



ETHNOMEDICINAL USES, PHYTOCHEMISTRY AND BIOLOGICAL ACTIVITIES OF *CITRULLUS COLOCYNTHIS* SCHRAD : AN OVERVIEW

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Abstract

Plants are used in ethnomedicine from prehistoric time due to presence of active biomolecules in them. Man depends upon plants for a variety of purposes viz. medicinal, clothing, food, fodder and fuel. Plants have been used to treat microbial infections and strengthening the immune system for health management. Plant products are easily accepted by human population for treatment of various health ailments as they are cost effective and without any side effect. *Citrullus colocynthis* Schrad (Cucurbitaceae), which is commonly called as Bitter Apple or Desert Gourd play important roles in traditional healthcare system. It is known for its anti-diabetic, anti-inflammatory, antipyretic, anthelmintic, cathartic and carminative activities; and used for blood purification, breast cancer treatment, urinary infection etc. It is abundant source of secondary metabolites like alkaloids, flavonoids, saponins, tannins, steroids, unsaturated sterols and terpenes. Some other phytochemicals viz. tocopherol, benzofuran, caffeic acid, catechin, cucurbitacin (E, B, L and I), chlorogenic acid, ferulic acid, gallic acid, hexanoic acid, isovitexin, phthalic acid and quercetin have also been reported. The phytoconstituents present in *Citrullus colocynthis* possess antimicrobial, anti-inflammatory, antioxidant, antirheumatic, anticancerous, cytotoxic, antidiarrhial, antiageing and analgesic properties. This review describes about ethnomedicinal importance, phytoconstituents present and various pharmacological activities of isolated phytochemicals from *Citrullus colocynthis* which would be helpful for researchers, scientists and pharmacologist to develop new medicines for health benefits of mankind.

Key words : Ethnomedicine, phytoconstituents, pharmacologist, *Citrullus colocynthis*.

Introduction

Primitive people chiefly depend upon on the plants for their food, healthcare and livelihood. Even today, plant products are widely accepted for treatment of various health ailments as they are cheap, easily available and with least side effects. According to WHO (World Health Organization), about 80% of the 5.2 billion people depends solely on conventional uses of plants; nearly 21,000 species of plants are used in folk medicine. Out of the total plant diversity available on earth, more than 30% have been used to treat various diseases (Khan and Iqbal, 2011). Plants are truly the “backbone” of traditional healthcare system and in developing countries about 3.3 billion people are mainly dependent on plants for their traditional uses. Semenya *et al.* (2018) reported that in South Africa about 306 plant species are used to cure the respiratory infection and other respiratory related

problems. In India, there are different system of medicinal usages like Aurveda, Unani, Homeopathy, Sidda, Amachi, Reflexology, Natropathy, Aromatherapy etc. (Gahlawat *et al.*, 2014).

The Cucurbitaceae family contains most diverse type of plant. This family includes mostly vegetables grown in summer. Cucurbits are the most common member of the family so that it is popularly known as gourd or cucurbit family (Rahman *et al.*, 2018; Kocyan *et al.*, 2007). About 130 genera and nearly 800 species are present in this family (Dhiman *et al.*, 2012). The gourd family hotspots areas included West Africa, Southeast Asia, Mexico and Madagascar (Schaefer and Renner, 2011). The family contains a number of compounds which are used for their cytotoxic, anti-inflammatory, hepatoprotective and cardiovascular effects (Dhiman *et al.*, 2012). Out of nearly 47,000 plant species present in India, about 7500 plant species have been reported for their medicinal

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Fig. 1 : *Citrullus colocynthis* (A-ripe fruit, B-dry fruit with seeds).

values; approximately 800 plant species are currently used for the preparation of modern medicines. So huge number of plant species are yet to be explored for their medicinal values.

Citrullus colocynthis Schrad commonly known as “Bitter apple” in English and “indrayan or ghorumba” in hindi is very important annual or perennial wild plant. It is found mainly in arid zones and has a great survival rate and can bear extremely harsh conditions (Loyal and John, 1898).

