Characteristics and Composition of Some Consumer-Available Vegetable Oils Blended with Olive Oil

AHMED A. AHMED, MOSTAFA A. MOHAMED AND MUHAMMAD S. RANA[1]

ABSTRACT

The physical and chemical indices of refined consumer-available olive oil, sunflower oil, and corn oil were examined. Quality characteristics range for olive oil and sunflower oil was found to be within FAO/WHO codex limits. The samples of corn oil were found to have lower iodine value and higher free fatty acids and peroxide value than the corresponded values recorded by FAO/WHO codex.

Fatty-acids composition was studied by gas liquid chromatography. The principal fatty acids in all oil samples were: palmitic acid; stearic acid, oleic acid and linoleic acid. The fatty-acids composition of the samples of olive, sunflower and corn oil agreed with those recorded by FAO/WHO codex.

When mixtures of these oils were prepared, the identity characteristics were completely changed. Remarkable peculiarities were observed regarding acid distribution in all olive oil blends. The saturation level in all blends was increased.

INTRODUCTION

Fats and oils represent an important and controversial part of our diet. A portion of 20%–40% fat by weight in the diet of a normal person is necessary (3). It is, therefore, essential that thorough and reliable data on the composition of consumer-available edible oils should be available to provide basic information to nutritionists and others concerned with the use and investigation of dietary fat.

Sources of dietary fat have been continuously changing. Since the early part of this century, consumption of vegetable oils has risen, and there has been a shift from lard to shortening, and from butter to margarine. There has been an increase in the use of salad and cooking oils (6). Changes in the kinds and amounts of fat in the diet have altered its fatty acids content. The consumption of oils rich in oleic and linoleic acids is increasing gradually. The share of oleic acid has risen from 13% to 17% and of linoleic acid from 3% to 6% in the last 20 years (6).

Olive oil has been traditionally considered the major source of fat in the diet of Libyan people. The increase in consumption exceeds local production of olive oil and the price, compared with other vegetable oils, is high on the international market. Therefore, there is an urgent need to offer to the Libyan consumers olive oil blended with cheaper vegetable oils.

Considering the previously mentioned factors, this work was undertaken with the main aim of studying the characteristics and composition of olive oil when blended

[1]*Department of Food Science, Faculty of Agriculture, University of Al-Fateh, Tripoli, S.P.L.A.J.*

with cheap vegetable oils. Such data will be an invaluable tool to all concerned with dietary fat and its effect on the general health of the population.

MATERIALS AND METHODS

Materials

Local refined olive oil and imported refined olive oil, corn oil and sunflower oil were purchased from local market (Tripoli, Libya).

Physico-chemical properties of oils

The specific gravity, refractive index, unsaponifiable matter, viscosity, acid value, iodine value, saponification value, Reichert Meissl value, and Polenske value of the different oil samples were determined according to the Official and Tentative Methods of AOCS (5). The free fatty acids were determined by the method of Doris (1). The thiobarbituric acid (TBA) was determined spectrophotometrically at 538 nm using Beckman spectrophotometer model 26 (7).

Fatty acids composition

The separation of neutral fat was done on silicic acid column and thin layer chromatography as described by Stahl (8). One g neutral fat fractioned on silicic acid column was dissolved in 10 ml chloroform and 0.5 ml aliquot of this solution was spotted on silica gel coated plates. The neutral lipids were developed first with solvent system No. 1: diethylether:benzene:ethanol:acetic acid (40:5:2:0.2), air dried and redeveloped in the same direction with solvent system, No. II: n-hexanol:diethylether (96:4). The lipids were detected with iodine vapours. The resoluted triglycerides were scraped off the plates and were used for the preparation of methyl esters. These esters were prepared by transesterification with boron trifluoride (4). The methylesters were assayed by gas chromatography (Pye-unicam model 104) equipped with flame ionization detectors, automatic temperature programming and 250 cm × 0.5 cm (I.D.) glass column containing 8% polyethyleneglycoladipate (PEGA) was used. The column temperature was held constant at 170°C; injection temperature was 210°C; samples were analyzed isothermally with a nitrogen flow rate of 50 ml/min. and recorder chart speed 0.5 cm/min. The fatty acids were identified on the basis of retention time against known standards.

RESULTS AND DISCUSSION

The physical and chemical indices of local olive oil, refined imported olive oil, sunflower oil and corn oil are given in Table 1. The values for both types of olive oil and sunflower oil samples are within the ranges given by joint FAO/WHO Food Standards Programme Codex Alimentarius Commission (2). The percentages of free fatty acids and peroxide value in corn oil samples are slightly higher than the international standards recommended by FAO/WHO Codex. The iodine value appeared to be lower than that of the international standards which is 103–128. For refractive index, the range according to codex should be 1.465 to 1.468 whereas in the corn oil sample under study it is 1.4754. The results suggest that the corn oil has become slightly rancid and there is a possibility of adulteration, since the identity characteristics; iodine value and refractive index do not agree with the codex limits. The physical and chemical indices for different blends prepared from these oils are given in Table 2. As was expected, the identity characteristics of the mixture were completely changed.

