

Pharmacognostical and phytochemical evaluation of *Cactus grandiflorus* (L.) Britton and Rose

Rajat Rashmi¹, Divya Mishra¹¹Department of Pharmacognosy, Homoeopathic Pharmacopoeia Laboratory, Government of India, Ministry of AYUSH, Ghaziabad, Uttar Pradesh, India

Abstract

Background: *Cactus grandiflorus* (L.) Britton and Rose, Family: *Cactaceae* is an evergreen shrub with creeping aerial roots, used in Homoeopathy for atheromatous arteries, angina pectoris, and constriction of heart muscles, endocarditis, and heart weakness due to arteriosclerosis. Flowering stems are used in the preparation of medicine. **Objective:** The pharmacognostic and phytochemical studies are carried out to facilitate identification of correct species and standardized raw materials. **Materials and Methods:** Pharmacognostic studies of stem of authentic samples of *Cactus grandiflorus* (L.) Britton and Rose have been carried out according to Trease and Evans, 1983, and Youngken 1959. To determine physicochemical constants, Indian Pharmacopoeia, 1970, was consulted and preliminary phytochemical properties were studied as per methods described by Trease and Evans, 1983. **Results:** Stem available in segments of variable length and thickness, roundish structure with 5 or 6 ridges and furrows with aerial roots, isodiametric cavities in cortex containing mucilage; aggregates of acicular and rhomboidal calcium oxalate crystals scattered in parenchymatous region are the key identification characteristic. Thin layer chromatography of chloroform extract of mother tincture reveals five spots with blue and violet colors. **Conclusion:** The macroscopic, microscopic, physicochemical, and phytochemical analysis of the authentic raw material were indicative to establish the standards for ensuring quality and purity of the drug.

Key words: *Cactus grandiflorus* (L.) Britton and Rose, Homoeopathy, Pharmacognosy, Physicochemical studies, Phytochemical studies

INTRODUCTION

Family *Cactaceae* composed of about 130 genera and nearly 1500 species belonged to arid lands and adopted to diversity of climates in all over the world, including India.^[1-4]

Cactus grandiflorus (L.) Britton and Rose (synonyms: *Selenicereus grandiflorus* L., *Cereus grandiflorus* Mill) is a native of Mexico and introduced in Indian gardens, commonly known as night-blooming cereus. It is an evergreen, succulent shrub with creeping aerial roots and is usually a “functional epiphyte” meaning the plant can thrive either as an epiphyte or a terrestrial plant. Stem green to bluish-green, becoming purplish along the ribs, branching, succulent, 5 or 6 angled and armed with clusters of short radiating spines or bristles. The prefix “Seleni” in the botanical name refers to the moon, in allusion to the nocturnal blooms, which are very large and full-bodied, terminal or lateral from the cluster of spines, large having a sweet-smelling vanilla-like fragrance, white in color, about 30 cm in diameter, opening only once in evening and closing again before morning [Figure 1a].^[5]

History shows the traditional use of night blooming cereus for the treatment of hemoptysis (coughing up blood from the lungs) and edema (swelling of soft tissues due to the accumulation of excess water). The indigenous people of America have used the night blooming cereus as a topical remedy for rheumatism and itchy rashes; it is also used as internal herbal remedy for worms, cystitis, and fever. The Death Valley Shoshone tribe called this plant “pain in the heart” and used for heart diseases and several other tribes of native Americans use the stem to treat diabetes.^[5]

Drug contains about 8 glycosylated flavonoids: narcissin (isorhamnetin-3- β -rutinoside), cacticin (isorhomnetin-3- β -galactoside), rutoside (rutin or quercetin-3-rutinoside),

***Address for correspondence:** Dr. Rajat Rashmi, Pharmacognosy Section, Homoeopathic Pharmacopoeia Laboratory, Government of India, Ministry of AYUSH, Near National Test House, Kamla Nehru Nagar, Ghaziabad - 201 002, Uttar Pradesh, India.
E-mail: rajatrashmi11@gmail.com

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hyperoside (hyperin or quercetin-3- β -D-galactopyranoside), kaempferitrin (kaempferol-3- β -L-arabinoside), isorhamnetin-3-O- β -(xylosyl)-rutinoside, and isorhamnetin-3-O- β -(galactosyl)-rutinoside. In addition, biogenic amines such as tyramine, N-methyltyramine, and N,N-dimethyltyramine (hordenine) have also been found. Further constituents of *C. grandiflorus* (L.) Britton and Rose are mucus, fat, wax, and resinous glycosides.^[6]