Scope of review

This present review describes about active phytoconstituents present in *Citrullus colocynthis* with their pharmacological activities along with its uses in traditional system of medicine. All the information have been collected from different search engines *viz.* science direct, google scholar, web of science, Scopus, pub med, Wiley online library, springer; online/offline thesis, journals, books, proceedings etc. All the collected information’s have been compiled at one place that would be helpful for researchers, pharmacologists, scientists, chemists and toxicologists for future research and development.

Origin and distribution

Citrullus colocynthis is a desert vine that grows in sandy and arid soils. It is native to dry area of North Africa or Mediterranean region and Asia. It is generally distributed in Kuwait, Iran, Arab, Pakistan, Lebanon, Afghanistan, India, and North Africa, Turkey, Jordan to Egypt, Europe, Australia and Sahel.

Classification

Kingdom	: Plantae
Sub-kingdom	: Tracheobionta

Division	: Magnoliophyta
Class	: Mangnoliopsida
Order	: Cucurbitales
Family	: Cucurbitaceae
Genus	: <i>Citrullus</i>
Species	: <i>Colocynthis</i>

Variety/synonyms

Citrullus psudocolocynthis, *Citrullus vulgaris* Schard and *Citrullus officinalis* Schard.

Vernacular name

African	: Egusi
German	: Koloquinthe
French	: Coloquinte
English	: BitterApple
Arabic	: Hindal
Urdu	: Tumba, Hanjal
Sanskrit	: Intravaruni
Hindi	: Indrayan, Ghorumba
Tamil	: Kumatti
Talgu	: Chittipapara
Bangali	: Makhhal
Gujrarati	: Indrayan
Punjabi	: Ghurumba

Botanical characters

Citrullus colocynthis is xerophytic annual or perennial creeper vine commonly known as desert gourd. Roots are large perpetual, bifurcated, long and rocky.

Table 1 : Ethnomedicinal profile of *Citrullus colocynthis*.

S. no.	Plant part	Ethnomedicinal uses	Reference
1.	Leaves	Used in diabetes and asthma treatment	Abo <i>et al.</i> (2008), Shrivastava and Roy (2013), Gurudeeban <i>et al.</i> (2010)
2.	Fruit	Used in diabetes treatment, blood purification, relieve constipation	Herbalpathy, Goldfain <i>et al.</i> (1989)
3.	Unripe green fruit	Used in tumour, leucoderma, ulcers, asthma, bronchitis, jaundice, elephantiasis, splenomegaly and tubercular glands (neck) treatment	Hutt and Houghton (1998), Nandagopalan <i>et al.</i> (2011)
4.	Root	Used for breast cancer, urinary infection and cough treatment	Shrivastava and Roy (2013), Yadav <i>et al.</i> (2006), Marzouk <i>et al.</i> (2010)
5.	Root and fruit combination	Used to treat irritation of palm of hand or sole of foot and scorpion stings bite	Shrivastava and Roy (2013), Razi <i>et al.</i> (2000)
6.	Leaf, root and flower combination	Used for jaundice, cancer, rheumatoid arthritis and constipation treatment; as an abortifacient	Nandagopalan <i>et al.</i> (2011)
7.	Seed	Used for diabetes treatment	Herbalpathy
8.	Whole plant	Has analgesic, anti-inflammatory, antipyretic, anthelmintic, carminative and cathartic activities	Torkey <i>et al.</i> (2009), Mehrzadi <i>et al.</i> (2016), Roy <i>et al.</i> (2007)

Table 2 : Phytochemical analysis of different parts of *Citrullus colocynthis*.

S. no.	Phytochemical Constituents	Fruit	Root	Leaves
1	Alkaloids	+	+	-
2	Flavonoids	+	+	-
3	Saponins	+	+	-
4	Sterols and steroids	+	+	+
5	Tannins	+	+	-
6	Unsaturated sterols and terpenes	+	+	+

Where, + indicates presence of phytochemical and – indicates absence of phytochemical.

