

Citrullus colocynthis

“Bitter-apple” and spelling variants redirect here. This is also used for the poisonous Soda Apple, a species of nightshade.

Citrullus colocynthis, with many common names including **colocynth**,^[2] **bitter apple**,^[2] **bitter cucumber**,^[2] **desert gourd**, **egusi**, **vine of Sodom**,^[2] or **wild gourd**,^[2] is a desert viny plant native to the Mediterranean Basin and Asia, especially Turkey (especially in regions such as İzmir), Nubia and Trieste. It resembles a common watermelon vine but bears small, hard fruits with a bitter pulp. It originally bore the scientific name *Colocynthis citrullus*, but is now classified as *Citrullus colocynthis*.

1 Origin of the species, distribution and ecology

Citrullus colocynthis is a desert viny plant that grows in sandy arid soils. It is native to the Mediterranean Basin and Asia and is distributed among the west coast of northern Africa, eastward through the Sahara, Egypt until India and reaches also the north coast of the Mediterranean and the Caspian seas. It grows also in southern European countries as in Spain and on the islands of the Grecian archipelago. On the island of Cyprus it is cultivated on a small scale; it has been an income source since the 14th century and is still exported today. It is an annual or a perennial plant (in wild) in Indian arid zone and has a great survival rate under extreme xeric conditions.^[3] In fact, it can tolerate annual precipitation of 250 to 1500 mm and an annual temperature of 14.8 to 27.8 °C. it grows from sea level up to 1500 m.a.s.l. on sandy loam, sub-desert soils, and sandy sea coasts with a pH range between 5.0 and 7.8.^[4]

2 Characteristics and morphology of the plant

2.1 Roots and stems

The roots are large, fleshy and perennial leading to a high survival rate thanks to the long tap root. The vine-like stems spread in all directions for a few meters looking for something to climb over. If present, shrubs and herbs are preferred and climbed by means of axillary branching tendrils.^[3]

2.2 Leaves

Very similar to watermelon leaves: they are palmate, angular with 3-7 divided lobes.

2.3 Flowers

The flowers are yellow and solitary in the axes of leaves and are borne by yellow-greenish peduncles. Each has a subcampanulate five-lobed corolla and a five-parted calyx. They are monoecious therefore the male (stamens) and the female reproductive parts (pistils and ovary) are borne in different flowers on the same plant. The male flowers' calyx is shorter than the corolla. They have 5 stamens, 4 of which are coupled and 1 is single with monadelphous anther. The female flowers have 3 staminoids and a 3-carpels ovary. The two sexes are distinguishable by observing the globular and hairy inferior ovary of the female flowers.^[3]



A *Citrullus colocynthis* female flower.

2.4 Fruits

The fruit is smooth, spheric with a 5–10 cm diameter and extremely bitter in taste. The calyx englobe the yellow-green fruit which becomes marble (yellow stripes) at maturity. The mesocarp is filled with a soft, dry and spongy white pulp, in which the seeds are embedded. Each of the 3 carpels bears 6 seeds. Each plant produces 15 to 30 fruits.^[4]



Iranian *Citrullus colocynthis*.



Ripe fruit of *Citrullus colocynthis*.

2.5 Seeds

The seeds are grey and 5 mm long and 3 mm wide. They are edible but similarly bitter, nutty-flavored and rich in fat and protein. They are eaten whole or used as an oilseed. The oil content of the seeds is 17–19% (w/w), consisting of 67–73% linoleic acid, 10–16% oleic acid, 5–8% stearic acid, and 9–12% palmitic acid. It is estimated that the oil yield is approximately 400 L/hectare.^[5] In addition, the seeds contain a higher amount of arginine, tryptophan and the sulfur-containing amino acids.^[6]

3 Cultivation

Citrullus colocynthis is a perennial plant that can propagate both by generative and vegetative means. However, seed germination is poor due to the extreme xeric conditions, therefore the vegetative propagation is more common and successful in nature. In the Indian arid zone the growth takes place between January and October but the most favorable period for the vegetative growth is during summer, which coincides with the rainy season. The growth declines as soon as the rains and the temperature decrease and almost stops during the cold and dry months

of December and January.^[7] *Colocynthis* prefers sandy soils and is a good example of good water management which may be useful also on research to better understand how desert plants react to water stress.^{[8][9]} To enhance production, an organic fertilizer can be applied.^[10] *Colocynthis* is also commonly cultivated together with cassava (intercropping) in Nigeria.^[7]



Colocynthis in Adrar desert (Mauritania).

