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The possibilities of obtaining, characterizing and valorification of almond oil (*Prunus Amygdalus*)

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Abstract

Almond kernels (*Prunus Amygdalus* L.) of the family *Rosaceae* were investigated for the oil seed characteristics. The physico-chemical properties and fatty acid composition of the seed oil were examined. . Almond kernel were found to be rich in oil 41.52%). The oil contains an appreciable amount of unsaturated fatty acids (87.37%) and saturated fatty acids (12.61%).

The oils were analysed for specific gravity, iodine and saponification numbers, refractive index, and fatty acid composition.

Physicochemical properties of oil were performed according to AOAC procedures and fatty acids were determined by gas chromatography (GC).

Keywords: almond oil, fatty acids, GC-MS, chemical composition

1. Introduction

Globally, the most popular and commercially important edible nuts are peanuts (Arachis hypogaea) and several tree nuts almond (*Prunus dulcis*), cashew (*Anacardium occidentale*), Brazil nut (*Bertholetia excelssa*), hazelnut (*Corylus avellana*), macadamia (*Macadamia integrifolia*), pecan (*Carya illinoinensis*), pine nut (*Pinus pinea*), pistachio (*Pistachia Vera*), and walnut (*Juglans regia*) [1].

Kernels of apricot, peach, plum and almond belong to this family are produced as byproducts in tonnages from food canning industry. The kernels are considered as non-traditional potential resources for oils [2].

The almond (*Prunus amygdalus, syn. Prunus dulcis, Amygdalus communis, Amygdalus dulcis*) is a species of tree native to the Middle East and South Asia. "Almond" is also the name of the edible and widely cultivated seed of this tree. Within the genus Prunus, it is classified with the peach in the subgenus Amygdalus, distinguished from the other subgenera by the corrugated shell (endocarp) surrounding the seed. The fruit of the almond is a drupe, consisting of an outer hull and a hard shell with the seed (which is not a true nut) inside. Almond belongs to the *Rosaceae* family and is considered one of the leading nut crops worldwide [3-5].

Almond kernel contains high level of unsaturated fatty acids, mainly monounsaturated fatty acids

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(MUFA) that play a significant role for human nutrition [5].

Almond is an important food product which in addition the local use as a dry nut; it's as important component of food and industrial products in normal condition. On other words, quality keeping of nut is very important from different aspects in nut harvesting. In this case, various factors, particularly physical characteristics of nut and chemical composites are effective attributes for determining quality. One of the most important biochemical characteristics can be vitamins, oil and fatty acids [6].

The almond is considered a pleasant nut throughout the world with applications in food, pharmaceutical and cosmetic industries. It is used as an ingredient in many snacks and other processed foods. As is the case with other nuts, almonds also reduce the risk of cardiovascular diseases. This is attributed to the hypocholesterolemic effect of high levels of fiber, sterols, ratio of unsaturated fatty acids (USFA) to saturated fatty acids (SFA) and also to the antioxidant capacity of vitamin E and sphingolipids present in almonds [7].

The fatty acid composition of almond oil also has dietary importance. Several studies have shown that almond oil is very rich in monounsaturated fatty acid (MUFA), particularly oleic acid (18:1) [8].

2. Materials and Methods

Materials. Almond kernels and were purchased from a local market. To obtain oil samples by solvent extraction, ground almonds were extracted with petroleum ether (Merck, 40-60°C) in a Soxhlet apparatus and the remaining solvent was removed by distillation. After extraction, the oil samples were filtered and stored for analysis.

Physicochemical characteristics of almond oil. The ordinary oil constants, e.g., acid value, iodine, saponification, and peroxide number, and refractive index, were estimated according to the AOAC Official Methods [15].

The fatty acids profiles were determined by GC-MS. Fatty acid methyl esters were prepared using BF3 methanolic solution and extracted with hexane.

GC-MS analysis of fatty acids methyl esters A 2 µL volume of each sample was injected in a HP6890 Series Gas Chromatograph coupled with a Hewlett Packard 5973 Mass Selective Detector. The gas chromatograph was equipped with a split-splitless injector and a Factor FourTM Capillary Column HP-5ms fused silica column of 5% phenyl-methylpolysiloxane, 30m*0.25 mm, film thickness 0.25 µm. The GC oven was set to a temperature range of 100 to 300°C with 60°C/min, and a solvent delay of 7 min. The injector temperature was maintained at 230°C. The carrier gas of the sample was helium at 1.0 mL/min and the sample was injected in the splitless mode. The MS conditions were the followings: ionization energy, 70 eV; electronic impact ion source temperature, 200°C; quadrupole temperature, 100°C; scan rate 1.6 scan/s; mass, 40-500 amu. For the identification of the compounds the mass spectra of the samples were compared with those of the NIST/EPA/NIH Mass Spectral Library 2.0.

