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Fagonia Shweinfurthii Hadidi: A Promising Plant For Future Therapies

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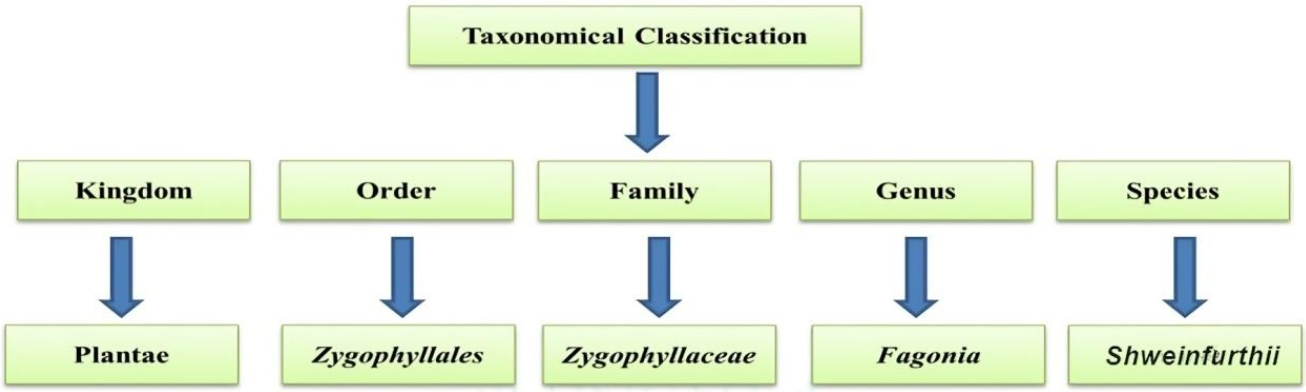
ABSTRACT

Fagonia Shweinfurthii Hadidi is a part of Zygophyllaceae family, has grabbed considerable attention due to its therapeutic potential. This review outlines the pharmacological activity, bioactive substances and possible therapeutic uses of *Fagonia Shweinfurthii* that can address many health issues. *Fagonia* is known for its various biological activities, such as anti-inflammatory, antioxidant, antimicrobial, antidiabetic and anticancer properties. Flavonoids, terpenoids and alkaloids are its main active ingredients and they play main role in its therapeutic effectiveness. *Fagonia Shweinfurthii Hadidi* has also shown protective action against liver harm, heart diseases and neurodegenerative disorders. Even though various researches are going on, the mechanism behind its therapeutic effects is not properly known, it will require additional studies on its pharmacokinetics, safety profiles and clinical efficacy. This review highlights the pharmacological potential of *Fagonia Shweinfurthii Hadidi* and also encourage its investigation as a source for new natural products aimed for the creation of future therapeutic approaches.

Keywords – Fagonia Shweinfurthii Hadidi, Dhamasa, Antioxidant Activity, Phytochemical, Anti-inflammatory

I. INTRODUCTION



Common Name - Desert Fagonia, Dhamasa, Dhamaso, Damhar, Dhanvayas, Hingun
Family – Zygophyllaceae
Geographic Distribution - Djibouti, Egypt, Eritrea, Ethiopia, Gulf States, India, Iran, Kenya, Oman, Pakistan, Saudi Arabia, Socotra, Somalia, Sudan, West Himalaya, Yemen

The Western Ghats (including Sri Lanka) is one of the biodiversity hotspots in India (Myers & al., 2000). The region of Western Ghats consists of rich medicinal resources, and these medicinal plant sources will be used for pharmacognostic and bioprospecting study. The medicinal flora of Western Ghats is quite rich and it carries more than 62.8 % endemic and medicinally significant plants. Due to its unique biodiversity, it is one of the important areas with very high value considering the bioprospecting of the plant (Rao, 2002). The Western Ghats distributes 700 unique medicinal plants, they are used in traditional and folk medicinal practices (Katole& al., 2018). In the Western Ghats, Selected ethnomedicinal plants used by tribal people as different therapeutic propose. By using the hidden, unexplored, valuable knowledge of the tribal people for new drug discovery [1]