Stem is globular, tough, slender, angular and have rough hair and branched tendril which helps in climbing. Leaves are palmate, regular and divided into 2-7 lobes. They are arranged alternately on petioles with length 5-10 cm and width 1.5-2 cm, respectively. Flower is monoecious, yellow in color, pedunculated, small, single, solitary in leaf axil. Flowering period is November to June and fruiting occurs in July to December. Fruits are globular, indehiscent, orange, yellow or green in color with surface marks, bitter in taste because of the presence of colocynth, pepo. They are usually 15-20 in number and round in shape with 7-10 cm diameter. Generally average mass of *Citrullus colocynthis* fruit is 506g and pulp mass is 50% of fruit

mass (Aviara *et al.*, 2007). Seed are numerous, compressed oblong shaped, parietal placenta, white and brown in color, hard coriaceous rind and embedded in white spongy pulp. Seed number per fruit varies from 200-300.

Ethnomedicinal uses

Citrullus colocynthis Schrad (Cucurbitaceae) is an important plant species having potential ethnomedicinal uses. Different plant parts *viz.* leaves, fruits, roots, flowers and seeds are used for the treatment of various human diseases. The ethnomedicinal uses are given in table 1.

Phytochemistry

Citrullus colocynthis is a rich source of secondary metabolites such as alkaloids, sterols, saponins, steroids, terpenes and flavonoids prepared in different solvents has been reported by various workers (Sultan *et al.*, 2010) as shown in table 2.

Biological activities

Citrullus colocynthis is useful medicinal plant due to presence of important phytoconstituents and used for the treatment of different diseases. Different phytoconstituents isolated from different parts of *Citrullus colocynthis* along with their biological activities are given in table 3.

Table 3: Biological activities of phyto-constituents of *Citrullus colocynthis* :

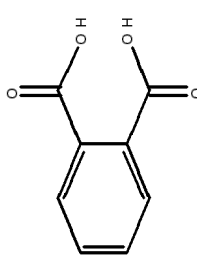
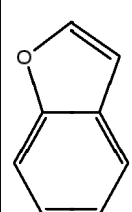
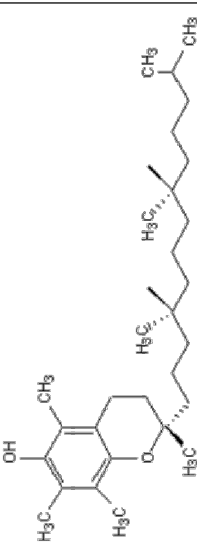
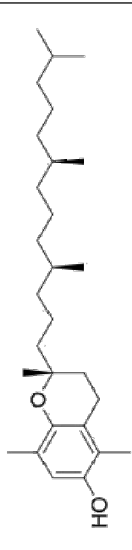

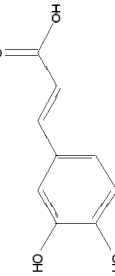
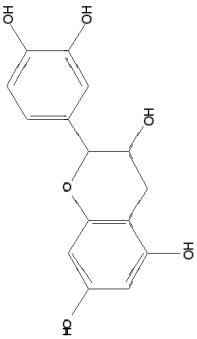
S.no.	Compound identified	Chemical Structure	Biological activities	References
1.	1,2-Benzenedicarboxylic acid		Anti- hypertension Reduce cholesterol	Idan <i>et al.</i> (2015)
2.	Benzofuran		Analgesic and anti-inflammatory	Idan <i>et al.</i> (2015)
3.	α -tocopherol		Antioxidant, anti-rheumatic	Duke (1992)
	β -tocopherol			
	γ -carotene			
4.	Caffeic acid		Antioxidant, anti-inflammatory, anticancerous, antiaging, analgesic	Duke (1992)
5.	Catechin		Antioxidant, anti-inflammatory	Duke (1992)

Table 3 continued...

