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Chemical analysis of American almond (*Prunns dulcis* L.) seed oil using gas-liquid chromatography-mass spectrometry (GC-MS)

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Abstract

American almond fruit oil was extracted using a saxolite device in the laboratories of the Medicinal and Aromatic Plants Unit, College of Agriculture, University of Basra, during the 2024-2025 season. The quantity and quality of fatty acids in the extracted oil were determined using GC-MS technology in the Food Engineering Laboratory of the Department of Food Sciences, University of Basra. The results revealed the detection of 15 compounds. The unsaturated fatty acid linoleoyl chloride occupied the highest percentage of 51.10%, followed by the saturated fatty acid stearic acid of 32.47%, and then the saturated fatty acid palmitic acid of 12.98%. These compounds are the main components of American almond fruit oil.

Keywords: American almond, GC-MS, unsaturated fatty acids, saturated fatty acids

Introduction

The almond tree (*Prunus dulcis* L.) is a perennial, deciduous tree belonging to the Rosaceae family, native to western Asia. Its leaves are oblong and lanceolate. The flowers are white to pink in color and bloom from early December to March. They are cross-pollinated by wind or insects. The fruits are harvested in the fall and are used as nuts and in making sweets and pastries. They have a high nutritional value, as 100 grams of almonds, with or without the shell, contain (4.01, 5.39)% moisture, (2.0, 2.07)% ash, (51.0, 47.8)% fat, (19.0, 21.76)% protein, and (13.17, 21.0)% carbohydrates, providing (586.65, 614.2) calories, respectively (Saeed *et al.*, 2024). Almonds are grown commercially in the United States. Spain, Morocco, Iran, Italy, Turkey, Tunisia, and Chile are the main producers of almonds worldwide, producing 78% of the global production in 2019 (Almad Board Calif, 2020) ^[3]. Edible oil is extracted from different parts of the plant, such as the peel, seeds, leaves, flowers, and fruits. The oil has many health benefits because it contains a variety of fatty acids (Ahmad, 2010) ^[1], both unsaturated fatty acids (39%) and saturated fatty acids (3.7%) (Yada *et al.*, 2013). The oil helps prevent water loss from the skin, so it is used as a softener and moisturizer for the skin, hair, and scalp (Ahmad, 2010) ^[1]. It prevents the spread of stretch marks on the abdomen, redness, and itching (Hajhashemi *et al.*, 2018) ^[6]. It contributes to lowering blood cholesterol (Ahrens, 2005) and improving blood vessel function by reducing atherosclerosis (Morgillo *et al.*, 2019) ^[11]. It helps regulate weight by curbing Appetite and blood sugar control (Dreher, 2021) ^[5], leads to a reduction in harmful cholesterol levels LDL while raising good cholesterol HDL by 6% (Hyson *et al.*, 2002) ^[7], the oil also has hepatoprotective, anti-inflammatory, anti-cancer, immunostimulating effects and treatment of constipation and intestinal restlessness (Merikli *et al.*, 2017) ^[10], and the oil is used as a medicine and pharmaceutical and cosmetic preparations to treat dry skin disorders such as psoriasis (Ahrens *et al.*, 2005) ^[2]. Zhu (2014) ^[16] showed when analyzing the oil in the American almond varieties Carmal and Nonpareil using GC-MS technology, the unsaturated fatty acid Oleic acid occupied the highest percentage at (58.1, 65.6)%, followed by the unsaturated fatty acid Linoleic acid at (22.6, 29.7)%, then the saturated fatty acid Palmitic acid at (6.6, 7.2%) respectively. Shelly *et al.* (2015) ^[14] found that when detecting fatty acids in almond fruit oil, four fatty acids appeared using GC-MS, as the fatty acid 4-H-1,2,4-Triazole-3-thiol,4-methyl-5-[5-(1-pentynyl)-3-pyridyl] occupied the highest percentage, reaching 50.49%, followed by the fatty acid 10-ctadecenoic acid, methyl ester, with a percentage of 36.16%, then the fatty acid Octadecenamide (Z) with a percentage

of 8.57%, and the compound Pentadecanoic acid, 14-methyl, methyl ester, with a percentage of 4.76%. Qureshi (2019) [12] found that when analyzing the active compounds in almond oil using GC-MS, 37 active compounds appeared, with the fatty compound Octadecenoic acid -6 occupying the highest percentage, reaching 37.52%, followed by the fatty acid compound 9-Octadecenoic acid (Z)-2,3-dihydroxypropyl ester of 13.92%, then n-Hexadecanoic acid of 8.44%, then Ethyl oleate of 5.09%. The study aims to identify the fatty acids present in American almond fruit oil using GC-MS technology and their percentages.

