**Study of the chemical content of extracted essential oil from the plant *Arbutus* *andrachne* L. using GC/MS in Syrian coast/tartous Governorate**

**ABSTRACT**

The present study investigates the chemical composition of the essential oil extracted from the leaves of Arbutus andrachne L., a plant native to Syria with notable medicinal, environmental, nutritional, and ornamental significance. Leaf samples were collected from the Baniyas region in Tartous, Syria, and subjected to steam distillation using a Clevenger apparatus to obtain the essential oil. Gas chromatography-mass spectrometry (GC/MS) analysis identified 61 chemical constituents, accounting for 99.7% of the total oil composition. The primary compounds included Phytol (19.9%), Decane, 5,6-bis(2,2-dimethylpropylidene)-(E,Z) (13.6%), 1,2-Benzenedicarboxylic acid, butyl octyl ester (6.8%), and Heptacosane (5.3%). The concentration of the remaining compounds ranged from 0.1% to 4.8%. The variations observed between this study and previous reports are attributed to differences in geographic and climatic conditions. These findings highlight the diverse chemical profile of A. andrachne essential oil and its potential value in various applications.

K**ey words: Arbutus *andrachne* L, Essential oil , Clevenger, GC/MS .**

# 1. Introduction

Arbutus andrachne L., commonly known as the Greek or Eastern strawberry tree, is one of the two recognized species in the Arbutus genus, belonging to the family Ericaceae (Serçe et al., 2010). It is a small evergreen tree native to the Mediterranean region and southwestern Asia (Markovski, 2017; Bertsouklis & Papafotiou, 2013; Dönmez et al., 2016).

Species within the Arbutus genus have long been utilized in traditional medicine for a variety of therapeutic purposes. For example, the leaves of Arbutus unedo L. have been traditionally employed for their diuretic, urinary antiseptic, antidiarrheal, astringent, depurative, and antihypertensive effects (Bessah & Benyoussef, 2012). Additionally, the red, edible berries of Arbutus species are widely consumed in several countries, either fresh or processed (Molina et al., 2011; Tardío et al., 2006; Çavuşoğlu et al., 2015). These fruits are used in the preparation of a broad range of food products including alcoholic beverages, jams, jellies, and marmalades (Ayaz et al., 2000; Pallauf et al., 2008; Oliveira et al., 2009).

The fruits of A. unedo L. and A. andrachne L. are often harvested in their immature stages and consumed for their refreshing qualities. They are also rich in antioxidant compounds such as vitamins C and E, carotenoids, niacin, and various polyphenolic compounds (Ruiz-Rodriguez et al., 2011). Beyond nutritional uses, the hard wood of A. andrachne is valued in handicrafts and construction, particularly in settings where dimensional stability is important, such as fireplaces or tool handles (Dingil, 1990).

The phytochemical composition and strong antioxidant potential of both the fruits and leaves of A. andrachne L. have been confirmed in preliminary investigations (Serçe et al., 2010; Şeker & Toplu, 2010). The screening of plant-derived essential oils and extracts for biological activities remains a significant area of research, contributing to the discovery of phytopharmaceuticals, natural preservatives, antioxidants, antibacterial agents, and fragrances for use in the food and cosmetic industries (Abu-rish et al., 2016; Djouahri et al., 2015; Sıcak et al., 2017).

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| AGeneral shape of the plant *Arbutus* *andrachne*L  | B*Arbutus* *andrachne*L.flowers | C *Arbutus* *andrachne*L.fruits |
| **Figre 1 : *Arbutus* *andrachne* L.** |

## 1.1 The importance of research:

Arbutus andrachne L. is a naturally occurring plant species in Syria, known for its medicinal, environmental, nutritional, and ornamental significance. Despite its potential value, it has received limited scientific attention, particularly with regard to its phytochemical properties. To date, no studies have been published on the chemical composition of essential oil extracted from the leaves of A. andrachne L. within Syria. This study represents the first research effort in the country aimed at extracting and characterizing the essential oil from the leaves of this native species.

## 1.2 Research objectives:

1. To extract the essential oil from the leaves of Arbutus andrachne L. using a Clevenger-type hydrodistillation apparatus.
2. To determine the chemical composition of the extracted essential oil through gas chromatography-mass spectrometry (GC/MS) analysis.