For preparation of medicines in Homoeopathy, Flowering Stem is used.^[7] Its authority was mentioned in Allen, T. F., Encyclopedia of Pure Materia-Medica, 1874; Boericke W. Pocket Manual of Homeopathic Materia Medica and Repertory, 2000; Bradford, T. L., Index to Homoeopathic Provings, 1901; Clarke, J. H., A. Dictionary of Practical Materia Medica, 1900^[8-11] for action in the incipency of cardiac incompetence, heart weakness of arteriosclerosis, on circular muscular fibers, and hence constrictions. It is the heart and arteries, especially that at once respond to the influence of *C. grandiflorus* (L.) Britton and Rose, producing very characteristic constrictions as of an iron band.^[9] In view of the importance of the drug, pharmacognostic and phytochemical studies of stem are carried out to lay down the standards.

MATERIALS AND METHODS

The authentic sample of stem of *C. grandiflorus* (L.) Britton and Rose was taken from repository and herb garden of Homoeopathic Pharmacopoeia Laboratory, Ghaziabad (Uttar Pradesh), India. All the chemicals and reagents used in the study were of extra pure and of analytical grade. Dried samples of the stem were spread on a clean dry plastic sheet and were investigated for different organoleptic features, namely, condition, thickness, color, odor, taste, and fracture by repeated observations up to 2–3 times using a magnifying glass (where required) and recorded. Free-hand section was taken, stained with safranin and fast green and examined under digital microscope and photographed as per Trease and Evans 1983^[12] and Youngken 1959.^[13] To determine physicochemical constants for finished product (mother tincture), Indian Pharmacopoeia 1970,^[14] was consulted and mother tincture is prepared as per Homoeopathic Pharmacopoeia of India (1978).^[7] Preliminary phytochemical properties were

studied as per methods described by Trease and Evans 1983, and Youngken 1959.^[12,13]

OBSERVATION AND RESULTS

Drug Evaluation

Macroscopical evaluation

Stem available in segments of variable length, thickness, with 5 or 6 angles or ribs, having tufts or clusters of 9–15 acicular spines, spines up to 2–5 mm in length and bears aerial roots, color dark green; odor not peculiar; taste mucilaginous and acid [Figure 1b].

Microscopical evaluation

Epidermis in surface view shows sunken, diacytic stomata, simple circular or oval dermal pores; spine multicellular, multiseriate, containing elongated tapering cells with micro hairs; transection shows roundish structure with 5 or 6 ridges and furrows; epidermis single layer of papillose cells, covered with thick cuticle; followed by three or four layers of sclerenchymatous hypodermis; cortex consists of loosely arranged, irregular shaped parenchyma and oval, isodiametric cavities containing mucilage; aggregates of acicular and rhomboidal calcium oxalate crystals scattered in parenchymatous region; vascular bundles conjoint, collateral, open and arranged in a ring; cambium three or four layered; pericycle sclerenchymatous; phloem containing phloem parenchyma, sieve tube; companion cells; xylem with thick-walled xylem parenchyma, vessels with scalariform thickening; medullary rays 6–8 seriate with lignified cells; pith small, parenchymatous containing mucilage cavities and aggregates of acicular and rhomboidal calcium oxalate crystals [Figures 2 and 3].

Physicochemical analysis (for finished product standard)

The analytical values in respect of physicochemical constant of finished product were established and results of alcohol content, pH, specific gravity, total solid, and λ max are listed in Table 1.

Chemical analysis

Preliminary phytochemical test

Phytochemical screening for the presence and absence of alkaloids, flavonoids, phenolics, sterols, saponins,



Figure 1: (a) Plant in earthen pot in garden. (b) Raw drug in dry form

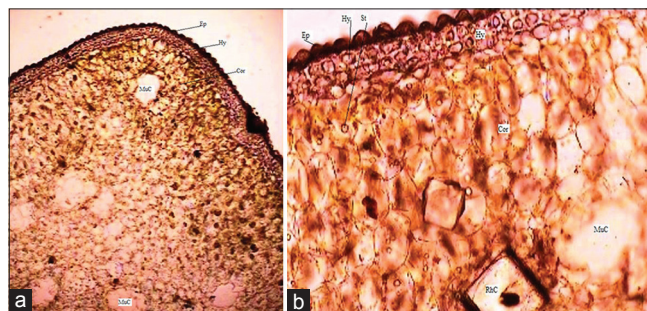


Figure 2: (a) Transection of stem through ridge. (b) Outer cortex of stem with large rhomboidal crystal

