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Edible wild fruits of the indian thar desert: A review

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Abstract

Edible wild fruits have been in use since a long time ago. Rural/tribal people mainly depend on roots, leaves, stems, bark, resins, fruits and seeds for their survival in harsh conditions and in famine. However, the agricultural practices involving the production and marketing of EWFs on a commercial scale is limited. The main objective of this study was to explore ethnomedicinal and pharmacological activities of EWFs to meet increasing fruit/food demand of world population and create awareness among people to protect and conserve xerophytic flora. Data for the study was collected through frequent field visits and survey methods. The analysis revealed that plants produce obtained from Cucurbitaceae and Fabaceae plant family are more consumed; share 36% of EWFs studied followed by Amaranthaceae, Apocynaceae, Capparaceae, Meliaceae, Malvaceae, Rhamnaceae, and Salvadoraceae family.

The finding suggests that serious efforts and action should be taken to protect and conserve local flora and fauna. Due to habitat destruction local flora and fauna has reached the verge of extinction. By this study, industry and medical professionals can be benefited from indigenous knowledge about these wild edible fruits and be able to synthesize new drugs and novel formulas for betterment of human health and address a range of current health concerns.

Keywords: Falsa; Jungle-jalebi; Khironi; Lana; Miswak; Nimboli

1 Introduction

The Indian Thar Desert covers broader region of western Rajasthan and is well known for its arid climate, high diurnal temperature, low rainfall, scanty vegetation, and largely distributed sand dunes. The Indian Thar Desert is a reservoir of the many valuable, medicinal, rare and endemic plant species. Due to low rainfall, high temperature and barren sandy soil, it is very difficult for the people to survive in the existing harsh conditions of the Thar Desert. The rural people depend on available local grasses, seeds, vegetables, resins, fruits, fibers, timbers and other plants produce for their survival. Due to low yield, and limited sources of income, rural people are forced to live in poverty.

Xerophytic flora mainly consists of *Acacia senegal, A. nilotica, A. tortillis, A. jaquemontii, Prosopis cineraria, P. juliflora, Capparis decidua, Lasiurus sindicus, Ziziphus nummularia, Leptadenia pyrotechnica, Calotropis procera, Aerva javanica, Commiphora wightii, Tacomella undulata, Tamarix gallica, Sarcostemma viminale., Euphorbia caducifolia, Heliotropium nerifolium, Chorchorus tricularis* etc. The main rainfed Kharif crops cultivated in western Rajasthan inclusive of Bajra, Moong bean, Moth bean, Gwar bean, *Sesamum indicum*, cucurbits i.e. *Citrullus lanatus, C. fistulous, Cucumis melo*, and *C. calosus* [1].

Seasonal, edible wild fruits, easily available in local areas, are the source of minerals, vitamins, proteins, fats, amino acids and many other active secondary metabolites such as flavonoids, steroids, terpenoids, alkaloids, glycosides, tannins, and phenols. Edible wild fruits are either consumed freshly or in a dried form. Plants produce can be protected

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and preserved for future consumption by drying of fruits method. Drying of fruits method enhances the aroma, texture, color, sugar contents, and lowers the pungency & water content in fruits and make them enabling long-distance transportation. A systematic detailed account of edible wild fruits of the Indian Thar Desert are discussed below.

2 Material and methods

The study was carried out by retrieving relevant literature from scientific databases like Google Scholar, Springer Link, Scopus, Science Direct, Wiley, PubMed, Elsevier, Web of Science, and Plants of the World Online. The data collection was carried out using specific keywords as 'Traditional uses', 'Phytochemistry', 'Pharmacology', and their combinations.

3 Result and Discussion

3.1 Prosopis cineraria

3.1.1 Classification

- Division: Tracheophyta
- Class: Equisetopsida
- Order: Fabales
- Family: Fabaceae
- Genus: Prosopis
- Species: *Prosopis cineraria*
- Veracular name: Khejadi, Khejri, Shami, Sangri

3.1.2 Traditional use

Very beautiful depiction of Shami tree is recorded in our religious literature. On Dusshehra festival, Shami tree is worshipped in India by Hindus and a tradition of take with leaves of Shami while returning to home back after Ravan Dahan; Shami leaves considered as equal of gold particles. There are references of Pandavas hiding their Gandiva bow in the Shami tree during the last year of their exile. Similarly, there is a mention of Lord Rama worshipping Shami tree before conquering Lanka. Shami wood is considered sacred for the Yagya and Havans.

