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Ethno-functional food studies of non-commercial fruits used by Tribals of southern Rajasthan India

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Abstract

Since time immemorial fruits form a suggestive major protective, restorative and curative element in various maladies. The present study aimed to document these functional fruits for their pharmacological properties. Ethno-medicinal survey of southern Rajasthan reveals usage of 50 fruit plants among which fifteen fruits are used in diabetes, eleven in digestive disorders and four in respiratory ailments. None of the informants depicted the usage of fruits or its components for immune system or ailments related to neurological complications. Grains and seeds were either utilized as boiled rice or were used for making bread.

Keywords: Functional foods, traditional fruits, diabetes, southern Rajasthan

Introduction

Food and health are intervened and their connections have been established since the inception of human civilization. The evolution of food processing has quenched the taste buds but has enormously declined its quality^[1]. Thermo-labile components of the foods are destroyed during cooking process and hence the dieticians recommend fruits and salads in the dietary health management strategies. Fruits are the good sources of simple sugars, fibers, vitamins, minerals and water. Their consumption as raw adds more functional quality as thermo-sensitive components are retained in their native forms^[2, 3].

Despite commercial fruit markets and plazas, the aboriginals still rely on their non-commercial local foods among which fruits occupy significant place^[4]. These peoples are aware of their functional properties and therefore apply as needed among various maladies. Documentation and further application of such inherent in modern scenario ignored fruits will help in managing pharmacopeia.

As per the 2011 census, the Scheduled Tribe (ST) population of Rajasthan state is 9,238,534 constituting 8.9 percent of the total ST population of India. Tribes in Rajasthan are classified as scheduled tribes, denotified, nomadic tribes and semi nomadic tribes. According to Salvi^[5] the Mina forms the major tribe of Rajasthan followed by Saharia, Bheel/Bhil and Garasia. These tribes reside in specific localities of Aravallis and health care system of tribal pockets in Rajasthan is managed by various tribal healers *viz.* Bhopa (Ritual therapist), Jhankar / Jhangar (Herbalist), Devala (Grain diviner), Khoonth (Priest) and Guni (Herbal practitioner)^[6-8]. For the documentation of functional properties of local fruits, an extensive survey was carried out of southern part of Rajasthan including Chittorgarh, Udaipur, Banswara and Dungarpur districts.

Material and methods

Ethno-medicinal field studies were carried out from 2015 to 2017 with following aims-

- Documentation of ethno-medicinal plants.
- Authentication of primary data.
- Preparation of herbarium sheets.

A. Documentation of ethno-medicinal plants

- For the documentation of ethno-medicinal plants, field surveys were carried out all around the year from 2015 to 2017 in various tribal, rural and sub-rural pockets.
- Various localities of Southern Rajasthan (District-Udaipur, Dungarpur and Banswara) were selected to unearth the information from all the dominating tribes.
- For recording and documentation, field interviews were made from different practitioner's *i.e.* ritual therapist, herbalist, grain diviner, priest and ancestral practitioner through local

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transcends to avoid language ambiguity and data were recorded in information retrieval form.

- According to CBD guidelines prior informant consent (PIC) was obtained and inscribed for usage, dose, mode of dose, tenure/ time interval etc.

B. Authentication of primary data

In order to determine the authenticity of information collected

during field visit, data was cross checked with published data of the same array and region. Data was also authenticated in criss cross manner by interviewing other informants.

C. Preparation of herbarium Sheets

Plant specimens were collected and herbarium sheets were prepared with all related information. Plants were identified up to species level through flora of region and prior work.

Table 1: Ethno-medicinal enumeration of functional fruits used by tribal's of Southern Rajasthan to treat human diseases and disorders