Fagonia Shweinfurthii Hadidi is a small, spiny, erect, undershrub, more and less grandullar; branches slander, terete, triate, glabrous. Leaves opposite, 1-3 foliate; petioles variable in length, from 3-30 mm long, deeply striate, very slender, stipules 2 pairs of sharp slender thorns, sometimes exceeding 12 mm in length; leaflets linear, acute, sessile or having very short petiolules. Traditionally, the plant has been used to cure various diseases by the people living in the desert region such as skin eruptions, in heal sores, skin diseases, anti-pyretic, in pain relief, ear infection, venereal diseases, etc. In Ayurveda it is called as Dhanvayaasa, Dhanvayavaasa, Dhanvayaasaka, Duraalabhaa, Samudraantaa, Gaandhaari, Kachhuraa, Anantaa, Duhsparshaa and it is locally known as Dhramau, Dhamaso, Kandhera, dhamasa and dhamasia [2]

Number of species like *Fagonia cretica, F. arabica, F. bruguieri, F. mysorensis, F. indica, F. schweinfurthii, F. laevis, F. longispina* etc. have been identified. Traditionally it is used in Sindh and Afganistan as a popular remedy for fever among the hill people. The plant is given as tonic and febrifuge (to reduce fever), and in the Peshawar Valley, it is given to children as a prophylactic against small-pox. The leaves and twings possess cooling properties. In the Ormara hills the plant is crushed and bounded upon the swellings of the neck and for scrofula. At Saruna in Jhalawan it is pounded in water and strained; the liquid is rubbed all over the bodies of children when they get fever. In Kharan an inoculate made with hot water is used as bath in case of fever. The plant is considered to cure for itch in the Las Bela State: and in the Levy tracts it is for that purpose pounded, mixed with milk, stored for three days and then applied all over the body

Many potential phytochemical constituents such as triterpenoids, saponins, flavonoid, saponins, sterols, terpenoids, flavonoids, coumarins, alkaloids, glycosides, proteins and amino acids have been identified in different *Fagonia* species [3]

From some selected traditional medicinal plant species, isolation and

identification of the bioactive compounds can be used for formulating new drugs to treat various diseases and disorders. The major bioactive chemical constituents of medicinal plants are tannins, alkaloids, flavonoids, terpenoids, phenolics, etc., and it has several biological activities [4]

The flavonoids present in many medicinal plants have an antioxidant activity. In the body developed scavenge free radicals, and thus body aerial parts fight against damage from free oxygen species. This plant's secondary metabolite protect body against scavenge free radicals. Antioxidants extracted from plants play major role in cell protection [5]

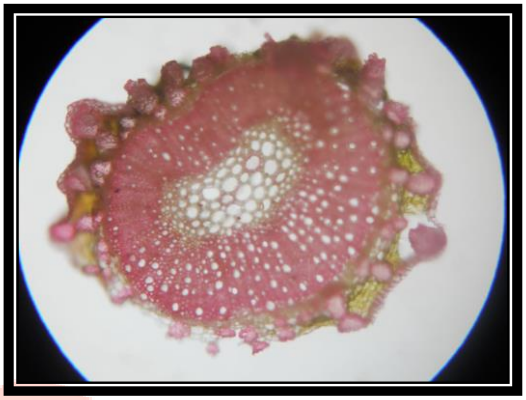
Fagonia species were extensively studied by many researchers for their medicinal uses, since these plants were antitumor, antioxidant, analgesic, astringent, febrifuge and prophylactic against small-pox agents. Species of *Fagonia* were also used for the treatment of cancer in indigenous(native) system, fever, asthma, urinary discharge, toothache, stomach problems and kidney diseases. Species of Fagonia have been found to contain saponins , alkaloids , terpenoids , sterols , flavonoids , proteins and amino acids, coumarins , trace elements [6]

