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## *Arum Cyrenaicum*: A comprehensive review of Phytochemistry and Bioactivity

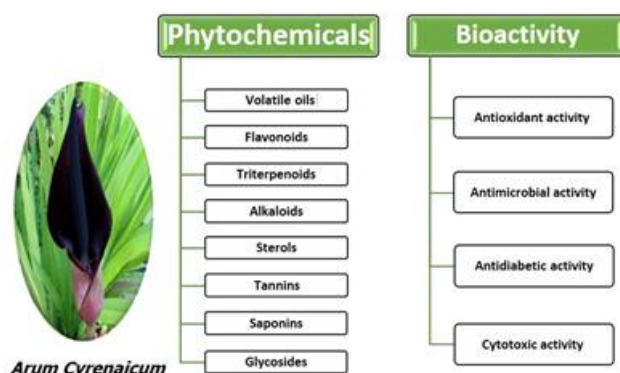
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**Abstract:** *Arum cyrenaicum* is a native species found in Al Aljabal Al-Akhdar region, NE Libya. Despite the toxicity of *Arum cyrenaicum*, Libyans use it extensively for medicinal purposes, garden decoration and in traditional dishes. There is limited research on *Arum cyrenaicum*. The present review summarizes phytochemical studies of the plant and discusses in detail the pharmacological activities of 7 published findings. To provide information about *Arum cyrenaicum*, a literature search was conducted on electronic databases and google scholar.

**Keywords:** *Arum cyrenaicum*, Al Aljabal Al-Akhdar, phytochemical study, pharmacological study.

**Received:** 2024.07.30

**Accepted:** 2024.09.16

**Published:** 2024.09.23

DOI: 10.58332/scirad2024v3i3a05

## Introduction

The genus *Arum* is a member of the Araceae family, with 105 genera and 3300 species. This genus includes about 29 species of flowering plants spread in North Africa, Europe and West and Central Asia [1-4]. The *Arum* is considered poisonous [5-7]. Several researches confirmed that its toxicity is due to the presence of some toxic compounds such as calcium oxalate [8,9], and cyanoglycosids [10]. The fact that *Arum* plants have toxic properties has not prevented people from using them as food. Iraqis [11], Iranian [12], and Jordanians [13] used leaves of some *Arum* species in their meals. Furthermore, the *Arums* have been utilized for their medicinal properties. In Italy, leaves and tubers of *Arum italicum* used to treat rheumatism after soaking them together in oil [14]. Turkish people used the tubers of various species of *Arum* to treat hemorrhoids and eczema [15], and they used the fruits of *Arum maculatum* to make wounds heal faster [16]. Several studies have shown that aqueous extracts of *Arum* leaves were commonly used to treat cancer. According to Palestinian folk medicine, *Arum dioscoridis* leaves were effective against liver and stomach cancer, and *A. Palaestinum* leaves inhibited liver, colon, kidney, and breast cancers [17].

Table 1. Chemical constituents and biological activities of some *Arum* plants.

<i>Arum</i> species	Extracts / Compounds	Biological activities	Ref.
<i>A. dioscorides</i>	Methanolic and aqueous extracts	Antioxidant activity	[24]
	Ethanollic and aqueous extracts	Enzyme inhibition	[25]
<i>A. elongatum</i>	Phenolic compounds	Antioxidant activity	[24]
<i>A. euxinum</i>	Aqueous, ethanolic and methanolic extracts	Antibacterial activity	[26]
<i>A. hygrophilum</i>	Alkaloids [(3H)-Pyrimidinone, pyrrolidin-2-one, 1H-Imidazole, 2-ethyl-4,5-dihydro]	Antibacterial activity	[27]
<i>A. maculatum</i>	Phenolic compounds	Antioxidant activity	[16]
	Petroleum ether extract	Antimicrobial activity	[28]
	Essential oil	Antibacterial and antioxidant activities	[29]
<i>A. palaestinum</i>	Flavonoids [luteolin, isovitexin, chrysoeriol, and isoorientin]	Cytotoxic and antitumor activities	[18]
	Alkaloids [S-3,4,5-Trihydroxy-1H-pyrrol-2(5H)-one]	Antioxidant and anticancer activities	[19]
	Alkaloids [piperazine]	Cytotoxic activity	[20]