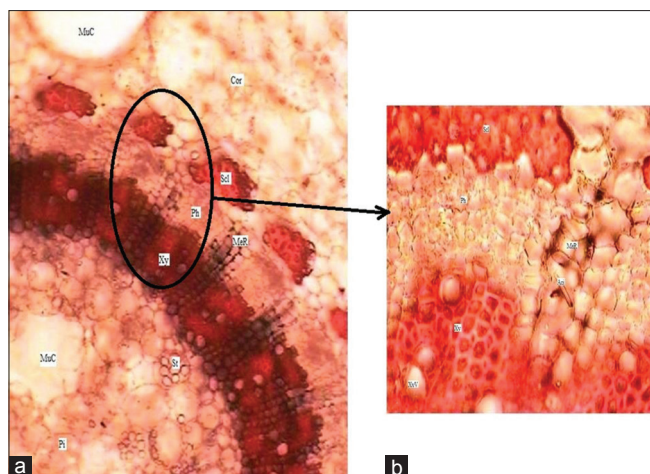


Figure 3: Transection showing Stellar region. (a) Enlarged view of stele. (b) Enlarge vascular bundles showing acicular crystal in medullary rays

carbohydrates, fixed oil and fats, proteins and amino acids, anthraquinone, gum and mucilage, tannins, and starch with specific reagents. Results are tabulated in Table 2.

Thin layer chromatography

Extract the powdered drug with 70% ethanol. Evaporate 20 ml mother tincture on water bath to remove alcohol. Make it alkaline with ammonia solution and extract with 3 × 20 ml chloroform. Concentrate the chloroform layer to 1 ml and carry out thin layer chromatography of chloroform extract of mother tincture on silica gel 60 F₂₅₄ precoated aluminum plate using chloroform: methanol (9:1 v/v) as solvent system. Under ultraviolet light (366 nm) five spots appear at R_f = 0.26 (blue), 0.31, 0.39 (both violet), and 0.59 and 0.72 (both blue). After spraying the plate with anisaldehyde–sulfuric acid reagent, five spots appear at R_f = 0.44 (purple), 0.50 (blue), and 0.58, 0.72, and 0.83 (all purple). Results are tabulated in Tables 3 and 4.

DISCUSSION

As the drug is very rare, it is generally adulterated with frequently found other species of *Cactus*, *Opuntia*, etc., in India.^[15,16] Some spiny *Euphorbia* species such as *Euphorbia royleana* Boiss are also added as an adulterant.^[14] Morphologically, it can be differentiated by the presence of aerial roots, number of stem angles and arrangement of spines on stem. Microscopical key characteristic features are the presence of rhomboidal Ca-oxalate crystals and large mucilage cavity in comparison to other *Cactus* species. *Euphorbia* species can be identified by the absence of mucilage as the latex is a characteristic feature of *Euphorbiaceae*.^[17] Details are given in Table 5.

CONCLUSION

The present study on pharmacognostical and phytochemical characters of *C. grandiflorus* (L.) Britton and Rose stem

Table 1: Physicochemical properties of Mother Tincture (ø) of *Cactus grandiflorus* (L.) Britton and Rose

Physico-chemical Constants	Analytical values
Alcohol content, % v/v	68.0 to 72.0
pH	5.5 to 6.0
Specific gravity, g	Not less than 0.860
Total solids, % w/v	Not less than 0.4
λ max, nm	260 and 268 nm

Table 2: Phytochemical screening of stem of *Cactus grandiflorus* (L.) Britton and Rose

Phyto-constituents	Test performed	Results
Alkaloids	Dragendorff's test	+ ve
Flavonoids	Lead acetate test	+ ve
Phenolics	Ferric chloride test	+ ve
Sterols	Liebermann-Buchardt test	-ve
Saponins	Alc. ext. + acetic anhydride + H ₂ SO ₄	-ve
Carbohydrates	Molisch test	+ ve
Fixed oil and fats	Sudan IV	+ ve
Proteins and amino acids	Million's test	+ ve
Anthraquinone	Borntrager reaction	- ve
Gum and mucilage	Swelling test	+ ve
Tennins	FeCl ₃	- ve
Starch	Weak Iodine Solution	+ ve

Table 3: R_f values of Mother Tincture (ø) of *Selenicereus grandiflorus* (L.) Britton and Rose (CHCl₃: CH₃OH; 9:1 v/v)

Colour of Spot	R _f Value
Blue	0.26
Violet	0.31
Violet	0.39
Blue	0.59
Blue	0.72

Table 4: After spraying the plate with anisaldehyde sulphuric acid reagent

Colour of Spot	R _f Value
Purple	0.44
Blue	0.50
Purple	0.58
Purple	0.72
Purple	0.83

provides useful information with regard to its correct identity and helps to differentiate it from the closely related other species of *Cactus*, *Opuntia*, and spiny *Euphorbia*, and it will help to achieve the desired therapeutic value of the drug.

