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Phytochemical Analysis of Medicinally Important Plants *Solanum Surattense* and *Citrullus Colocynthis*

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Abstract:

Medicinal plants are unique in having the ability to produce diverse chemical compounds with remarkable biological activities. Investigations of medicinal plants resulted in the discovery of a large number of bioactive compounds with excellent therapeutic properties. Solanum surattense, a perennial wild growing medicinal herb, is widely used in the traditional medicine. Exhaustive literature availability reveals the presence of phytochemical compounds from different plant parts like roots, stem, leaves, fruits, and seeds reported to possess a wide range of pharmacological activities like hepatoprotective, cardioprotective, antiasthmatic and mosquito repellents properties. Intensive investigation on phytochemical constituents resulted in isolation of alkaloid and steroidal compounds solasonoine, solamargine, campesterol, and diosgenin. Evaluation of therapeutic activity of isolated compounds proved as potent ones with reference to the standard. Current literature on the pharmacological activity of S. surattense confirms the scientific validation of folklore claims and its traditional use to cure various ailments. Present review is undertaken to summarize all the available information on pharmacological activities, which provide a baseline support for further exploration of its unexplored therapeutic effects like immunomodulation, antipiles activity, antianaphylactic activity, and sexual behavior claimed by folklore.

Phytochemical screening of different extracts from Citrullus colocynthis (C. colocynthis) seeds extracts and to assess their antioxidant activity on the DPPH free radical scavenging. None of these extracts contained detectable amount of alkaloid, quinone, antraquinone, or reducing sugar. Catechic tannins and flavonoids were abundant in E1, HM and EA, whilst terpenoids were abundantly present in E1 and n-B but only weekly in HM. Coumarins were found in E2, EA and n-B. Polyphenols, expressed as gallic acid equivalent, amounted, per 100 g plant matter, to 329, 1002 and 150 mg in EA, HM an E1 respectively. Flavonoids, expressed as catechin equivalent, amounted, per 100 g plant matter to 620, 241 and 94 mg in EA, HM and E1 respectively. Comparable values were found in n-B and E1, with lower values in E2. Quercetin, myricetin and gallic acid were found in the EA and HM extracts by thin layer chromatography, The antioxidative effect of these extracts yielded, when tested at a concentration of 2 000 µg/mL in a 1,1-diphenyl-2-picrylhydrazyl assay, a reducing percentage of 88.8% with EA, 74.5% with HM and 66.2% with E1, and corresponding IC50 of 350, 580 and 500 µg/mL as compared to 1.1 µg/mL for ascorbic acid.

Keywords: Citrullus colocynthis, Solanum surattense, phytochemical screening, medicinal plants, extracts.

Introduction

Citrullus colocynthis, with many common names including Abu Jahl's melon, (native name in Turkey)[2] colocynth,[3] bitter apple,[3] bitter cucumber,[3] egusi,[4] vine of Sodom,[3] or wild gourd,[3]

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is a desert viny plant native to the Mediterranean Basin and Asia, especially Turkey (especially in regions such as İzmir), and Nubia.It resembles a common watermelon vine, but bears small, hard fruits with a bitter pulp. It originally bore the scientific name *Colocynthis citrullus*. The vine ranges from 2.4–3 metres (8–10 feet) in length.[5] The roots are large, fleshy, and perennial, leading to a high survival rate due to the long tap root. The vine-like stems spread in all directions for a few meters looking for something over which to climb. If present, shrubs and herbs are preferred and climbed by means of auxiliary branching tendrils.[6] Very similar to watermelon, the leaves are palmate and angular with three to seven divided lobes. The flowers are yellow and solitary in the axes of leaves and are borne by yellow-greenish peduncles. Each has a subcampanulated five-lobed corolla and a five-parted calyx. They are monoecious, so 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 five stamens, four of which are coupled and one is single with monadelphous anther. The female flowers have three staminoids and a three-carpel ovary. The two sexes are distinguishable by observing the globular and hairy inferior ovary of the female flowers.[6] The fruit is smooth, spheric with a diameter of 5 to 10 centimetres (2 to 4 inches) and an extremely bitter 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 three carpels bears six seeds. Each plant produces 15 to 30 fruits.[7] The seeds are gray and 5 millimetres (¼ in) long by 3 mm (⅛ in) wide. They are 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. The oil yield is about 400 L/hectare.[8] In addition, the seeds contain a high amount of arginine, tryptophan, and the sulfur-containing amino acids. *Citrullus colocynthis* is a desert viney 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 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 the wild in Indian arid zones, and survives under extreme xeric conditions.[6] In fact, it can tolerate annual precipitation of 250 to 1,500 mm (10 to 59 in) and an annual temperature of 14.8 to 27.8 °C. It grows from sea level up to 1,500 m (4,900 ft) above sea level on sandy loam, subdesert soils, and sandy sea coasts with a pH range between 5.0 and 7.8.[7]