Table 1 Physical and chemical indices of the investigated vegetable oils.

Indices**	Values*			
	Local refined olive oil	Imported (refined)		
		Olive oil	Sunflower oil	Corn oil
Acid value	1.10	0.76	0.38	0.64
Free fatty acid (as oleic)	0.55	0.38	0.38	0.32
Saponification value	191.98	191.0	189.04	188.65
Iodine value	86.01	87.43	129.42	93.90
Peroxide value (meq O_2/kg)	5.04	4.59	2.34	12.26
TBA number	1.27	0.33	1.67	0.31
Reichert-Meissl value	1.29	0.66	0.88	1.17
Polenske value	6.81	8.18	2.0	2.83
Specific gravity at 25/25°C	0.921	0.910	0.923	0.923
Refractive index	1.4706	1.4705	1.4664	1.4754
Viscosity (at 40°C) in centipoises	76.92	79.28	62.02	81.34

*Each value is the mean of triplicate analyses.

The distribution of fatty acids in both types of olive oils, sunflower oil and corn oil samples is given in Table 3. The percentage of principal fatty acids both in sunflower oil and corn oil fall within the ranges tentatively adopted by the FAO/WHO Codex Alimentarius Committee on fats and oils (2). In olive oil samples the percentage of

Table 2 Physical and chemical indices of the blends[a]

Indices	Values[b]					
	1	2	3	4	5	6
Acid value	0.76	0.26	0.38	1.94	1.74	1.10
Free fatty acid (% as oleic)	0.38	0.13	0.19	0.97	0.87	0.55
Saponification value	166.36	167.86	162.98	161.61	158.80	128.68
Iodine value	91.19	92.90	95.43	95.90	122.88	122.05
Peroxide value (meq O_2/kg)	7.75	8.95	9.8	7.45	8.23	8.18
TBA number	0.33	0.31	0.046	0.43	0.38	0.05
Reichert-Meissl value	0.36	0.84	0.45	1.10	0.53	0.51
Polenske value	1.34	0.98	4.10	2.72	3.42	5.24
Polenske value	1.34	0.98	4.10	2.72	3.42	5.24
Specific gravity	0.9252	0.9280	0.9283	0.9297	0.9292	0.9279
Refractive index	1.4775	1.4679	1.4688	1.4687	1.4692	1.4694
Viscosity (at 20°C) in centipoises	63.4065	66.36	64.66	63.87	63.82	63.87

[a]Blends:
1. 50% local olive oil + 25% sunflower oil + 25% corn oil.
2. 50% imported olive oil + 25% sunflower oil + 25% corn oil.
3. 33.3% imported olive oil + 33.3% sunflower oil + 33.3% corn oil.
4. 33.3% local oil + 33.3% sunflower oil + 33.3% corn oil.
5. 25% local olive oil + 75% sunflower oil.
6. 25% imported olive oil + 75% sunflower oil.

[b]Each value is the mean of triplicate analyses.

Table 3 Distribution of fatty acids in olive oil, sunflower oil and corn oil (weight %).

Fatty acids*	Local olive oil	Imported		
		Olive oil	Sunflower oil	Corn oil
C14:0	—	—	0.2	—
C14:1	—	—	—	—
C15:0	—	—	0.1	—
C16:0 (ISO)	—	—	0.2	—
C16:0	7.0	18.0	11.6	12.81
C16:1	1.5	1.3	0.4	0.2
C17:0	0.1	0.1	0.2	0.1
C17:1	0.6	0.2	0.2	—
C18:0	3.0	4.6	7.7	2.6
C18:1	47.4	53.2	30.0	39.0
C18:2	29.1	20.4	48.1	43.7
C18:3	0.6	0.9	0.8	0.8
C20:0	0.5	0.8	0.5	0.6
C20:1	0.2	0.5	0.2	0.2

*Each value is the mean of triplicate analyses.

oleic acid (18:1) does not fall within codex range which is 56–85. The percentage of stearic acid is also higher than that registered in the codex (2).

The fatty acids composition of the different blends is shown in Table 4. Remarkable peculiarities were observed regarding fatty acids distribution in all olive oil blended samples. There is a significant increase in the percentages of both C17:0 and C20:1 comparing with the samples of individual oils where these fatty acids are in traces (Table 3). Another significant change in the blends is the distribution of oleic acid which is reduced to traces (Table 4). The linoleic acid is comparatively less affected. It was also noted that the saturation level in all blends was increased, which may be due to the noticeable increase of C17:0 fatty acid in the blended samples. The results obtained may be of use for all concerned with the industrial and nutritious uses of such olive oil blends. The production of such blends on commercial scale will depend upon the acceptance and taste of the consumers.