Cultivated *colocynthis* suffers of climatic stress and diseases such as cucumber mosaic virus, melon mosaic virus, *Fusarium* wilt, etc. as any other crop. To improve it, a relatively new protocol for regeneration has been developed with the aim of incorporating disease and stress resistance to increase yield potential and security avoiding interspecific hybridization barriers.^[11]

4 Uses

Citrullus colocynthis can be used for different purposes: it can either be eaten or elaborated for further uses in medicine and as energy source, e.g. oilseed and biofuel. The characteristic small seed of the *colocynthis* have been found in several early archeological sites in northern Africa and the Near East, specifically at Neolithic Armanat, Nagada in Egypt; at sites dating from 3800 BC to Roman times in Libya; and the pre-pottery Neolithic levels of the Nahal Hemar Caves in Israel.^[12] Zohary and Hopf speculate that “these finds indicate that the wild *colocynthis* was very probably used by humans prior to its domestication.”^[12]

4.1 Medical study

Colocynthis has been widely used in folk medicine for centuries. Johann Weyer, in *De praestigii daemonum* (1563), offers it as a cure for lycanthropy.^[13] Interest in its anti-inflammatory properties has been renewed in modern times.

Aqueous and methanol extracts of *colocynthis* showed high antimicrobial activity against *Escherichia coli*, *Staphylococcus aureus* and other bacteria. Extracts of

fruits, leaves, roots and stems were also found to be potentially usable against many gram positive bacilli and fungi as *Aspergillus fumigatus*, *Aspergillus flavus* and *Mucor sp.*^[6]

In addition, some of these extracts were found to have an insulin tropic effect and therefore an antidiabetic effect, which may make them relevant to the treatment of diabetes mellitus.^{[6][14][15]}

Cucurbitacin glucosides seem potentially important for therapy against breast cancer cells because of their ability to modify cell morphology and signaling, and to induce apoptosis and changes in mitochondrial membrane potential.^[16]

Another property of colocynth is hair growth stimulation: an experiment on rats demonstrated that hair growth initiation time was significantly decreased after treatment with colocynth petroleum ether extracts.^[17]

4.1.1 Pre-modern medicinal uses

In pre-modern medicine it was an ingredient in the electuary called *confectio hamech*, or *diacatholicon*, and most other laxative pills; and in such cases as required purging, it was very successful. It is one of the most violent purgative drugs known; insomuch that it excoriates the passages to such a degree as to sometimes draw blood and induce a so-called “superpurgation”. Sometimes, it was taken boiled in water, or beer, in obstruction of the menses, which was considered successful in strong constitutions. Some women used it in the same manner, in the beginning of pregnancy, to cause an abortion, which often occurred due to the violence of its operation.^[18] Its usage for this purpose is documented in ancient times; for example, the following recipe was found in the Ebers medical papyrus in Egypt, dated to about 1550 BCE:^[19]

“To cause a woman to stop [terminate] pregnancy in the first, second or third period [trimester]: unripe fruit of acacia; colocynth; dates; triturate with 6/7th pint of honey. Moisten a pessary of plant fiber [with the mixture] and place in the vagina.”

— Ebers papyrus, c. 1550 BCE; translation from *Eve's Herbs*, by John M. Riddle^[19]

The powder of colocynth was sometimes used externally, with aloes, etc., in unguents, bandages, etc., with remarkable success against parasitic worms; and some, for the same purpose, recommended that the pulp be used as an enema. In iliac passion, enemas of colocynth were used effectively where most other pre-modern medicines had failed.^[18] Troches, or lozenges, made of colocynth were called “troches of alhandal”. They were prepared by cutting the colocynth to a small size, and reducing it to a fine powder in a mortar, rubbed with oil of sweet almonds;

adding gum tragacanth, and mastic afterwards.^[18] Remedies for counteracting colocynth have included emetics, such as zinc sulfate, and apomorphine, if caught early; later, demulcents and opiates, with stimulants to combat collapse.^[20]

4.2 Nutritional uses

The desert Bedouin are said to make a type of bread from the ground seeds. There is some confusion between this species and the closely related watermelon (*Citrullus lanatus* (Thunb)), whose seeds may be used in much the same way. In particular the name “egusi” may refer to either or both plants (or more generically to other cucurbits) in their capacity as seed crops, or to a soup made from these seeds and popular in West Africa.