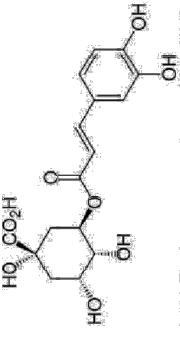
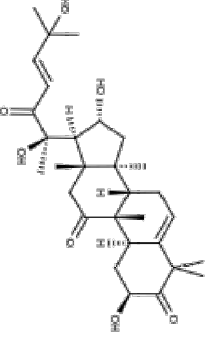
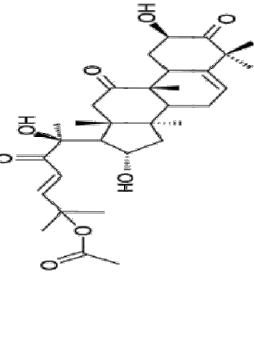
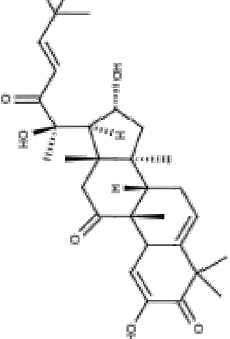
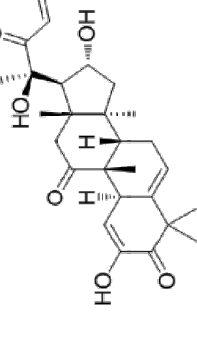

6.	Chlorogenic acid		Antioxidant	Huang and Ferraro (1992)
7.	Cucurbitacin E		Anti-microbial, anti-cancerous, cytotoxic, anti-allergic	Abdullah <i>et al.</i> (2014)
8.	Cucurbitacin B		Cytotoxic, anti-cancerous	Abdullah <i>et al.</i> (2014)
9.	Cucurbitacin II		Cytotoxic	Abdullah <i>et al.</i> (2014)
10.	Cucurbitacin L		Antimicrobial, cytotoxic	Abdullah <i>et al.</i> (2014)
11.	1,1-Cyclopropanedimethanol		Immunosuppressant and anti-tumor	Idan <i>et al.</i> (2015)

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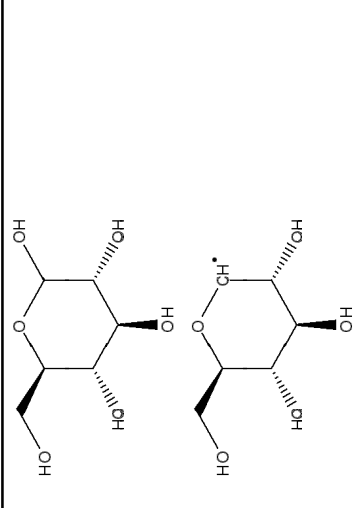
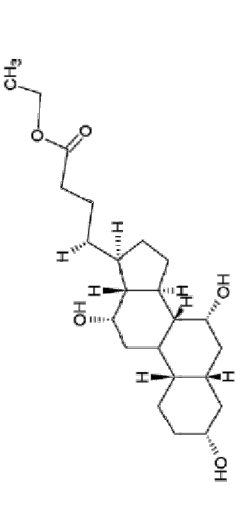
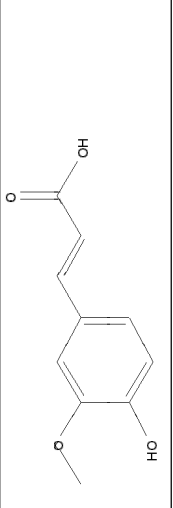
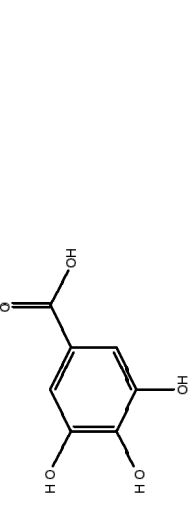
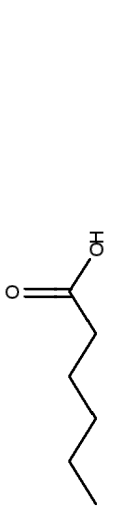
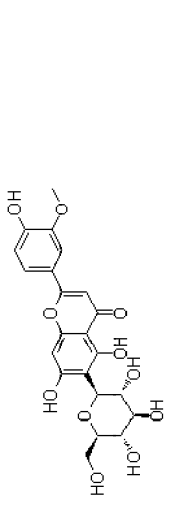
12.	D-Glucopyranoside D glucopyranosyl		Anti-microbial and anti-spasmodic	Idan <i>et al.</i> (2015)
13.	Ethyl iso-allocholate		Anti-microbial agents and anti-inflammatory activity	Idan <i>et al.</i> (2015)
14.	Ferulic acid		Antioxidant, anti-inflammatory, antiallergic	Hussain <i>et al.</i> (2013), Leung and Foster (1995)
15.	Galic acid		Anticancerous, anti-inflammatory, analgesic, floral inhibitor	Kroes (1991), Jeffery <i>et al.</i> (1983)
16.	Hexanoic acid		Antifungal activity	Idan <i>et al.</i> (2015)
17.	Isorientin3-o-methyl ether		Antioxidant	Duke (1992)

