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A comprehensive review on phytochemical and pharmacological properties of *Opuntia elatior* (Hathlo-thore)

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Abstract
Opuntia elatior Mill., a member of Cactaceae family known as Nagaphani, Hathlo-thore or prickly pears has been reported for its traditional uses as a medicinal plant. The presence of potentially active nutrients and their multifunctional properties make *Opuntia spp*. fruits and cladodes perfect candidates for the production of phytopharmaceutical products. It is used traditionally as remedy in different disease conditions like anaemia, hyperglycemia, antihyperlipidemic, asthma, analgesic, antiinflammatory, anticancer, and - hypercholesterolemic, antioxidant, antiulcer, antiviral, diuretics, immunomodulatory, improve platelet function, neuroprotective, wound healing, monoamino-oxidase inhibitor, and nutritional important etc. by tribal of Rajasthan and Gujrat. It is important to clarify these health benefits to public due to the increasing need for prevention and treatment of chronic diseases. Although it is used widely around the country, single hand information about its ethno-botanical, phytochemical and pharmacological action is still lacking. Traditionally appreciated for its pharmacological properties by the various researcher cactus pear is still hardly recognized because of insufficient scientific information. The aim of this review is to summerised all the traditional property of *Opuntia elatior*. cacti fruit, leaf and combined or unidentified Opuntia spp. products

Keywords: *opuntia elatior*, medicinal plant, hyperglycemia, hathlo-thore, phytochemical

1. Introduction
Herbal Medicines:
The use of herbal drugs and phytoconstituents or nutraceuticals continues to expand rapidly across the globe with many people now resorting to these products for treatment and prevention of various health issues in different national healthcare systems [1]. There are many different systems of traditional medicine, and the philosophy and practices of each are influenced by the prevailing conditions, environment, and geographic area within which it first evolved [2]. Herbal medicinal system has been postulated and established through empirical observation and trial and error experiments since time immemorial to maintain good health and alleviate ailments and diseases [3]. Medicinal plant products and Phytotherapy have a long tradition history of use in India as well as other countries., although proper scientific explanation is relatively new. The status of herbal medicine has been fast growing all over the world during the last few decades. Although some herbal medicines have promising potential and are widely used, many of them remain untested and their use also not monitored [1]. Many conventional drugs originate from plant sources: a century ago, most of the few effective drugs were plant-based. The development of drugs from plants continues, with drug companies engaged in large-scale pharmacologic screening of herbs [4].
Despite the fact that medicinal plant use has been an old habit in most communities, the emergence of drug and multi drug resistant strains of microorganisms have even opened a more wider window for continued research and discoveries on medicinal plants. Also many Society in developing country are keen into medicinal plant utilization due to the increase rates of poverty rates and therefore this needs scientific knowledge mainly in deducing their efficacies to treatment of such disease [5].
A traditional medicinal plant, widely distributed in the Rajasthan, known as Cactus, Prickly pears or Hathlo thore, Botanically identified as *Opuntia elatior* Mill. of family Cactaceae [6]. This family contain near about 127 genera including the genus *Opuntia* and nearly 1750 known species [7]. Cactaceae family or opuntia plant tolerates a variety of growing conditions, it is well adapted to arid and semiarid climates, where irrigation shall be a limiting factor for cultivation. It is found that all cacti in India did not belong to one species, but to three or four species distributed over different regions in India [8].

Habitat
Opuntia elatior is a large, succulent shrub, trunk-forming, segmented cactus that may grow to 5–7 m (16–23 ft) with a crown of possibly 3 m (9.8 ft) in diameter and a trunk diameter of 1 m (3.3 ft). [9] Cladodes are green to blue-green, bearing few spines up to 2.5 cm (0.98 in) or may be spineless. Prickly pears typically grow with flat, rounded cladodes (also called platyclades) containing large, smooth, fixed spines (2-5 on each areole) and small, hairlike prickles called glochids that readily adhere to skin or hair, then detach from the plant. The flowers are at first yellow, than convert into pink or red colour, typically large, axillary, solitary, bisexual, and epiperigynous, with a perianth consisting of distinct, spirally arranged tepals and a hypanthium. The stamens are numerous and in spiral or whorled clusters, and the gynoecium has numerous inferior ovaries per carpel. Placentation is parietal, and the fruit is a berry with arillate seeds. Prickly pear species can vary greatly in habit; most are shrubs, but some, such as *Opuntia*

echios are trees [10, 11, 12].