The seed flour is rich in micronutrients (vitamins and minerals), calcium and niacin and could therefore be used in food formulations especially in regions with low milk consumption like West Africa.^[6] A normal dose of fluid extracted from the fruit pulp is 2 to 5 minims (120 to 310 µL), and for the powdered extract 1 to 2 grains (60 to 130 mg).^[20]

4.3 Practical uses

Since colocynth is not strongly used as staple food, its seeds might become an interesting source for biofuel production.^[4] In addition, colocynth can grow on marginal lands and may improve soil quality as experienced with intercropping.^[7] The oil obtained from the seeds (47%) can also be used for medicinal and soap production.^[4] The production is not very time and energy consuming due to the ability of colocynth to grow on poor soils with just a little moisture and organic fertilizer. The fruits are harvested still unripe by hand, the rind is removed by peeling and the inner pulp filled with seeds is dried at sun or in ovens. The seeds yield is about 6.7-10 t/ha, which means that for an oil profit of 31-47%, oil yields may reach up to 3 t/ha.^{[4][21]}

Oleic and linoleic acids isolated from *C. colocynthis* petroleum ether extracts show larvicidal activity against mosquitoes.^[22]

5 References in religion

5.1 Judaism and Christianity

The colocynth’s characteristic bitter taste and dangerous properties seem to be consistent with the “wild gourd” mentioned in 2 Kings 4:39-40:

“[39] And one went out into the field to gather herbs, and found a wild vine, and

gathered thereof wild gourds his lap full, and came and shred them into the pot of pottage: for they knew them not. [40] So they poured out for the men to eat. And it came to pass, as they were eating of the pottage, that they cried out, and said, O thou man of God, there is death in the pot. And they could not eat thereof."

— Old Testament, 2 Kings 4:39-40, King James Version

5.2 Latter day saints

The Book of Mormon associates the “gall of bitterness” with those who sin and are without God in the world (see Alma 41:11, Mosiah 27:29, Mormon 8:31, Alma 36:18, Moroni 8:14).

5.3 Islam

It is reported from Abu Musa Al Ash'ari that Muhammad said:

"The example of a believer who recites the Qur'an and acts on it, like a citron which tastes nice and smells nice. And the example of a believer who does not recite the Qur'an but acts on it, is like a date which tastes good but has no smell. And the example of a hypocrite who recites the Qur'an is like a Raihana (sweet basil) which smells good but tastes bitter. And the example of a hypocrite who does not recite the Quran is like a colocynth which tastes bitter and has a bad smell."