C. colocynthis, a perennial plant, can propagate both by generative and vegetative means. However, seed germination is poor due to the extreme xeric conditions, so vegetative propagation is more common and successful in nature. In the Indian arid zone, 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.[8,9] Growth declines as soon as the rains and the temperature decrease and almost stops during the cold and dry months of December and January. Colocynth 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.[9][10] To enhance production, an organic fertilizer can be applied.[11] Colocynth is also commonly cultivated together with cassava (intercropping) in Nigeria.

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Citrullus colocynthis

Cultivated colocynth 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.[12]

C. colocynthis can be eaten or processed for further uses in medicine and as energy source, e.g. oilseed and biofuel. The characteristic small seed of the colocynth have been found in several early archeological sites in northern Africa and the Near East, specifically at Neolithic Armant, 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.[13] Zohary and Hopf speculate, "these finds indicate that the wild colocynth was very probably used by humans prior to its domestication."[13] In Arabia the colocynth had numerous uses in traditional medicine, such as a laxative, diuretic, or for insect bites.[16] The powder of colocynth was sometimes used externally with aloes, unguents, or bandages.[17] Lozenges or troches made of colocynth were called "troches of alhandal" or Trochisci Alhandalæ and used as a laxative.[17] They were usually composed of colocynth, bdellium, and gum tragacanth. Alhandal was a term used in Arabia for the extract of colocynth and is derived from the Arabic الْحَنْظَل al-Ḥanẓal, a name for colocynth.

In traditional Arab veterinary medicine, colocynth sap was used to treat skin eruptions in camels.[16]

The seeds of colocynth, which must be separated from the pulp and heated to make edible,[5] have been used since antiquity as a food source in areas of the Sahara and Sahel where crops frequently fail or regular farming is impossible. The enigmatic early Egyptian ceramic Clayton rings found in the Western Desert may have been portable ovens for roasting colocynth seeds.[18] The desert Bedouin are said to make a type of bread from the ground seeds. The closely related watermelon (*Citrullus lanatus* (Thunb)) was domesticated in Ancient Egypt, and may have been developed for edible seed from cultivated colocynth.[19] In West Africa, some confusion exists between this species and watermelon, 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

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as seed crops, or to a popular soup made from these seeds. The seed flour is rich in micronutrients,[20] and could therefore be used in food formulations especially in regions with endemic micronutrient deficiencies, such as West Africa.[21]

The flowers can be eaten, and the stem tips are a source of water.[5]

The oil obtained from the seeds (47%) can be used for soap production.[7] 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 in the sun or in ovens. The seeds yield is about 6.7 to 10 t/ha, which means that for an oil profit of 31 to 47%, oil yields may reach up to 3 t/ha.[7][22]

Oleic and linoleic acids isolated from *C. colocynthis* petroleum ether extracts show larvicidal activity against mosquitoes.[23]

