UK Journal of Pharmaceutical and Biosciences
Available at www.ukjpb.com
ISSN: 2347-9442

# Therapeutic Properties and Nutritive Values of Some Fruit Bearing Medicinal Plants of Rajasthan State in India

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**Article Information**
Received 10 August 2017
Received in revised form 16 Oct 2017
Accepted 18 Oct 2017

***Keywords:***
Medicinal Plant,
Rajasthan,
Therapeutic Properties,
Nutritive

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**Abstract**

The medicinal plants imparts chief role in protecting our health from various disease. It is nature's gift to human being to live healthy life. Medicinal plants are believed to be much safer and proved as elixir in the treatment of various ailments. Medicinal plants used in Indian system of medicine from Rajasthan state have been surveyed and categorized systematically. The manuscript incorporated the therapeutic properties and nutritive values of medicinal plants of Rajasthan. The paper deals with 11 medicinal plants, thoroughly indexed along with their important traditional application for the cure of various ailments. This study also incorporates the ethno-botany and biological activities of these important plants.

## 1 Introduction

Folk medicines today play a key role in the developing countries due to a lack of or limited modern health service. 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 of both urban and rural areas in China and India. Information from ethnic groups about indigenous traditional medicines has played a vital role in the discovery of novel products from plants for use as chemotherapeutic agents. Herbal medicines have been the main source of primary health care in many nations. About 80% of the world's populations are still dependent on traditional medicines[1,2].

Traditions are dynamic entities of unchanging knowledge. Traditional medicine is in an evolutionary process as communities and individuals continue to discover new techniques that can transform practices. Ethnopharmacology and drug discovery using natural products remain important issues in the current target-rich, lead-poor scenario. Many modern drugs have their origin in ethnopharmacology. However, despite technologic advances, the drug discovery process is facing a major innovation deficit that is adversely affecting the pharmaceutic industry[3,4].

Rajasthan is the largest state in the Northeastern part of India, geographically it lies between 23º3' to 30º12'N longitude and 69º30' to 78º17'S latitude and is rich in diversity of medicinal plants[1]. Medicinal uses of different plants have been recorded in numerous literatures standing from the age of Vedas. In Rajasthan also a lot of work has been done on ethnomedicinal plants used for various ailments by different tribal communities and researchers. The present paper represent the data of the therapeutic properties and nutritive values of fruit bearing medicinal plants occurring in the Rajasthan state which may be used in future as plant resources for modern system of medicine.

## 2 Therapeutic properties and nutritive values of medicinal plants of Rajasthan

*Balanites aegyptiaca*

*Balanites aegyptiaca* is a member of Zygophyllaceae family, is also known as 'Desert date' in English, one of the most common but neglected wild plant species of the dry land areas of Africa and South Asia[7]. It is a slow growing, small, not very spreading, multibranched, evergreen, spiny and medium size tree up to l0 m tall, or shrub[8]. This tree is native to Africa and parts of the Middle East. In India, it is particularly found in Rajasthan, Gujarat, Madhya Pradesh, and Deccan[9]. It can be found in

many kinds of habitat, tolerating a wide variety of soil types, from sand to heavy clay, and climatic moisture levels. This plant has been reported to have anthelminthic, insecticidal, antidiabetic, antimicrobial, antibacterial, antifungal, hepatoprotective, anticancerous, antiparasitic, anti-inflammatory, molluscicidal and antioxidant properties[10-12].

*Balanites aegyptiaca* is traditionally used in treatment of various ailments i.e. jaundice, intestinal worm infection, wounds, malaria, syphilis, epilepsy, dysentery, constipation, diarrhea, hemorrhoid, stomach aches, skin boils, leucoderma, malaria, wounds, colds, syphilis, liver and spleen disorders, asthma, snake bite[13] and fever. The bark of the plant is useful in curing mental diseases, yellow fever, jaundice and syphilis and can also act as a fumigant to heal circumcision wounds. Fruit kernel has been found as a mild laxative, an antidote to arrow poison, and also acts as a vermifuge. Kernel oil helps in curing skin disease. The seeds are useful as ointments, to cure cough, colic pain and also have magicoreligious properties[14,15].