[Pictures of Fagonia Shweinfurthii Hadidi

II. MICROSCOPICAL AND PHYSICOCHEMICAL ANALYSIS [7] [8]

Microscopic study of Fagonia schweinfurthii highlighted the presence of trichomes, stone cells, fibers, calcium oxalate crystals, and vessels. Additionally, physicochemical parameters were also determined, revealing a total ash value of 10±0.3%, acid-insoluble ash value of 2.5±0.5%, and water-soluble ash value of 5±0.2%. The extractive values demonstrated the plant's potential as a medicinal resource, with water-soluble and alcohol-soluble extractive values measured at 80±1.5% and 24±1.2%, respectively. The pH levels for 1% and 10% aqueous solutions were observed at 6.09 and 5.07, indicating a mild acidity.

T.S of root of *Fagonia schweinfurthii*



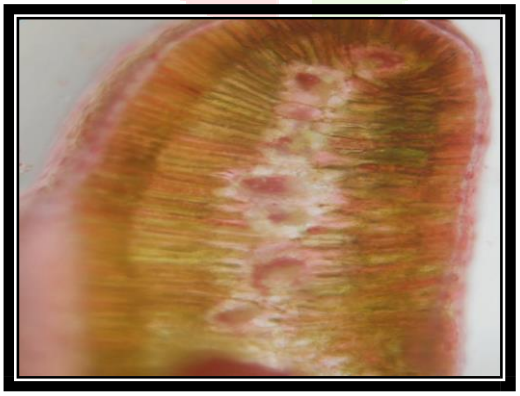
T.S of stem of *Fagonia schweinfurthii*

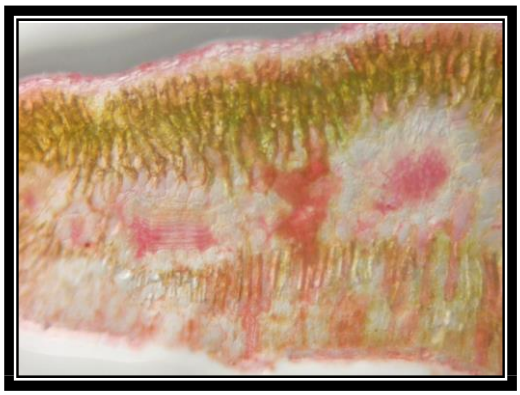
T.S of leaf of *Fagonia Schweinfurthii*

IV. PHYTOCHEMICAL ANALYSIS

Chemical tests were carried out using aqueous extracts of plant parts of Fagonia schweinfurthii Hadidi to identify various phyto-constitutes using standard methods.[9] [10] [11]

Sample preparation for phytochemical screening:





50 gm powdered sample was weighed and separately taken. The powder was moistened with ammonia and evaporated to dryness. Dried sample was extracted with chloroform and then filtered. After filtration, 10% sulfuric acid was added to the filtrate using separating funnel and aqueous layer was separated by adjusting pH to 8 with ammonia. After adjusting the pH of extract the solution with chloroform and the organic extract which obtained is evaporated to concentrate by keeping in open at room temperature. However, aqueous extract was evaporated

to dryness by heating in water-bath to obtain semi solid mass. Dried extract was then stored in refrigerator for their future usage in phytochemical analysis. Dried extract was re-dissolved by using 5ml of distilled water**.**

Test for Alkaloid: 3 ml aqueous extract was mixed with 3 ml of 1% HCl on water bath. Wagner's reagent was then added to the mixture. Turbidity of the resulting precipitate was accepted as an evidence for the presence of alkaloid

Test for Flavonoids: 1 ml of aqueous extract was mixed with 1 ml of 10% lead acetate solution. The formation of a yellow precipitate was taken as a positive test for flavonoids.

Tests for steroids: A red color produced in the lower chloroform layer when 2 ml of organic extract was dissolved in 2 ml of chloroform and 2 ml concentrated sulphuric acid was added in it. This indicates the presence of steroids. When 2 ml of the organic extract was dissolved in 2 ml of chloroform and treated with sulphuric and acetic acid, the development of a greenish color indicates the presence of steroids.