Discussion

Solanum surattense

The plant is commonly called wild eggplant. Branches are spreading on the ground.The plant is very prickly diffused bright green perennial herb, somewhat woody at the base.Branches are numerous, the younger ones clothed with dense stellate tomentum, prickles compressed, straight, yellow, glabrous, shining often exceeding and 1.3 cm long.Leaves are 5-10X2.5-5.7 cm, ovate or elliptic, bearing stellate hairs on both sides (especially so beneath), sometimes becoming nearly glabrous with age.Petioles are 1.3-2.5 cm long. Mainly flowers are axillary but some flowers are cymes and bluish-violet in colour. Pedicels are short, curved with stellate hairy.Calyx is nearly 1.3 cm long, densely hairy and prickly, tube short, globose, lobes 11 mm long, linear-lanceolate, acute and prickly outside.Cololla is purple, 2 cm long, lobes deltoid, acute, hairy outside.Filament is 1.5 mm long, glabrous, anthers 8 mm long, oblong lanceolate and opening by small pores.Ovary is

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ovoid, glabrous and style glabrous.Fruits are berry, 1.3-2.0 cm in diameter, yellow or white with green veins and surrounded by the enlarged calyx.Seeds are 0.25 cm in diameter, glabrous, smooth, sub- reniform and yellowish-brown. Plant is widely distributed throughout India in dry situation as weed ascending to 1500 meter on the Himalaya, abundant by road sides and wastelands, mainly in Rajasthan,[3] Gujarat, Madhya Pradesh, Uttar Pradesh and Haryana. It is a hardy plant. It does well over light well-drained sandy-loam to rich loamy soils having pH of 7.0-8.0.The crop can also be grown under over saline lands.Kantakari is essentially a warm season crop grown mainly in tropical and sub tropical regions.Generally a long period of warm, preferably dry weather with abundant sunshine is required.Temperature range of 21-27°C is most favourable for its growth and reproduction.In northern India, the crop is adversely affected during December-January due to frost as it causes injury to vegetative parts and recovers in the spring season.[11]

The crop is raised by seed.The seeds are yellowish-brown in colour, small in size i.e. 2.5 mm in diameter and glabrous.The seeds have no dormancy period and can be sown after few days of harvesting.It takes 10-15 days to germinate and the percentage of germination is around 60-70%.

Raising Propagules: Before sowing, the seeds are soaked in water for 24 hours. This facilitates germination. Seeds take 10-15 days for germination. Raising seedlings in the nursery and later transplanting in field produce good crop strand. Generally nursery beds are prepared in the size of 7.5-10 meter long, one meter width and 10-15 cm above the ground level. An area of about 500 sqm is required to raise seedlings for one hectare area. Well decomposed farmyard manure is mixed into the top soil of the nursery beds at the rate of 10 kg/sqm. The seeds are sown around 15 June in rows made at a distance of 7.5 cm at 0.5-1.0 cm depth. Seeds are mixed in the sand which helps in proper distribution of seeds. After sowing, the rows are covered with a thin layer of the mixture of well rotten FYM and fine sand. Thereafter, the beds are irrigated. Light watering is required daily.Propagule Rate and Pre-treatment: 1.25 to 2.5 kg seeds are required for planting on one hectare area. For raising good and healthy plants, the seeds are treated with fungicides like Captan or Thiram @ 2.0 gm/kg.[15]

Land Preparation and Fertilizer Application: The field is ploughed, harrowed and planked well, to obtain a fine tilth. Well decomposed application of FYM at the rate of 12.5 tonnes and NPK 30:40:20 kg/ha as basal dose was found optimum for optimum yield.Transplanting and Optimum Spacing: The seedlings are ready for transplanting in 6-7 weeks after sowing in nursery beds; it has attained 10-12 cm in height and bear 4-6 leaves. Watering should be withheld 3-4 days in nursery before transplanting so that seedlings get hardened. Before uprooting, the beds are thoroughly soaked with water to facilitate easy removal of seedlings without much root injury. About 37,500 plants are recommended for planting in one hectare area by adopting 60X45 cm spacing. It gives high yield.Inter culture and Maintenance Practices: Initially, the plants grow at slow rate and are unable to compete with fast growing rainy season weeds. Therefore, early weeding is essential to keep weeds under control.[23] Later, the crop spreads easily and smoother weed. Thus, one hand weeding at 20 days after transplanting and second at 45 days after transplanting is recommended. The crop responds well to the application of manure and fertilizers. The crop is given 90:60:40 kg of NPK, of which 30 kg N with entire P and K is given basally before planting seedlings. Adequate supply of nitrogen increases fruit size and colour. High level of phosphorus throughout root region is essential for rapid root development and increasing number of flowers. Besides basal dose, 30 kg of N should be applied as top dressing in two equal doses i.e. 45 and 90 days after transplanting.Irrigation Practices: Kantkari crop is raised as a rainfed crop where the amount of annual rainfall is 400-600 mm and well distributed in the season. It requires protective irrigation

