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WILD *ASPARAGUS* SPECIES OF ISRAEL AND PALESTINE – A MINIREVIEW

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ABSTRACT

Compared with Europe, the communities of Israel and Palestine (the reviewed region, RR) did not consume WILD species of *Asparagus* and hardly grew domesticated species. This fact reflects also on lack of clear reported ethnomedicinal and ethnobotanical uses. Contrary to this, modern research found notable interest in these plants, with clear differences between published literature about each one. In this minireview article, the published ethnomedicine, ethnobotany, along with findings of modern studies about these plants will be presented. Among the medicinal activities-properties, some were largely published (anticancer) while others were hardly reported or not at all. The chemical compositions of these plants were also partially reported, and among the isolated natural products, saponins were some of the earliest.

KEYWORDS: wild *Asparagus*, *Asparagus acutifolius*, *Asparagus aphyllus*, *Asparagus setaceus*, anticancer, antimicrobial, antioxidant, chemical composition, saponins, ethnomedicine.

Abbreviations ABTS 2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid), ahc and her/his colleagues, AChE acetylcholine esterase, βCBM β-Carotene bleaching method, CAT catalase, CUPRAC cupric reducing antioxidant capacity, DCM dichloromethane, DEE diethyl ether, DPPH 2,2-Diphenyl-1-picrylhydrazyl, EO essential oil, EtOAc ethyl acetate, FRAP ferric reducing activity power, GABA γ-amino butyric acid, GCC general chemical composition, GC-MS gas chromatography mass spectrometry, GSH glutathione, LC-MS liquid chromatography mass spectrometry, LPS lipopolysaccharide, MDA malondialdehyde, ORAC oxygen radical absorbance capacity, OSI oxidative stress index, PBD phosphomolybdenum (assay), PE petroleum ether, RR reviewed region, SOD superoxide dismutase, STZ streptozotocin, Syn synonym, TFC total flavonoid content, TPC total phenolic content, TTC total tannins content.

1. INTRODUCTION: Taxonomy and Ethnomedicine

The genus *Asparagus* (هليون in Arabic, אספרגוס in Hebrew) is part of the Asparagaceae family, and the number of species that this genus includes is very highly debated.[1,2,3] It ranges between 200 and 300 species. However, according to the reliable website of "Plants of Israel and Adjacent Areas"[4], in the RR, there are six WILD *Asparagus* species, and these are: *A. acutifolius*, *A. africanus*, *A. aphyllus*, *A. horridus* (Syn. *stipularis*), *A. palaestinus* and *A. setaceus* (Syn. *plumosus*).

Traditional societies around the world have used plants of the genus *Asparagus* for various ethnomedicinal and ethnobotanical goals. In addition, modern societies cultivate *Asparagus officinalis* for food, where in 2025 the data of the production was: it is cultivated in more than 60 countries, on over 1.6 million hectares, producing an annual yield exceeding 8 million metric tons.[5]

But in the present minireview article the focus will be only on ethnomedicinal and ethnobotanical uses of WILD *Asparagus* species of the RR. These uses are summarized in **Table 1**. Strangely enough, no reports of such uses from the RR.

Table 1: Ethnomedicinal/Ethnobotanical Uses of WILD *Asparagus* Species of the RR.

Species	Region	Use(s), Reference
A. acutifolius	Sardinia	Food: cooked vegetables, omelettes[6]
	Spain	Food: cooked in several ways, rarely eaten raw[7]
	Lebanon	Antihypertensive: decoction of stem tops, 1 cup/day[8]
	Morocco	Digestive problems[9]
A. africanus	Saudi Arabia	Leaf paste, topically, leishmaniosis treatment[10]
	Tanzania	Diabetes, decoction, half tea cup, twice a day[11]
A. horridus	Tunisia	Gout, headache[12]
	Morocco	Young stems as food[13]
	Morocco	Food, to treat cold[14]
A. palaestinus	Pakistan	Antidysenteric[15]
	Turkey	Ornamental[16]
A. setaceus	Pakistan	Gastrointestinal disorders, cardiovascular pains[17]
	Pakistan	Roots, decoction, oral, diarrhea, dysentery, stomach[18]
	DR Congo	Root powder, decoction, oral, impotence, headache[19]
	Bangladesh	Ornamental, shoots extracts for heart diseases[20]

2. Selected Publications about WILD *Asparagus* Species of Israel and Palestine

As listed in **Table 1** and published literature, many cultures and nations around the world consumed both cultivated and wild species of *Asparagus*. In some parts of the Middle East (north), this use for nutritional purposes was much wider than in the RR. This also reflected on ethnomedicine and ethnobotany.

Modern research found relatively limited interest in the six WILD species of *Asparagus* of the RR, and the published findings will be listed below. Unless stated otherwise, percentages of solvent mixtures are given as volume/volume (v/v).

Asparagus acutifolius

Fresh young shoots acetone-ethanol (1:1) extract was tested for adaptogenic (milk induced leucocytosis assay in rats), anti-inflammatory (carrageenan-induced rat paw edema) and antioxidant (DPPH, hydroxyl radical scavenging and NO radical scavenging methods) activities. The extract was analyzed for partial GCC and TPC.[21]

Dried shoots aqueous extract was tested for anticancer activity against T24 and A549 cell lines. It was chromatographed resulting the identification of six known phenolics. *Tamus communis* and *Ruscus aculeatus* were also studied in this research.[22]

Aerial parts were separately extracted with DCM and methanol. The extracts were tested for anticancer (against A549 cell line), antimicrobial (against six bacterial and three fungal species) and antioxidant (OSI and total antioxidant status methods) activities. *Asparagus officinalis* was also studied in this research.[23]

Leaves, precaps, rhizomes and stems were separately extracted with 80% aqueous ethanol. The extracts were tested for anticancer (against HCT-116 and HepG2 cell lines), enzyme inhibition (pancreatic lipase), antioxidant (using ABTS, DPPH and FRAP methods) and antimicrobial (against 16 bacterial and 6 fungal species) activities. The extracts were chromatographed yielding known phenolics. Interestingly, Narcissin (**Figure 1**) was found only in the stems extract. In addition, seven saponins were isolated and identified by molecular formulas.[24]

Fruits and leaves were separately extracted with 96% aqueous ethanol and water (4 extracts). The extracts were analyzed for TFC, TPC and TTC, and tested for antioxidant activity using βCBM, PBD, ABTS and DPPH methods. The cytotoxic activity of the extracts was determined using the Brine shrimp lethality bioassay.[25]

Freeze dried spears were defatted with chloroform and extracted with methanol, and the extract was analyzed for partial GCC, TFC, TPC, amino acids, sugars and microelements. The extract was tested for antioxidant (ABTS, DPPH, FRAP, ORAC and NO scavenging methods) and anticancer (against HepG2, A549, HeLa and SK-N-BE cell lines) activities. The extract was chromatographed for phenolics affording 8 known acids (including Chlorogenic acid, **Figure 1**) and three other compounds.[26]

Freeze dried flowering aerial parts were successively extracted with DEE, acetone, ethanol and water. The extract were tested against 11 bacterial and 4 fungal species (with notable mistake in table 2 of this article, that is supposed to present the results). Three other plant species were studied in this research.[27]

Aqueous, ethanolic and methanolic extracts (plant parts/s not indicated) were tested for antibacterial (against 4 bacterial strains), antioxidant (using ABTS and DPPH methods) and AChE inhibition activities.[28]

Roots 70% aqueous methanolic extract was partitioned with several solvents including *n*-butanol, and this

fraction was chromatographed affording seven saponins (**Figure 1**). These compounds were active against three *Candida* species.[29]

Shoots ethanolic extract was analyzed for TPC and tested for antioxidant activity with ABTS, DPPH and ferrous (Fe^{+2}) chelating methods. Seven other plants species were studied in this research.[30]