Due to these medicinal values, the phytochemical compounds of the plants have been identified. Phytochemical studies of *Arum* species reported the presence of flavonoids [18], alkaloids [19,20], terpenes [13], phenolic compounds [16], carotenoids [21], sterols [22] and essential oils [23]. Few *Arum* plants have been studied to investigate their chemical constituents and their biological activities in vivo and/or in vitro and more research is

required. Table 1 summarizes the phytochemicals and biological properties of some *Arum* species based on electronic literature researches.

In Libya, the genus *Arum* is represented by one species, *Arum cyrenaicum*. *Arum cyrenaicum* (commonly known as Renish) is identified and classified as a wild species that is only concentrated in Al Aljabal Al-Akhdar region, northeast Libya [30], due to its unique geography and climate [31]. Local people used *Arum cyrenaicum* to decorate their gardens and consume its corms as food [30]. Since 1977, the morphological analysis of *Arum cyrenaicum* has not been studied [32]. Recently, the plant morphology was characterized and the investigations confirmed that *Arum cyrenaicum* is an endemic plant to Al Aljabal Al-Akhdar [33]. Despite *Arum cyrenaicum* is discovered and classified by Libyan people a long time ago, research on *Arum cyrenaicum* is rare and a comprehensive review has not been conducted yet. The following report summarizes published findings of the chemical constituents and pharmacological effects of *Arum cyrenaicum*.

## Discussion

### 2.1. Phytochemistry of *Arum cyrenaicum*

It was reported that *Arum cyrenaicum* contains many secondary metabolites. The results of phytochemical investigations of *Arum cyrenaicum* are presented in Table 2.

Table 2. The Phytochemical screening of *Arum cyrenaicum*.

Phytochemicals	Whole plant [34]	Leaves [35]	Roots [35]
Volatile oils	+	Not detected	Not detected
Flavonoids	+	+	-
Carbohydrates and/or glycosides	+	+	+
Sterols and/or triterpenoids	+	+	+
Tannins	-	+	+
Alkaloids	+	+	+
Saponins	-	-	-

In a phytochemical study, three flavonoid compounds were isolated from n-butanol fraction for whole plant of *Arum cyrenaicum* using polyamide column chromatography. The flavonoids structures were characterized by UV, <sup>1</sup>H-NMR, and MS spectral data. Figure 1 represents proposed structures of the obtained flavonoids [36].

According to a research was done, three phenolic acids were isolated from the ethyl acetate extract of aerial parts of *Arum cyrenaicum* (*p*-hydroxybenzoic acid and a mixture of *p*-coumaric acid and 3,4 -dimethoxycinnamic acid). The *p*-coumaric acid was also obtained from the hexane extract of the aerial parts. The structures of the isolated compounds (Figure 2) were characterized by using 1D, and 2D NMR spectra [37]. Reading another report

showed that phenolic acids, caffeic acid and *p*-coumaric acid, were detected in methanolic leaves and corms extracts of *Arum cyrenaicum* by HPLC analysis [38]. The leaves extracts contained 148.4 µg/mg caffeic acid and 50.1 µg/mg *p*-coumaric acid, while corms extracts contained 52.4 µg/mg caffeic acid and 14.6 µg/mg *p*-coumaric acid.