S. No	Botanical name; Family (Local name)	Plant part/s used	Form of usage; Application	Ailment/Disorder
1.	<i>Acacia leucophloea</i> (Roxb.) Willd.; Mimosaceae (Ronj)	Unripe pods	Cooked as a vegetable	Demulcent
2.	<i>Acacia nilotica</i> (L.) Del.; Mimosaceae (Bawal)	Pods	Powder is added to bread flour	Impotency
3.	<i>Achyranthes aspera</i> L.; Amaranthaceae (Kantha)	Seeds	Roasted seed powder is mixed with wheat/ maize flour	Whooping cough
4.	<i>Aegle marmelos</i> (L.) Corr.; Rutaceae (Bel)	Fruit pulp	Boiled pulp consumed orally	Dysentery & Diarrhea
5.	<i>Alangium salvifolium</i> (L.f) Wang.; Alangiaceae (Ankol)	Ripe fruits	Eaten raw/Cooked as vegetable	High blood pressure
6.	<i>Alloteropsis cimicina</i> (L.)Stapf.; Poaceae (Basanti ghash)	Grains	Flour used for making bread	Diabetes & Flatulence
7.	<i>Amaranthus gangeticus</i> L.; Amaranthaceae (Kangani)	Seeds	Used as pseudocereal; boiled as rice	Constipation & Liver tonic
8.	<i>Bauhinia variegata</i> L.; Caesalpinaceae (Kachnar)	Fruits	Powder is added to wheat flour	Diabetes
9.	<i>Capparis decidua</i> (Forssk.) Edgew.; Capparaceae (Ker)	Unripe fruits	Used for the preparation of vegetable / pickle.	Digestive disorders
		Ripe fruits	Eaten raw	Asthma
10.	<i>Capparis sepiaria</i> L.; Capparaceae (Kanthor)	Ripe fruits	Eaten raw	Tumors
11.	<i>Carissa congesta</i> Wt.; Apocynaceae (Karonda)	Unripe fruits	Cooked as a vegetable	Stone problems
		Ripe fruits	Eaten raw or used in preparation of sausages	Stone problems
12.	<i>Coix lacryma-jobi</i> L.; Poaceae (Garelo)	Grains	Boiled and consumed as rice. Seeds along with <i>Zea mays</i> / <i>Triticum</i> are used for making porridge.	Dysentery, Diabetes & Urinary complaints
13.	<i>Cordia dichotoma</i> Forst. F; Ehretiaceae (Gunda)	Unripe fruits	Used as vegetable & pickles	Biliousness
		Ripe fruits	Eaten raw	Gastritis, Indigestion & Constipation
14.	<i>Cordia gharaf</i> (Forssk.) EHrenb. ex. Asch.; Ehretiaceae (Gundi)	Ripe fruits	Eaten raw	Flatulence
15.	<i>Cucumis callosus</i> (Rottl.)Cogn.; Cucurbitaceae (Kachri)	Fruits	Eaten raw or cooked as vegetable	Peptic ulcer
16.	<i>Cucumis melo</i> L.; Cucurbitaceae (Garelo)	Fruits	Eaten raw or cooked as vegetable	Peptic ulcer
17.	<i>Cyamopsis tetragonoloba</i> (L.)Taub; Fabaceae (Gaur)	Pods	Used as a vegetable	Asthma, Inflammation & Sprain
18.	<i>Echinochloa colonum</i> (L.) Link.; Poaceae (Sama)	Grains	Boiled and consumed as rice	Diabetes
19.	<i>Echinochloa crusgalli</i> (L.) P.Beauv.; Poaceae (Sama)	Grains	Boiled and consumed as rice	Diabetes & Nostril hemorrhage
20.	<i>Eleusine coracana</i> (L.) Gaertn.; Poaceae (Garelo)	Grains	Boiled and consumed as rice	Diabetes & Fever
21.	<i>Ensete superbum</i> (Roxb.) Chees; Musaceae (Jungli kela)	Fruits	Consumed raw	♀ Contraceptive
22.	<i>Feronia limonia</i> (L.) Swingle; Rutaceae (Kotambadi)	Ripe fruits	Consumed raw and also used for the preparation of chutney.	Diabetes & Leucorrhea
23.	<i>Grewia hirsuta</i> Vahl.; Tiliaceae (Gurushira)	Ripe fruits	Consumed raw	Dysentery
24.	<i>Grewia tenax</i> (Forssk.) Fiori.; Tiliaceae (Gangir)	Ripe fruits	Consumed raw	Dysentery
25.	<i>Holoptelea integrifolia</i> (Roxb.) Planch.; Ulmaceae (Bandarbatti)	Seed kernels	Eaten raw	Skin eruptions
26.	<i>Ipomoea pes-tigridis</i> L.; Convolvulaceae(Ghebatti)	Seeds	As a powder used for bread preparation	Gastric troubles
27.	<i>Lagenaria siceraria</i> (Molina.) Standl.; Cucurbitaceae (Tumbi)	Fruits	Used as a vegetable	Jaundice