Spears were analyzed for extended GCC and nutritional values, amino acids, monosaccharides composition, total sugar content, total lipid content, total amino acids content, fatty acids composition, Ascorbic acid content and Folic acid (**Figure 1**) content. The methanolic extract was prepared and analyzed for TPC and tested for antioxidant activity using DPPH, hydrogen peroxide scavenging and nitric oxide scavenging methods. Some results were compared to *Asparagus officinalis*.[31]

Roots 70% aqueous ethanolic extract was active against CaCO2 cancer cells. Three more *Asparagus* species were studied in this research.[32]

Aerial parts and roots were separately extracted with 70% aqueous ethanol, and the extracts had protective activity in Carbon tetrachloride-induced hepatotoxicity in rats. The positive effect was measured with several parameters including antioxidant biomarkers. The extracts were chromatographed yielding known phenolics like Caffeic acid and Rutin. Three more *Asparagus* taxa were studied in this research.[33]

Asparagus africanus

Roots were defatted with PE and extracted with methanol. The extract was tested for analgesic (using tail-flick and hot-plate tests) and anti-inflammatory (egg albumin-induced paw edema) activities in rats. In the analgesic activity tests Morphine was standard drug and in the anti-inflammatory activity tests, Indomethacin.[34]

Roots aqueous extract had anticonvulsant activity against Pilocarpine-induced convulsions (tonic and clonic) in mice. Sodium valproate was reference drug. The positive effect was measured with several biomarkers including GABA levels in the brain, antitumor necrosis factor-alpha (TNF-α) and oxidant-antioxidant (CAT, GSH, MDA and SOD).[35]

Aerial parts aqueous extract had antidiabetic, anti-inflammatory and antihyperlipidemic activities in diabetic rats, where diabetes was induced by high fat diet and STZ. In addition to whole body and isolated organs weight, the positive effect was measured using 13 biomarkers. The extract was analyzed for extended GCC.[36]

Roots aqueous extract had antidiabetic (mainly lowering blood glucose levels) and antioxidant (mainly increasing CAT and SOD levels) in STZ-induced diabetic rats.[37]

Leaves and roots were separately extracted with water and 90% aqueous ethanol. The four extracts were tested for antifertility activity in rats (both sexes). *In vivo* by administration to living animals and *in vitro* by testing on isolated uterine strip.[38]

Roots aqueous extract was analyzed for GCC, and tested for antifertility activity in female rats, with/without roots extract of *Annona senegalensis*. The combination was more effective than the each one of the extracts.[39]

Roots aqueous extract had antifertility activity in female rats. The extract had no effect on body weight and was not toxic. The extract was analyzed by LC-MS yielding eleven known compounds including Acetylcaranine and Prosopinine (**Figure 2**).[40]

Whole plant 80% aqueous methanolic extract had antimalarial activity in *Plasmodium berghei* infected mice.[41]

Roots 80% aqueous methanolic extract was partitioned with several solvents and analyzed affording thirty-three compounds of which ten were new (**Figure 2**). The antioxidant activity of the isolated phenolics was tested using CUPRAC, DPPH and hydroxyl radical scavenging methods.[42]

Aqueous extract (plant part/s not indicated) had positive effect in high fat fed and STZ-induced diabetic rats. The effect was mainly protection of kidneys (measured by urine biomarkers) and alleviation of oxidative stress (eight biomarkers).[43]

Roots were defatted with PE and successively extracted with DCM, EtOAc and methanol. The EtOAc fraction was chromatographed yielding Muzanzagenin and (+)-Nyasol (**Figure 2**). The crude extracts and the two isolated compounds were tested for antiprotozoal activity against *Leishmania major* promastigotes.[44]

Three new steroidal saponins (**Figure 2**) were isolated from roots methanolic extract that was fractionized ad chromatographed.[45]

GCCs of roots aqueous and methanolic extracts are reported.[46]

Rhizomes were defatted with PE and extracted with methanol and the extract was partially analyzed for GCC, It had diuretic activity in mice.[47]

Stems ash was analyzed for elements resulting the presence of Cr, Fe, K, Mg and Zn, while iodine, which is believed to promote hair growth was absent.[48]

Roots aqueous extract was administered to mice resulting decrease of sleep latency period, increase of sleep duration, increase of GABA and decrease of GABA-T in

the animals brain. Authors concluded that this extract has sedative and hypnotic effects.[49]

Roots ethanolic extract was analyzed for TFC, TPC and extended GCC. It was administered to mice with Gentamicin-induced nephrotoxicity, resulting protective effect was measured by levels of Creatinine, Uric acid, and blood urea nitrogen.[50]

Roots aqueous extract had oestrogenic effect in female rats, with Ethinyl-Estradiol as reference drug. GC-MS analysis resulted the identification of nine compounds with Sarsasapogenin (**Figure 2**) as major component, 40.78%.[51]

Asparagus aphyllus

Roots 70% aqueous ethanolic extract was active against CaCO2 cancer cells.[32]

Aerial parts and roots were separately extracted with 70% aqueous ethanol, and the extracts had protective activity in Carbon tetrachloride-induced hepatotoxicity in rats. The positive effect was measured with several parameters including antioxidant biomarkers. The extracts were chromatographed yielding known phenolics like Caffeic acid and Rutin.[33]

Aerial parts (shown in graphical abstract) 50% aqueous ethanolic extract was active against monocultures and co-cultures of Hepg2 and THP-1-derived macrophages. *Crataegus aronia* and *Ephedra alata* were also studied in this research.[52]

Follow up of the previous research that tested the effect of the extracts on Glucose-tranferase-4 membrane translocation on L6 muscle cells and blood glucose levels in mice.[53]

Aerial parts were separately extracted with PE, chloroform and 70% aqueous ethanol. These extracts were tested against MCF7 and HCT cancer cell lines. The aqueous ethanolic extract was analyzed for TFC, TPC, and single phenolics resulting the identification of 27 compounds. Among these were 15 phenolic acids, where Vanillic acid (**Figure 3**) was major with a concentration of 1037 ppm.[54]

Another publication by the group cited as references 52 and 53. The tested anticancer activity as in reference 52, anti-inflammatory activity in LPS-treated THP1 and HepG2 cells (effect was measured using three biomarkers) and antioxidant activity (using ABTS, DPPH, FRAP and PBD methods). The extracts were analyzed for TFC and TPC.[55]

Leaves were successively extracted with methanol, ethanol, chloroform, EtOAc and water. The extracts were tested against five bacterial strains showing notable activities.[56]

Asparagus horridus (Syn. ***stipularis***)

Methanolic extract (plant part/s not indicated) was tested for anticancer (against HepG2 cancer cells) and anti-inflammatory (protein denaturation assay) activities. It was analyzed for TFC and TPC and tested for antioxidant activity using DPPH and FRAP methods.[57]

Aerial parts 70% aqueous ethanolic extract was tested for anticancer (against HepG2 and HCT116 cancer cell lines) and antidiabetic (inhibition of α-Amylase and α-Glucosidase) activities. The extract was chromatographed resulting known phenolics including Caffeic and Ferulic acids, Tiliroside, Nicotiflorin, Quercetin and Brassicin. Molecular docking for hypoglycemic activity was conducted for the last four compounds. The structures of Tiliroside, Nicotiflorin and Brassicin are shown in **Figure 4.**[58]

Young shoots were analyzed for nutritional values: total carbohydrates composition (8), total fibres, energy and mineral. In addition, it was analyzed for fatty acids composition (17), aliphatic acids (3), volatile compounds (30) and tocopherols (2). Dried young shoots were separately extracted with water and 80% aqueous methanol. The hydro-methanolic extract was chromatographed for phenolics (13, known), tested for anticancer activity (against MCF-7, NCI-H460 and HepG2 cell lines) and antioxidant activity (using ABTS, DPPH, FRAP and TBRAS methods).[59]

