

**Phytochemical, and clinical
investigation of
*Amaranthus viridis***

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Amaranthus viridis

- Green amaranth, slender amaranth, Chinese spinach
- *Amaranthus viridis* belongs to Amaranthaceae (pigweed family).
- This species is native to the Caribbean, found in tropical and subtropical regions of the world.
- It commonly grows in many countries such as Iran, Jordan, Pakistan, India, Bhutan, Iraq, Sudan, Ghana, USA, Egypt, Turkey,



Description

- *Amaranthus viridis* is an annual or **short-lived**, fast-growing herb with erect stems.
- Leaves ovate, elongate rhombic ovate, 2-6 cm long, dark green in color.
- Flower Pale white to green, which mostly flowers in summer and fall.
- The inflorescences are brownish green, and terminal panicles varied according to the age of the plant.
- Fruit of a subglobose capsule, c. 1.5 mm in diameter
- Seeds of *A. viridis* are predominantly black.
- This plant stands out for its adaptability to the environment and prolific seed production.

Traditional use of *A. viridis*

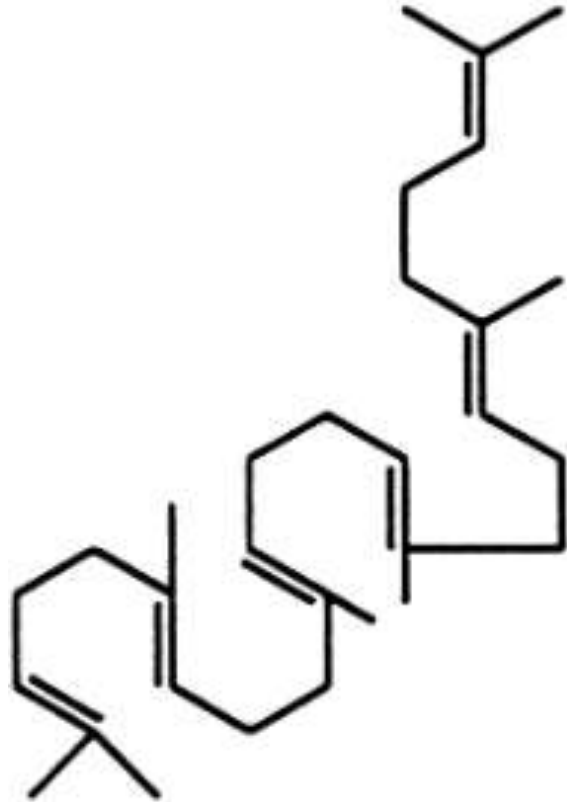
- In India and Nepal, this plant is cultivated and used to **reduce pain** due to **intense activity**.
- Pakistan, like some plants, is used to treat respiratory diseases and **regulate bleeding**, and excessive menstruation.
- . Other traditional uses are **anti-inflammatory** of the urinary tract, vermifuge for venereal diseases, and **diuretic**, It can **improve appetite**, and treat respiratory problems, eye diseases, and asthma.

Phytochemistry

- the phytochemical analysis of the extracts revealed the presence of the following constituents:
- **Flavonoids, alkaloids**, phenolics, **steroids, terpenoids, saponins**, cardiac glycosides, and tannins.
- **Alkaloids, flavonoids, unsaturated steroids**, saponins, **triterpenoids**, and polyose were found to be present in root aqueous extract.
- **anthraquinones, anthracene glycosides**, tannins, leucoanthocyanins, cardenolides, embodies, quinones, and polyurenoids were found to be absent.
- Coumarin, Saponin, and cardioactive some articles documented their **presence**, while others documented their **absence**.