Preparation of extracts for HPTLC: 1 g of plant parts of leaf, stem, fruit and root of Fagonia schweinfurthii Hadidi was taken and reflux with 250 ml of methanol using a soxhlet apparatus on a water bath for 60 minutes for two cycles. Filter the extract and concentrate it to 5 ml then the sample extract obtained is used for further analysis. Then the extract was filtered with Whatman filter paper No 1. The filtrates were stored in a glass bottle in the freeze at 8ºc temperature

Table 1. Preliminary observation of *Fagonia schweinfurthii* Hadidi

Group of Phytoconstituents	**Extracts**			
	Chloroform	**Alcoholic**	**Hydroalcoholic**	**Aqueous**
Alkaloid	(+)	(-)	(-)	(-)
Cardiac glycoside	(+)	(-)	(-)	(-)
Flavoinds	(-)	(+)	(+)	(-)
Carbohydrate	(-)	(+)	(+)	(-)
Anthraquinones glycosides	(-)	(-)	(-)	(-)
Protein	(+)	(-)	(-)	(-)
Tannin	(-)	(-)	(-)	(+)
Amino acids	(-)	(+)	(+)	(+)
Saponins	(+)	(+)	(+)	(+)
Steroids	(-)	(+)	(+)	(+)
Gums and mucilage	(-)	(-)	(-)	(-)

(+) = present , (-) = absent

II. PHARMACOLOGICAL ACTIVITY OF *FAGONIA* PLANT

1. Anti-inflammatory and wound healing property

In a research done by Saleh I. Alqasoumi et al., the anti-inflammatory and wound-healing effects of a 90% alcoholic extract of a gel made from Fagonia schweinfurthii were examined in rats with carrageenan-induced paw edema and an excision wound model, respectively. The results were compared with those of the wound-healing povidone-iodine (Betadine®) and anti-inflammatory diclofenac sodium ointment (Diclomax®). After applying 0.5 g of the herbal gels and diclofenac sodium ointment topically to the left hind paw's planter surface, an anti-inflammatory effect was seen in three hours. By applying 0.5 g/wound of the F. schweinfurthii gel and Betadine® once daily for 19 days to the excision wound of albino rats, the wound healing effect was examined and monitored at 4-day intervals. Gel formulations have been found to provide a gradual anti-inflammatory impact and accelerate the healing process. According to this study, a gel formulation of F. schweinfurthii plant extract can be formulated as a medicinal agent with anti-inflammatory and wound-healing properties.[12]

2. Androgenic activity

Abirami V. et al. conducted research on Fagonia cretica. The effect of an alcoholic extract of F. cretica's arial part on the female albino rat's estrous cycle and implantation was studied. The study discovered that Fagonia cretica causes the rats' estrous cycle to become distorted, with the heat phase (estrous phase) being randomly omitted. The decrease in females' desire to mate with males is explained by its disappearance index of +53.33. It had a considerable anti-implantation effect when given at a dose of 250 mg/kg p.o. As the weights of the ventral prostate and seminal vesicles increased relative to the control value, the drug suspension showed considerable androgenic activity. Given that the results of testosterone propionate treatment did not changed much when the two were administered together, it does not seem to have any anti-androgenic properties. [13]

3. Anti-allergic property

Al-Tahya et al. studied the anti-allergic properties of Fagonia bruguieri by extracting the entire plant with boiling water and then freeze-drying it; the dried extract's LD50 values were found to be 11.5 and 10.75 g/kg i.p. in mice and rats, respectively. Treatment of albino guinea-pigs with the extract at 200 mg/kg (i.v.) or orally antagonized histamine (20 µg/kg i.v.) and capsaicin (100 µg/kg i.v.) caused bronchoconstriction without influencing that caused by ACh and 5-HT; the percentage antagonisms were 72 ± 0.9 and 65 ± 4% against histamine and capsaicin, respectively ($P < 0.01$, $N = 10$). After five minutes of exposure to histamine aqueous aerosols (10 mg/ml), conscious guinea pigs experienced initial grasping and a reversible loss of consciousness. The animals were considerably protected against histamine-induced grasps and unconsciousness when the guinea-pigs were given the extract orally for two hours or intraperitoneally (i.p.) at doses of 1.25 g/kg for 20 minutes ($P < 0.01$, $N = 11$). [14]