Roots methanolic extract was partitioned with several solvents including EtOAc, and this fraction was chromatographed affording two new alkaloids: Aspastipuline and 5-Hydroxyaspastipuline (**Figure 4**). Aspastipuline had moderate activity against MCF-7 cancer cells.[60]

Roots and rhizomes were separately extracted with high pressure super critical CO_2 ad the extracts were analyzed for TPC. They were tested for antioxidant activity using ABTS, DPPH, FRAP and quenching assay.[61]

Follow up of previous research but in this case roots and rhizomes were studied. The extracts were encapsulated and resulting material was tested for availability of its components for biological activity.[62]

Leaves, pericarps, rhizomes and roots were separately extracted with 80% aqueous ethanol. The extracts were analyzed for TFC, TPC and total saponin content. The extracts were tested for antioxidant (using ABTS, DPPH and FRAP methods), anticancer (against (HCT-116 and HepG2 cell lines) and pancreatic lipase inhibition activities. The extracts were chromatographed affording 9 known phenolics and 6 known saponins including Diosgenin (**Figure 4**).[63]

Roots 70% aqueous ethanolic extract was fractionized with several solvents including *n*-butanol and this fraction was chromatographed affording Asparagalin A

(**Figure 4**). This compound had anti-schistosomiasis activity (*Schistosoma mansoni*).[64]

Follow up of the research cited as reference 62: in this research, shoots decoction was used to treat metabolic syndrome in high-fructose diet-fed rats. The decoction was used to prepare nanoparticles, and these were also used for the same treatment. Effect was measured mainly by levels of oxidant-antioxidant biomarkers.[65]

Asparagus palaestinus
Aerial parts were analyzed for GCC, fatty acids composition (3), total carbohydrates and composition.[66]

Asparagus setaceus (Syn. ***plumosus***)
Leaves ethanolic extract had allelopathic activity against *Lactuca sativa* (Lettuce) seeds. The extract was analyzed for extended GCC (15 compound families).[67]

Whole plant EO (hydrodistillation) and the remaining aqueous phase were tested for antibacterial (against four bacterial strains) and antioxidant (using DPPH method) activities. Another 21 plant species were studied in this research.[68]

Leaves methanolic extract was analyzed for TFC, TPC and was tested for antioxidant activity using DPPH method, and for antimicrobial activity against *Escherichia coli*. It was analyzed for chemical composition (GC-MS) yielding 19 compounds after silylation.[69]

Follow up study by the group that published reference 67: in this study they tested antibacterial (against eight bacterial species) and toxicity (against *Artemia salina*). Extensive GCC is reported.[70]

Leaves 90% aqueous methanolic extract was chromatographed affording three new saponins (**Figure 5**).[71]

Another publication by the same group cited by reference 71, using the same methods, afforded two new saponins (**Figure 5**).[72]

Roots 95% aqueous ethanolic extract was chromatographed affording two saponin derivatives of 2-Yamogenin and 2-Furostanol (1 and 2 in **Figure 5**). These compounds caused immobilization of human spermatozoa.[73]

Roots methanolic extract was chromatographed yielding Shatavarin IV (**Figure 5**). Another four *Asparagus* species were studied in this research.[74]

Cladodes were separately extracted with chloroform, EtOAc and methanol, and the extracts were chromatographed for chemical compositions. A very detailed report is presented but no new compounds. Another two *Asparagus* species were studied in this research.[75]

Juices were prepared from fresh fruits, leaves, stems and roots, and these plant parts were dried and extracted with ethanol (total of 8 materials). These materials had larvicidal properties against Aedes aegypti. GCCs is provided.[76]

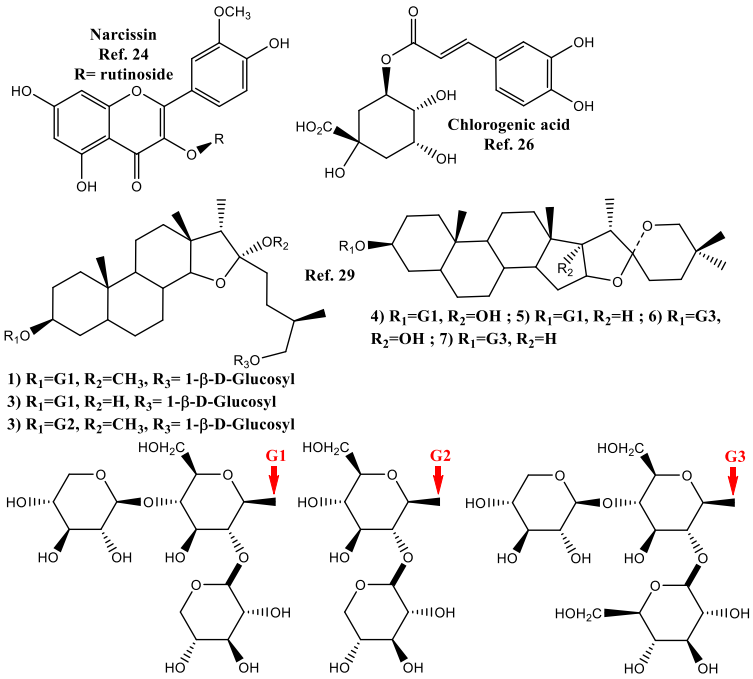


Figure 1: Natural products isolated from *Asparagus acutifolius.*

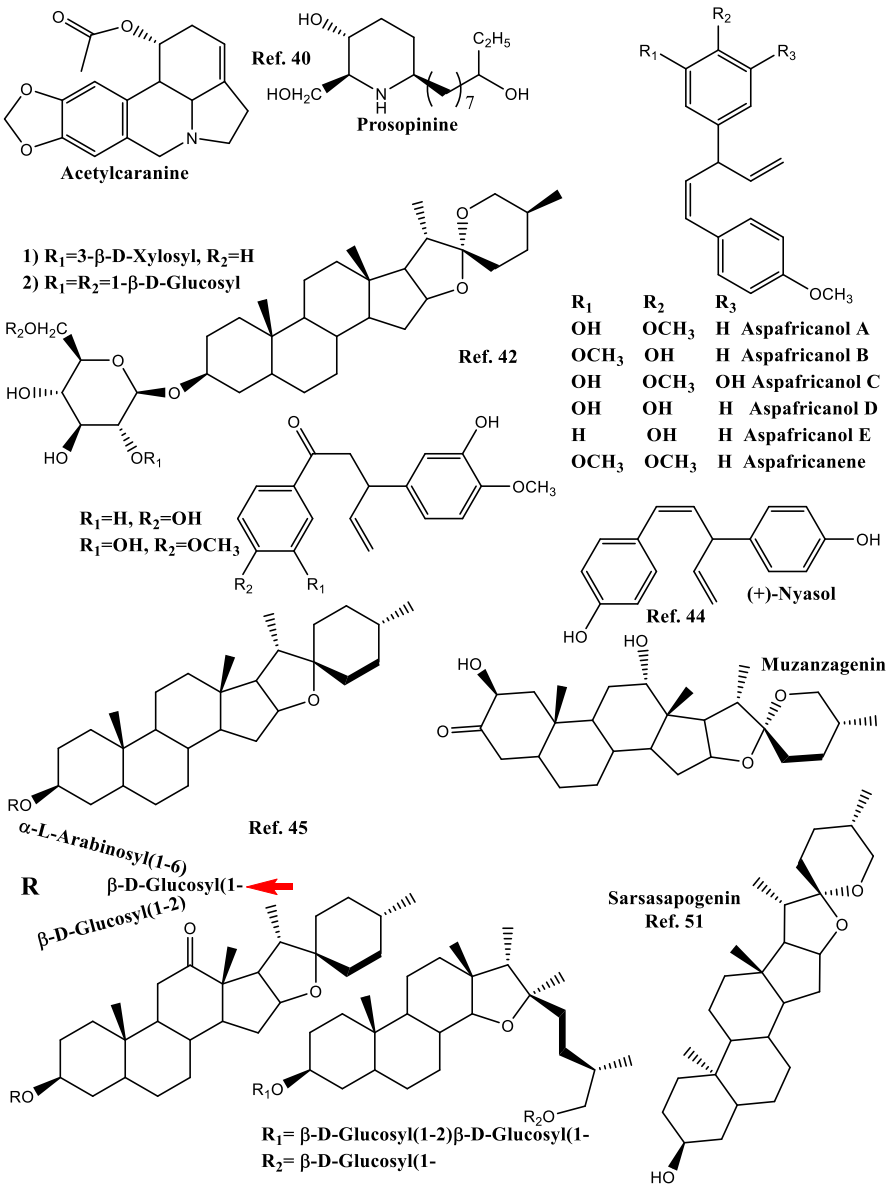
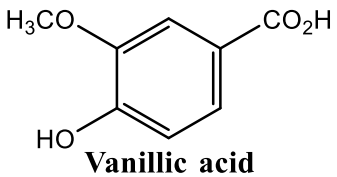