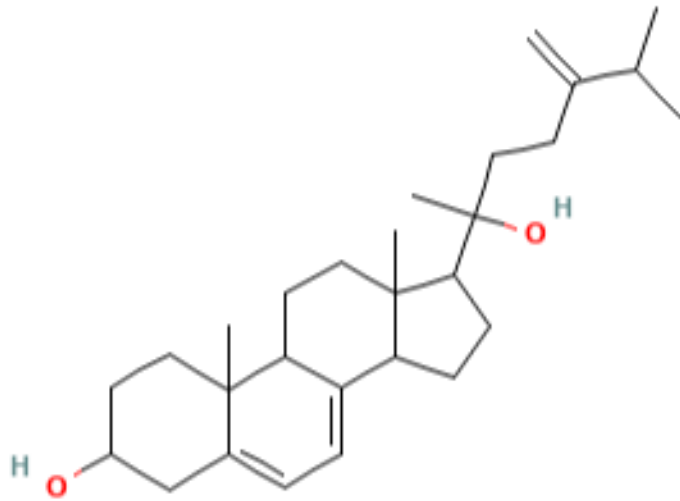
Terpenoids

- **Squalene** was isolated from the stems and leaves, polyprenol and phytol from the leaves of *A. viridis*

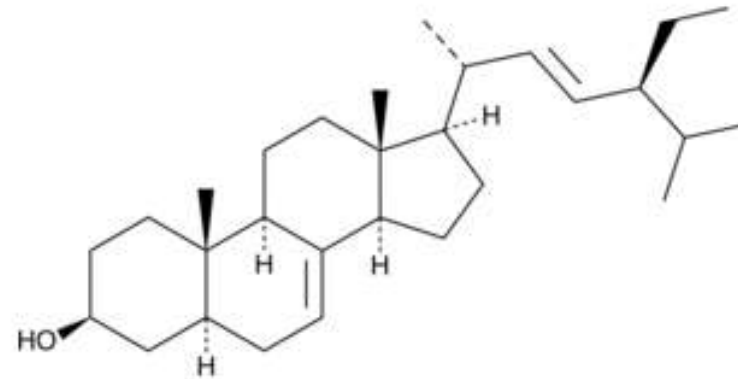


phytosterols

- Amasterol from the roots, Spinasterol from the stems and roots.
- 24- methyl-22-dehydrolathosterol, 24-methylathosterol, 24- ethyl-22-dehydrocholesterol, and 24-ethylathosterol,