P. cineraria serve as a versatile crop, being the most prevalent species in alkaline, dry climates, supplying livestock, fruits, timber, fuel, gum, and tannin [2]. The pods are abundant in protein and carbohydrates, serving as fodder for animals. Local people also consume as a vegetable and pickle. “Sangri,” the green pods are dried and stored for future use. Khokha; ripe pods are considered as dry fruits of desert. The blossoms are beneficial for producing honey. Khejri is utilized for enhancing soil quality and stabilizing sand dunes. The timber is perfect for home heating. The bark serves as a source for medicine. Bark is parched, pungent, harsh with a biting flavor. It possesses abortifacient, laxative and anthelmintic characteristics and is recommended for treating bronchitis, asthma, hemorrhoids, etc.

Khejri is known for its ability to treat asthma and worms [3]. Fresh/dry leaves; "Lunkh" serve as tasty and nutritious, most sought-after fodder for livestock in arid regions of the Rajasthan [4]. The Shami plant is utilized for addressing anxiety, dysplasia, fever, dysentery, leprosy, lack of focus, and tremors [5].

3.1.3 Phytochemistry

Khejadi contains multiple phytochemical compounds such as alkaloids, flavonoids, steroids, fatty acids and their derivatives, phenylpropanoids, and tannins [5].

3.1.4 Pharmacological activity

Recent research findings indicated that the Shami tree possess analgesic, antitumor, anticonvulsant, antihyperlipidemic, antipyretic, antimicrobial, anti-inflammatory, antirheumatic, and vermifuge properties [5].

3.2 Salvadora oleoides Decne.

3.2.1 Classification

- Div: Tracheophyta
- Class: Magnoliopsida
- Order: Capparales

- Family: Salvadoraceae
- Genus: Salvadora
- Species: *Salvadora oleodis* Decne.
- Vernacular name: Mithi Jaal, Miswak, Peelu

3.2.2 Traditional use

The 'Miswak' tree possess deeper root system and considered as xerophytes and facultative halophytes with high tolerance to salinity [6]. Plant bears pendulum branches and greyish thick stem. Tender sticks of green stem used to clean teeth and promotes oral hygiene. Fruits are used to cure constipation. Dried fruits are sent to friends/relatives as a gift item in rural areas. Leaves are dark green and leathery contain high amount of water. During extreme summer, the plant itself maintains lower temperature under its canopy as compare to outer environment. 'Peelu'; The ripened fruits, red yellow in color, sweet in taste and peppery with a pungent aroma and eaten handful, instead of one by one; results good on empty stomach consumption. If consumed one by one fruit, causes mouth ulcer. Leaves are used in the treatment of open wounds and act as a blood purifier and cooling agent. The stem is used to cure fever, asthma, cough, leprosy, rheumatism, and anthelmintic with diuretic properties [7]. Roots are effective against chest and teeth diseases [8,9]. The oil can be used to manufacture candles, while oil cake is used as feed for animals [10]. *Salvadora persica*; Khari Jaal occupied in western Rajasthan possess more bitter and pungent fruits which are not edible.

3.2.3 Phytochemistry

Miswak tree possess several metabolic actively phytocompounds sterols as beta-sitosterol and their glycosides, flavonoids, dihydroisocoumarin, terpenoids as methoxy-4-vinylphenol and cis-3-hexenyl benzoate [11].

3.2.4 Pharmacology

Peelu tree is best known for its antiulcer, antifungal, antiparasitic, antiviral, and antibacterial properties [12-14]. *S. oleoides* leaves contain anti-inflammatory and antiulcer [15], hypoglycemic & hypolipidemic, analgesic and antimicrobial activity [11].