Figure 2: Natural products isolated from *Asparagus africanus.*



Ref. 54

Figure 3: Natural products isolated from *Asparagus aphyllus.*

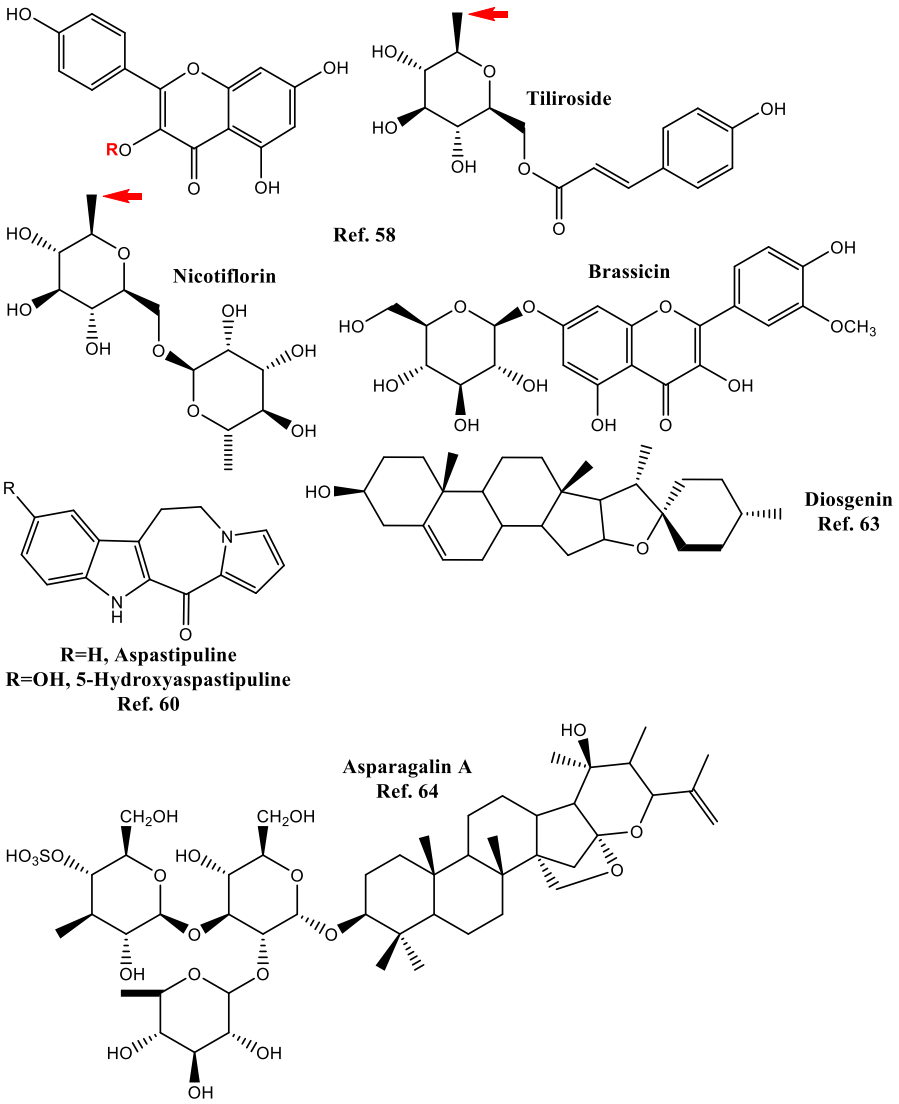


Figure 4: Natural products isolated from *Asparagus horridus.*

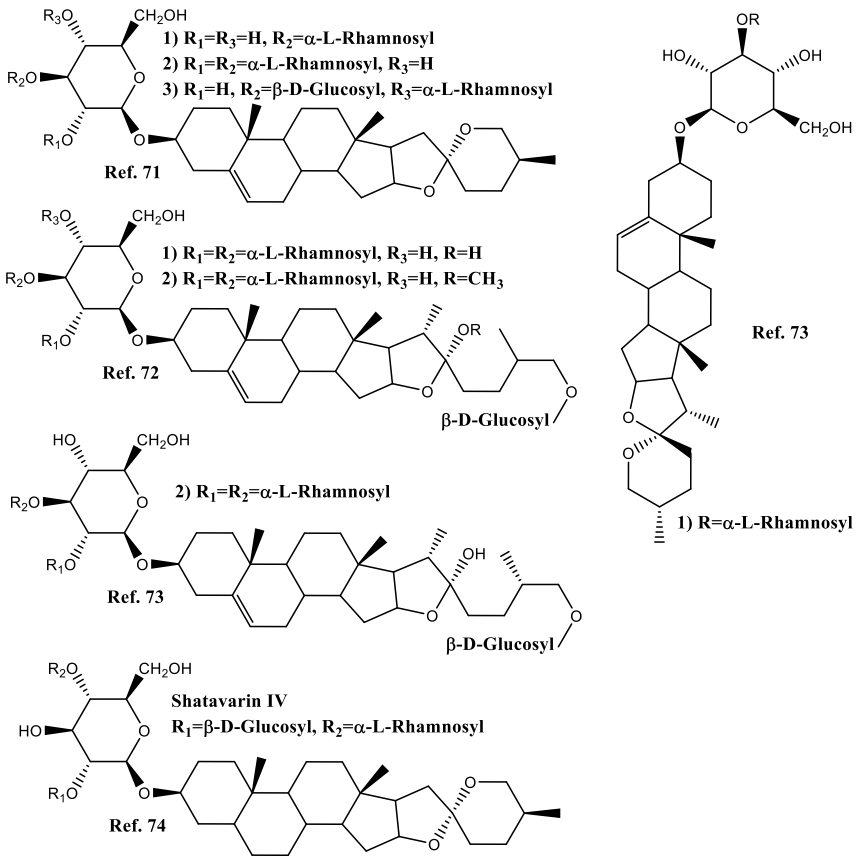


Figure 5: Natural products isolated from *Asparagus setaceus.*

3. DISCUSSION

Among the six WILD *Asparagus* species, the cultivation of *Asparagus acutifolius* drew most attention. O. Alan ahc reported the seasonal variations of quality parameters, phenolic content and antioxidant activity of cultivated and wild plants of this species.[77] In short, they found clear seasonal changes in antioxidants pigments such as phenolics and chlorophylls but not in carbohydrates and compositions. D Mantovani ahc studied the effects of drought and temperature on photosynthesis of this species.[78] They report that optimal growth temperature was about 30°C, while the is a significant decrease over 45°C. As for water shortage, this species demonstrated high tolerance to drought. A. Martínez-Coronado ahc reported that *A. acutifolius* growth was unaffected by high to extremely high concentrations of mercury pollution, even though the metal accumulated in the plant roots.[79]