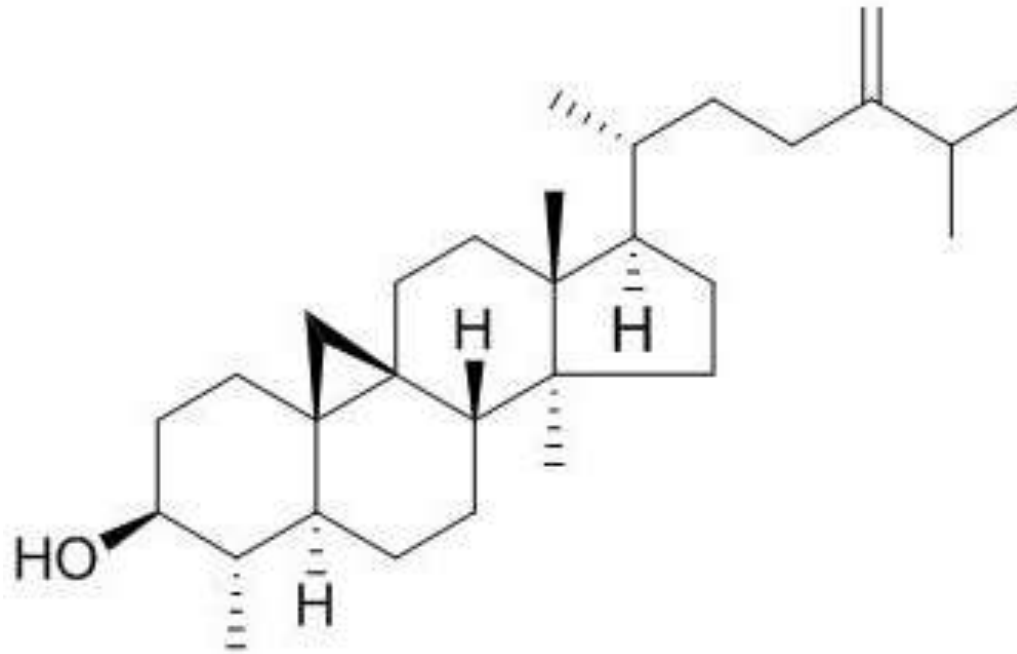


Amasterol

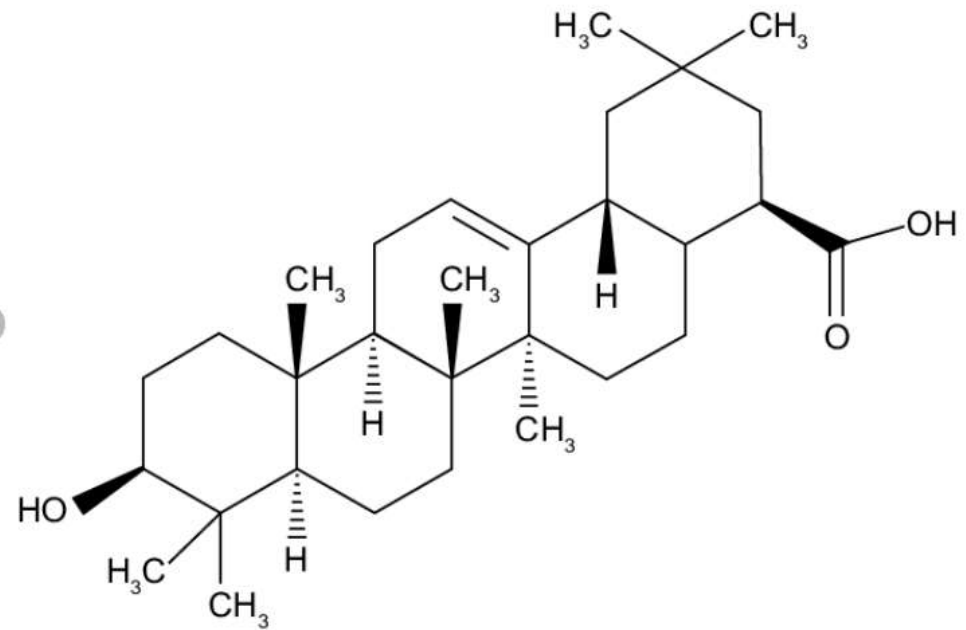


Spinasterol

Pentacyclic triterpenoids



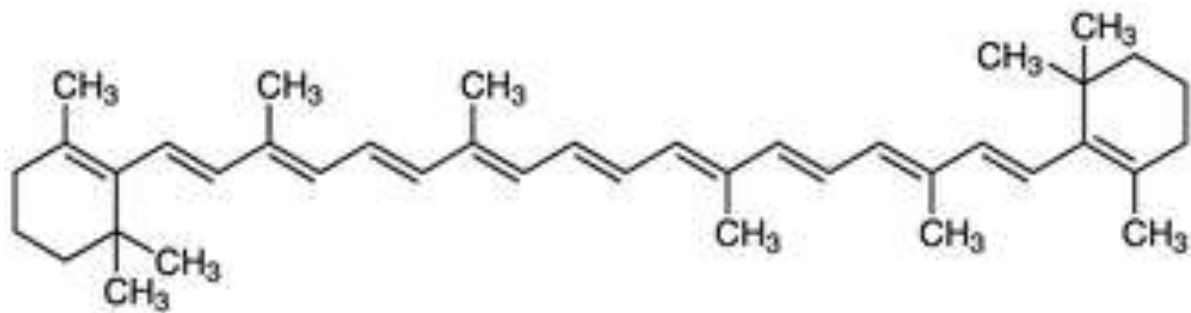
Cycloeucalenol



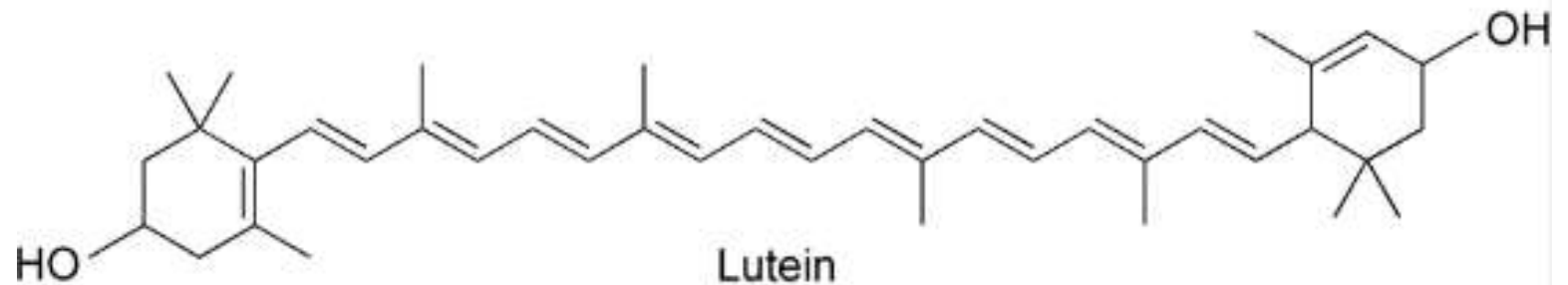
Oleanolic acid

Carotenoids

- β -Carotene, lutein had been isolated from *A. viridis* L
- A carotenoid content (92.87mg 100 g⁻¹) was measured in a study conducted by Sarker et al.