*Balanites aegyptiaca* contains saponin, furanocoumarin, and flavonoid namely quercetin 3-glucoside, quercetin-3-rutinoside; 3-glucoside, 3-rutinoside, 3- 7-diglucoside and 3-rhamnogalactoside of isorhamnetin[16]. Fruit contains protein, sugars, organic acids, other constituents like 3-rutinoside and 3-rhamnogalactoside, diosgenin. kernel contains a xylopyranosyl derivative of above saponin present in mesocarp. Balanitoside (furostanol glycoside) and 6-methyldiosgenin, balanitin-3 (spirostanol glycoside) have been reported from fruits (mesocarp) of *B. aegyptiaca*. The kernels also contained oil and protein, oil contains mainly palmitic, stearic, oleic, and linoleic acids which were the main fatty acids. The leaves and fruit kernels of *B. aegyptiaca* L. were found to contain six diosgenin glucosides including di-, tri, and tetraglucosides[16, 17].

Roots is reported to contain steroidal saponin about 1% glycosides and major sapogenin is yamogenin other glycosides. Bark is reported to contain furanocoumarin bergapten and dihydrofuranocumarin D- marmesin, two alkaloid namely, N-trans-feruloyltyramine and N-cis-feruloyltyramine, and three common metabolites, vanillic acid, syringic acid; and 3-hydroxy-1-(4-hydroxy-3-methoxyphenyl)-1-propanone[18, 19].

*Calligonum polygonoides*

*Calligonum polygonoides* is a member of family Polygonaceae. It is a small leafless shrub, which has a reputation in folklore medicine as a stimulant and astringent[20]. *Calligonum polygonoides* is locally known as Phog, Phogala or Phogaro[21]. Usually it is seen as a small glabrous, winter shedding, perennial shrub 3-4 feet high with whitish and fragile branches. Sometimes a small tree with 12-15 feet in height and a trunk with 2-3 feet in girth[22]. It is found from arid and semi-arid areas of Thar desert in India. It grows on sand dunes as a psammophytic vegetation of Barmer, Bikaner, Churu, Jaisalmer, Jhunjhunu, Nagaur, Sikar and Shri Ganganagar.

Leaves and stems are chewed to wash teeth and to treat gummosis while young shoots infusion is used as tonic[23]. Paste of Root is applied on the affected areas for the treatment of Prickly heat and scabies. Decoction is used for the treatment of sore gums, typhoid. Flowers buds are effective in sun stroke. Flowers are also used for the treatment of asthma, eczema, cough and cold. It is reported that juice of the plant is applied in eyes to remove poisonous effect of *Calotropis procera*[24].

*Calligonum polygonoides* possesses hypoglycemic, cytotoxic, antioxidant, antimicrobial, anti-cancer, antiulcer, anti-inflammatory, antifungal, and mosquitocidal activities[25-27].

Findings show that flavonoids, alkaloids, tannins, steroids, phenols, carbohydrates and terpenoids are present in different parts of C. polygonnoides[28]. Chemical analysis of *Calligonum polygonoides* revealed the presence of catechin, dehydrodicatechin A, kaempferol-3-*O*-rhamnopyranoside, quercitrin, *β*-sitosterol-3-*O*-glucoside, isoquercitrin, kaempferol-3-*O*-glucuronide, and mequilianin. Campesterol, stigmasterol, (3 β, 5 α, 24 S)-stigmastan-3-ol, and stigmast-4-en-3-one were isolated from the roots of the plant, whereas *β*-sitosterol, kaempferol, quercetin, taxfolin, gallic acid, and astragalin were isolated from leaves[29, 30].

*Citrullus colocynthes*

*Citrullus colocynthis* is perennial herbs usually trailing belongs to family Cucurbitaceae, commonly known as Chitrapala or Bitter apple. It is found wild in the sandy lands of North West, the Punjab, Sind, and Central and southern India, and coromandal coast. Also found indigenous in Arabia, West Asia, and Tropical Africa and in the Mediterranean region. *Citrullus colocynthis* is tender climbing monoecious plant with 2-3tendrils. Leaves are deeply 3-5 lobate and both, the male & female flowers are yellow. Fruits are globular, variegated, dark green with yellowish blotches. When ripe, it is filled with a dry spongy very bitter pulp[31, 32].

Citrullus colocynthis shows mild stomachic, bitter tonic, anthelmintic, anti-cancer, antioxidant, antimicrobial, antidiabetic, analgesic, antipyretic, anti-inflammatory, carminative, diuretic and anthelminthic property[33, 34].

*Citrullus colocynthis* is used generally in the cure of various diseases such as leprosy, gut disorders, diabetes, constipation, asthma, indigestion, colic, rheumatism, hypertension, gastroenteritis, dysentery, bronchitis, jaundice, joint pain, cancer and mastitis[35, 36].

