferent technological treatments to inhibit lipase activity before processing . (Khalil *et al.*, 1983).

Therefore, this study aims to use safe dose of gamma irradiation for disinfestation of olive fruits to protect the oil quality and to study the effect of this treatment and other technological treatments on physical and chemical properties, stability, fatty acids profiles and unsaponifiable matter constituents of Picual olive oil .

MATERIALS AND METHODS

The ripe Picual olive fruits were obtained from Alexanderia provience, then divided into four groups. First group was left without any treatment as control, the second group was soaked in hot water at 80oC for 10min., the third was sun - dried to 50% weight and the last one was irradiated at 1.5 KGy using Mega Gamma - 1 irradiator of NCRRT, Nacr City , Cairo , Egypt.

Oil extraction

Each fruit groups was ground , packed in cheese cloth, then pressed by using hydraulic Laboratory (Carver) press. The separated oils were dried over anhydrous sodium sulphate , filltered and kept in brown glasses at -5°C till analysis.

Oil properties

Refractive index at 25°C, acidity (as oleic acid Percent) , Peroxide value (meq. /Kg. oil) iodine value , saponification value and unsaponifiable matter percent were determined as described in A. O. A. C. (1984) . Specific Extinction $E^{1\%}_{1cm}$ at 232 , 270 nm was measured according to the method reported in FAO/ WHO (1970).

Fatty acid and unsaponifiable matter composition

The methyl esters were prEpared as described by Stahle, (1967) , while unsaponifiable matter (USM) were separated according to A. O. A. C. (1984). the fatty acid methyl esters and USM were analyszed by using PYE. Unicam Model 104 gas Chromatography as described by Rady *et al.* (1987).

Stability

Olive oil was distributed in test tubes placed in an incubator at 63±1°C to accelerte the autoxidation of oil (Thampson, 1960); the temination of induction period was characterized by a sharp and sudden increase in peroxide value. Oxidative stability is the period of oil incubation at 63± 1°C to reach 70 Meq/Kg peroxide value.

RESULTS AND DISCUSSION

Physical and chemical properties:

Table 1. shows the physical and chemical properties of olive oils obtained from fresh, soaked, sun-dried and irradiated picual olive fruits . Fresh Picual olive fruits used in this study was of good quality as indicated by law inital peroxide value (1.04 meq. /Kg) and acidity (0.2%) as weel as $E^{1\%}_{1cm}$at 232 nm (2.05) and at 270nm (0.20) of their oil . The results indicated also that all treatments under investigation had no effect of refractive index and unsaponifiable matter percentage of olive oil. Meanwhile peroxid value increased by sun - drying and soaking fruits in hot water, but the former treamtent had more effect on increasing peroxide value thant the latter one. The increase in peroxide value is due to accelaration of oil oxi-

Table 1. Physical and chemical properties of oils extracted from fresh, soaked, sun - dried and irradiated olive fruits.

Oil characteristics	Fresh	Soaked	Sun-dried	Irradiated
Refractive index at 25oC	1.4675	1.4675	1.4675	1.4675
Free fatty acids % (oleic acid)	0.20	0.24	0.46	0.20
Peroxide value	1.04	2.2	7.02	0.76
Iodine value	82.6	82.40	81.20	82.8
Saponifaction value (meq./kg)	193.4	194.1	193.9	193.2
Unsaponifiable matter %	1.02	1.05	1.02	1.03
Spectrophotomertic values:				
$E^{1\%}_{1cm}$ 232 nm	2.05	2.15	2.35	2.10
$E^{1\%}_{1cm}$ 270 nm	0.20	0.21	0.23	0.20

dation by heat treatments. Moreover, acidity and $E^{1\%}_{1cm}$ at 232 and nm of olive oil were relatively increased by sun- drying treatment , while other treatments had no effect on these values.

Fatty acid composition

Methyl esters of oils pressed from fresh, soaked sun - dried and irradiated Picual olive fruits were analyzed by gas chromatographic technique and the obtained results are presented in table 2. The results reveal that fresh picual olive oil contained 16.78% total saturated fatty acid (Ts) and palmitic acid represented the main saturated fatty acid (15.90%) . Meanwhile, total unsaturated (Tus) amounted to 83.22% and oleic acid was the predominant unsaturated acid (71.96%) followed by linoleic 8.41%, palmitoleic 2.07% and linolenic 0.78% . It is obvious from the obtained results in table 2 that individual fatty acids, Ts, Tus and Ts/ Tus of olive oil

Table 2. Fatty acid composition of oils extracted from fresh, soaked, sun - dried and irradiated oilve fruits.