Beta carotene

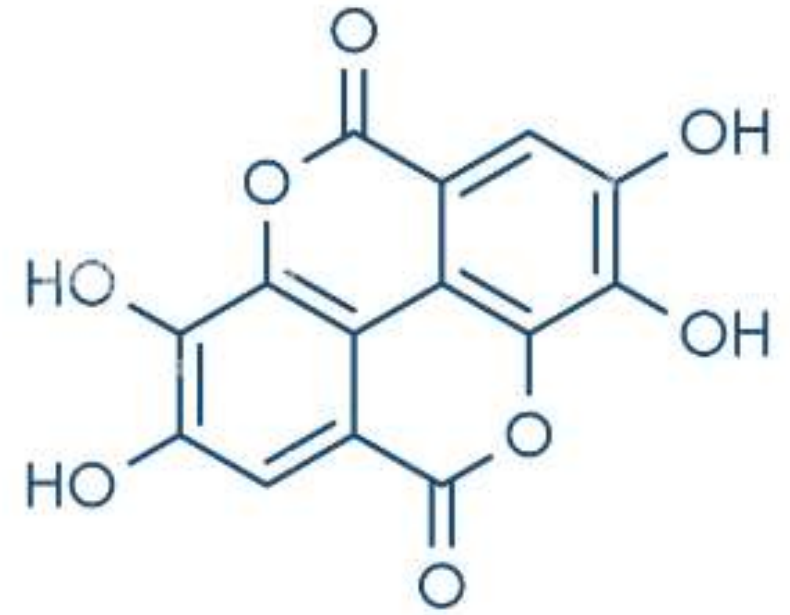


Lutein

Phenolic acids

- Phenolic acids in both types of hydroxybenzoic acids (protocatechuic acid, vanillic acid para OH benzoic acid syringic acid),
- Hydroxycinnamic acids (ferulic Acid, cinnamic acid sinapic acid p.coumaric Acid, caffeic acid) were identified in methanolic seeds extract by HPLC.