— Book #61, Hadith #579 Bukhari & Sahih Muslim

6 References

- [1] “The Plant List: A Working List of All Plant Species”. Retrieved 13 November 2014.
- [2] “USDA GRIN Taxonomy”. Retrieved 3 December 2014.
- [3] Lloyd, John U. (1898). "*Citrullus Colocynthis*". *The Western Druggist* (Chicago).
- [4] "*Citrullus colocynthis* - Potential Arid Land Biodiesel Feedstock from an Ancient Cucurbit". Retrieved 8 November 2012.
- [5] Schafferman, D.; Beharav A.; Shabelsky E.; Yaniv Z (1998). “Evaluation of *Citrullus colocynthis*, a desert plant native in Israel, as a potential source of edible oil”. *Journal of Arid Environments* **40**: 431–439. doi:10.1006/jare.1998.0454.
- [6] Gurudeeban, S.; Satyavani K.; Ramanathan T. (2010). “Bitter Apple (*Citrullus colocynthis*): An Overview of Chemical Composition and Biomedical Potentials”. *Asian Journal of Plant Sciences* **9**: 394–401. doi:10.3923/ajps.2010.394.401.
- [7] Agahiu, A. E.; Udensi U.E.; Tarawali G.; Okoye B.C.; Ogbuji R.O.; Baiyeri K.P. (2011). “Assessment of weed management strategies and intercrop combinations on cassava yield in the middle belt of Nigeria”. *African Journal of Agricultural Research* **6**: 5729–5735. doi:10.5897/ajar11.428.
- [8] Althawadi, A. M.; Grace J. (1986). “Water-use by the desert cucurbit *Citrullus-colocynthis* (L) Schrad”. *Oecologia* **70**: 475–480. doi:10.1007/bf00379514.
- [9] Si, Y.; Zhang C.K.; Meng S.S.; Dane F. (2009). “Gene expression changes in response to drought stress in *Citrullus colocynthis*”. *Plant Cell Rep* **28**: 997–1009. doi:10.1007/s00299-009-0703-5.
- [10] Sen, D. N.; Bhandari M.C. (1974). “On the ecology of a perennial cucurbit in Indian arid zone — *Citrullus Colocynthis* (Linn.) Schrad”. *International Journal of Biometeorology* **18**: 113–120. doi:10.1007/bf01452231.
- [11] Ntui, V. O.; Thirukkumaran G.; Iioka S.; Mii M. (2009). “Efficient plant regeneration via organogenesis in “Egusi” melon (*Colocynthis citrullus* L.)”. *Scientia Horticulturae* **119**: 397–402. doi:10.1016/j.scienta.2008.08.031.
- [12] Zohary, Daniel; Hopf Maria (2000). *Domestication of Plants in the Old World* (Third Edition ed.). Oxford University Press. p. 194.
- [13] George Mora, Benjamin G. Kohl, Erik Midelfort, and Helen Bacon, ed. (1991). *Johann Weyer, De praestigiis daemonum*. John Shea (trans.). Binghamton: Medieval and Renaissance Texts and Studies. p. 343.
- [14] Katsaridis, V.; Papagiannaki C.; Aimar E. (2009). “Embolization of brain arteriovenous malformations for cure: because we could and because we should”. *American Journal of Neuroradiology* **30** (5): e67. doi:10.3174/ajnr.a1458. Retrieved 7 November 2012.
- [15] Patel, D. K.; Prasad S.K.; Kumar R.; Hemalatha S. (2012). “An overview on antidiabetic medicinal plants having insulin mimetic property”. *Asian Pacific Journal of Tropical Biomedicine* **2**: 320–330. doi:10.1016/s2221-1691(12)60032-x.
- [16] Tannin-Spitz, T.; Grossman S.; Dovrat S.; Gottlieb H.E.; Bergman M. (2007). “Growth inhibitory activity of cucurbitacin glucosides isolated from *Citrullus colocynthis* on human breast cancer cells”. *Biochemical Pharmacology* **73**: 56–67. doi:10.1016/j.bcp.2006.09.012.
- [17] Roy, K.; Thakur M.; Dixit V.K. (2007). “Effect of *Citrullus colocynthis* on hair growth in albino rats”. *Pharmaceutical Biology* **45**: 739–744. doi:10.1080/13880200701585709.
- [18] This article incorporates text from a publication now in the public domain: Chambers, Ephraim, ed. (1728). ^{“article name needed”}. *Cyclopaedia, or an Universal Dictionary*

of Arts and Sciences (first ed.). James and John Knapton, *et al.*

- [19] Riddle, John M. (1999). *Eve's Herbs: A History of Contraception and Abortion in the West*. Harvard University Press. ISBN 0-674-27026-6.
- [20] Davis & Company Parke (1909). *Manual of therapeutics*. Parke, Davis & Co. pp. 262–266.
- [21] Giwa, S.; Abdullah L. C.; Adam N. M. (2010). “Investigating “egusi” (*Citrullus colocynthis* L.) seed oil as potential biodiesel feedstock”. *Energies* **3**: 607–618. doi:10.3390/en3040607.
- [22] Mosquito larvicidal activity of oleic and linoleic acids isolated from *Citrullus colocynthis* (Linn.) Schrad A. Abdul Rahuman, P. Venkatesan and Geetha Gopalakrishnan, *Parasitology Research*, November 2008, Volume 103, Issue 6, pages 1383-1390

7 External links

- Information on oilseed uses
- “Evaluation of *Citrullus colocynthis*, a desert plant native in Israel, as a potential source of edible oil”
- *Citrullus colocynthis* in West African plants – A Photo Guide.