28.	<i>Leptadenia reticulata</i> (Retz.) Wt. & Arn.; Asclepiadaceae (Chiep)	Unripe fruits	Used as a vegetable	Arthritis & Rheumatism
29.	<i>Madhuca indica</i> J. F. Gmelin; Sapotaceae (Mahua)	Fruits	Eaten raw and also cooked as vegetable	Tuberculosis & Eczema
30.	<i>Mimusops elengi</i> L.; Sapotaceae (Khirmi)	Ripe fruits	Fruits are eaten raw	Mouth boils & Tonsillitis
31.	<i>Moringa concanensis</i> N. ex Dalz. & Gibs.; Moringaceae (Sargana)	Pods	Used as a vegetable	Biliousness & Flatulence
32.	<i>Moringa oleifera</i> Lamk.; Moringaceae (Sargana)	Pods	Used as a vegetable	Arthritis, Rheumatism & Inflammation
33.	<i>Morus alba</i> L.; Moraceae (Shatut)	Fruits	Eaten raw	Goiter
34.	<i>Mucuna pruriens</i> (L.) DC; Fabaceae (Kaunch)	Unripe fruits	Eaten raw and/ used for the preparation of Konch pak	General debility & Low BP
35.	<i>Panicum miliaceum</i> L.; Poaceae (Samlai)	Grains	Flour used for making bread	Diabetes
36.	<i>Panicum sumatrense</i> Schult.; Poaceae (Samlai)	Grains	Flour used for making bread	Diabetes
37.	<i>Paspalidium flavidum</i> (Retz.) A. Camus; Poaceae (Samlai)	Grains	Flour used for making bread	Diabetes
38.	<i>Paspalum scrobiculatum</i> L.; Poaceae (Kodra)	Grains	Boiled and consumed as rice	Diabetes & Dysentery
39.	<i>Pedaliium murex</i> L.; Pedaliaceae (Bada Gokhru)	Fruits	Powder added to bread	General Debility
40.	<i>Pithecellobium dulce</i> (Roxb.) Benth.; Mimosaceae (Kikar)	Aril	Eaten raw	Demulcent
41.	<i>Salvadora persica</i> L.; Salvadoraceae (Pilu)	Fruits	Eaten raw	Scurvy & Rheumatism
42.	<i>Setaria glauca</i> (L.) P. Beauv.; Poaceae (Kukarva)	Grains	Flour used for making bread	Diabetes
43.	<i>Setaria italica</i> (L.) P. Beauv.; Poaceae (Kangini)	Grains	Flour used for making bread	Diabetes & Dysuria
44.	<i>Solanum nigrum</i> L.; Solanaceae (Makao)	Fruits	Eaten raw	Cold and Cough
45.	<i>Spondias mangifera</i> Willd.; Anacardiaceae (Parangi)	Fruits	Eaten raw	Apnea
46.	<i>Syzygium heyneanum</i> (L.) P. Beauv.; Myrtaceae (Jungle jamun)	Fruits	Eaten raw or used as a vinegar	Diabetes & Obesity
47.	<i>Tribulus terrestris</i> L.; Zygophyllaceae (Gokhru)	Seeds powder	Flour used for bread during famines	Urinary infections & Kidney dysfunction
48.	<i>Trichosanthes anguina</i> L.; Cucurbitaceae (Chachinda)	Fruits	Consumed as a vegetable	Diabetes & Bronchitis
49.	<i>Ziziphus glabrata</i> Heyne ex Roth.; Rhamnaceae (Bor)	Fruits	Eaten raw	Leucorrhoea
50.	<i>Ziziphus nummularia</i> (Burm. F.) Wt. & Arn.; Rhamnaceae (Jhari Bor)	Fruits	Eaten raw	Leucorrhoea & Constipation

Result and Discussion

Documentation of ethno-functional food from southern Rajasthan reveals usage of 50 fruits and their respective components for different maladies. In order to correct water mediated diarrhea fruit pulp of *Aegle marmelos* is consumed orally. *Aegle marmelos*, *Coix lacryma-jobi*, *Grewia hirsute*, *Grewia tenax* and *Paspalum scrobiculatum* are used to check dysentery. Flowers and fruits of *Madhuca indica* are utilized as raw or cooked as vegetable and thereafter consumed to cure tuberculosis. These herbs are either cidal or static against the microbes. They block the anabolic pathway by subsidizing the ionic channels and thereby inhibit their growth^[9]. Informants were not aware about the concept of malignancy with respect to cancer and tumor. Therefore, the plant usages in cases where the patient was clinically diagnosed for cancer were included in cancer subcategory while all clinically undiagnosed masses of tissues were included under tumors. No plant source based usage was cited for cancer whereas one citation i.e. raw fruits of *Capparis sepiaria* are used to get rid off for tumors. Flavonoids are effective anti-tumor molecules therefore plants with rich pool of flavanoid may help in tumor^[10].