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Table 5: Difference among authentic drug and adulterants:

<i>Cactus grandiflorus</i> (L.) Britton and Rose	<i>Opuntia</i> spp.	<i>Euphorbia</i> spp.
Stem round and 5-6 angled	Palm like flat stem	Stem conical or angled number of angles may differ
Arial root present	Absent	Absent
Spines present on ridges in clusters of 9-15 at each spine base	Spines distributed	Spine solitary, stipular or number may be differ
Epidermis pepillose with very thick cuticle	Epidermis single layered, papillae absent	Epidermis single layered, papillae absent
Hypodermis sclerenchymatous, 2 layered of radially broad cells followed by parenchymatous cortex	Hypodermis single layer of Collenchymatous or sclerenchymatous cells, followed by parenchymatous cortex	Hypodermis Collenchymatous, single layered followed by parenchymatous cortex
Cortex contains acicular and large rhomboidal crystals of Calcium oxalate	Cortex contains large number of rosette ca-oxalate crystal	Crystals absent
Large mucilaginous cavity present in cortex	Mucilage canal present but small and lesser in number, Water containing cells present in cortex	Mucilage cavity/canal absent, Latex cells or ducts present
A cylinder of radially elongated vascular bundles with pericyclic patches of sclerenchymatous cells	Vascular bundles scattered, vessels with scalariform thicking	Vascular bundles arranged in ring or scattered

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Conflicts of Interest

There are no conflicts of interest.

REFERENCES

- Griffith MP. The origins of an important cactus crop, *Opuntia ficus-indica* (Cactaceae): New molecular evidence. *Am J Bot* 2004;91:1915-21.
- Inglese P, Basile F, Schirra M. Cactus pear fruit production. In: Nobel PS, editor. *Cacti: Biology and Uses*. Berkeley, California: University of California Press; 2002. p. 163-79.
- Osuna-Martínez U, Reyes-Esparza J, Rodríguez-Fragoso L. Cactus (*Opuntia ficus-indica*): A review on its antioxidants properties and potential pharmacological use in chronic diseases. *Nat Prod Chem Res* 2014;2:153.
- Saenz C. Processing technologies: An alternative for cactus pear (*Opuntia* spp.) fruits and cladodes. *J Arid Environ* 2000;46:209-25. Available from: <http://www.sciencedirect.com/science/article/pii/S0140196300906761>. [Last accessed on 2015 Dec 24, 3:15 pm].
- Anonymous. Online Link. Available from: <http://www.herbal-supplement-resource.com/night-blooming-cereus.html>. [Last accessed on 2015 Dec 24, 1:18 pm].
- Anonymous. Online Summary Report. Committee for Veterinary Medicinal Products: *Cactus grandiflorus*. The European Agency for the Evaluation of Medicinal Products Veterinary Medicines Evaluation Unit; 1999. Available from: <http://www.EMA/MRL/601/99-Final>. [Last accessed on 2015 Dec 24, 1:18 pm].
- Homoeopathic Pharmacopoeia of India. Vol. 1. New Delhi: Ministry of Health and Family Welfare, Government of India; 1971.
- Allen TF. *Encyclopedia of Pure Materia Medica*. Vol. 2. Boericke & Tafel, Philadelphia, New York, 1874. p. 321.
- Boericke W. *Pocket Manual of Homeopathic Materia Medica and Repertory*. New Delhi: B. Jain, Publishers (Pvt.) Ltd.; 2000. p. 186.
- Bradford TL. *Index to Homoeopathic Provings*. Boericke & Tafel, Philadelphia, New York, 1901. p. 79.
- Clarke JH. *A Dictionary of Practical Materia Medica*. Vol. 1. B. Jain Publishers. Pvt. Ltd., New Delhi; 2000. p. 323.
- Trease GE, Evans WV. *Pharmacognosy*. 12th ed. London: Bailliere Tindall; 1983.
- Youngken HW. *Textbook of Pharmacognosy*. 6th ed. New York, London: McGraw-Hill Book Company, Inc.; 1959. p. 579.
- Anonymous. *Indian Pharmacopoeia*. New Delhi: Government of India; 1970.
- Mathur RC. *Systematic Botany (Angiosperms)*. 6th ed. Agra: Revised and Enlarged, Agra Book Store; 1976. p. 164, 185.
- Wren RC. *Potter's New Cyclopedia of Botanical Drugs and Preparations*. New Delhi: Jain Publishing Co.; 1983. p. 217.
- Somavarapu S, Reddy IB, Naidu MP. A study on plant latex, a rich source of proteases and cutting edge for disease invasion. *World J Pharm Res* 2015;4:1696-711.