Table 3 continued...

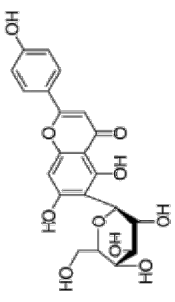
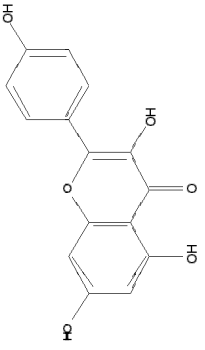
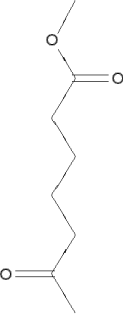
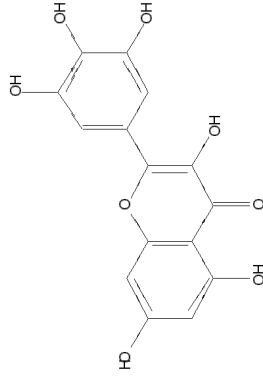
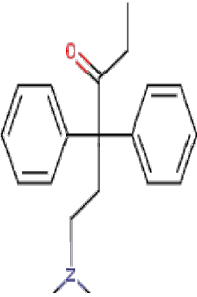
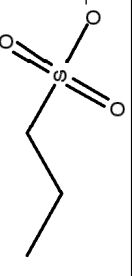
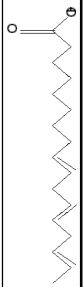
18.	Isovitexin		Antioxidant	Nigg and Seigler (1992)
19.	Kaempferol		Antioxidant, anticancerous, anti-inflammatory, antiallergic	Duke (1992)
20.	Methyl 6-oxoheptanoate		Anti-cancer activity	Idan <i>et al.</i> (2015)
21.	Myricetin		Antioxidant	Duke (1992)
22.	Normethadol		Antioxidant activity	Idan <i>et al.</i> (2015)
23.	Propanesulfonate		Anti-scaling agents	Idan <i>et al.</i> (2015)
24.	Octadecanoic acid		Antimicrobial and anti-inflammatory	Idan <i>et al.</i> (2015)
25.	9,12,15-Octadecatrienoic acid		Anti-inflammatory and anti-atherogenic properties	Idan <i>et al.</i> (2015)