Materials and Methods

The biologically active compounds in almond seed oil were identified by extracting the oil from the seeds using hexane in the laboratories of the College of Agriculture, University of Basra, Iraq. Gas chromatography-mass spectrometry (GC-MS) model QP210 Ultra. Shamadzu APAN was performed, equipped with a DB-MAS5 capillary column (95% methylpolysiloxane, 5% vinyl) as the stationary phase, in addition to the use of helium gas (99.9%). The following conditions were used: injection mode: split, column oven temperature: 40 °C, injection temperature: 280 °C, column flow: 1.71 ml/min, pressure: 96.1 kPa, purge flow: 3.0 ml/min, split ratio: 46.9, total flow: 79.2 ml/min, linear velocity: 47.2 cm/s, interface temperature: 280 °C, mass spectrometer: ion source temperature: 200 °C. Celsius, Solvent cut-off time: 3.00 min, Detector gain: 1.24 kV + 0.10 kV, Start time: 3.00 min, End time: 35.00 min, ACQ mode: Scan, Event time: 0.50 sec, Scan speed: 2000, Start speed:

50.00, End speed: 800.

Results and Discussion

Table (1) and Figure (1) show the GC-MS chromatograms resulting from the analysis of the oil extracted from American almonds, where 15 active compounds appeared. The unsaturated fatty acid 9,12-Octadecadienoyl chloride with, (Z, Z) with chemical name of Linoleoyl chloride and formula of C18H3C10 had the highest percentage, at 51.10%. It has antioxidant and anti-inflammatory properties (Chio *et al.*, 2013) [4], followed by the saturated fatty acid Octadecadienoic acid, methyl ester (E, E)-9, 12 with chemical name of Stearic acid and chemical formula of CH₃-(CH₂)₁₆-COOH at 32.47%, which consists of 18 carbon atoms making it less harmful to cardiovascular health compared to other saturated fats and does not raise harmful LDL cholesterol levels in the blood (Kris-Etherton, 2005) [9]. The third saturated fatty acid was Hexadecanoic acid methyl ester, chemically named Palmitic acid with chemical formula of CH₃-(CH₂)₁₄-COOH at 12.98%, that contains 16 carbon atoms. This compound has an important role in enhancing the body's immune response by helping fight infections. It is used in the manufacture of many skin care products such as creams and ointments due to its moisturizing properties. Excessive consumption of it leads to an increase in harmful cholesterol levels (LDL) and thus an increase in the risk of cardiovascular diseases (Kris-Etherton *et al.*, 2005) [9]. The results are consistent with what was obtained by AL-Rabea'a *et al.*, (2021) [8], Zhu (2014) [16], Shelly *et al.*, (2015) [14] and Qureshi *et al.*, (2019) [12].

Table 1: Components Identified in *Prunns dulcis* L.

Peak Area %	Name of the compound	RT	No.
0.05	3-Methylbenzyl alcohol, TBDMS derivative	3.934	1
0.12	.alpha.-Terpinyl acetate	8.459	2
0.04	2,6-Di-tert-butyl-4-hydroxy-4-methylcyclohexa-2,5-dien-1-one	10.088	3
0.11	Hexasiloxane, 1,1,3,3,5,5,7,7,9,9,11,11-dodecamethyl-	11.055	4
0.06	Epinephrine, (.beta.)-, 3TMS derivative	14.089	5
0.08	Methyl tetradecanoate	14.335	6
0.07	7-Hexadecenoic acid, methyl ester, (Z)-	17.575	7
2.00	(Z)-Methyl hexadec-11-enoate	17.673	8
12.98	Hexadecanoic acid, methyl ester	18.183	9
0.16	Cadmium, [5,10,15,20-tetraphenylporphinato(2)]-	18.359	10
0.19	n-Hexadecanoic acid	18.903	11
0.36	Methyl 9-heptadecenoate or 9-17:1	19.517	12
0.20	Heptadecanoic acid, methyl ester	20.030	13
32.47	9,12-Octadecadienoic acid, methyl ester, (E,E)-	21.260	14
51.10	9,12-Octadecadienoyl chloride, (Z,Z)-	21.431	15