कैक्टस ग्रैंडीफ्लोरस एल. का फार्माकोगनोसटीकल एवं पादपरासायनिक (फाइटोकेमिकल) आंकलन

पृष्ठभूमि: कैक्टसी वर्ग का कैक्टस ग्रैंडीफ्लोरस (एल.) फैली हुई वायवीय जड़ों वाली एक सदाबहार झाड़ी है, जोकि मेदाबुर्दग्रस्त धमनियों, हृदयशूल और हृदय की मांस पेशियों की सिकुड़न, अंतर्हृदशोथ, धमनीकाठिन्य के कारण हृदय कमजोरी में उपयोग की जाती है। औषधि को बनाने में फूल वाले तने का प्रयोग किया जाता है।

उद्देश्य: सही प्रजातियों और मानक अनिर्मित सामग्री (रॉ मटेरियल) की पहचान को सुगम बनाने हेतु फार्माकोगनोसटीकल एवं फाइटोकेमिकल अध्ययन किये गए हैं।

सामग्री और विधि: ट्रीस और इवान्स, 1983, एवं यंगकीन 1959 के अनुसार कैक्टस ग्रैंडीफ्लोरस एल. के विशुद्ध नमूनों के तने का फार्माकोगनोसटीक अध्ययन किया गया। भौतिक रासायन स्थिरांक को निर्धारित करने हेतु भारतीय औषधकोश (1970) का मत लिया गया और ट्रीस और इवान्स (1983) द्वारा निर्दिष्ट पद्धतियों के अनुसार प्रारंभिक फाइटोकेमिकल गुणों का अध्ययन किया गया।

परिणाम: तने विभिन्न लम्बाई और मोटाई के भागों में उपलब्ध होते हैं, वायवीय जड़ों सहित 5 या 6 ऊबड़ खाबड़ परत के साथ गोलाकार संरचना के होते हैं, छाल में लसदार पदार्थ से भरे लगभग गोलाकार छिद्र होते हैं; जीवितक युक्त क्षेत्र में सुई आकार एवं चतुष्कोणी कैल्शियम ऑक्सालेट के एकत्रित फैले हुए टोस कण पहचान के प्रमुख लक्षण हैं। मदर टिंचर के क्लोरोफॉर्म सत्व के टीएलसी में नीले और बैंगनी रंग के पांच धब्बे प्रकट होते हैं।

निष्कर्ष: विशुद्ध अनिर्मित सामग्री के स्थूल, सूक्ष्म, भौतिक-रासायनिक और फाइटोकेमिकल विश्लेषण से औषधि की गुणवत्ता और शुद्धता सुनिश्चित करने हेतु मानकों को स्थापित करने के संकेत मिलते हैं।

Evaluación farmacognósica y fitoquímica de *Cactus grandiflorus* L.

RESUMEN

Fundamento: *Cactus grandiflorus* L., Familia: Cactaceae, es un arbusto perenne con raíces aéreas trepadoras, que se utiliza en homeopatía para arterias ateromatosas, angina de pecho y constricción del miocardio, endocarditis y debilidad cardíaca por arteriosclerosis. En la preparación del medicamento, se utilizan el tallos de floración.

Objetivo: Realizar estudios farmacognósicos y fitoquímicos para facilitar la identificación correcta de la especie y de la materia prima estandarizada.

Material y métodos: Los estudios farmacognósicos del tronco de las muestras auténticas de *cactus grandiflorus* L. se han realizado conforme a Trease y Evans, 1983 y Youngkeen 1959. Para determinar las constantes físico-químicas, se consultó la Farmacopea India (1970) y se estudiaron las propiedades fitoquímicas preliminares mediante los métodos descritos por Trease y Evans (1983).

Resultados: Las características de identificación clave en los segmentos de diferentes longitudes y grosores de los troncos disponibles son una estructura redondeada con 5 o 6 crestas y surcos con raíces aéreas, cavidades isodiamétricas en la corteza que contienen mucílago y agregados de cristales de oxalato cálcico aciculares y romboidales dispersos en la región parenquimatosa. La tomografía en capa fina del extracto de cloroformo de la tintura madre mostró cinco puntos con colores azules y violetas.

Conclusiones: El análisis macroscópico, microscópico, físico-químico y fitoquímico de la materia prima auténtica fueron indicativos para establecer los estándares y asegurar la calidad y pureza del medicamento.