3.Results and Discussion

Figures 1 and table 2 representing GC-MS chromatogram, are shown the results obtained for samples of fatty acids from almond oil and physicochemical characteristics of rapeseed oil obtained are as follows: oil content (43.25%), acid value (0.47mg KOH/g), iodine (112.4 $gI_2/100g$), saponification (178.7 mg KOH/g), peroxide number (0.53 mEO_2/kg) and refractive index (1.4650). Predominantly in the composition of unsaturated fatty acids is oleic acid (57.32%) and the category of unsaturated fatty acids were linoleic acid observed (30.05%) and linolenic acid unobserved.

Results of this study on the oleic acid levels in the almond oil are in good agreement with those reported by Venkathacalam and Sathe [1] (60.98%). Özcan [10], Givianrad et al. [9] and Moayedi et al. [7] reported oleic acid levels of 72.5-79.97%, 67.18% and 66.7%, which are higher than almond oil used in the present study.

Table 1. Fatty acids composition for almond oil (%)

14:0	16:0	16:1	18:0	18:1	18:2	18:3	References
-	6.94 ± 0.11	0.30 ± 0.03	3.3 ± 0.12	67.18 ± 0.72	22.13 ± 0.42	0.15 ± 0.02	(Givianrad et al., 2013) [9]
0.26-0.64	4.96-8.15	0.32-0.88	1.32-2.48	63.25-79.83	11.80-26.97	-	(Celik and Balta, 2011) [4]
-	7.1-9.5	0.3-0.6	1.0-2.6	66.7-69.7	18.2-23	-	(Moayedi et al., 2010) [7]
-	5.87-6.73	0.18-0.82	-	72.5-79.97	13.52-19.77	-	(Özcan et al., 2011) [10]
0.03	5.97	0.03	1.85	68.63	21.77	-	(Sabudak, 2007) [11]
-	5.0-7.3	0.3-0.6	1.1-2.3	61.7-76.8	15.4-29.5	-	(Abdallah, 1998) [8]
0.04	7.86	0.66	1.56	60.98	29.21	-	(Venkatachalam and Sathe, 2006) [1]
-	7.28-7.43	0.77-0.78	1.86-1.89	69.89-70.01	19.49-19.57	-	(Miraliakbari and Shahidi, 2007) [12]
1.40	8.19	-	0.87	64.43	25.04	-	(Samah S.H. Allam, 2001) [13]
-	6.5	-	1.5	67.1	24.2	-	(Keun Hee Chung et. al., 2013) [14]

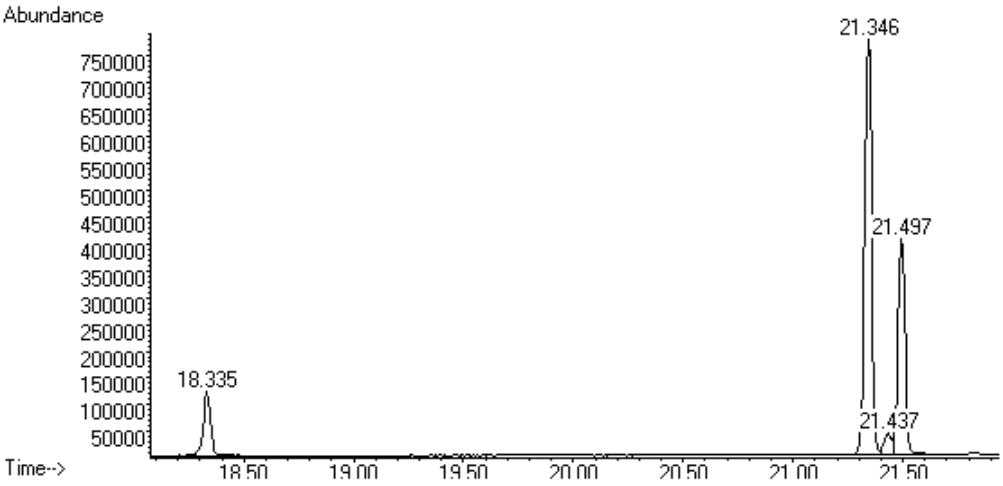

Figure 1. The chromatogram from the GC-MS analysis of the almond oil

Table 2. Composition in fatty acids (saturated and unsaturated) for almond oil

Fatty acids	Retention time (min)	Content (%)
Palmitic acid (C16:0)	18.335	9.46
Stearic acid (C18:0)	21.437	3.15
Oleic acid (C18:1)	21.346	57.32
Linoleic acid (C18:2)	21.497	30.05

FA compositions in the almond oils from this study indicated slight differences from that reported by literature who studied the almond oil from a region different from those of this study.

Compliance with Ethics Requirements:

Authors declare that they respect the journal's ethics requirements. Authors declare that they have no conflict of interest and all procedures involving human and/or animal subjects (if exists) respect the specific regulations and standards.

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