The enzyme family of Peroxidases is part of a larger family named Oxidoreductases. The major activity of Peroxidases is to catalyse oxidation processes. In recent years, there is growing interest in Peroxidases and the number of their applications and uses is constantly increasing: see the review article of I. Nnamchi ahc.[80] V. Guida ahc isolated a group of Peroxidases from *A. acutifolius* and used them to oxidize phenolic compounds in olive oil production wastewater, a very high environmental and economic application.[81] In a follow up research, the immobilized the enzymes and used them more efficiently for the same purpose.[82]

The concern of possible adverse effects of plants, especially edible and medicinal plants is always present. For this reason, Abubakar El-Ishaq conducted a toxicological study of *Asparagus africanus* in rats.[83] Relying testing several effects of the methanolic extract, this widely used as medicinal plant is safe. Riaz ahc published a computational study of S. Riaz ahc about possible use of this plant species to treat polycystic ovarian syndrome (PCOS).[84] And even though a follow up *in vitro* or *in vivo* studies were not published yet, this work has special significance since PCOS is “one of the most prevalent endocrine system conditions affecting women of reproductive age”.[85]

The search of improved conditions for cultivation of *Asparagus* species is continuous due to the high nutritional value and fine taste of these plants. S.S. Mustafa reported a study where she managed to increase the growth and production of beneficial secondary metabolites of *Asparagus aphyllus.*[86] K. Ulukapi ahc analyzed nutrients content in cultivated and naturally growing (Turkey) in *A. horridus.*[87]

Finally, natural and synthetic saponins have special importance as drugs and drugs carriers.[88,89] C. Paczkowski ahc managed to glycolyze some steroidal

compounds using Glucosyltransferases that they isolated from *Asparagus setaceus* (Syn. *plumosus*).[90]

4. CONCLUSIONS

1) *Asparagus* species of Israel and Palestine have special nutritional value.
2) These species contain important medicinally active natural products, especially saponins.
3) Some of these species were significantly studied and published while others were not.
4) Based on item 3, there is a notable need for extensive additional investigations.
5) The chemical compositions on these plants are partially known and must be completed.

5. REFERENCES

1. Urbani M, Becca G, Ledda MG. Notes on systematics and chorology of *Asparagus* L. (Asparagaceae) in Sardinia (Italy). *Bocconea*, **2007;** *21*: 267-271. [Google scholar]
2. Jaramillo-Carmona S, Rodriguez-Arcos R, Jiménez-Araujo A, López S, Gil J, Moreno R, Guillén-Bejarano R. Saponin Profile of Wild *Asparagus* Species. *J Food Sci*., **2017;** *82:* 638-646. DOI: 10.1111/1750-3841.13628
3. Sheng WT, Zhang TL, Kuang Q, Wang ZF, Luo SC. Research on the progress of systematic taxonomy in the genus *Asparagus* of China, *Mol Plant Breed*, **2021;** *12:* 1-9. DOI: 10.5376/mpb.2021.12.0026
4. Plants of Israel and Adjacent Areas, *Asparagus*
5. Lopez FJ, Navarro E, Atero S, Lastra E, Ruiz JM, Soriano T. Evaluation of the Effects of Asparagus Decline Syndrome on Yield and Quality Parameters over Three Years in Western Europe. *Horticulturae*, **2025;** *11:* 159. DOI: 10.3390/horticulturae11020159
6. Signorini MA, Piredda M, Bruschi, P. Plants and traditional knowledge: An ethnobotanical investigation on Monte Ortobene (Nuoro, Sardinia). *J Ethnobiol Ethnomed*, **2009;** *5:* 6. DOI: 10.1186/1746-4269-5-6
7. Molina M, Santayana M, García E, Mata L, Morales R, Tardío J. Exploring the potential of wild food resources in the Mediterranean region: natural yield and gathering pressure of the wild asparagus (*Asparagus acutifolius* L.). *Span J Agric Res*., **2012;** *10:* 1090-1100. DOI: 10.5424/sjar/2012104-3050
8. Samaha AA, Fawaz M, Salami A, Baydoun S, Eid AH. Antihypertensive Indigenous Lebanese Plants: Ethnopharmacology and a Clinical Trial. *Biomolecules*, **2019;** *9:* 292. DOI: 10.3390/biom9070292
9. Merrouni I, Kharchoufa L, Bencheikh N, Elachouri M. Ethnobotanical profile of medicinal plants used by people of North-eastern Morocco: Cross-cultural and Historical approach (Part I). *Ethnob Res Appl*., **2021;** *21:* 1-45. DOI: 10.32859/era.21.34.1-45
10. Almoshari Y. Medicinal plants used for dermatological disorders among the people of the kingdom of Saudi Arabia: A narrative review. *Saudi J Biol Sci*., **2022;** *29:* 103303. DOI: 10.1016/j.sjbs.2022.103303
11. Roman WP, Martin HD, Ismail H, Islam MS. Medicinal plants used in the Maasai traditional healthcare system for diabetes and associated conditions in Monduli District, Arusha, Tanzania. *Sci Afr*., **2026;** *31:* e03165. DOI: 10.1016/j.sciaf.2025.e03165
12. Barhoumi T, Barhoumi T, Abderraba M. Ethnobotanical study of medicinal plant in Djerba Island, Tunisia. *Arab J Med Aromat Plants*, **2019;** *5:* 67-97. [ResearchGate]
13. Ghanimi R, Ouhammou A, Ahouach A, Cherkaoui M. Ethnobotanical study on wild edible plants traditionally used by Messiwa people, Morocco. *J Ethnobiol Ethnomed*, **2022;** *18:* 16. DOI: 10.1186/s13002-022-00500-4
14. Ghanimi R, Ouhammou A, Babahmad RA, Cherkaoui M. A Quantitative Study on the Ethnobotanical Knowledge about Wild Edible Plants among the Population of Messiwa. *Ethiop J Health Sci.*, **2022;** *32:* 1237. DOI: 10.4314/ejhs.v32i6.22
15. Sarangzai AM, Ahmed A, Laghari SK. Traditional uses of some useful medicinal plants of Ziarat District Balochistan, Pakistan. *FUUAST J Biol*., **2013;** *3:* 101-107. [ResearchGate]
16. Çakır EA. Geophytes of Iğdır (East Anatolia) and their economic potentialities as ornamental plant. *Eurasian J For Sci*., **2017;** *5:* 48-56. DOI: 10.31195/ejejfs.327365
17. Murad W, Ahmad A, Gilani SA, Khan MA. Indigenous knowledge and folk use of medicinal plants by the tribal communities of Hazar Nao Forest, Malakand District, North Pakistan. *J Med Plants Res*., **2011;** *5:* 1072-1086. [ResearchGate]
18. Murad W, Ashfaq A, Ishaq G, Khan MS, Khan AM, Ullah I, Khan I. Ethnobotanical studies on plant resources of Hazar Nao forest, district Malakand, Pakistan. *Pak J Weed Sci Res*., **2012;** *18;* 509-527. [ResearchGate]
19. Bashige CV, Alombong AG, Kamwimba MA, Bakari AS, Okusa NP. Ethnobotanical study of medicinal plants used in the treatment of sexual dysfunctions in traditional medicine in Kampemba-Lubumbashi, DR Congo. World J Adv Res Rev., **2020;** *7:* 16-32. DOI: 10.30574/wjarr.2020.7.3.0328
20. Jone JH, Ashrafuzzaman M, Pramanik MH. Pteridophytes (Ferns and Fern Allies) diversity in Bangladesh Agricultural University Botanical Garden. *J Bangladesh Agric Univ*., **2022;** *20:* 122-132. DOI: 10.5455/JBAU.105308
21. Kasture S, Kasture A, Ballero M, Maxia A. Antioxidant, anti-inflammatory, and adaptogenic activity of *Asparagus acutifolius* extract. *Orient Pharm Exp Med*., **2009;** *9:* 83-89. DOI: 10.3742/OPEM.2009.9.1.083
22. Bilušić T, Šola I, Rusak G, Poljuha D, Čikeš Čulić V. Antiproliferative and pro-apoptotic activities of wild asparagus (*Asparagus acutifolius* L.), black bryony (*Tamus communis* L.) and butcher's broom (*Ruscus*