# 2. Materials and methods

## 2.1 Equipment and tools used:

The following equipment and materials were employed during the extraction and analysis of essential oil from Arbutus andrachne L.:

* **Clevenger apparatus** – used for the hydrodistillation of essential oils.
* **Gas Chromatography–Mass Spectrometry (GC/MS)** – CHROMATEC 9000 system equipped with a mass spectrometric detector, used for the identification and quantification of oil components.
* **Analytical balance** – Sartorius (Germany), used for precise weighing of plant materials and reagents.
* **Chloroform** – procured from Honeywell (Germany), used as a solvent in the oil preparation process.
* **Electric spherical heater** – Ittmann Heraeus (Germany), used for controlled heating during distillation.
* **Anhydrous sodium sulfate** – obtained from Titan Biotech Ltd. (India), used to remove moisture from the extracted oil.
* **Filter paper** – Type ZELPA (Belgium), Hatman No. 1, used for filtration of extracts.
* **Glass laboratory instruments** – sourced from Isolab (Germany), including flasks, measuring cylinders, and pipettes.

## 2.2 Sample collection and preparation for extraction

**Study Site:**
The plant material was collected from a village called Bablota, located in the Baniyas district of the Tartous Governorate, Syria. The site is situated at an altitude of approximately 350 meters above sea level.

**Plant Material:**
Leaves of Arbutus andrachne L. shrubs were collected on May 30, 2024. The collected leaves were carefully cleaned to remove dust and other surface impurities. They were then air-dried in a shaded, well-ventilated area at room temperature (20–25°C) for approximately one month to preserve their phytochemical integrity.

After drying, the leaves were ground using an electric grinder until a fine consistency was achieved. The powdered plant material was stored in tightly sealed nylon bags to prevent moisture absorption and contamination, ensuring preservation until the time of extraction.

## 2.3 Essential oil extraction:

Essential oil was extracted from the leaf samples of Arbutus andrachne L. using hydrodistillation in a Clevenger-type apparatus. A total of 100 grams of dried, powdered leaf material was mixed with 600 mL of distilled water and subjected to distillation for four hours.

The oil layer obtained was then extracted using 30 mL of chloroform in a separating funnel, divided into three successive batches to ensure maximum recovery. The chloroform layer containing the essential oil was dried over anhydrous sodium sulfate to remove residual moisture. Following filtration, the chloroform was carefully evaporated by passing a gentle stream of nitrogen gas over the extract.

The purified essential oil was then stored in tightly sealed glass tubes at 4°C until further analysis. All experimental procedures were conducted in the Organic Chemistry Research Laboratory 2, Faculty of Science, Latakia University, Syria.

## 2.4 GC-MS analysis of essential oil

The analysis of the essential oil was carried out at the laboratories of the Higher Atomic Energy Commission in Damascus, Syria. A 1 μL aliquot of the essential oil sample was injected into a GC-MS system (CHROMATEC 9000) equipped with a mass spectrometric detector and a BP5MS capillary column (30 m length × 0.25 mm inner diameter × 0.25 μm film thickness).

Helium, with a purity of 99.9%, was used as the carrier gas at a constant flow rate of 30 cm/min. The injector temperature was set at 300 °C, while the ionization source temperature was maintained at 280 °C.

The oven temperature program was as follows: the initial temperature was set at 50 °C and held for 5.5 minutes, then increased at a rate of 10 °C per minute to 300 °C, where it was maintained for an additional 5 minutes. The total run time for the analysis was 35.5 minutes.

Chemical constituents of the essential oil were identified by comparing the mass spectra of each chromatographic peak with reference spectra available in the instrument’s built-in libraries.

# 3. Results and Discussion:

## 3.1 Analysis of Essential oil

Analysis of the essential oil extracted from the leaves of Arbutus andrachne L. using GC/MS revealed the presence of 61 chemical compounds, collectively representing 99.2% of the total oil composition. The chromatogram of the essential oil is presented in Figure 2. Table 2 provides a detailed list of all identified compounds along with their respective percentages, while Table 3 highlights the major constituents.

The predominant compounds identified in the essential oil were Phytol (19.9%), Decane, 5,6-bis(2,2-dimethylpropylidene)-(E,Z) (13.6%), 1,2-Benzenedicarboxylic acid, butyl octyl ester (6.8%), and Heptacosane (5.3%). These findings indicate a unique chemical profile compared to other studies, suggesting potential geographic or environmental influences on the composition of the essential oil.