4. Neuroprotective activity

According to Avinash K. Rawal et al., three herbs—Rubia cordifolia (RC), Fagonia cretica linn (FC), and Tinospora cordifolia (TC)—have neuroprotective properties. In the study, slices of the hippocampal tissue were exposed to oxygen glucose deprivation (OGD) and split into three groups: control, OGD, and OGD plus medication. Protein tests were conducted in the corresponding groups at different intervals, and cytosolic Cu-Zn superoxide dismutase (Cu-Zn SOD), reduced glutathione (GSH), glutathione peroxidase (GPx), and nitric oxide (NO) were quantified as nitrite (NO2) in the supernatant. With regard to the superoxide anion (O2.-), hydroxyl radicals (.OH), nitric oxide (NO) radical, and peroxynitrite anion (ONOO) produced by pyrogallol, menadione, DETA-NO, and Sin-1, respectively, EPR was used to determine the antioxidant impact of RC, FC, and TC. For the three groups, RT-PCR was used to measure the expression of the genes for GCLC, iNOS, Cu-Zn SOD, and GAPDH. According to the findings, all three herbs were capable in increasing GSH levels as well as the expression of the genes for Cu-Zn SOD and gamma glutamylcysteine ligase. According to electron paramagnetic resonance spectroscopy, the herbs also shown potent free radical scavenging capabilities against reactive oxygen and nitrogen species.

In addition all the three herbs notably reduced the expression of iNOS gene after 48 hours which plays a major role in neuronal injury during hypoxia/ischemia [15]

5. Endocrinological property

Asif *et al*. studied the effect of powdered *Fagonia cretica* plant and its two major triterpenoid saponins (saponin-I and saponin-II) on various blood endocrinological parameters. Prolactin namely, serum prolactin, serum thyrotropin, serum thyroxine and serum cortisol of normal male rabbits were studied. Two major triterpenoid compounds, saponin-I and saponin-II, were isolated from its ethanol extract by repeated chromatography using silica gel, sephadex LH-20 and on biogel P-2. These compounds were identified after comparing their values of 1H NMR and 13C NMR chemical shifts with previously studied values of similar compounds. Radio-immunological assay was done for the analysis of blood hormones of crude drug and saponin-treated animals using radioactive I125. The radioactivity of the standard and the unknown sample in each case was measured on NE-1612 gamma scintillation counter for 90 seconds. Both the saponins in 30 mg doses had significant decrease in prolactin and in the serum TSH levels as compared to crude drug treatment and control groups. The thyroxine level was also significantly reduced by saponin-II in a 30 mg dose while the crude drug and saponin-I had non-significant effects on thyroxine level after 16 days. A significant increase in serum cortisol appeared with the crude drug in a 1g dose and with both saponins in 30 mg doses. Maximum increase in the serum cortisol appeared with saponin-II after 16 days [16]

6. Antimicrobial activity

Anjum *et al*. worked on *Fagonia cretica* and investigated the antimicrobial activity of its constituents. In the study eleven compounds were isolated from methanol extract of plant of *F. cretica*. The methanolic extract was separated into n-hexane, EtOAc, n-BuOH, and H2O soluble fractions. The repeated silica gel column chromatography and preparative TLC of n-hexane and EtOAc soluble fractions resulted in eleven compounds including linoleic acid, β-sitosteryl-3-O- β -D-(6-hexadecanoyl)-glucopyranoside), methyltriacontanoate, teraxerol, β-amyrin acetate, etc. The isolated compounds were then analysed for their antimicrobial activity. The compounds showed significant antimicrobial activity against *Bacillus subtilis, Shigella flexneri, Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, Salmonella typhi, Trichophyton longifusus, Candida albicans, Aspergillus flavus and Candida glabrata* [17]