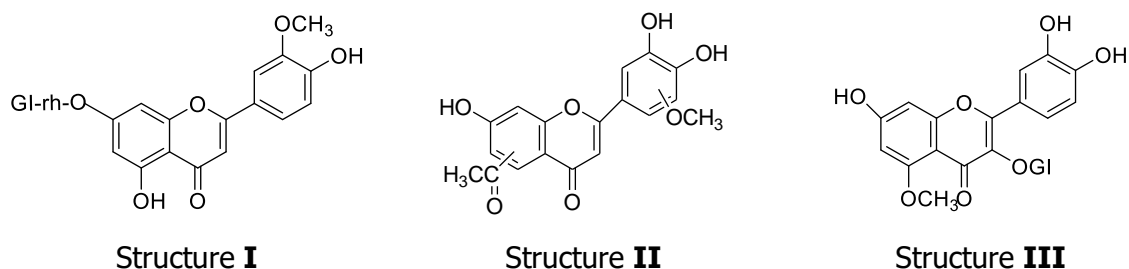


Fig. 1. The proposed structures for isolated flavonoid compounds.

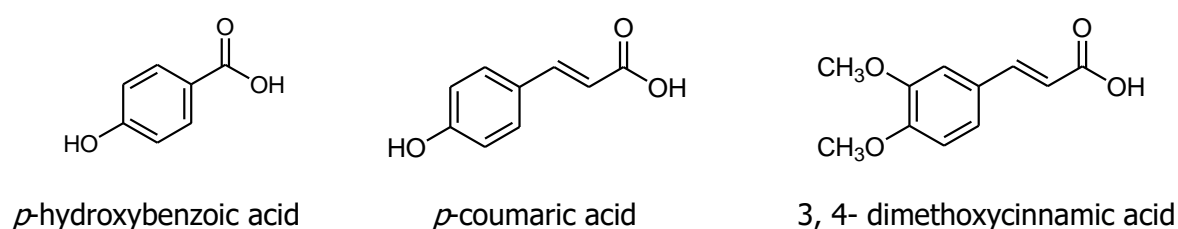


Fig. 2. Isolated phenolic acids from *A. cyrenaicum*

Table 3. The lipid constituents (> 10 %) in different organs of *Arum cyrenaicum*.

Plant organs	Unsaponifiable lipids	Fatty acid methyl esters	Acetone insoluble fraction (fatty alcohols and hydrocarbons )	Ref.
Whole plant	Stigmasterol	Linolenic acid Linoleic acid Palmitic acid	Not investigated	[34]
Flowers	Stigmasterol n-C22	Arachidic acid Erucic acid Linolenic acid Palmitic acid Stearic acid	Not investigated	[34]
Tubers	$\beta$ -sitosterol Stigmasterol	Linoleic acid Arachidic acid Palmitic acid	Not investigated	[34]
Roots	9,12-Octadecadiene Hexadecane	Margaric acid Myrestic acid Palmitic acid	Heptacosane Nonacosane	[39]
Seeds	9,12-Octadecadiene Hexadecane	Myrestic acid Lauric acid Oleic acid	Nonacosane Nonacosanol	[39]

The lipid profile of *Arum cyrenaicum* was investigated for the first time in 2018. The study identified the lipid compositions (fatty acids, and unsaponifiable matters) of the flowers, tubers, and whole plants of *Arum cyrenaicum* by using GLC [34]. Moreover, in 2020,

Aziza *et al.* isolated and analyzed the lipid constituents of the roots and seeds of *Arum cyreniacum* using GC-MS [39]. The lipid constituents (> 10 %) in different organs of *Arum cyreniacum* are shown in Table 3.

The toxicity of *Arum cyreniacum* was expected because the genus *Arum* is considered poisonous [5-7]. Chemical and microscopic analyses were performed to verify the presence of toxic materials in *Arum cyreniacum*. The result showed that all parts of plant contained two toxic compounds: calcium oxalate and cyanogenic glycoside. Both materials were found in all parts of the plant, except in corms, which lack to presence of cyanogenic glycoside [38].