 **Figure 2 : GC/MS chromatogram of essential oil *Arbutus* *andrachne* L. leaves**

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| **Table 1: the main compounds in the essential oil extracted from the leaves of the *Arbutus* *andrachne* L.** |
| **Area (%)** | **Compounds** | **No**  |
| 19.9 | Phytol | 1 |
| 13.6 | Decane, 5,6-bis(2,2-dimethylpropylidene)-, (E,Z)- | 2 |
| 6.8 | 1,2-Benzenedicarboxylic acid, butyl octyl Ester | 3 |
| 5.3 | Heptacosane | 4 |

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| **Table 2: components of the essential oil extracted from the leaves of the *Arbutus* *andrachne* L.** |
| **Area (%)** | **M.W(g/mol)** | **M.F.** | **Compounds** | **RI** | **No** |
| 0.1 | 214.39 g/mol | [C14H30O](https://pubchem.ncbi.nlm.nih.gov/#query=C14H30O) | Hexyl octyl ether | 12.39 | 1 |
| 0.1 | 170.25 g/mol | C10H18O2 | 2H-Pyran-3-ol, 6-ethenyltetrahydro-2,2,6- trimethyl- | 14.49 | 2 |
| 0.2 | 240.42g/mol | C16H32O | Oxirane, tetradecyl- | 14.56 | 3 |
| 0.5 | 154.25 g/mol | C10H18O | α-Terpineol | 14.85 | 4 |
| 0.1 | 207.15g/mol | C9H19Br | 2-Bromononane | 16.01 | 5 |
| 0.1 | 884.1 g/mol | C45H73NO16 | Solasonine | 16.57 | 6 |
| 0.3 | 157.21 g/mol | C8H15NO2 | 1-Piperazinecarboxylic acid, ethyl ester | 16.86 | 7 |
| 0.8 | 206.24 g/mol | C12H14O3 | Phenol, 2-methoxy-4-(1-propenyl)- | 17.24 | 8 |
| 0.3 | 178.27 g/mol | C12H18O | 2-Propenal, 3-(2,6,6-trimethyl-1- cyclohexen-1-yl)- | 17.82 | 9 |
| 0.4 | 190.28 g/mol | C13H18O | Oxacyclotetradeca-4,11-diyne | 18.19 | 10 |
| 0.4 | 196.29 g/mol | C12H20O2 | Cyclohexanol, 2-methyl-3-(1- methylethenyl)-, (1α,2α,3α)- | 18.35 | 11 |
| 0.3 | 196.29 g/mol | C12H20O2 | Cyclohexanecarboxaldehyde, 3,3- dimethyl-5-oxo- | 18.46 | 12 |
| 1.2 | 249.35 g/mol | C14H23N3O | 3-Buten-2-one, 4-(2,6,6-trimethyl-1- cyclohexen-1-yl)- | 18.87 | 13 |
| 0.1 | 286.05 g/mol | C9H18Br2 | 1-Bromo-3-(2-bromoethyl)heptane | 18.94 | 14 |
| 0.3 | 166.22 g/mol | C10H14O2 | 7-Oxabicyclo[4.1.0]heptane, 1-methyl-4-(2-methyloxiranyl)- | 19.08 | 15 |
| 1.3 | 206.32 g/mol | C14H22O | 2,4-Di-tert-butylphenol | 19.15 | 16 |
| 0.7 | 296.5 g/mol | C19H36O2 | 11-Octadecynoic acid, methyl ester | 19.36 | 17 |
| 0.2 | 166.22 g/mol | C10H14O2 | 3H-Naphth[1,8a-b]oxiren-2(1aH)-one, hexahydro- | 19.60 | 18 |
| 0.2 | 220.35 g/mol | C15H24O | Caryophyllene oxide | 19.79 | 19 |
| 0.1 | 220.35 g/mol | C15H24O | Lanceol, cis | 19.99 | 20 |
| 0.5 | 446.7 g/mol | C28H46O4 | Didodecyl phthalate | 20.09 | 21 |
| 0.2 | 268.5 g/mol | C19H40 | Octadecane, 6-methyl- | 20.18 | 22 |
| 0.3 | 284.4 g/mol | C20H28O | Retinal | 20.35 | 23 |
| 3.5 | 222.37 g/mol | C15H26O | Ledol | 20.44 | 24 |
| 2.2 | 222.37 g/mol | C15H26O | (1S,3aS,4S,5S,7aR,8R)-5-Isopropyl-1,7a- dimethyloctahydro-1H-1,4-methanoinden-8-ol | 20.60 | 25 |