8 Text and image sources, contributors, and licenses

8.1 Text

- **Citrullus colocynthis** *Source:* <http://en.wikipedia.org/wiki/Citrullus%20colocynthis?oldid=647290703> *Contributors:* Llywrc'h, Ralmin, Sanders muc, Donreed, MPF, Oknazevad, Xezbeth, Mani1, Brian0918, Circeus, Shenme, Polylerus, Pekinensis, BD2412, Rjwilmsi, Eubot, Kerowyn, Quuxplusone, Drvgaikwad, Gdrbot, Dysmorodrepanis, Asarelah, SmackBot, Brya, Melchoir, Alex earlier account, Chris the speller, Rkitko, Delink, Bazonka, Dwpaull, Syrcatbot, Cydebot, Dancter, Snograt, Marco Schmidt, Nick Number, JAnDbot, Cynwolfe, Jschrir, Baristarim, Danieliness, CommonsDelinker, Neutron Jack, Chiswick Chap, Belovedfreak, VolkovBot, TXiKiBoT, GirasoleDE, Alexbrn, Drmies, Alexbot, Ptutini, Addbot, Cuaxdon, Luckas-bot, Yobot, Pganas, AnomieBOT, Materialsscientist, Xqbot, RibotBOT, FrescoBot, LucienBOT, Doremo, SuperJew, Discobedience, Lb.at.wiki, Look2See1, Widr, Jacopo188, Drift chambers, DPL bot, NotWith, Shisha-Tom, Khazar2, Sminthopsis84, Marciume, Lebaronmatthew, Monkbot, Dr.M.Venugopal Reddy, Betterthanyourmom and Anonymous: 36

8.2 Images

- **File:Adrar-Coloquintes.jpg** *Source:* <http://upload.wikimedia.org/wikipedia/commons/8/86/Adrar-Coloquintes.jpg> *License:* CC BY-SA 3.0 *Contributors:* Own work *Original artist:* Ji-Elle
- **File:Ambox_important.svg** *Source:* http://upload.wikimedia.org/wikipedia/commons/b/b4/Ambox_important.svg *License:* Public domain *Contributors:* Own work, based off of Image:Ambox scales.svg *Original artist:* Dsmurat (talk · contribs)
- **File:Citrullus_colocynthis_002.JPG** *Source:* http://upload.wikimedia.org/wikipedia/commons/f/f1/Citrullus_colocynthis_002.JPG *License:* CC BY-SA 3.0 *Contributors:* Own work *Original artist:* H. Zell
- **File:Citrullus_colocynthis_004.JPG** *Source:* http://upload.wikimedia.org/wikipedia/commons/3/3b/Citrullus_colocynthis_004.JPG *License:* CC BY-SA 3.0 *Contributors:* Own work *Original artist:* H. Zell
- **File:Commons-logo.svg** *Source:* <http://upload.wikimedia.org/wikipedia/en/4/4a/Commons-logo.svg> *License:* ? *Contributors:* ? *Original artist:* ?
- **File:Folder_Hexagonal_Icon.svg** *Source:* http://upload.wikimedia.org/wikipedia/en/4/48/Folder_Hexagonal_Icon.svg *License:* Cc-by-sa-3.0 *Contributors:* ? *Original artist:* ?
- **File:Hanzal_001.jpg** *Source:* http://upload.wikimedia.org/wikipedia/commons/4/42/Hanzal_001.jpg *License:* CC BY-SA 3.0 *Contributors:* Own work *Original artist:* Jacopo188
- **File:Melon_casaba.jpg** *Source:* http://upload.wikimedia.org/wikipedia/commons/d/db/Melon_casaba.jpg *License:* Public domain *Contributors:* ? *Original artist:* ?
- **File:Rod_of_Asclepius2.svg** *Source:* http://upload.wikimedia.org/wikipedia/commons/e/e3/Rod_of_Asclepius2.svg *License:* CC BY-SA 3.0 *Contributors:* This file was derived from: Rod of asclepius.png *Original artist:*
- Original: CatherinMunro

8.3 Content license

- Creative Commons Attribution-Share Alike 3.0