3.3 Grewia tenax (Frosk.) Fiori

3.3.1 Classification

- Div: Tracheophyta
- Class: Equisetopsida C. Agardh
- Order: Malvales Juss.
- Family: Malvaceae Juss. (Tiliaceae)
- Genus: Grewia
- Species: *Grewia tenax*
- Vernacular name: Gangeni, Gangeti

3.3.2 Traditional use

The tender leaves and shoots are used as fodder for camels, sheep and goats. Orange-red colored, ripe, juicy fruits; naturally occurring in pairs of four, sweet in taste with stony seeds, are used to quench thirst and treat heat stroke in summer; fruits paste aid in relieving local inflammation. A soothing summer drink is prepared from *Grewia asiatica*; "Falsa" in India which is more explored in comparison to *G. tenax*.

3.3.3 Phytochemistry

Grewia tenax leaves contain alkaloids, glycosides, fats, diterpenes, triterpenoids, sterols, flavonoids, saponins and tannins [16]. Fruits possess sugar contents, starch, tannins, phenolic compounds, flavonoids, steroids, ascorbic acid, and proteins [17,18]. Presence of important phytocompounds as phenolics, flavonoids and antioxidants in *Grewia tenax* indicated the use of plant in therapeutics at a very lower cost and with minimal side effects [19].

3.3.4 Pharmacological activity

Different extracts of various parts of *Grewia tenax* showed antioxidant, anticancer, antidiabetic, anti-inflammatory, antimicrobial, radioprotective and hepatoprotective activities [20].

3.4 Ziziphus nummularia

3.4.1 Classification

- Division: Tracheophyta
- Class: Equisetopsida
- Order: Rosales
- Family: Rhamnaceae
- Genus: Ziziphus Mill
- Species: *Ziziphus nummularia*
- Vernacular name: Bor, Jhad Ber

3.4.2 Traditional use

It is widely used in traditional folk medicine. Roots' bark is used to make local liquor added with dry fruits of *Terminalia chebula*; Harad, a key ingredient of ayurvedic "Trifala Churna" and Jaggery. Leaves are used as fodder for cattle, dried cuttings/whole plant is used to make fencing around mud houses/farms or cattle yards. Its ripe fruit, red colored, sweet-sour in taste, is used as food in winter; commercially sold in market as "Borkut". If consumed in more quantity, causes cough. Fruits have a cooling effect and removes biliousness [21], and its ripe fruit powder has been reported to treat constipation [22]. Its leaves are used in the treatment of scabies and other diseases of the skin [23], conjunctivitis [24], diarrhea [24], gastrointestinal spams [25], and helminthiasis [23]. The roots are used for the treatment of dysentery [26] and the stem bark is used for alleviating joint pain as well as sore throat and bleeding gums [27,28]. *Ziziphus mauritiana*, spiny shrub/small tree occupied in arid regions of Rajasthan contain leaves and fruits in greater size compared to *Z. nummularia.*

3.4.3 Phytochemistry

Ziziphus nummularia plant, a rich source of flavonoids, alkaloids, steroids, terpenoids, glycosides, tannins, saponins, and other minor compounds as cholinergic acid, aromatic/polyaromatic compounds cerebrosides and nucleosides [29].

3.4.4 Pharmacological activity

Ziziphus nummularia; an anti-drought and heat tolerant shrub/ small tree showed antimicrobial, antifungal, anthelmintic, antioxidant, anticancer, anti-inflammatory, antidiabetic, anticholinesterase, analgesic & sedative, and gastrointestinal properties [29].

3.5 Citrullus lanatus

3.5.1 Classification

- Division: Tracheophyta
- Class:Equisetopsida
- Order: Cucurbitales
- Family: Cucurbitaceae
- Genus: Citrullus
- Species: *Citrullus lanatus*
- Vernacular name: Water melon, Tarbooj, Matira, Kalinga

3.5.2 Traditional use

The dried and semi-ground seeds of "Matira" (watermelon) are combined with Bajra flour to make "Khakhra," or "hard baked roti/bread. "During the winter, the seeds are roasted with salt and consumed to treat "whooping cough. "Loiya" are fragile, immature fruits that are utilized as a green vegetable. Sliced loiya that has been sun-dried and kept for later use. Consuming "Matira," or ripened fruit, throughout the summer helped to relieve thirst [1]. Slices of ripe fruits are sun-dried and stored for future use during famine [30]. The wild variety of *Citrullus colocynthis*, commonly known as "Indrayan" or "Tumba," is poisonous and bitter.