7. Analgesic and Antimicrobial activity

Sharma S *et al*. examined the analgesic and anti-microbial activity of the ethanol extract and aqueous extract of *Fagonia indica* leaves. Antimicrobial study of ethanol extract of *Fagonia indica* leaves extracts (25, 50 and 100 mg/ml) were tested against gram-negative and gram-positive bacterial strains by noticing zone of inhibition. The bacteria which were used in this study were *Escherichia coli* (ATCC 25922), *Staphylococcus aureus* (ATCC 29213), *Pseudomonas aeruginosa* (ATCC 27853) and *Bacillus cereus* (ATCC 6633). Analgesic activity of various solvent extracts (200 and 400 mg/kg) of *Fagonia indica* was studied by tail flick method in rats. The results were evaluated statistically using regression method. The result showed that the ethanol extract had significant inhibitory effect against all bacterial strains but it showed maximum inhibitory effect against *Bacillus cereus* and minimum inhibitory effect against *Pseudomonas aeruginosa*. In the analgesic activity both extracts (ethanol and water) were shown significant ($p < 0.05$) analgesic activity [18]

8. Cytotoxic and antitumor activity

Ahsan Hussain, *et al*. studied the cytotoxic and antitumor activity of *Fagonia cretica*. This information was studied at laboratory level by performing cytotoxic, antitumor (potato disc) and DNA damage assay. Significant cytotoxic activity was noted against brine shrimps at LD50 118.89 ppm, while antitumor assay showed that the extract stopped the tumor induction on potato discs. Significant antitumor activity was found against all the tumor-inducing Agrobacterium strains tested (At6, At10 and At77) with maximum tumor inhibition (77.04%) against At10. However, the extract haven't showed any lethal activity against *Agrobacterium tumefaciens* strains, and furthermore, there was no DNA damaging activity was observed. The overall results indicates a strong anti-cancerous potential of this plant [19]

Matt Lam et al studied that an aqueous extract of *Fagonia cretica* can induce cell cycle arrest and apoptosis via p53-dependent and independent mechanisms, with activation of the DNA damage response. They also showed that FOXO3a is required for the activity in the absence of p53. Their findings indicates that *Fagonia cretica*

aqueous extract contains potential anti-cancer agents acting either singly or in combination against breast cancer cell proliferation via DNA damage-induced FOXO3a and p53 expression [20]

Soomro AL et al investigated the effect of *Fagonia indica* on experimentally produced tumors in rats. They found that the survival of the rats administered Fagonia extract was significantly longer than the control group. In the treated group the survival of female rats was 83.2+12.67 days (range 55- 118 days), while that of the untreated male rats was 59.4+ 10.07 days (range 39-98). In the untreated female rats the survival was 38.9+4.16 days (range 21-57 days) while the non-treated males survived for 17.0+2.55 days (range 10-27 days). The difference in survival between the treated and untreated rats was statistically significant (P <0.01) with the females significant (P<0,.01) in both the male and female rats. In treated group the difference between the survival of female and male rats surviving longer. In the non-treated group, no such difference was found between the survival of male and female rats (P>0.1). This initial experiment has shown that an aqueous infusion of *Fagonia indica* has a tumor static effect which is more significant in the females [21]

III. CONCLUSION

In conclusion, Fagonia shows great potential in future medical therapies because of its various beneficial properties. Many researches have been done on the plant which has shown its strong antioxidant, anti-inflammatory, anti-microbial, anticancer, anti-allergic, analgesic, androgenic and neuroprotective effects, which makes it an essential plant resource for developing treatment of various diseases. Also, its natural compounds seem to have considerably low toxicity, which further improve its potential as a safe and effective therapeutic agent. But even after all these findings, more in-depth studies such as clinical trials are required to better understand its effects and how it can be safely used for treatment in humans. As the research will progress, Fagonia Shweinfurthii Hadidi can become an essential part of natural therapy, which can offer new alternatives for the treatment of various conditions that currently lacks effective treatments. With continuous research, it has great potential to contribute considerably to the development of innovative and sustainable therapies for the future.

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