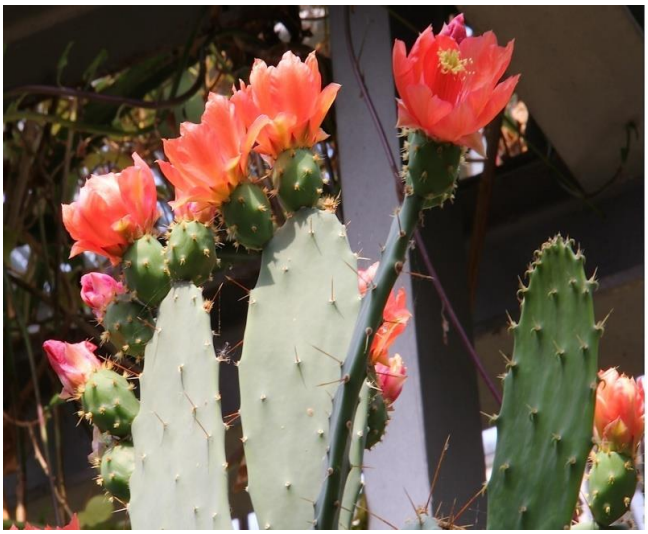

Fig 1: Opuntia elatior Plant

Plant Classification:
Kingdom: Plantae
Phylum: Spermatophyta
Subphylum: Angiosperms
Class: Dicotyledonae
Subclass: Eudicots
Order: Caryophyllales
Family: Cactaceae
Subfamily: Opuntioideae
Genus: *Opuntia*
Species: O. elatior
Synonyms: English: Prickly pear, Slipper Thorn, Hindi: Haththathoira, Fafda thor, Nagphana, Nagphani Kannada: Paapaskalli Sanskrit: Bahudugdhika, Bahushala, Dondavrikshaka, Guda, Gula, Kandarohaka. [13].
Many species of Opuntia e.g O. ficus indica, O. dillenii. O. elatior, were reported for their various Traditional-medicinal uses, and still have not been reported for its phyto-chemistry and pharmacological property. In this review, an attempt has been made to gather all the ethno-medicinal uses, phytochemical and pharmacological properties of Opuntia elatior.

Materials and methods
In this review paper O. elatior mill was studied from various available literatures, journals books, with regards to its Pharmacognostical profile, Phytochemistry and traditional ethno-medicinal uses and latest research carried out on its pharmacological properties.

Ethno-Medicinal Uses
Various species of Opuntia e.g O. ficus indica, O. dillenii. O. elatior, whole or their parts like, phylloclade, fruit, stem, flowers, leaves and thorns were reported for their traditional-medicinal uses. O. elatior is used traditionally as remedy in different disease conditions like abscess & wound, burning sensation in the stomach, diphtheria [14], anaemia, hyperglycemia, antihyperlipidemic [15, 16, 17]. analgesic, antiinflammatory, anticancer and hyper cholesterolemic, antioxidant, antiulcer, antiviral, diuretics [18], asthma, cough, refrigerant, gonorrhea, Ophthalmia [19]. Antileukemic [20]. immunomodulatory, antiasthmatic, improve platelet function, neuroprotective, wound healing, monoamino-oxidase inhibitor, and nutritional important etc. by tribal of Rajasthan [21]. Beside its uses it can cause severe skin irritation and eye damage if not taken in proper form. [22].

Phytochemical study
The phytochemical analysis of the Opuntia fruit showed the presence of pectin, flavonone, carbohydrates, tannins, sterols, flavonoids, proteins, betanin pigment, total phenolic, citric acid and vitamin C. [23, 24]. Its stem contain flavonoid, carbohydrate, tannin, protein and pectin compounds. The seed oil extracted from O. elatior Mill. have acid value, iodine value, saponification value, unsaponifiable matter and fatty acid composition. [22, 25]. Flower contains flavonoids, glycosides of iso-rhamnetin, uercetin, iso-uercitrin and narcissi [26]. The plant also contains β-sitosterol, opuntiol and opuntiol acetate. Other phytochemical components (biopeptides, soluble fibers) have been characterized and contribute to the medicinal properties of Opuntia spp [27]. A polysaccharide containing galactose and arabinose in 3:1 molar ratio has been isolated from pods [6, 28].

Table 1: Phytochemical components present in the whole fruit extract of *Opuntia elatior*

S.No	Compounds	Present/ Absent
1	Alkaloids	Present
2	Carbohydrates	Present
3	Fats and oils	Present
4	Reducing Sugar	Absent
5	Flavanoids	Present
6	Phenolics	Present
7	Saponin	Present
8	Steroids	Present
9	Tannins	Present
10	Amino Acid	Present

Pharmacological Properties
Acute and long-term toxicity study
Oral acute toxicity study was calculated by administering the juice once only at the dose of 20.0 ml/kg orally in rats. For long-term toxicity, O. elatior fruit juice was administered at the three different dose levels of 1.8, 9.0, and 18.0 ml/kg orally for 60 alternate days in rats following WHO guideline. The effects of the drug on ponderal changes, hematological, biochemical, and histological parameters were noted down. Results show no significant behavioral changes and sign symptoms of toxicity were observed during acute oral toxicity study implicating that the sample is relatively safe at 20.0 ml/kg. Long-term toxicity results showed that O. elatior fruit juice even at a higher dose of 18.0 ml/kg administered for 60 days, did not affect the parameters studied to a significant level in rats [29, 30].

