



PHYTOCHEMICALS AND BIOLOGICAL ACTIVITIES OF *FAGONIA INDICA*

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ABSTRACT

Fagonia Indica (family Zygophyllaceae) is a small spiny under-shrub, mostly found in the deserts of Asia and Africa. It is widely used in Ayurvedic system of medicine to treat vitiated conditions since this plant was antioxidant, analgesic, anti-inflammatory, antimicrobial, astringent, febrifuge and prophylactic against small-pox agents.

There are reports providing scientific evidences for antimicrobial, analgesic, anti-inflammatory, and antioxidant activities of this plant. These activities were attributed to the presence of a variety of active ingredients including triterpenoidal saponins, flavonol glycosides, ursolic and oleanolic acids either alone or with their derivatives. A comprehensive account of the morphology, photochemical constituents, ethanobotanical uses and pharmacological activities reported are included in this review for exploring the immense medicinal potential of this plant.

Keywords : *Fagonia Indica*, zygophyllaceae, antioxidant, saponins, flavonoids

INTRODUCTION

Herbal medicines have been the main source of primary health care in many nations. The plants as medicine are used in different system of medicine such as Ayurveda, Allopathy, Unani, Homeopathy and even in other system. About 80% of the world's populations are still dependent on traditional medicine. From ancient times, plants have been a rich source of effective and safe medicines. Due to their safe, effective and inexpensive nature, indigenous remedies are popular among the people worldwide. *Fagonia indica* (family Zygophyllaceae) is a small spiny under-shrub, mostly found in the deserts of Asia and Africa.¹ It is reputed to be a medicinal plant in scientific and folkloric literature and its medicinal values are well documented.²⁻⁵ The medicinal properties of the plant were attributed due to its variety of active phytochemical constituents. Although the plant had received a great interest for the phytochemical investigation since many years, yet the chemical structures of most of its constituents were established during the last 15 years.

Genus *Fagonia* includes about 35 species that are distributed in the deserts and dry areas in India, tropical Africa, Chile and South West USA. Many of the species are spiny herbs or sub-shrubs. *Fagonia* species are reported to be medicinal in the scientific literature as well as in folk medicine.³ Species of *Fagonia* have been found to contain saponins⁶, alkaloids⁷, terpenoids⁸, sterols⁹, flavonoids¹⁰, proteins and amino acids¹¹, coumarins¹² and trace elements¹³

COMMON NAME

Dhamasa, Kanti

TAXONOMIC CLASSIFICATION

Kingdom: *Plantae*

Subkingdom: *Viridaplantae*

Phylum: *Tracheophyta*

Subphylum: *Euphyllophytina*

Infraphylum: *Radiatopses*

Class: *Magnoliopsida*

Subclass: *Rosidae*

Superorder: *Geranianae*

Order: *Zygophyllales*

Suborder: *Zygophyllineae*

Family: *Zygophyllaceae*

Genus: *Fagonia*

Specific epithet: *indica* - Burm.f.

Botanical name: - *Fagonia indica* Burm.f.

MORPHOLOGY

Fagonia indica is profused branched, pale-green, glandular, annual or perennial shrublets upto 60 cm high; internodes 2.5-5.0 cm long. Leaves all uni or lower ones trifoliate; leaflets 8-16X3-4 mm, narrowly ovate-lanceolate, mucronate, distinctly articulate at the base; stipular spines suberect, equal to or shorter than leaves. Flower *ca.* 12 mm across, pinkish *ca.* 6X3 mm, spatulate, obtuse. Stamens *ca.* 6 mm long. Capsule *ca.* 4X4 mm, softly hairy; pedicels reflexed, equal to the length of the fruits (Figure 1.).¹⁴⁻¹⁶