Table 4 Fatty acid composition of the blends[a]

Fatty acids[b]	1	2	3	4	5	6
C17:0	46.43	39.6	37.5	36.30	32.92	32.30
C18:1	0.55	1.8	0.9	0.30	1.28	1.48
C18:2	25.00	27.4	23.4	22.6	18.4	19.22
C20:1	28.02	31.2	38.20	40.8	47.4	47.00

[a]Blends:
1. 50% local olive oil + 25% sunflower oil + 25% corn oil.
2. 50% imported olive oil + 25% sunflower oil + 25% corn oil.
3. 33.3% imported olive oil + 33.3% sunflower oil + 33.3% corn oil.
4. 33.3% local olive oil + 33.3% sunflower oil + 33.3% corn oil.
5. 25% local olive oil + 75% sunflower oil.
6. 25% imported olive oil + 75% sunflower oil.

[b]Each value is the mean of triplicate analyses.

LITERATURE CITED

1. Doris, B. 1964. Free fatty acids in vegetable oils. J. Am. Oil Chemists Society 41: 21–23.
2. Joint FAO/WHO Standards Programme Codex Alimentarius Commission (Corn oil Ref: CAC/RS-2-1969/Olive oil Ref: CAC/RS-33-1970, Sunflower oil Ref: CAC/RS 23-1969).
3. Jones, R. J. 1974. Role of Dietary Fat in Health. J. Am. Oil Chemists Society 51: 251–254.
4. Metcalfe, L. D., A. A. Schmitz and J. J. Pelka. 1966. Rapid preparation of fatty acid esters from lipids for gas chromatographic analysis. Anal. Chem. 38: 514–516.
5. Official and Tentative Methods of the American Oil Chemists Soc. 1976. 3rd ed. Champaign. IL.
6. Rizek, R. L., B. Friend and L. Page. 1974. Fat in Today's Food Supply—level of use and sources. JAOCS 51: 244–250.
7. Salwin, H. M., A. Benca and G. H. Mitchell Jr. 1954. Spectrophotometric method for the determination of thiobarbituric acid. J. A. Oil Chemists Soc. 31: 603–606.
8. Stahl, E. 1969. Thin-layer Chromatography. A Laboratory Handbook. Springer-Verlag, New York.

خواص وتركيب مخاليط زيت الزيتون مع بعض الزيوت النباتية المتوفرة للاستهلاك

أحمد عاشور أحمد
مصطفى عبد المنعم محمد
محمد سليم رانا

المستخلص

تم فى هذا البحث دراسة الخواص الطبيعية والكيمائية للزيوت النقية التالية المتوفرة للاستهلاك : زيت الزيتون ـ زيت عباد الشمس ـ وزيت الذرة . وقد اتضح أن خواص كلا من زيت الزيتون وزيت عباد الشمس تماثل الخواص المذكورة فى المواصفات القياسية لهذه الزيوت والمسجلة بواسطة منظمة الفاو ـ ومنظمة الصحة العالمية . أما بالنسبة لزيت الذرة فقد وجد أنه يتميز برقم يؤدى أقل ونسبة أحماض دهنية حره أعلى ورقم بيروكسيدى أعلى من القيمة المبينة فى المواصفات القياسية العالمية لهذا الزيت .

كذلك تم تقدير الاحماض الدهنية لهذه الزيوت باستخدام طريقة التحليل الكروماتوجرافى الغازى السائل ـ ولقد دلت النتائج على أن الأحماض الدهنية الأساسية الموجودة فى كل عينات الزيوت المختبرة هى : حمض البالمتيك ـ حمض الستياريك ـ حمض الاوليك ـ حمض اللينوليك . كما وجد أن نسبة الاحماض الدهنية فى عينات الزيوت المختبرة تقع فى نطاق القيم المسجلة فى المواصفات القياسية العالمية لهذه الزيوت .

وتوضح النتائج المتحصل عليها بأنه عند خلط زيت الزيتون مع الزيوت النباتية السابقة الذكر فأن الخواص الطبيعية والكيمائية لمخاليط الزيوت الناتجه تغيرت تغيرا شاملا . كما أنه حدثت تغيرات جوهرية وحيوية فى توزيع الاحماض الدهنية فى كل مخاليط الزيوت المحضره وحدثت زيادة ملموسة فى مستوى التشبع فى مخاليط الزيت وانخفضت نسبة حمض الاوليك انخفاضا كبيرا .