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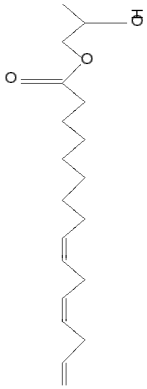
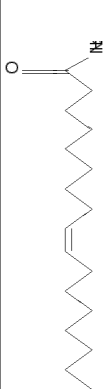
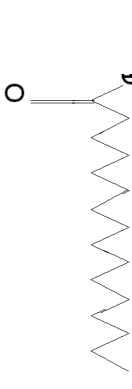
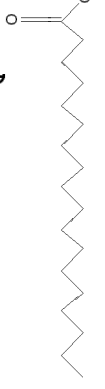
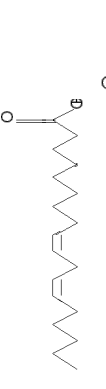
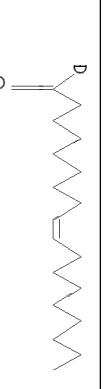
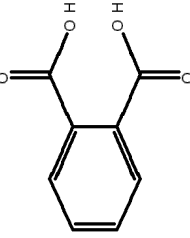
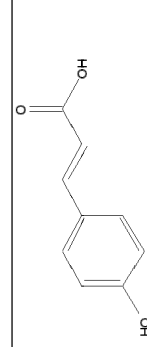
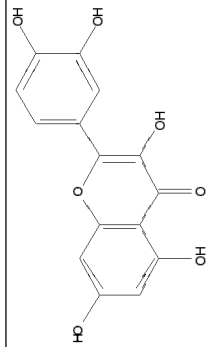
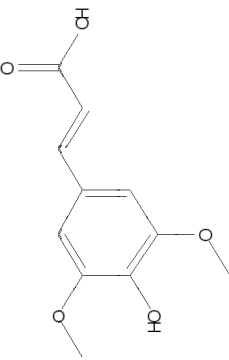
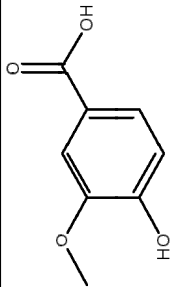
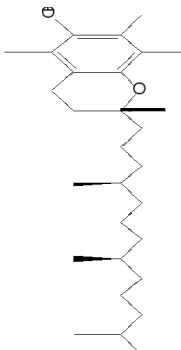
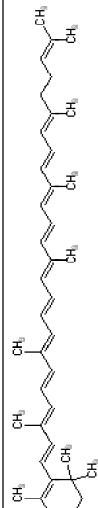
26.	9,12,15-Octadecatrienoic acid, 2,3,-dihydroxypropyl ester		Anti-inflammatory and CNS depressant activity	Idan <i>et al.</i> (2015)
27.	9-Octadecenamide,(z)-		Anti-inflammatory activity, antibacterial activity	Idan <i>et al.</i> (2015)
28.	Palmitic acid		Larvicidal activity	Idan <i>et al.</i> (2015)
	Stearic acid			
	Linoleic acid			
	Oleic acid			
29.	Phthalic acid		Anti-hyper cholesterol, Biological activities like antimicrobial, antifungal and antioxidant activity	Idan <i>et al.</i> (2015)
30.	p-Coumeric acid		Antioxidant	Duke (1992)
31.	Quercetin		Antioxidant, antidiabetic, anti-inflammatory antiaging, analgesic	Duke (1992)

Table 3 continued...

32.	Sinapic acid		Antioxidant	Duke (1992)
33.	Triazido-(1,2,3,4,5-pentamethyl)cyclopent	-	Anti-inflammatory	Idan <i>et al</i> (2015)
34.	Vanillic acid		Antioxidant	Duke (1992)
35.	Vitamin E		Antioxidant activity	Idan <i>et al</i> (2015)
36.	γ-tocopherol		Antioxidant activity	Idan <i>et al</i> (2015)

Conclusion

After analysis of the available literature; it is concluded that root and fruits of *Citrullus colocynthis* are the most widely used in ethnomedicine viz. diabetes, tumour, leucoderma, ulcers, asthma, bronchitis, jaundice, elephantiasis, splenomegaly, breast cancer, urinary infection and cough treatment. They are used to treat irritation in palm of hand or sole of foot, blood purification and scorpion stings bite. Alkaloids, sterols, saponins, steroids, flavonoids, terpenes and simple phenolics are the dominant phytoconstituents of this plant. Additionally pure compounds such as isovitexin, kaempferol, phthalic acid, quercetin, sinapic acid, vanillic acid, vitamin E, vanillic acid, benzofuran, caffeic acid, catechin, gallic acid, ferulic acid, palmitic acid, myricetin, normethadalm etc. were identified as biologically active compounds. As this plant ratify many traditional uses further research, clinical and in vivo trials should be taken along in future directions. However seasonal and geographical variation could play an important role for the authentication of the phytoconstituents that are responsible for biological activities. Further research and trails should be under taken for the better therapeutic and economic utilization of *Citrullus colocynthis*.

Authors contribution

DG collected information from different online as well offline sources, designed, prepared, and interpreted the available literature, Ashmita collected data on ethnomedicinal uses and contributed in editing of manuscript, PD drafted the manuscript and give the final approval to manuscript to be published.

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