MICROSCOPIC CHARACTER

Pollen description

Pollen type is psilate, tricolpate. Shape in paler view is circular and in equatorial is spheroidal to prolate to apple shaped. Polar diameter is 26.2 μ m (25 - 27.5) while equatorial is 24.12 μ m (22.5 - 32.5 μ m). P/E ratio is 3. Length and width of colpi is 2.5 μ m both. Exine thickness is 1.25 μ m. Percentage fertility is 80.48 (Figure 1. C and D).¹⁷

Leaf description

Types of epidermal cells are tetra, penta to polygonal and irregular to less undulating. Diameter of epidermal cell is 48.335 μ m (33.34 - 63.34 μ m). Length of stomatal complex is 46.25 μ m (35 - 55 μ m). Both sides of the leaf are same. Type of stomata is staurocytic. Diameter of stomata is 13.34 μ m (12.5 - 15 μ m)X5.417 μ m (5 - 6.25 μ m) (Figure 1. E).¹⁷

Branch description

A transverse section of the branch is cordate to kidney-shaped in outline. The epidermis consists of small rectangular uniform cells with thick cell wall covered by a thick cuticle. The outer layer of the cortex consists of round to polygonal cells followed by several layers of oblong cells. Scattered in the cortex are many vascular bundles with annularly thickened vessels and many short compactly packed fibres with markedly thick walls. The pith consists of hexagonal cells with different sizes and slightly thick cell walls; those existing at the centre are larger. Crystalline and amorphous substances are frequent in the cortex and pith (Figure 1. F).¹⁷

PHYTOCHEMISTRY**Preliminary phytochemical screening on shoot systems of *Fagonia indica***

Fagonia indica stems and fruits have high amounts of saponins; leaves and flowers have high amounts of tannins;

leaves, flowers and fruits have high amounts of cardiac glycosides; stems are devoid of irodoids; the remaining constituents are found in the remaining parts of the four parts of shoot systems of the plant in week to moderate amounts.¹⁷

Table 1: Preliminary phytochemical screening on shoot systems of *Fagonia indica* (Stems/Leaves / Flowers/Fruits)

S. No.	Experiment	Stems	Leaves	Flowers	Fruits	Shoot
1.	Carbohydrates and / or Glycosides	+	+	+	+	+
2.	Saponins	+++	++	+	++++	++++
3.	Tannins	++	++++	+++	+	++++
4.	Sterols and / or Triterpenoids	+	+	+	+	+
5.	Alkaloids	+	+	+	+	+
6.	Cardiac glycosides	+	+++	++	++	+++
7.	Flavonoids	+	+	+	+	+
8.	a- Chlorides	+	+	+	+	+
	b- Sulphates	+	+	+	+	+
9.	Anthraquinones	-	+	+	+	+
10.	Irodoids	+	+	+	+	+
11.	Cyanogenic glycosides	+	+	+	+	+
12.	Coumarins	+	+	+	+	+

- = The active constituents were not found.

+ = Weak to moderate amounts of the active constituents were found.

++, +++ and ++++ = High amounts of active constituents were found.

Sapogenins

Three sapogenins named nahagenin¹⁸, hederagenin¹⁹ and ursolic acid²⁰ have been isolated from aerial part of *Fagonia indica*.

Saponins

Several saponins or triterpenoid glycosides have been isolated from *Fagonia indica*. They were characterized as 23,28-di-*O*- β -D-glucopyranosyltaraxer-20-en-28-oic acid²⁰, 3 β ,28-di-*O*- β -D-glucopyr acid²⁰, 21,22 α -epoxy-23-*O*- β -D-glucopyranosyl-nahagenin²¹, 3-*O*-{[β -d-glucopyranosyl-(1 \rightarrow 2)]-[α -l-arabinopyranosyl-(1 \rightarrow 3)]- α -l-arabinopyranosyl}-ursolic acid-28-*O*-[β -d-glucopyranosyl] ester (indicasaponin A)²² and 3-*O*-{[β -d-glucopyranosyl-(1 \rightarrow 2)]-[α -l-arabinopyranosyl-(1 \rightarrow 3)]- α -l-arabinopyranosyl}-oleanolic acid-28-*O*-[β -d-glucopyranosyl] ester (indicasaponin B)²².