| 4.8 | 222.36g/mol | C15H26O | 2-Naphthalenemethanol, 1,2,3,4,4a,5,6,7- octahydro-α,α,4a,8-tetramethyl-, (2R-cis)- | 20.83 | 26 |
| 0.7 | 222.37 g/mol | C15H26O | .tau.-Muurolol | 20.94 | 27 |
| 0.1 | 537.0 g/mol | C37H76O | 1-Heptatriacotanol | 21.04 | 28 |
| 3.6 | 222.37 g/mol | C15H26O | 2-Naphthalenemethanol, decahydro- α,α,4a-trimethyl-8-methylene-, [2R- (2α,4aα,8aβ)]- | 21.12 | 29 |
| 0.2 | 254.41 g/mol | C116H30O2 | cis-7-Hexadecenoic acid | 21.20 | 30 |
| 0.6 | 220.35 g/mol | C15H24O | trans-Z-α-Bisabolene epoxide | 21.31 | 31 |
| 0.1 | 288.9 g/mol | C18H37Cl | Octadecane, 1-chloro- | 21.36 | 32 |
| 0.3 | 222.37 g/mol | C15H26O | 1H-Cycloprop[e]azulen-4-ol, decahydro-1,1,4,7-tetramethyl-, [1aR- (1aα,4β,4aβ,7α,7aβ,7bα)]- | 21.61 | 33 |
| 0.3 | 294.5 g/mol | C19H34O2 | 2,5-Octadecadiynoic acid, methyl ester | 21.78 | 34 |
| 0.8 | 224.42g/mol | C16H32 | Cetene | 22.31 | 35 |
| 1.4 | 198.34g/mol | C13H26O | 2-Undecanone, 6,10-dimethyl- | 22.83 | 36 |
| 6.8 | 334.44g/mol | C20H30O4 | 1,2-Benzenedicarboxylic acid, butyl octyl Ester | 23.04 | 37 |
| 0.7 | 272.9 g/mol | C17H33Cl | 7-Heptadecene, 17-chloro | 23.24 | 38 |
| 0.4 | 256.46g/mol | C17H36O | 1-Hexadecanol, 2-methyl- | 23.41 | 39 |
| 1.5 | 268.4 g/mol | C17H32O2 | Cyclopentaneundecanoic acid, methyl ester | 23.63 | 40 |
| 0.4 | 150.21g/mol | C10H14O | Benzenebutanal | 23.76 | 41 |
| 0.7 | 296.5 g/mol | C20H40O | Isophytol | 23.87 | 42 |
| 0.5 | 266.38 g/mol | C16H26O3 | 2-Dodecen-1-yl(-)succinic anhydride | 23.93 | 43 |
| 2.0 | 334.4 g/mol | C20H30O4 | 1,2-Benzenedicarboxylic acid, butyl 2- ethylhexyl ester | 24.02 | 44 |
| 0.7 | 284.47g/mol | C18H36O2 | Hexadecanoic acid, ethyl ester | 24.28 | 45 |
| 2.2 | 186.33g/mol | C12H26O | 1-Octanol, 2-butyl- | 24.31 | 46 |
| 1.2 | 232.83g/mol | C14H29Cl | Tetradecane, 1-chloro- | 24.38 | 47 |
| 13.6 | 278.5 g/mol | C20H38 | Decane, 5,6-bis(2,2-dimethylpropylidene)-, (E,Z)- | 24.77 | 48 |
| 0.8 | 172.31 g/mol | C11H24O | 1-Undecanol | 25.19 | 49 |
| 19.9 | 296.5 g/mol | C20H40O | Phytol | 25.44 | 50 |
| 1.1 | 282.5 g/mol | C18H34O2 | Oleic Acid | 25.89 | 51 |
| 2.7 | 281.47g/mol | C18H35NO | 9-Octadecenamide, (Z)- | 27.65 | 52 |
| 2.1 | 296.53g/mol | C20H40O | Octadecane, 1-(ethenyloxy)- | 27.85 | 53 |
| 0.7 | 226.44 g/mol | C16H34 | Hexadecane | 28.62 | 54 |
| 1.8 | 390.6 g/mol | C24H38O4 | Bis(2-ethylhexyl) phthalate | 28.96 | 55 |
| 2.4 | 308.6 g/mol | C22H44 | 1-Docosene | 29.33 | 56 |
| 2.3 | 268.5 g/mol | C19H40 | Nonadecane | 29.36 | 57 |
| 0.6 | 362.5 g/mol | C21H30O3S | 2,6,10-Dodecatrien-1-ol, 3,7,11-trimethyl- | 30.98 | 58 |
| 1.5 | 326.60g/mol | C22H46O | Behenic alcohol | 32.40 | 59 |
| 5.3 | 380.7 g/mol | C27H56 | Heptacosane | 33.37 | 60 |
| 0.5 | 258.5 g/mol | C16H34S | tert-Hexadecanethiol | 34.51 | 61 |