Antioxidant activity
Medicinal plant Opuntia elatior Mill., family Cactaceae, was studied for its nutritional value and health benefit properties from fruit. *Opuntia* is a good source of vitamin C this helps increase antioxidant properties and reduces the risk of diseases such as atherosclerosis and cancer. Vitamin C is an electron donor. As an electron donor, it helps stabilize unpaired electrons in the body and reduces oxidative stress.

The Opuntia protects cells against oxidative damage, acts as radical scavengers, reduces lipid peroxidation and increases GSH levels [31]. The fruit of the plants was extracted in sequential manner using methanol, hexane and distilled water. Methanolic extract exhibits the highest antioxidant activity that is 54.10% and the lowest antioxidant activity is exhibited by the hexanoic extract at 45.66% and the distilled water at 50.40% of antioxidant activity. The methanolic extracts of fruits containing high content of protein, vitamin-C and carbohydrates provide good nutritional potential value and antioxidant activity**.** [32, 33].

Anti-inflammatory activity

This activity analysed by using inhibition of protein denaturation method. Means the loss of biological property of protein molecules. Denaturation of proteins is responsible for the cause of inflammation and its conditions like rheumatoid arthritis, diabetes, cancer, and so on. Hence, prevention of protein denaturation may also help in preventing inflammatory conditions. (Patel, Krishna) Anti-inflammatory action of Opuntia elatior is due to the presence of betacyanin and other phenolic compounds. Carrageenan-induced rat paw edema method was used for this purpose. According to the finding, the maximum dose (20 ml/kg) was safe and based on that three different dose selected for the study: low (5 ml/kg), medium (10 ml/kg), and high (15 ml/kg). The paw size was measured in cm by wrapping a piece of cotton thread around the paw of each rat and measuring the circumference on a meter rule. Result shows that oral doses of 10 ml/kg and 15 ml/kg showed significant suppression of carrageenan-induced rat paw edema after 2 h when compared with the control group ($P <$ 0.01 and $P < 0.001$, respectively). [34, 35].

Analgesic Activity

The Opuntia elatior fruit juice was tested at dose 5, 10, and 15 mlqkg. Abdominal constriction induced by intra peritoneal injection of acetic acid (0.75/).

- Peripheral analgesic by using acetic acid induced writhing test, Opuntia elatior fruit juice and reference substance (Diclofenac sodium) were injected intraperitoneally (i.p.) 30 min before the intraperitoneal administration of acetic acid (0.75/, 8 mlqkg), control group received saline solution (8 mlqkg, i.p.).
- Central analgesic by using tail immersion test, The reaction time for the test groups was taken at intervals 0.5, 1, 2, 4, 5 and 6 h after a latency period of 30 min following the administration of the Opuntia elatior fruit juice and tramadol.

Study concluded that the fruits of O. elatior Mill. is endowed with central and peripheral analgesic properties might be due to presence of phenolic and betanin content**.** [14, 35].

Hematinic effect

For analysis of this activity mercuric chloride (HgCl2) was used to induce anaemia in rats. Than Opuntia elatior fruit extract was given to albino rats for 30 consecutive days at the doses of 1.8 mL/kg and 3.6 mL/kg. The effects of both drugs were assessed on ponderal changes, haematological, serum biochemical, and histopathology of various organs. The fruit extract showed significant increase in the haemoglobin content, serum ferritin level and serum TIBC level. The test drug at both dose levels produced adverse changes of mild intensity in liver, kidney and heart and reverted the disturbance in the cytoarchitecture of the spleen, thymus and lymph node. Result also indicate that test drug, fruit extract reversed anaemia induced by HgCl2 in a dose-dependent manner. [36, 37, 38].

Antileukemic activity

Opuntia elatior fruit was studied for in vitro anti-leukemic activity. anticancer evalution of O. elatior fruit was showed a potent action against to K-562 (Human chronic myelocytic leukemia) cell line. It was found that hydroalcoholic extract of the fruits of O. elatior have promising anti-leukemic activity. [21, 24, 37].