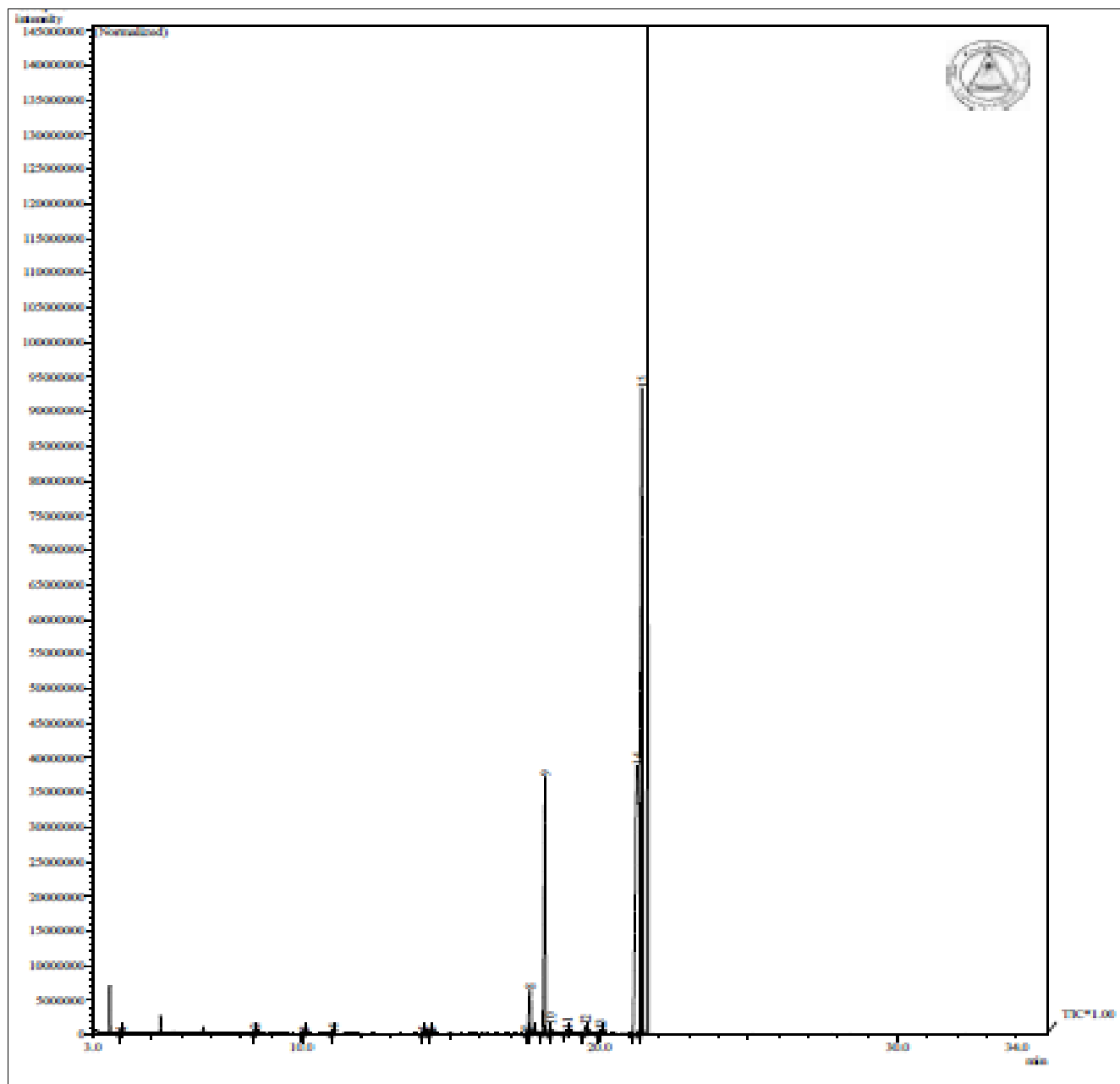


Fig 1: A bioactive compounds in *Prunus dulcis* L. seeds that identified by GC-Mass device

Conclusions

An investigation was carried out to study the chemical analysis of American almond (*Prunus dulcis* L.) seed oil using gas-liquid chromatography-mass spectrometry (GC-MS). The results revealed the detection of 15 compounds. The unsaturated fatty acid linoleoyl chloride occupied the highest percentage of 51.10%, followed by the saturated fatty acid stearic acid of 32.47%, and then the saturated fatty acid palmitic acid of 12.98%. These compounds are the main components of American almond fruit oil.

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