## 3.2 Comparative Discussion

A comparison between the essential oils derived from the leaves of Arbutus andrachne L. in the present study and those obtained from other plant parts in previous studies reveals considerable chemical diversity within the species. Notably, our analysis identified 61 compounds constituting 99.2% of the total oil composition, with Phytol (19.9%), Decane, 5,6-bis(2,2-dimethylpropylidene)-(E,Z) (13.6%), 1,2-Benzenedicarboxylic acid, butyl octyl ester (6.8%), and Heptacosane (5.3%) as the predominant constituents.

In contrast, a study conducted in Turkey on the essential oil of A. andrachne L. wood identified only 25 compounds comprising 80.5% of the oil, with cinnamyl alcohol (21.97%), 4-tert-butylcyclohexyl acetate (16.59%), and isobornyl acetate (15.37%) as the main components (Sıcak & Eliuz, 2019). Similarly, Kıvçak et al. (2001) reported 37 compounds from the leaves of Arbutus unedo L. in Turkey, with the most abundant being E-2-decenal (12%), α-terpineol (8.8%), hexadecanoic acid (5.1%), and E-2-undecenal (4.8%).

Kahriman et al. (2010) examined the essential oils from the flowers and fruits of A. unedo L. and identified 49 components. The primary constituents included α-terpineol (16.3%) in the flower oil and hexadecanoic acid (21.7%) in the fruit oil. In Algeria, Bessah and Ben Youssef (2010) analyzed the essential oil of A. unedo L. leaves and found palmitic acid (35.2%), linoleic acid (18.8%), and p-cresol, 2,6-di-tert-butyl- (6.2%) to be the major components.

Furthermore, a study from Jordan reported 35 different compounds in the essential oil of A. andrachne L. fruits, with pentadecanoic acid, 14-methyl-, methyl ester being the most abundant (19.87%) (Shaheen et al., 2024).

The chemical composition observed in our study is distinctly different from those reported in other studies, underscoring the remarkable phytochemical variability within the Arbutus genus. These differences are likely influenced by multiple factors, including the specific plant part analyzed, geographic origin, environmental conditions, and seasonal variation. As highlighted by Baydar (2000), such variability is often attributable to differences in geographical characteristics and climatic conditions.

# 4. Conclusion

1. Many of the major compounds identified in the essential oil of Arbutus andrachne L. leaves possess significant medicinal and pharmaceutical properties, contributing to the plant's potential therapeutic value.
2. The essential oil extracted from the leaves exhibited a diverse chemical profile, comprising hydrocarbons, oxygenated compounds, nitrogenous compounds, and other bioactive constituents, reflecting the plant's complex phytochemical nature.

# 5. Suggestions

1. Further studies should be conducted to evaluate the biological activity of the essential oil, considering the known medicinal significance of Arbutus andrachne L.
2. Future research should also focus on the extraction and analysis of essential oils from other parts of the plant, including fruits, flowers, and wood, to gain a comprehensive understanding of its phytochemical potential.
3. It is recommended to investigate samples collected from various geographical locations, as the composition of essential oils can vary significantly due to environmental and climatic differences, which influence the concentration and presence of key bioactive compounds.

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