3.5.3 Phytochemistry

Fruits known as "Matira" are heavy in water (93%), low in sugar (6%), and a good source of vitamins A, B, and C. Seeds store high levels of protein, fat, water, energy and a variety of fatty acids, including oleic acid, palmitic acid, stearic acid, & linoleic acid glycosides [31].

3.5.4 Pharmacological activity

Citrullus lanatus showed anti-hypertensive, anti-diabetic, antibacterial, antioxidant, anticancer, laxative, anti-ulcer, neuroprotective, anti-prostatic-hyperplasia, gastric-antacid, and anti-inflammatory activities [32].

3.6 Cucumis trigonus Roxb.

3.6.1 Classification

- Division: Tracheophyta
- Class: Equisetopsida
- Order: Cucurbitales
- Family: Cucurbitaceae
- Genus: Cucumis
- Species: *Cucumis trigonus*
- Vernacular name: Kachar, Kachri

3.6.2 Traditional use

Kachri fruits, when semi-mature, are bitter and utilized as a green vegetable; in adverse conditions, unripe fruits are cut and sun-dried for 4-7 days, then preserved for future use [1]. The ripe fruits of *C. trigonus* are useful for treating fever, leprosy, jaundice, diabetes, cough, bronchitis, ascites, anemia, constipation, digestive issues, and amentia [33]. Fruit pulp utilized as a thermogenic anthelmintic, liver tonic, cardiotonic, appetite stimulant, expectorant, and cognitive enhancer [34].

3.6.3 Phytochemistry

Key secondary metabolites identified in *C. trigonus* include alkaloids, flavonoids, tannins, lignin, and glycosides. serpentines, terpenoids, saponins, and phenolics [35].

3.6.4 Pharmacological activity

C. trigonus exhibits activities such as analgesic, anthelmintic, antiasthmatic, antibacterial, anti-diabetic, antidiuretic, anti-inflammatory, antioxidant, antihyperglycemic, hepatoprotective, proteolytic, and promoting wound healing [35].

3.7 Capparis decidua (Forssk.) Edgew.

3.7.1 Classification

- Division: Tracheophyta
- Class: Equisetopsida
- Order: Capparales
- Family: Capparaceae
- Genus: Capparis
- Species: *Capparis decidua*
- Vernacular name: Karil, Ker, Dhalu

3.7.2 Description

"Ker" is a dark green, multibranched, spiky, bushy, leafless (leaves only stay for a short time), soil-binding plant that grows in a dense tuft. With the right pruning, it can grow into a small tree with a tap root system. The plant produces reddish-orange blossoms that are cooked with buttermilk; green, immature fruits that are either sold in the market for a high price or preserved in form of pickles and micronate pink berries, which are juicy and used by herders to quench their thirst in the hot summer months. Goats and camels also eat them. In Rajasthan, mud houses are made from Kerwood, which is quite hard [1].

3.7.3 Traditional use

The bark of "Karil/Ker" is highly effective for treating asthma, ulcers, boils, vomiting, hemorrhoids, and various inflammations. The unripe fruits “Dhalu” possess a pungent quality that affects the intestines; eliminates bad breath, bile issues, and pus in urine; beneficial for heart ailments. The root bark has a strong odor and is used to treat intermittent fevers, asthma, inflammation, and rheumatism [36,37].

3.7.4 Phytochemistry

Phytochemical analysis of Ker indicated the existence of significant diverse phytocompounds, including polyamine alkaloids, glucosinolates, phenolics, glycosides, sterols, flavonoids, and vitamins [38,39].

3.7.5 Pharmacological activity

Karil trees have analgesic, diaphoretic, emmenagogue, and laxative qualities [40]. *C. decidua* is a significant xerophytic plant, possesses sedative and anticonvulsant, anti-diabetic, antistress, hypocholesterolemic, anthelmintic, antioxidant, antibacterial, antiatherosclerosis, hypolipidemic, hepatoprotective, anti-inflammatory, insecticidal, and oviposition inhibitory, hypotensive and spasmolytic properties [41].