Fatty acids	Fresh	Soaked	Sun-dried	Irradiated
$C_{14:0}$	0.24	0.15	0.24	0.16
$C_{16:0}$	15.90	16.70	16.29	16.33
$C_{16:1}$	2.07	2.00	2.14	2.15
$C_{18:0}$	0.64	0.20	0.23	0.46
$C_{18:1}$	71.96	70.95	70.00	70.78
$C_{18:2}$	8.41	8.40	9.54	9.29
$C_{18:3}$	0.78	1.60	1.56	0.83
Total Sat . (Ts.).	16.78	17.05	16.76	19.95
Total Unsat. (TUS.)	83.22	82.95	83.24	83.05
(Ts. / TUs.)	0.202	0.206	0.201	0.204

showed no real change by soaking, sun - drying and Irradiation of olive fruits . Therefore, all treatment undertaken had no effects on the fatty acid composition of olive oil.

Unsaponifiable matter (USM) constituents

The USM samples separated from oils of fresh, soaked, sun-dried and irradiated picual olive fruits were analyzed by gas chromatographic technique and the obtained results are shown in table (3). The results indicate that, USM of fresh fruits contained 55.54% total hydrocarbons which consisted of 12 components. Squalene was the predominant hydrocarbon (51.90%), while the rest of hydrocarbon components formed only 3.64% and B-sitosterol was the major sterol compound (42.13%) while cholesterol and stigmasterol represented only 0.62% and 1.71% of USM of fresh fruits respectively. It is clear that soaking olive fruits in hot water caused no

Table 3. Gas chromatographic analysis of USM samples soaked, sun- dried or irradiated.

Compounds	Treatments			
	Fresh	Soaked	Sun-dried	Irradiated
C_{15}	0.11	0.12	0.14	0.07
C_{16}	0.21	0.20	-	0.39
C_{17}	-	0.01	-	-
C_{18}	0.06	0.05	1.18	0.09
C_{19}	-	-	-	0.12
C_{20}	0.10	0.10	1.14	0.22
C_{21}	0.13	0.12	-	0.42
C_{22}	0.20	0.22	2.90	1.72
C_{23}	0.18	0.15	-	1.63
C_{24}	0.08	0.10	-	-
C_{25}	0.09	0.10	-	1.09
C_{26}	-	0.20	-	-
C_{30}	1.35	1.33	2.67	3.11
Squalene	51.90	51.20	25.90	76.50
C_{32}	1.13	1.11	1.89	-
CHO.	0.62	0.50	0.69	-
Compesterol	-	0.02	0.94	0.42
Stigmaterol	1.71	1.52	1.18	0.44
B-sitosterol	42.13	42.65	61.37	13.78
Total Hydrocarbons	55.54	55.31	53.82	85.36
Total Sterols	44.46	4496	64.18	14.64

noticeable changes in either hydrocarbons or sterol components.

It is obvious from the resutls in table (3) that sun - drying of olive fruits to 50% weight led to a remarkable decrease in total hydrocarbons and markedly in increased total sterols. Among hydrocarbons, the predominant compound , squalene , showed a pronounced decrease by sun - drying treatment . Moreover, C_{30} and C_{32} Hydrocarbon coponents increased. while C_{16}, C_{21}, C_{24} and C_{25} hydrocarbon components completely disappeared by this treatment. On the other hand , total sterols and B - sitosterol showed a noticeable increase as well as the compesterol compound which was indentified by sun - drying treatment. These results partially agreed with those obtained by Rady *et al*. (1987) upon exposing soybean seeds to dry heat treatments.

Results of table (3) indicated that , the exposure of olive fruits to gamma irradiation caused remarkable changes in USM of olive oil . Total hydrocarbons showed a noticeable increase and squalene compound followed the same trend. As the relative percentage of squalene increased from 51.90 % in USM of fresh fruits to 76.50% in the irradiated sample . Other hydrocarbon component showed a relatively slight change in their relative percentages as compared with squalene. In addition , C_{32} hydroosarbon compound was not detected by irradiation. Several studies found that , ionizing radiation produced different hydrocarbons (IAEA, 1982). This may be due to the destruction of esterified fatty acids at different loaction by ionizing radiation to produce different hydrocarbons.

On the other hand , total sterols and the major sterol compounds, B - sitosterol, showed dramatic decrease, compesterol was identified, while cholesterol disappeared by irradiation.