Scurvy results due to lack of vitamin C (ascorbic acid). Early symptoms include weakness, feeling of tiredness and sore arms and legs. Without treatment, decreased red blood cells, gum disease, changes in hair morphological patterns and bleeding from the skin may occur. As scurvy worsens there can be poor wound healing, personality changes and finally death from infection or bleeding. *Salvadora persica* is used to combat ascorbic acid deficiency (Table 1).

With respect to nutritional disease/s no supplementary functional food or drugs are ingested. Obesity is considered to be outcome of over eating and they do not relate it as an output to any other metabolic disorder. *Syzygium heyneanum* vinegar is used to reduce the stuffed body fat. Their fruits are also used for the same. As they are rich in fiber which in turn may help in early satiety, less uptake and in turn causing weight loss. Symptoms related to sugar anomaly was recorded to differentiate the sub-category of diabetes. Among diabetes mellitus no juvenile or gestational record was obtained and the informants were not aware about diabetes insipidus. Therefore, in present documentation diabetes refers to diabetes mellitus II. Fifteen plants viz. *Alloteropsis cimicina*, *Bauhinia variegata*, *Coix lacryma-jobi*, *Echinochloa colonum*, *Echinochloa*

crusgalli, *Eleusine coracana*, *Feronia limonia*, *Panicum miliaceum*, *Panicum sumatrense*, *Paspalidium flavidum*, *Paspalum scrobiculatum*, *Setaria glauca*, *Setaria italica*, *Syzygium heyneanum* and *Trichosanthes anguina* are used to reduce high glycemic levels. As earlier reported the active component of these plants effectively seizes post prandial hyperglycemia^[11-14].

Among other endocrine maladies only one plant *Morus alba* was reported to be used in iodine related thyroid dysfunction although there was no cited demarcation for hypothyroidism and hyperthyroidism. These fruits are used in goiter suppression which is accordance to the earlier report by Ghosh *et al.*^[15].

Sleep-wake disorders were least observed among the populations except in the agedly/s. *Spondias mangifera* was reported to be used in apnea. Probably it slows down the nervous system, which relaxes the body^[16].

Mucuna pruriens is used to elevate and regulate low blood pressure whereas *Alangium salvifolium* are used to lower high blood pressure. Probably these plants possess angiotensin converting enzyme inhibitor activity due to which they act as cardiotonics and reduce hypertension^[17].

Achyranthes aspera, *Solanum nigru*, *Spondias mangifera* and *Trichosanthes anguina* are used as remedial source in respiratory diseases. *Bauhinia variegata* and *Mimusops elengi* are used to refrain from tonsillitis. Ethnically *Capparis deciduas* and *Cyamopsis tetragonoloba* are used by patients of asthma. When an asthma patient comes in contact with an allergic substance, it behaves as an antigen and reacts with the corresponding antibodies already present in patients bodies. The histamine and other substances liberated during the allergic reactions cause the damage in the bronchi. Plants having biomolecules that can repair mast cells of bronchi serve as anti asthmatic or serve as leukotriene antagonists^[18-20].

Undefined and combined symptoms including nausea or recurrent upset stomach, abdominal bloating and pain, vomiting, indigestion and/ or loss of appetite are termed under common category as gastric problems^[21]. *Alloteropsis cimicina*, *Amaranthus gangeticus*, *Capparis deciduas*, *Cordia dichotoma*, *Cordia gharaf*, *Cucumis callosus*, *Cucumis melo* *Ipomoea pes-tigridis*, *Mimusops elengi*, *Moringa concanensis* and *Ziziphus nummularia* are used to cure mouth boils, gastritis, flatulence, indigestion, constipation and peptic ulcer. Liver is a chief detoxifying organ of the body. Liquor consumption with sub standard practices predominates in tribal patches. Many plants are used in various forms for the restoration and regeneration of hepatic cells. The present study reveals usage of *Lagenaria siceraria* in jaundice and application of boiled grains of *Amaranthus gangeticus* as liver tonic. According to local therapist *Carissa congesta* is used to get rid of stone problems but they were unable to demarcate between kidney and gall bladder stones (Table 1).