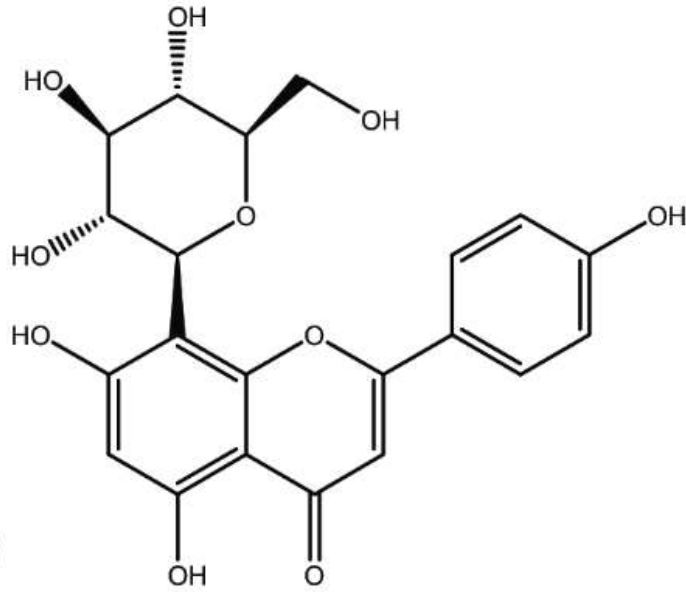
- In hydroalcoholic leaf extract using HPLC the **most** preponderant benzoic acids are identified as **salicylic acids**, and ellagic acid was the **least** content.
- *Trans*-cinnamic acid was identified as the **most prominent** component within **cinnamic acids** followed by **chlorogenic acid**.



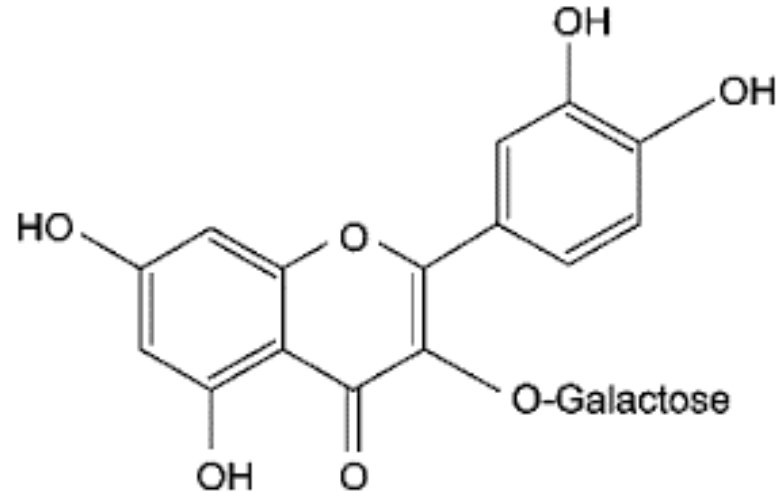
ellagic acid

Flavonoids

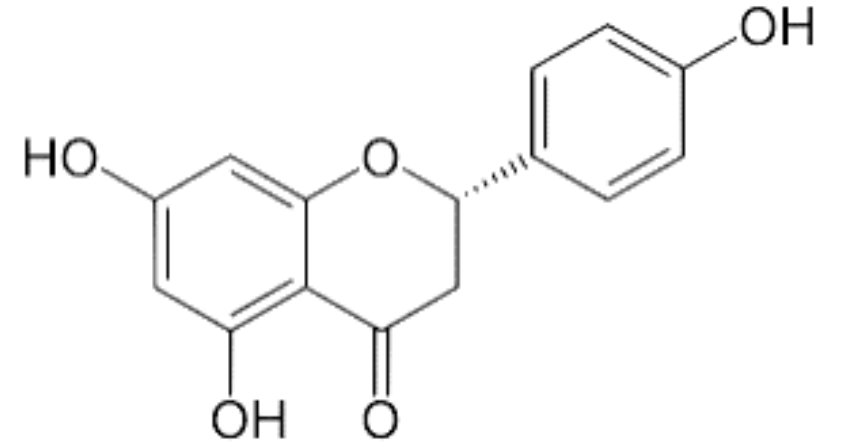
- Leafy vegetable amaranth had **abundant** flavonoids such as rutin, isoquercitrin, quercetin, myricetin, naringenin, kaempferol, catechin, apigenin, and hyperoside.
- Coumaroylquinic acid, Quercetin, Feruloylquinic acid, hydroxykaempferol, Caffeoylglucaric acid, Quercetin-3-O-neohesperidoside, Kaempferol-3-O-neohesperidoside, sorhamnetin-3-O-glucoside, , Kaempferol, Quercetin, Quercetin-3-O-rutinoside, Isorhamnetin-3-O-neohesperidoside, Rutin, Kaempferol, Isorhamnetin-3-O-neohesperidoside were identified in hydroalcoholic leaves extract using LCMS.