Stability:

Fig. (1) show that there was a sharp and sudden rise in peroxide value in olive oils of fresh, soaked , sun - dried and irradiated Picual olive fruits after 11, 11, 8 and 14 days of incubation oil sampes at $63^{o}C \pm 1$, respectively . The relative stability depending on induction periods was 1, 1, 0.73 and 1.27 for the above mentioned treatment, respectively. This means that, soaking olive fruits in hot water at $80^{o}C$ for 10 min. had no effect on olive oil stability . Moreover, sun drying olive fruits decreased the stability of olive oil, while this stability was increased by exposing olive fruits to irradiation. These results were confermed by oxidative stability of olive oils obtained from fresh and treated olive fruits. As the periods of oil incuba-

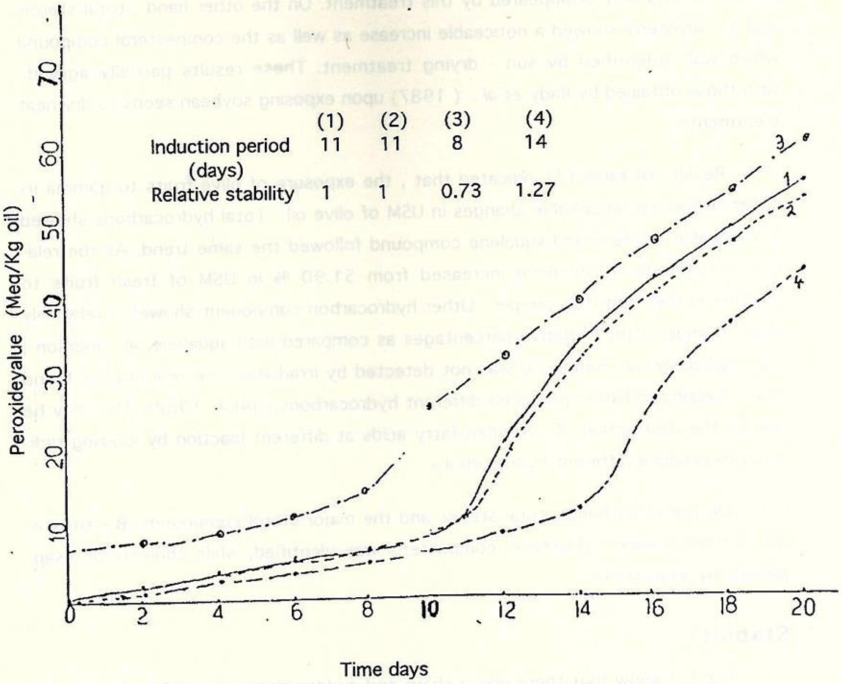

Fig . 1. Development of peroxide value of oils extracted from fresh (1), soaked (2), sun - (3) irradiated (4) olive fruits at 63^{o}C tion at 63+1°C required to rise the peroxide value to 70 meg/Kg oil were 27, 27, 24 and 32 days for oils of fresh, soaked sun- dried and irradiated fruits respectively. The realtive stability calculate from oxidative stability was 1, 1, 0.72 and 1.27 for the sam treaments , respectively. This , completely agree with relative stability of induction period.

Rao and Achaya (1967) mentioned that . squalene is responsible to the high olive oil stability. Therefore, the increase in picual olive oil stability by irradiation could be attributed to the increase in the relative percentage of squalene in USM by irradiation. While the reverse trend observed in stability by sun drying treatment had resulted possibly from the decrease in squalene.

It could be concluded that, using sun-drying treatment to decrease olive fruits weight before pressing had changed some of oil quality , and decreased the olive oilrability. Irradiation treatment to disinfest olive fruits flies although did not change the oil quality and fatty acid composition, it increased olive oil stability. Therefore this study does not reommend sun- drying olive fruits before pressing while supports irradiation for disinfestation of olive fruits without fearing any change in olive oil quality.

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تأثير أشعه جاما ومعاملات تكنولوجية أخري لثمار الزيتون علي جودة الزيت

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أجريت معاملة ثمار الزيتون صنف البيكوال بالغمر في الماد الساخن والتجفيف الشمسي والإشعاع بجرعه ١,٥ك. جراي وتم استخلاص زيت الزيتون بالكبس. اجري تقدير الصفات الطبيعيه والكيماويه ومكونات الأحماض الدهنية ومكونات المادة الغير متصبنه واشارت النتائج الي أن عمليه التجفيف الشمسي ادت الي زيادة واضحه في رقم البيروكسيد بينما لم يحدث تغير في باقي الصفات والكيماويه وكذلك تركيب الاحماض الدهنية باستخدام جميع المعاملات . هذا ولم يحدث تغير في تركيب مكونات الماده الغير متصبنه باستخدام عمليه الغمر بينما حدث تغير ملحوظ في هذه المكونات بواسطة التجفيف الشمسي والاشعاع حيث زادت نسبه الاسكوالين ونقصت نسبه البيتاسيتوستيرول بالاشعاع وحدث العكس باستخدام عمليه التجفيف الشمسي. بالاضافه الي ذلك حدث زياده في درجة ثبات زيت الزيتون نتيجة المعامله الاشعاعيه ونقص الثبات بالتجفيف الشمسي.