The primary function of the skin is to serve as a protective barrier against the environment. Loss of the integrity of large portions of the skin as a result of injury or illness may lead to major disability or even death. Wounds and cuts are the major entry doors of microbial world and in due time clogs the tissue^[22]. Delayed wound healing sometimes leads to ulceration which becomes more crucial in diabetic patients. *Holoptelea integrifolia* is reported to enhance skin eruptions. Plants with metalloproteinase synthesizing capabilities promote wound healing through multiple routes and therefore are deployed ethnically^[23, 24]. *Acacia leucophloea* and *Pithecellobium dulce* are used as demulcent.

Madhuca indica is used as topical over infected parts of skin. Eczema is a term for a group of medical conditions that cause the skin to become inflamed or irritated. The most common type of eczema is known as atopic dermatitis or atopic eczema. The exact cause of eczema is unknown, but it's thought to be linked to an overactive response by the body's immune system to an irritant. Generally it is imposed by fungal moieties. Therefore, plants that boost immunity or have antifungal properties serve as phyto drug in eczema^[25].

Cyamopsis tetragonoloba, *Leptadenia reticulate*, *Moringa oleifera* and *Salvadora persica* are used to cure muscular anomalies and bone deformities. Enzymatic degradation of hypoxanthine and xanthine leads to the production of uric acid. Elevated concentrations of uric acid in the blood stream of human body leads to formation of gout, characterized by hyperuricemia and recurrent attacks of arthritis. Xanthine oxidase is an enzyme responsible for catalyzing the oxidation of hypoxanthine to xanthine and xanthine to formation of uric acid. The treatment of gout entails the use of therapeutic agents such as xanthine oxidase inhibitors which acts by blocking the biosynthesis of uric acid from purine in the body and it is believed that either by increasing the excretion of uric acid or reducing the uric acid production helps to reduce the risk of gout^[26].

Among different genital diseases *Feronia limonia*, *Ziziphus labrabra* and *Ziziphus nummularia* are used for leucorrhea. *Coix lacryma-jobi*, *Setaria italica* and *Tribulus terrestris* are used to treat urinary infections. Urinogenital disorders include bladder cancer, cystocele, hematuria, impotence / erectile dysfunction, interstitial cystitis, male factor infertility, neurogenic bladder, peyronie's disease, benign prostatic hyperplasia and prostate cancer. Informants claim uses of *Tribulus terrestris* to treat renal dysfunction. Renal maladies include tubular necrosis, acute interstitial nephritis, Fanconi's syndrome, hypokalemia or hyperkalemia, hypertension, papillary necrosis, chronic interstitial nephritis, nephrolithiasis, urinary retention and cancer of the urinary tract. *Tribulus* might promote effective filtration by restoring the effective equilibrium between afferent and efferent filtration pressures^[27].

In the studied region many applications and medications were reported to be gender based. No male oral contraceptive medications were cited by informants while *Ensete superbum* is used as a femalely contraceptive. Many of these medicinal plants appear to act through an antizygotic mechanism either they inhibit sperm head activation or changes the biochemical milieu of developed eggs^[28].

Similarly aphrodisiac are used by male members and no report regarding usages in female has been reported. *Acacia nilotica* are used to energize, vitalize and improve sexual function whereas *Mucuna pruriens* and *Pedalium murex* are used to treat general debility. These function either by increasing testosterone or activate melanocortin receptors MC3/4-R^[29]. Fever (also known as pyrexia or controlled hyperthermia) is a condition when a human's body temperature goes above the normal range of 36-37 °C. In the study area, the fever is common and frequent. Local therapist deploy many plants as therapeutics but only *Eleusine coracana* is used as a remedial food for the same but the informants were not aware about the causal sources of fever and therefore were treated in general. Ethno-medicinal survey also reveals that in 68% applications fruits and pods are deployed as a whole unit whereas in aril is deployed in 2% disease and 30% applications involve usage of seeds and grains. 42% fruits and their parts are eaten raw while

25% are used as vegetable, 21% grains are used as flour for bread while 10% are consumed as boiled rice. Only 2% fruits are used as decoction to check /regulate anomalies.

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