aculeatus L.) aqueous extracts against T24 and A549 cancer cell lines. *J Food Biochem*., **2019;** e12781. DOI: 10.1111/jfbc.12781
23. Mohammed FS, Pehlivan M, Sevindik E, Akgul H, Sevindik M, Bozgeyik I, Yumrutas O. Pharmacological properties of edible *Asparagus acutifolius* and *Asparagus officinalis* collected from North Iraq and Turkey (Hatay). *Acta Aliment*., **2021;** *50:* 136-143. DOI: 10.1556/066.2020.00204
24. Hamdi A, Carmona S, Arcos R, Araujo A, Lachaal M, Bouraoui N, Bejarano R. Phytochemical Characterization and Bioactivity of *Asparagus acutifolius*: A Focus on Antioxidant, Cytotoxic, Lipase Inhibitory and Antimicrobial Activities. *Molecules*, **2021;** *26:* 3328. DOI: 10.3390/molecules26113328
25. Kaska A, Nahide Deniz N, Mammadov R. Biological Activities of Wild Asparagus (*Asparagus acutifolius* L.). *Int J Second Metab*., **2018;** *5:* 243-251. DOI: 10.21448/ijsm.458827
26. Di Maro A, Pacifico S, Fiorentino A, Galasso S, Gallicchio M, Guida V, Severino V, Monaco P, Parente A. Raviscanina wild asparagus (*Asparagus acutifolius* L.): A nutritionally valuable crop with antioxidant and antiproliferative properties. *Food Res Int*., **2013;** *53:* 180-188. DOI: 10.1016/j.foodres.2013.04.026
27. Çoban EP, Biyik H, Uzun C. Investigation of antimicrobial activity of some natural plants which are not-cultivated and are sold at bazaars in Aydın vicinity. *Int J Eng Sci*., **2009;** *3:* 59-62. [Journal website]
28. Basdag S, Dogan S, Diken ME. Some Biological Activities of *Asparagus acutifolius* L. *J Int Sci Publ*., **2022;** *10:* 326-331. [ResearchGate]
29. Sautour M, Miyamoto T, Lacaille-Dubois MA. Steroidal saponins from *Asparagus acutifolius*. *Phytochemistry*, **2007;** *68:* 2554-2562. DI: 10.1016/j.phytochem.2007.02.033
30. Taskin T, Bitis L. *In vitro* antioxidant activity of eight wild edible plants in Bursa province of Turkey. *Farmacia*, **2016;** *64:* 706-711. [Journal website]
31. Ferrara L, Dosi R, Di Maro A, Guida V, Cefarelli G, Pacifico S, Mastellone C, Fiorentino A, Rosati A, Parente A. Nutritional values, metabolic profile and radical scavenging capacities of wild asparagus (*A. acutifolius* L.). *J Food Comp Anal*., **2011;** *4:* 326-333. DOI: 10.1016/j.jfca.2010.10.008
32. Saltan Iscan G, Karacaoglu M, Ileri Ozler HK, Cansaran Duman D. *In vitro* Anti-proliferative Effect of Some *Asparagus* Taxa on Colon Cancer Cell Lines. *Macedonian Pharm Bull*., **2022;** *68:* 175-176. DOI: 10.33320/maced.pharm.bull.2022.68.04.080
33. Karaaslan M, Gürgen DG, Çakici Ç, Ergene B, Sönmez NI, Keskin I, Sarıaltın SY, Özbek H, İşcan HG. Comparative hepatoprotective and molecular insights into phenolic compounds from *Asparagus* taxa. *S Afr J Bot*., **2026;** *193:* 88-98. DOI: 10.1016/j.sajb.2026.04.006
34. Hassan H, Ahmadu AA, Hassan AS. Analgesic and anti-inflammatory activities of *Asparagus africanus* root extract. *Afr J Tradit Complement Altern Med*., **2008;** *5:* 27-31. DOI: 10.4314/ajtcam.v5i1.31252
35. Tchinmi E, Ngah E, Kameni JN, Nkamguie CN, Jeweldai VE, Bum EN. Anticonvulsant effect of *Asparagus africanus* Lam. root decoction on pilocarpine-induced temporal lobe epilepsy in white mice (*Mus musculus* Swiss). *World J Adv Res Rev*., **2020;** *8:* 296-306. DOI: 10.30574/wjarr.2020.8.2.0431
36. Evans Ngwenah F, Mahamat O, Christopher T. Hypoglycaemic, anti-hyperlipidemic, and anti-inflammatory activities of *Asparagus africanus* (Asparaceae) extract on high-fat diet/streptozotocin-induced diabetes in Wistar rats. *Asian Pac J Trop Biomed*, **2024;** *14:* 532-539. DOI: 10.4103/apjtb.apjtb_472_24
37. Sunday RM, Ibeh BO. Effect of Asparagus Africanus on Glucose Level and Enzymatic Antioxidants: Antidiabetic Study. *Eur J Med Plants*., **2022;** *33:* 17-24. DOI: 10.9734/ejmp/2022/v33i430459
38. Tafesse G, Mekonnen Y, Makonnen E. Antifertility effect of aqueous and ethanol extracts of the leaves and roots of *Asparagus africanus* in rats. *Afr Health Sci*., **2006;** *6:* 81-65. DOI: 10.5555/afhs.2006.6.2.81
39. Okello OO, Nkwangu D, Oloro J. Anti-fertility activity of aqueous root bark extracts of *Asparagus africanus* Lam and *Annona senegalensis* Pers combination on female Sprague Dawley rats. *Afr J Pharm Pharmacol*, **2019;** *13:* 12-16. DOI: 10.5897/AJPP2014.4229
40. El-Ishaq A, Alshawsh MA, Mun KS, Chik Z. Phytochemical screening and anti-implantation activity of *Asparagus africanus* root extract in female Sprague–Dawley rats. *Rev. Bras. Farmacog*, **2019;** *29:* 621-630. DOI: 10.1016/j.bjp.2019.06.003
41. Dikasso D, Makonnen E, Debella A, Abebe D, Urga K, Makonnen W, Melaku D, Assefa A, Makonnen Y. *In vivo* anti-malarial activity of hydroalcoholic extracts from *Asparagus africanus* Lam. in mice infected with *Plasmodium berghei*. *Ethiop J Health Devel*., **2006;** *20:* 112-118. [Journal website]
42. Akissi ZL, Yao-Kouassi AP, Magid AA, Koffi JK, Voutquenne-Nazabadioko L. Chemical constituents and antioxidant capacities of *Asparagus africanus* Lam. *Phytochem Lett*., **2023;** *53:* 22-30. DOI: 10.1016/j.phytol.2022.11.004
43. Ngwenah FE, Mahamat O, Mugob BB, Chrsitopher T. Effect of *Asparagus africanus* (Asparaceae) Aqueous Extract on Renal Complications in High Fat Diet and Streptozotocin-Induced Type 2 Diabetes in Male albino Wistar Rats. *Int J Diabetes Clin Res*., **2024;** *11:* 181. DOI: 10.23937/2377-3634/1410181
44. Oketch-Rabah HA, Dossaji SF, Christensen SB, Frydenvang K, Lemmich E, Cornett C, Olsen CE, Chen M, Kharazmi A, Theander T. Antiprotozoal