## 2.2. Bioactivity on *Arum Cyreniacum*

In an experimental study, different solvents extracts of roots, seeds and herbal parts of *Arum cyreniacum* were prepared, in order to evaluate the antimicrobial activity against 10 microorganisms (*Staphylococcus aureus*, *Bacillus cereus*, *Salmonella typhimurim*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Bacillus subtilis*, *Sa. sarcina*, *Aspergillus niger*, *Aspergillus flavus* and *Candida albicans*). The results revealed that the butanol extract of roots and all chloroform extracts of the herbs, roots, and seeds possessed antibacterial effects against *Staphylococcus aureus* only. Whereas *Escherichia coli*, *Salmonella typhimurim*, *Staphylococcus aureus*, and *Sa. sarcina* were inhibited by the petroleum ether extract of herbal parts, the petroleum ether extracts of seeds and roots were found to be potent against *Salmonella typhimurim* and *Sa. Sarcina*, respectively. On the other hand, the research did not produce any antifungal effect and also did not show any inhibitory effect for the water and methanol extracts at all concentrations [38].

In another study, the corms of *Arum cyreniacum* were evaluated for their antibacterial activity against four types of pathogenic and nonpathogenic bacteria [40]. The corms were extracted using petroleum ether, methanol, and chloroform. The petroleum ether extract of corms was effective against *Staphylococcus aureus*, and the methanolic extract of corms was effective against *Pseudomonas auregenosa*. On the other hand, the chloroform extract of corms was inactive against all tested bacteria.

In addition to the antimicrobial effects, the antioxidant properties of *A. cyreniacum* were evaluated for the first time. Free radical-scavenging capacity using DPPH assay was investigated for leaves and corms methanolic extracts. As mentioned above, this study also revealed the presence of antioxidant compounds, caffeic acid and *p*-coumaric acid. Thus the extracts exhibited DPPH radical scavenging effects and possessed antioxidant properties [38].

In terms of cytotoxic activity, *A. cyrenaicum* was tested against 8 cancer and 2 normal cells. The roots, fruits and aerial parts were extracted with hexane, ethyl acetate and methanol. Among the nine extracts, the hexane root extract (250  $\mu\text{g}/\text{mL}$ ) showed growth inhibitory effects on 2 cancer cells (HeLa,  $\text{IC}_{50}$  =181.3  $\mu\text{g}/\text{mL}$  and HepG2,  $\text{IC}_{50}$  =128.3  $\mu\text{g}/\text{mL}$ ) and the normal cells (HEKa,  $\text{IC}_{50}$  = 136.6  $\mu\text{g}/\text{mL}$  and PNT2,  $\text{IC}_{50}$  =140.7  $\mu\text{g}/\text{mL}$ ), whereas all the fruit extracts showed toxicity only on normal cells. In the same study, the nine extracts of *Arum cyrenaicum* were examined to antidiabetic activity. The assessments were screened using protein tyrosine phosphatase 1B (PTP1B) enzyme assay. The result was that the root and aerial parts of *A. cyrenaicum* possessed high antidiabetic activity [37].

## Conclusions

Here we review the literature on *Arum cyrenaicum*. Based on the findings, phytochemical studied have revealed the presence of volatile oils, flavonoids, alkaloids, tannins, saponins, sterols and, glycosides in the plant extracts. To date, three flavonoid and three phenolic acids have been isolated from *Arum cyrenaicum*. Furthermore, the studies have shown that various parts of the plant, including flowers, leaves, roots, seeds, tubers, and whole plant parts, have been used in investigations. The pharmacological assessments indicated that *Arum cyrenaicum* have exhibited appreciable antioxidant, antimicrobial, cytotoxic and antidiabetic activities. It is important to note that only very few attempts have been made so far to isolate chemical compounds from *A. cyrenaicum*. Thus, further research is needed, especially on the fruits of *Arum cyrenaicum* and its nitrogen containing compounds. In addition, studies of biological activities need to be expanded and organized.

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DOI:10.36811/ljbs.2021.110076.

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