Vitxin



Hyperoside



Naringenin

Notes

- A recent study indicated **leaves** and **inflorescence** of *A. viridis* possessed higher phenols and Flavonoids.
- Hydroxycinnamic acids and flavonoids content of the seed extracts increased when subjected to **autoclaving and germination**.
- It was found that the *A. viridis* phenolic **acid and flavonoid contents increase by drought**.

Alkaloids

- Concerning the alkaloids these compounds were identified in leaves and seeds of plants but till now not isolated and nothing is known about their type.
- Percentage of alkaloids shown by *A. tricolor*, *A. viridis*, and *A. caudatus* (8- 8.8%) when compared to other Amaranthus species.
- Another study reported the alkaloid percentage in leaves to be 26.7%, another study 13.14%, another study

Extraction methods and examined pharmacological effects

Method of extraction	Part used	Solvent used	Pharmacological activity
Maceration	leaves Whole plant	Hexane, ethanol, EtOAc Defatting, extraction, fractionation Ethanol, then fractionation pet. Ether, ethyl ether, ethyl acetate and n-butanol	Anticancer MCF-7 HT-29 cell line
Soxhelt	Whole plant	methanol	MCF-7 antiinflammatory
Maceration	whole plant	methanol. The crude extract was extracted sequentially with petroleum ether, ethyl ether, ethyl acetate, and n-butanol	HT-29 and HpeG 2

Soxhelt	Whole plant	methanol	Cardioprotective effect
Soxhelt	Leaves	ethanol	For anemia
Maceration	Whole plant	Hexane, water Defatting, extraction,	Hypoglycemic, hypolipidemic effect
Sequential Extraction maceration with shaking	leaves	Hexane, dichloromethane, methanol, water	Antidaibetic, antioxidant

Maceration	Leaves, seeds	MeOH, 80% MeOH	Antibacterial, antioxidant
Soxhelt	Whole plant	ethanol	Antibacterial
Maceration	Leaves, seeds	MeOH, 80% MeOH	Antibacterial, antioxidant
Maceration	Leaves, roots	ethanol	Antimicrobial, laxative
Soxhelt	Whole plant	methanol	Antioxidant, hepatoprotective anti-inflammatory

Soxhlet	leaves	methanol	Analgesic effect
Magnetic stirrer	seeds	methanol	antioxidant
Maceration	leaves	of methanol, distilled water, chloroform, and hexane	antioxidant, antityrosinase, and antigenotoxic
Maceration with micro-vortex stirring	leaves	95% methanol	Acute and chronic toxicity

Conclusion

- Wild and cultivated *Amaranthus viridis* is **not studied** phytochemically in Iraq.
- *Amaranthus viridis* is an important source of phytochemicals.
- Flavonoids and phenolic acid, carotenoids were identified and isolated.
- **Alkaloids and cardioactive glycosides** were detected in the plant but not identified and isolated.
- Only **traditional extraction** methods were used for extraction.
- Multiple studies concerning the **antioxidant, and antibacterial** effects of the plant had been done.
- **Leaves and the whole plant** are the most extensively studied parts.