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when it enters reproductive phase; moisture during both growth and fruiting should be adequate for proper plant development. It has been found that three irrigations viz., first twenty days after transplanting, second irrigation at flowering time and third irrigation at fruit development were found desirable to fetch the higher production.Weed Control: Weeds compete for moisture, nutrients, sunlight and space with the crop resulting in reduced yield and quality.[21] The growth of Kantkari is slow at initial stage due to which it is unable to compete with fast growing weeds; therefore, in order to keep the field weed free, a shallow inter culture operation is to be done at initial growth. Usually, two hoeing and weeding at 20 and 45 days after transplanting are needed for an effective control of weeds, proper aeration and good growth of the plants. The crop is spreading in nature and do not allow weeds to grow at later growth stages.Disease and Pest Control: No serious pest and diseases have been observed on this crop.[22]

The plants produce flowers at 50-60 days after transplanting. Generally, this period occurs in the month of October. Fruiting starts in the month of November. The plants have indeterminate growth, meaning that flowering and fruiting continues together.Crop Maturity and Harvesting: It takes about five months from transplanting for first picking of matured berries. Complete crop harvesting can be done in the month of March. The berries are harvested before its colour turns from green to yellowish. About 2 to 3 pickings are done at 20-25 days intervals. Fruits is picked manually and kept in open for sun drying. Similarly, complete plant including roots is harvested at the end of season. It should be done before abscission of leaves starts.Post-harvest Management: The whole plant should be uprooted after giving a shallow irrigation. The berries and whole herb should be dried in sun and dry herb is packed in gunny bags and stored in cool and dark place.[14] Seed material for next crop should be obtained from fully matured and dry berries. After cleaning, seed should be treated with any fungicide, and then packed in polythene bags and kept at cool and dark place.Chemical Constituents: Carpesterol, solanocarpine, solasonine, solamargine and β-solamargine are the chief alkaloids of Kantkari.Yield : An average crop of Kantkari yields about 16-20 t/ha of dry biomass (Panchang) including 500 kg berries (dried) under good management practices. After drying, 15-20% dry matter can be obtained under these conditions.Panchang (whole herb including roots) and berries, have anthelmintic property, useful in bronchitis, asthma, fever relieving, thirst and given in urinary concretions.The leaves have good application for piles.The fruit is laxative.Fumigations with the vapour of the burning seeds of this plant are found useful for the cure of toothache.[15]

Results

To evaluate the antioxidant activity of alcoholic leaf-extract of *Solanum surattense* (Solanaceae) (*S. surattense*). Leaf extract were tested for *in vitro* free radical scavenging assays, such as hydroxyl radical and hydrogen peroxide, inhibition of superoxide anion radical and 2, 2-diphenyl-1-picryl hydrazyl radical (DPPH), total antioxidant activity and reducing ability. Further, total phenolic content of *S. surattense* was analyzed. *S. surattense* extract effectively scavenged free radicals at all different concentrations and showed its potent antioxidant activity. Further, these effects were in a dose dependent manner. Results were compared to standard antioxidants such as butylated hydroxytoluene, ascorbic acid and α-tocopherol. *S. surattense* have strong antioxidant potential. Further the study validates the therapeutic benefits of the Indian system of medicine.[12]

To study the phytochemical screening of different extracts from *Citrullus colocynthis* (*C. colocynthis)* seeds extracts and to assess their antioxidant activity on the DPPH free radical scavenging. Phytochemical screening, total content of polyphenols and flavonoids of *C. colocynthis*