Anti-Diabetic Activity

The Opuntia spp. cacti and its components have been reported to have ‘anti-diabetic’ or ‘anti-hyperglycemic’ properties [18]. *Opuntia elatior* traditionally used among Mexicans as a food and medicinally as laxative, for alcohol hangover, and for high blood sugar. The exact mechanism of the blood-sugar-lowering property of Nopal is unknown although it has a high soluble fiber and pectin content which may affect glucose uptake [39]. However, still very less scientific data exists within the literature that which Opuntia spp. components are responsible for the hypoglycemic effect [40].

Anti-microbial or Antibacterial Property

Antimicrobial activity of oil extracted from GCPS and RCPS was carried out using the disc diffusion method. Petri plates were filled with ~20 mL of sterile tryptone soy agar for bacteria and malt extract agar for fungi. The test cultures were swabbed on the top of the solidified media and allowed to dry for 10 minutes. Serial dilutions (10–50 μg/mL) of the seed oil from a stock solution (1 mg/mL) were prepared in 20% DMSO and 10 μL loaded onto the sterile blank discs (BBL™ Sensi-Disc™) of 6 millimeters of diameter. On the media surface the loaded disks were placed and left for 30 minutes at room temperature to allow compound diffusion. The seed oil was serially diluted in Mueller–Hinton broth medium and duplicate tubes of each dilution (10–100 μg/mL) were inoculated with 5×10^6 cells of the test bacteria strain and cultures. The antibiotic agents Sensi-Disc streptomycin, ampicillin, and sulfamethoxazole/ trimethoprim (BBL Sensi-Disc) were used as positive controls at the same concentration level. After plates were incubated at 37°C for 24 h, the diameters of the inhibition zones were recorded in millimeters. Three independent repetitions were performed and tests were made in triplicate. Result indicate that cactus pear oils produced a microbial inhibition zone in most of the microorganisms evaluated, particularly Saccharomyces cerevisiae which had similar diameter (38–40 mm). (Esther Ramírez) Antimicrobial activity of the peel extracts of O. elatior was also determined by using cup plate method [14, 41, 42].

Antiasthmatic Effect or Bcronchodilatory Properties

Bronchodilatory properties of O. elatior fruit juice (5 mlq kg, 10 mlqkg, 15 mlqkg) was evaluated using bronchospasm induced by acetylcholine(Atropine sulfate 2 mgqkg) and histamine(Ketotifen 1 mgqkg), anticholinergic action on isolated rat ileum, and antihistaminic action on isolated guinea pig ileum. This study suggested that fruits of O.

elatior Mill. possess a significant inhibitory effect on rat and guinea pig ileum [43, 44].

Effect on Mastcell degranulation Opuntia

Fruit juice (OFJ) (10-200 >lqml) were studied for the effect on sensiti%ed rat peritoneal mast cell degranulation induced by immunological (egg albumin), and nonimmunological (compound 48q80) stimuli and compared with that of the reference standard, sodium cromoglycate and ketotifen (10 >gqml). The OFJ exhibited significantly (P ì 0.001) concentration dependent inhibition of mast cell degranulation. The IC50 value of OFJ was found 12.24 and 18 >lqml for immunological and nonimmunological induced mast cell degranulation [45].

Anti-ulcer activity

Traditional folk medicine Opuntia Mill. cladodes are used for the treatment of gastric ulcer. [46]. Anti ulcer activity of cactus evaluated by ethanol induced gastric ulcer in albino rats. Alcoholic extract at 100, 200 and 400 mg/kg, p.o doses significantly ($P < 0.01$) reduced the ulcer score, ulcer number, ulcerindex, free acidity and total acidity in ethanol induced ulcer model in rats. Antiulcer activity of stem extract of O.elatior is due to the presence of mucilage and flavonoid which is the cytoprotective active material for which antiulcerogenic efficacy has been extensively confirmed. [47, 48, 49].

Diuretic Activity or Renal Disorder

Flower infusion of Prickly pears indicates modest increase in diuresis and natriuresis. By analysis of Diuretic and antiuric effects of cladode and flower infusions in rats, it is found that their is increased in diuresis but do not significantly influence the uric acid formation.. This effect was more marked with the fruit infusion and it was particularly significant during the chronic treatment. [50, 51, 52].

Conclusion

The present review reveals that various parts of *Opuntia elatior* as fruit, cladode leaves and stem are being used traditionally to treat inflammation, abscess, analgesic, wound healing, asthma, cough, diabetes, gonorrhoea, diphtheria, burning sensation in the stomach and body ache and bronchitis. World Health Organization considered that plant drugs and herbal formulations are considered to be less toxic and free from side effects than synthetic ones. The Finding of this review would further help for the renaissance of other Phytochemical and Pharmacological activities on the plant and can also give a lead to take clinical studies based on present reported activities.

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