3.8 Pithecellobium dulce

3.8.1 Classification

- Division: Tracheophyta
- Class: Equisitopsida
- Order: fabales
- Family: fabaceae
- Genus: Pithecellobium
- Species: *Pithecellobium dulce*
- Vernacular name: Jungle-jalebi, Manila Tamarind

3.8.2 Traditional use

The bark and pulp of Manila Tamarind are used as a traditional remedy against gum ailments, toothache, and hemorrhage. Bark extract is also used against dysentery, diarrhea, and constipation. An extract of leaves is used for gall bladder ailments and to prevent miscarriage. Plumply seeds covered with edible, fleshy, bright colored arils, which are sweet in taste. Grounds seeds are used to treat ulcer. Numerous studies have been performed on anti-oxidant, anti-inflammatory, anti- diabetic, anti- cancer properties of Manila tamarind. It provides relief from pain, eczema, fever, cold, sore throat, pigmentation, acne and pimples [42].

3.8.3 Phytochemistry

Manila tamarind contains various secondary metabolites such as essential amino acids, polyphenols, steroids, tannins, saponins, glycosides, lipids, glycolipids, phospholipids, polysaccharides, ascorbic acid [43] and vit B1, B2, B3, B6, C, and E, [42].

3.8.4 Pharmacological activity

Different plant parts of Jungle Jalebi tree showed antioxidant, antibacterial, anti-inflammatory, antidiabetic, cardioprotective, anthelmintic, antiulcer, antidiarrheal, hepatoprotective, analgesic, hypolipidemic and larvicidal & ovicidal against mosquito vectors [42].

3.9 Azadirachta indica A. Juss.

3.9.1 Classification

- Division: Tracheophyta
- Class: Equisetopsida
- Order: Rutales
- Family: Meliaceae
- Genus: Azadirachta
- Species: *Azadirachta indica*
- Vernacular name: Neem, Nimboli

3.9.2 Traditional use

Since ancient times in India, “Neem” has been used in traditional medical systems as in Ayurveda, Sidha and Unani. All plant parts are equally important. Tender leaves are advised to be consumed orally in “Chaitra” month of Hindu calendar to be healthy and disease free for subsequent years. Fresh/dried leaves used to be burnt to remove mosquitoes during summer nights. Leaves decoction used to treat acne, heat rashes, skin infections, ringworm, and eczema. Dried leaves

are mixed in cereals and kept in the storehouse to make them pest free. Young tender shoots are used as a natural toothbrush to protect gums and teeth. Chewing young shoots promotes saliva production and maintain oral health. Neem oil used to protect wooden furniture from termites, treat dandruff and lice problems. Nimboli; neem fruits are sweet in taste, relieves fever, pain and swelling.

3.9.3 Phytochemistry

All plant parts of Neem equally offer several important phytocompounds such as alkaloids, flavonoids, steroids, terpenoids, glycosides, saponins, tannins, phenolics and oxalic acid [44].

3.9.4 Pharmacological activity

Roots, bark, leaves, flowers and fruits of Neem tree showed pharmaceutical important activities such as immunostimulant, hypoglycemic, antiulcer, anti-inflammatory, antioxidant, anticancer, antidiabetic, antimalarial, antifungal, antibacterial, antiviral, CNS depressant, anti-leprosy, antipyretic, analgesic, anti-spiro-chaetal and emmenagogue properties [45].

3.10 Haloxylon salicornicum (Moq.) Bunge ex Boiss.

3.10.1 Classification

- Division: Tracheophyta
- Class: Equisetopsida
- Order: Caryophyllales
- Family: Amaranthaceae
- Genus: Haloxylon
- Species: *Haloxylon salicornicum*
- Vernacular name: Lanna, Lana

3.10.2 Traditional use

Haloxylon salicornicum, known as “Lana”; is a shrub halophyte, found in arid regions and possesses important traditional applications. Seeds are pounded mixed with Bajra flour, added spicy ingredients, made small doughballs and steam cooked on Lanna wood sticks to prepare a seasonal dish named “Dhokali” consumed with chutney by native people with a great relish. During famine, seeds were used as emergency food, tender leaves, shoots, fruiting tops & seed as fodder for cattle, timber as fuel, different plant parts used for medicine, and aids in restoration of degraded lands. In earlier times indigenous people were used to clean/wash cloths by plants’ ash in absence of modern cleaning chemicals.