Flavonoid

Four flavonoidal compounds identified as quercetin, isorhamnetin- α -3-*O* rhamnoside, quercetin 3-*O*- β -D-glucopyranosyl -(1"-6"-)- β -D-glucopyranoside and quercetin 3-*O*- β -D-galactopyranosyl -(6"-1"-)- α -L-2" acetyl rhamnose-(3"-1"-) β -D-glucopyranoside were isolated from the alcoholic extract of *Fagonia indica*.²³

PART USED

Whole plant

ETHANOBOTANICAL CLAIM

Fagonia indica has been a rich source of effective and safe medicines. It is astringent, antiseptic, blood-purifier, febrifuge and prophylactic against smallpox. The plant is bitter and used for the treatment of fever, thirst, vomiting, dysentery, asthma, urinary discharge, liver trouble, typhoid, toothache, stomach troubles and skin diseases.^[14,15] In Barmer district of Rajasthan, the natives prepare a powder of this plant mixing with fruits of *Terminalia chebula* and leaves of *Casisa italic* (Goral, Gharawal) and take it orally to cure abdominal pain and as a tonic against weakness.²⁴⁻²⁸

An aqueous decoction of the aerial parts of the plant is a popular remedy in the indigenous system of medicine for cancer in its early stages and for the treatment of various other diseases of digestive and blood vascular system.²⁹ According to the rural inhabitants of the area, equal quantity

of extract obtained from the fresh aerial parts of *Fagonia indica*, fresh leaves and stem of *Aloe vera* and fresh branches of *Tylophora hirsuta* L. is very effective to lower the blood glucose level of diabetics.³⁰ *Fagonia indica* is used by the women folk for menstruation problems, to regulate the menstruation cycle and inducing abortion.^{31, 32} Whole plant without roots is crushed and extract is taken for pimples and acne problem of face. Dried plant is crushed, mixed with black salt and powder is taken for gas trouble.³³

The powder made up of whole plant is dusted on boils and skin eruptions. Whole plant is boiled in water and its bath is taken for allergies and other skin disease. The decoction of plant is given orally for skin eruption.^{34,35}

PHARMACOLOGICAL ACTIVITY**Antimicrobial activity**

The ethanolic extract of *Fagonia indica* showed antimicrobial activity against some bacterial and fungal strains.³⁶⁻³⁸

Analgesic and anti-inflammatory activity

The analgesic activity of the alcoholic extract of *Fagonia indica* Burm F. was tested by the writhing and the hot-plate tests using acetyl salicylic acid (200 mg kg⁻¹, i.p.) and morphine (10 mg kg⁻¹, i.p.) as reference drugs. The alcoholic extract of the whole plant possesses analgesic action which is probably mediated through both central and peripheral mechanisms and does not seem to involve opioid receptors.³⁹

Acute and sub-acute anti-inflammatory activity of the 10% ethanolic extract of *Fagonia indica* in rats were assessed. A promising anti-inflammatory activity of this plant was shown in rats.⁴⁰

Antioxidant activity

Powdered sample of shoot of *Fagonia indica* was estimated for antioxidant activity using Electron Spin Resonance (ESR) instrument.¹⁶ The extract *Fagonia indica* effectively reduced free radical levels by mechanisms involving increased expression of Cu-Zn SOD, decreased expression of iNOS and simultaneous scavenging of the free radicals such as O²⁻, OH, NO and ONOO.⁴¹

CONCLUSION

Fagonia indica is a plant distributed in the deserts of Asia and Africa. *F. indica* was extensively studied by many

workers regarding its medicinal uses, since this plant has, antioxidant, analgesic, anti-inflammatory, antimicrobial, astringent, febrifuge and prophylactic against small-pox agents. This plant is also used for the treatment of cancer in the indigenous system, fever, asthma, urinary discharges, toothache, stomach troubles and kidney diseases. The nutritive values of the wild species, growing in Rajasthan areas of India, have also been evaluated. The medicinal properties of this plant were attributed to its variety of active phytochemical constituents. Although the plant had received a great interest for the phytochemical investigation since many years, yet the chemical structures of most of its constituents were established during the last 15 years. *Fagonia Indiga* was investigated mainly for the presence of two major types of phytochemical compounds, i.e. flavonol glycosides and saponins or triterpenoid glycosides.