compounds from *Asparagus africanus*. *J Nat Prod*., **1997;** *60:* 1017-1022. DOI: 10.1021/np970217f
45. Debella A, Haslinger E, Kunert O, Michl G, Abebe D. Steroidal saponins from *Asparagus africanus*. *Phytochemistry*, **1999;** *51:* 1069-1075. doi: 10.1016/s0031-9422(99)00051-5
46. Okolie OD, Manduna I, Mashele SS. Phytochemical analysis of *Asparagus africanus* root extracts. *J Pharm Pharmacol*, **2019;** *7:* 351-354. DOI: 10.17265/2328-2150/2019.07.001
47. Hassan HS, Haruna AK, Ilyas M, Sule MI, Pateh UU, Ahmadu AA, Abubakar MS, Kunle OF. Diuretic activity of the methanolic extract of rhizomes of *Asparagus africanus* in rats. *J Phytomed Therap*, **2004;** *9:* 25-28. DOI: 10.4314/JOPAT.V9I1.48584
48. Lohdip AM, Tyonande TT. Analysis of *Asparagus africanus* (LAM) for some hair growth–stimulating elements. *ChemClass J*., **2005;** *2:* 93-94. [Journal website]
49. Tchinmi E, Ngah E, Ngo Bum E. Sedative and hypnotic effects of the roots of *Asparagus africanus* (Asparagaceae) decoction on white mice (*Mus musculus* Swiss). *GSC Biol Pharm Sci*., **2020;** *11:* 254-260. DOI: 10.30574/gscbps.2020.11.3.0189
50. Meka Kedir W, Dukassa Dubiwak A, Tofik Ahmed E. Nephroprotective Effect of *Asparagus africanus* Lam. Root Extract against Gentamicin-Induced Nephrotoxicity in Swiss Albino Mice. *J Toxicol*, **2022;** 8440019. DOI: 10.1155/2022/8440019
51. El-Ishaq A, Alshawsh MA, Chik ZB. Evaluating the oestrogenic activities of aqueous root extract of *Asparagus africanus* Lam in female Sprague-Dawley rats and its phytochemical screening using Gas Chromatography-Mass Spectrometry (GC/MS). *PeerJ*., **2019;** *7:* e7254. DOI: 10.7717/peerj.7254
52. Kmail A, Lyoussi B, Zaid H, Bashar Saad B. *In vitro* Assessments of Cytotoxic and Cytostatic Effects of *Asparagus aphyllus*, *Crataegus aronia*, and *Ephedra alata* in Monocultures and Co-Cultures of Hepg2 and THP-1-Derived Macrophages. *Pharmacog Commun*., **2015;** *5:* 165-172. DOI: 10.5530/pc.2015.3.2
53. Kmail A, Saad B, Lyoussi B, Said O, Abu Darwish MS, Kadan S, Sammar S, Qalalweh H, ALbzoor R, AlArda M, Zaid H. *In vitro* evaluations of cytotoxicity of *Abelmoschus esculentus* L., *Asparagus aphyllus* L. and *Crataegus azarolus* L. extracts and their effects on GLUT4 membrane translocation on L6 muscle cells and blood glucose levels in mice. *Adv Med Plant Res*., **2019;** *7:* 23-30. DOI: 10.30918/AMPR.71.19.015
54. Abd El-Halim MD, Emam SS, Assy MG, Atta EM, El-Sayed AA. Isolating flavonoid derivatives from *Asparagus aphyllus* L. extract and their Cytotoxic against tumor cells. *Afinidad. J Chem Eng Theor Appl Chem*., **2025;** *82:* 577-582. DOI: 10.55815/9900668
55. Kmail A, Lyoussi B, Imtara H, Zaid H, Saad B. *In vitro* evaluation of anti-inflammatory and antioxidant effects of *Asparagus aphyllus* L., *Crataegus azarolus* L., and *Ephedra alata* Decne. in monocultures and co-cultures of HepG2 and THP-1-derived macrophages. *Pharmacog Commun*, **2017;** *7:* 24-33. DOI: 10.5530/pc.2017.1.4
56. Sharma P, Goel D. Antimicrobial and Minimum Inhibitory Concentration activity of leaf extract of *Asparagus aphyllus*. *Int J Life Sci Res*., **2018;** *6:* 144-148. [Journal website]
57. Altundag EM, Gençalp D, Özbilenler C, Toprak K, Kerküklü N. In vitro antioxidant, anti-inflammatory and anti-cancer activities of methanolic extract of *Asparagus horridus* grows in North Cyprus. *Turk J Biochem*., **2020;** *45:* 365-372. DOI: 10.1515/tjb-2019-0325
58. Elshabrawy MO, Farid MM, Ragab NA, El Sawi SA, Kawashty SA, Marzouk MM. Phytochemical Profiling, Cytotoxic Effect, and *In Vitro* Anti-diabetic Assessment of *Asparagus horridus* L. with *In Silico* Insights of Brassicin. *Egypt J Chem*., **2025;** *68:* 583-600. DOI: 10.21608/ejchem.2025.368979.11470
59. Adouni K, Chahdoura H, Mosbah H, Santos-Buelga C, González-Paramás AM, Ciudad-Mulero M, Fernandes Â, Calhelha RC, Morales P, Flamini G, Ferreira IC, Achour L. Revalorization of wild *Asparagus stipularis* Forssk. as a traditional vegetable with nutritional and functional properties. *Food Funct*., **2018;** *9:* 1578-1586. DOI: 10.1039/c7fo01687e
60. Galala AA, Ahmad KF, Zaghloul MG, Mansour E. Two new alkaloids from *Asparagus stipularis* Forssk. roots. *Phytochem Lett*., **2015;** *12:* 220-223. DOI: 10.1016/j.phytol.2015.04.004
61. Adouni K, Bendif H, Zouaoui O, Kraujalis P, Flamini G, Venskutonis PR, Achour L. Antioxidant activity of extracts obtained by high-pressure extraction procedures from *Asparagus stipularis* Forssk. *S Afr J Bot*., **2022;** *146:* 789-793. DOI: 10.1016/j.sajb.2021.12.027
62. Adouni K, Júlio A, Santos-Buelga C, González-Paramás AM, Filipe P, Rijo P, Lima SA, Reis S, Fernandes Â, Ferreira IC, Fernández-Ruiz V, Morales P, Flamini G, Achour L, Pedro Fonte P. Roots and rhizomes of wild Asparagus: Nutritional composition, bioactivity and nanoencapsulation of the most potent extract. *Food Biosci*., **2022;** *45:* 101334. DOI: 10.1016/j.fbio.2021.101334
63. Hamdi A, Jaramillo-Carmona S, Rodríguez-Arcos R, Jiménez-Araujo A, Karray Bouraoui N, Guillén-Bejarano R. Phytochemical Profile and In Vitro Bioactivities of Wild *Asparagus stipularis*. *Molecules*, **2024;** *29:* 817. DOI: 10.3390/molecules29040817
64. El-Seedi HR, El-Shabasy R, Sakr H, Zayed M, El-Said AM, Helmy KM, Gaara AH, Turki Z, Azeem M, Ahmed AM, Boulos L, Borg-Karlson AK, Göransson U. Anti-schistosomiasis triterpene glycoside from the Egyptian medicinal plant *Asparagus stipularis*. *Rev Bras Farmacog*, **2012;**