3.10.3 Phytochemistry

Lana plant is a reservoir of important metabolic active compounds such as flavonoids, alkaloids, coumarins, pyranones, tannins, saponins and several glycosides [46].

3.10.4 Pharmacological activity

Plant parts extracts of *Haloxylon salicornicum* in different solvents showed antioxidant, antidiabetic, antifungal, lipoxygenase inhibition, anticoagulant, hepatoprotective, antituberculosis, anti-inflammatory, antibacterial, and antiparasitic properties [46].

3.11 Glossonema varians (Stocks) Benth. Ex Hook.f.

3.11.1 Classification

- Division: Tracheophyta
- Class: Equisetopsida
- Order: Gentianales
- Family: Apocyanaceae
- Genus: Glossonema
- Species: *Glossonema varians*
- Vernacular name: Khironi, Dodha, Dodiya

3.11.2 Traditional use

Glossonema varians; local name "Khironi", a rare endemic species available in the Jaisalmer region of the Thar Desert, is of immense economic/ecological importance. Tender leaves and softly spinous, fleshy edible follicles; Dodiya are consumed as vegetables in rural and remote areas rarely sold into the local market. Seeds from immature fruits are edible and cooked by native people. Fresh and unripe fruits known as 'Khironi/ Dodiya" lookalike follicles of *Pedallium murax* Linn.; "Bada gokhru" are consumed as famine food by indigenous people. Fruits are used as body tonic and energy promoters also for curing cough, throat infection and fatigue [47]. The infusion of leaves is given for painful urination [48].

3.11.3 Phytochemistry

Follicles of Khironi contain high nutritional value as they possess carbohydrates, flavonoides, amino acids and fatty acids [49,50]. Phobo et al., [51] reported moderate levels of antioxidant potential soluble phenolic and ACE inhibitor activity in *Glossonema edule* from Qatar which may be useful for potentially managing hypertension and oxidation linked vascular complications.

4 Conclusion

Indigenous knowledge of the edible wild fruits and their therapeutic uses is well evidenced by our traditional medical systems as Ayurveda, Unani, and Sidha. EWFs are still essential to the rural/tribal people's healthcare system in western Rajasthan. Most of the xeric, halophytic plant species considered as an emergency food in famine time and provide fodder, bark, wood, gum, resins, fruits to rural people, for their survival in hard time. Due to rapid urbanization, deforestation, overgrazing and extensive land use, the indigenous plant species are being destroyed, so the less explored, local plant species has reached the verge of extinction. We should not only have to make maximum use of the WEFs to be healthy and disease free but should also have to make serious efforts to protect and conserve the local plant species.

Haloxylon salicornicum and *Grewia tenax* both are halophytic and xeric plant species restricted to western Rajasthan. Due to multipurpose uses and ecological, medicinal, and nutritional importance, *H. salicornicum* and *G. tenax* are of immense value. Due to over exploitation by various ways these plants become threatened now. There is an urgent need for its conservation and propagation. Propagation techniques and value addition in these species not only improve the livelihood of local habitants but also helpful in conservation of desert biodiversity.

Glossonema varians is an important plant species of western Rajasthan, flourishing in different climatic conditions of Jaisalmer only. Serious efforts are needed to safeguard and improve this species due to its limited distribution and habitat destruction. Scientific professionals and scholars should be making efforts to focus and detailed study on medicinal uses, phytochemistry and therapeutics applications of *G. varians,* so data on pharmacological activities of Khironi shall be employed into pharmaceutical industries and drug companies to synthesize a novel formula or a new drug for betterment and wellness of humankind.

Compliance with ethical standards

Disclosure of conflict of interest

Authors declare no conflict of interest.

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