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seeds extracts, including a crude aqueous extract (E1), a defatted aqueous extract (E2), a hydromethanolic extract (HM), an ethyl acetate extract (EA) and a n-butanol extract (n-B) was carried out according to the standard methods and to assess their corresponding effect on the antioxidant activity of this plant. None of these extracts contained detectable amount of alkaloid, quinone, antraquinone, or reducing sugar. Catechic tannins and flavonoids were abundant in E1, HM and EA, whilst terpenoids were abundantly present in E1 and n-B but only weekly in HM.[17] Coumarins were found in E2, EA and n-B. Polyphenols, expressed as gallic acid equivalent, amounted, per 100 g plant matter, to 329, 1002 and 150 mg in EA, HM an E1 respectively. Flavonoids, expressed as catechin equivalent, amounted, per 100 g plant matter to 620, 241 and 94 mg in EA, HM and E1 respectively. Comparable values were found in n-B and E1, with lower values in E2. Quercetin, myricetin and gallic acid were found in the EA and HM extracts by thin layer chromatography, The antioxidative effect of these extracts yielded, when tested at a concentration of 2 000 µg/mL in a 1,1-diphenyl-2-picrylhydrazyl assay, a reducing percentage of 88.8% with EA, 74.5% with HM and 66.2% with E1, and corresponding IC50 of 350, 580 and 500 µg/mL as compared to 1.1 µg/mL for ascorbic acid. These qualitative and quantitative analytical data document the presence in *C. colocynthis* extracts of such chemical compounds as flavonoids responsible for the antioxidant activity, as well as other biological activities of this plant.[18]

Conclusions

Medicinal plants are the spine of long-established systems of medication accepted all the way through the world. They are worthless, barely credible and conventional source for the remedial assortment of diseases in the appearance of medicines. The aim of our current study was to evaluate the antibacterial, antifungal and antiplasmodial activities property of *Citrullus colocynthis.* Phytochemical screening of *Citrullus colocynthis* revealed the presence of glycosides flavonoids, tannin alakloids and saponnin. The primary metabolites such as glycosides- flavonoids- tannin- alakloids and saponnin.[19] The activities of extract metabolites as antimicrobial, antifungal and antipalsmodial have, there been tested. Two cucurbitacin compounds (E and I) were found in fruit pulp and two (B and E) were found in fruit- rind. The highest inhibition effect against the bacteria studied were exhibited by ethanolic extracts of fruit-pulp and cucurbitacin E, where as B and I cucurbitacin showed moderate effect, cucurbitacin B and I showed a marked inhibitory effect against fungi. For antiplasmodial effect, the ethanolic extracts of the fruit-pulp at concentration of 500µg/ml, was the most active giving 100% inhibition of the parasite growth. . For antiplasmodial effect, the ethanolic extracts of the fruit-pulp at concentration of 500µg/ml, was the most active giving 100% inhibition of the parasite growth.[21]

In a study to investigate macroscopic, microscopic, qualitative phytochemical and pharmacognostic parameters of Kantakari (*Solanum surrattense* Burm f.) root, a plant species which is well mentioned in Ayurvedic classics and an important constituent of Ayurvedic combination forms i.e. laghupanchmula and dashmula. The plant is also used in preparation of variety of indigenous medicine.[22] Methods: Macroscopic, microscopic, qualitative phytochemical analysis, physiochemical analysis, extractive values in ethanol and water of the root were done. Results: Macroscopic and microscopic study showed distinct morphological characteristics in the root. Physiochemical analysis of root powder revealed, moisture content 2.1%, total ash 10.4%, acid-insolubal ash 2.7%, sulphated ash 11.33%, alcohol soluble extractive7.5%, water soluble extractive 13.6%. Alkaloids, carbohydrates, proteins, resins, saponins, steroid, tannin, starch, glycosides, flavonoids and triterpenoids were present in root extracts. Conclusions: pharmacognostic study of root is helpful in sample identification and to ensure quality and purity standards of Kantakari

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(Solanum surrattense Burm f.). The qualitative phytochemical screening is helpful in further pharmacological approaches[23]

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