22: 314-318. DOI: 10.1590/S0102-695X2012005000004
65. Adouni K, Zouaoui O, Brandão P, Rijo P, Costa Lima SA, Reis S, Achour L, Fonte P. Preclinical evaluation of *Asparagus stipularis* in a rat model of metabolic syndrome and development of its nanoencapsulated form. *Drug Devel Ind Pharm*., **2026;** *52:* 1377-1390. DOI: 10.1080/03639045.2026.2674218
66. Aberoumand A, Ziaei-Nejad S. Nutritive values of some food plants, fresh and processed fish species. *Int J Agric Res Innov Technol*, **2015;** *5:* 75-81. DOI: 10.3329/ijarit.v5i2.26278
67. Castro JW, Costa NC, Bezerra JW, Antunes DF, Souza DL. Felício EF, Oliveira BA, Ulisses VR, Santos MA, Filho AM, Costa A, Rodrigues FF. Chemical Profile and Allelopathic Potential of *Asparagus setaceus* (Kunth) Jessop (Asparagaceae). *Rev Gest Soc Ambient*, **2024;** *18:* e09802. DOI: 10.24857/rgsa.v18n11-133
68. Sahin S, Kilic O. Antioxidant and antibacterial activities of essential oils and aromatic waters of some plants grown in the highlands. *J Agric Environ Food Sci*., **2021;** *5:* 133-139. DOI: 10.31015/jaefs.2021.2.1
69. Thomas J, Sasi A, Lhamo P, Evangeline S, Vinuba N, Swetha S. Natural bioactive compounds of Asparagus: A study of antioxidant and antibacterial activity. *BIO Web Confer*., **2025;** *172:* 04005. DOI: 10.1051/bioconf/202517204005
70. Castro JW, Macedo CL, Bezerra JW, Costa A, Lima L, Feitosa LF, Oliveira EC, Nascimento G, Silva N, Sousa F, Oliveira EN, Rodrigues FF. Chemical Profile, Antibacterial and Toxicological Study of *Asparagus setaceus* (KUNTH). *Rev Gest Soc Ambient*., **2024;** *18:* e08256. DOI: 10.24857/rgsa.v18n10-258
71. Sati OP, Pant G. Spirostanol glycosides from *Asparagus plumosus*. *Phytochemistry*, **1985;** *24:* 123-126. DOI: 10.1016/S0031-9422(00)80820-1
72. Sati OP, Pant G. New furostanol glycosides from *Asparagus plumosus* Leaves. *J Nat Prod*., **1985;** *48:* 390-394. DOI: 10.1021/np50039a006
73. Pant G, Panwar MS, Negi DS, Zagorski M. Steroidal glycosides from *Asparagus plumosus* Baker roots. *Herba Polon*., **1988;** *34:* 175-181. [Google scholar]
74. Champati BB, Padhiari BM, Ray A, Sahoo A, Jena S, Sahoo T, Panda PC, Nayak S. Identification and quantification of Shatavarin IV in five different species of the genus *Asparagus* through a validated HPTLC method. *Res J Pharm Technol*, **2023;** *16:* 2615-2621. DOI: 10.52711/0974-360X.2023.00429
75. Maphari PW, Simelane MBC, Madala NE, Mhlongo MI. Comparative metabolites profiling of different solvent extracts of *Asparagus* species cladodes using liquid chromatography-mass spectrometry-based metabolomics and molecular networking. *Phytochem Anal*., **2025;** *36:* 506-519. DOI: 10.1002/pca.3446
76. Chakraborty S, Singh A, Chandra G. Larvicidal activity of different plant parts of *Asparagus setaceus* against dengue vector *Aedes aegypti*. *Int J Mosq Res*., **2021;** *8:* 1-6. DOI: 10.22271/23487941.2021.v8.i5a.554
77. Alan O, Turk B, Sen F. A comparative study on the quality attributes, phenolic content and antioxidant activity of cultivated and wild asparagus as influenced by seasonal variations. *J Agric Sci*., **2022;** *160:* 483-492. DOI: 10.1017/S0021859622000569
78. Mantovani D, Rosati A, Perrone D. Photosynthetic Characterization and Response to Drought and Temperature in Wild Asparagus (*Asparagus acutifolius* L.). *HortScience*, **2019;** *54:* 1039-1043. DOI: 10.21273/HORTSCI13954-19
79. Martínez-Coronado A, Oyarzun R, Esbrí JM, Llanos W, Higueras P. Sampling high to extremely high Hg concentrations at the Cerco de Almadenejos, Almadén mining district (Spain): the old metallurgical precinct (1794 to 1861 AD) and surrounding areas. *J Geochem Explor*, **2011;** *109:* 70-77. DOI: 10.1016/j.gexplo.2010.04.007
80. Nnamchi I, Chukwudi C, Onyetugo A, Amarachi N. Peroxidase, an Example of Enzymes with Numerous Applications. *Asian J Chem Sci*., **2021;** *10:* 11-22. DOI: 10.9734/AJOCS/2021/v10i219087
81. Guida V, Cantarella M, Chambery A, Mezzacapo MC, Parente A, Landi N, Severino V, Di Maro A. Purification and Characterization of Novel Cationic Peroxidases from *Asparagus acutifolius* L. with Biotechnological Applications. *Mol Biotechnol*, **2014;** *56:* 738-746. DOI 10.1007/s12033-014-9752-2
82. Guida V, Niro E, Landi N, Chambery A, Parente A, Cantarella L, Cantarella M, Di Maro A. Immobilised peroxidases from *Asparagus acutifolius* L. seeds for olive mill waste water treatment. *RSC Adv*., **2014;** *4:* 61482-61490. DOI: 10.1039/c4ra11310a
83. El-Ishaq A, Alshawsh MA, Mun KS, Chik Z. Biochemical and toxicological effects of methanolic extract of *Asparagus africanus* Lam in Sprague-Dawley rats. *PeerJ*., **2020;** *8:* e9138. DOI: 10.7717/peerj.9138
84. Riaz S, Haider F, Ur-Rehman R, Zafar A. Exploring the therapeutic potential of *Asparagus africanus* in polycystic ovarian syndrome: a computational analysis. *J Integr Bioinform*, **2024;** *21:* 20240019. DOI: 10.1515/jib-2024-0019
85. Singh S, Pal N, Shubham S, Sarma DK, Verma V, Marotta F, Kumar M. Polycystic Ovary Syndrome: Etiology, Current Management, and Future Therapeutics. *J Clin Med*., **2023;** *12:* 1454. DOI: 10.3390/jcm12041454
86. Mustafa SS. *In vitro* propagation and secondary metabolites production in the wild rare *Asparagus aphyllus* L. plant. *Egypt J Desert Res*., **2021;** *71:* 149-61. DOI: 10.21608/ejdr.2021.71517.1083
87. Ulukapi K, Nasircilar AG, Onus AN, Baktir İ. *In vitro* propagation and determination of the nutrient

content of naturally grown Asparagus stipularis Forssk. *Arch Biol Sci*., **2014;** *66:* 1333-1338. DOI:10.2298/ABS1404333U

88. Ramos M, Alonso A, González L, Jaimes C, Villafuerte J, Guerrero A, Sosa F. Therapeutic Value of Plant Saponins, Challenges and Opportunities: A Review. *Nat Prod Commun*., **2026;** *21*. DOI: 10.1177/1934578X261418409
89. Juang YP, Liang PH. Biological and Pharmacological Effects of Synthetic Saponins. *Molecules*, **2020;** *25:* 4974. DOI: 10.3390/molecules25214974
90. Paczkowski C, Zimowski J, Krawczyk D, Wojciechowski ZA. Steroid-specific glucosyltransferases in Asparagus plumosus shoots. Phytochemistry, **1990;** *29;* 63-70. DOI: 10.1016/0031-9422(90)89011-W