The pharmacological studies reported in this review confirm the therapeutic value of *Fagonia Indiga* Linn. However, less information is available regarding the clinical, toxicity, and phytoanalytical properties of this plant. Several phytochemical studies have been reported but still it needs to progress. If the ethnobotanical claims are scientifically evaluated, then it can provide good remedies and can help the mankind in various ailments.

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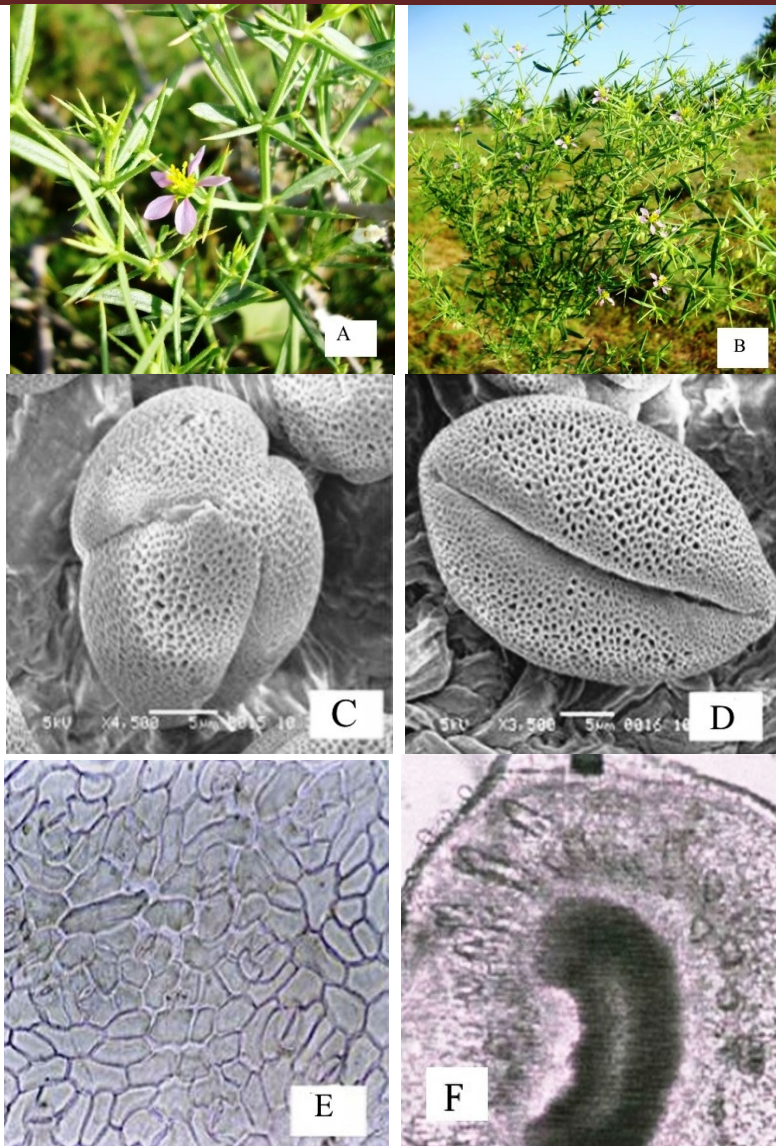


Figure 1. A- Flower of *Fagonia indica*, B- Aerial Parts, C- SEM of pollen polar view, D-SEM of pollen equatorial view, E- Stomata, F- TS of branch