*Citrullus colocynthis* contain various bioactive compounds such as alkaloids, flavonoids, carbohydrates, glycosides, fatty acids and essential oils. Cucurbitacins (Cucurbitane type triterpen glycoside viz colocynthoside A & B) have been documented as

the major constituent of *Citrullus colocynthis* fruits[37]. Seeds contain Fatty acid like Stearic, Myristic, Palmitic, oleic, Linoleic, Linolenic acid, Protein 8.25 % and rich content rich in lysine, leucin and sulfo amino acid like methionine, Vitamin B1, B2 and Niacin, Mineral like Ca, Mg, K, Mn, Fe, P and Zn. Aerial part and fruit contain flavonoid glycoside quercetin, Flavone- 3-glucoside viz iso-vitexin, iso-orentine and isoorentine -3-methyl ether[38].

*Commiphora wightii*

Guggulu consists of oleo-gum resin obtained as an exudate from the tapping of stem and branches of *Commiphora wightii* (Arnott) Bhandari; Family, Burseraceae. The plant is commonly known as guggal, gugar, and Indian bdellium tree and is found in arid areas of India, Bangladesh, and Pakistan. In India, it is found in Rajasthan, Gujarat, Assam, Madhya Pradesh, and Karnataka. It is a small, bushy tree with thorny branches and produces a yellowish gum resin (guggulu) in small ducts located throughout its bark. The trees are tapped by making an incision on the bark. The resin, which flows out, is allowed to harden before it is collected. The tree is tapped from November to January and the resin is collected through May to June[39].

Guggulu possesses hypolipidemic, anti-inflammatory, anti-arthritic, antifertility, Anti-atherosclerotic, astringent, anti-septic, anti-inflammatory, analgesic, wound healing, anti-obesity, anti-spasmodic activity[40].

In Indian traditional system of medicine, guggulu has been used for thousands of years in the treatment of arthritis, inflammation, stimulates libido, nervous diseases, bronchial congestion, cardiac and circulatory problems, weak digestion, wounds, abscess, foetid ear, fractures, gout, skin rashes, irregular menstruation, diarrhea, headache, mild nausea, liver toxicity, rheumatism, obesity, and disorders of lipids metabolism[41].

Guggulu contains guggultetrols, monoterpenoids, sesquiterpenoids, diterpenoids, triterpenoids, steroids, long-chain aliphatic tetrols, aliphatic esters, ferulates, lignans, flavonoids, sugar, amino acids carbohydrates, and a variety of inorganic ions besides minor amounts of sesamin and other unidentified constituents. Guggul gum is a mixture of 61% resins, 29.3% gum, 6.1% water, 0.6% volatile oil and 3.2% foreign matter. The important biologically active principles of C21 or C27 steroids are: guggulsterol-I, guggulsterol-II guggulsterol-III, guggulsterol-IV guggulsterol-V, E-guggulsterone, Z-guggulsterone and related ketones[42].

*Cordia myxa*

*Cordia myxa* belongs to family Boraginaceae, is also known as clammy-cherry, glueberry, Indian-cherry in English and Gondi in Hindi. *Cordia myxa* is Dioecious shrub or small tree up to 12 m tall, straight, forming a dense crown, with very prominent leaf scars. *Cordia myxa* originated from the area stretching from the eastern Mediterranean region to eastern India, and was introduced long ago in tropical Africa, tropical Asia and Australia, and more recently also in the Americas[43, 44].

Pharmacological studies revealed that *Cordia myxa* possessed analgesic, anti-inflammatory, immunomodulatory, antimicrobial, antiparasitic, insecticidal, cardiovascular, respiratory, gastrointestinal and protective effects[45,46].

*Cordia myxa* was eaten to suppress cough and for the treatment of respiratory infections and a sore throat, as it has demulcent properties. The pulp was also applied as an emollient to mature abscesses, to calm rheumatic pain and as an anthelminthic. Fruit pulp is applied on ringworm. leaves were applied to wounds and ulcers. A macerate of the leaves was taken to treat trypanosomiasis, and is externally applied as a lotion to tse-tse fly bites. Bark powder was used externally in the treatment of skin diseases. Bark juice together with coconut oil was taken to treat colic[47, 48].

The preliminary phytochemical screening carried out on *Cordia myxa* fruit extract revealed the presence of oil, glycosides, flavonoids, sterols, saponins, terpenoids, alkaloids, phenolic acids, coumarins, tannins, resins, gums and mucilage. The seeds of *Cordia myxa* was consisted of palmitic acid, stearic acid, oleic acid and linolenic acid. The flavonoids and phenolic derivative content of the five species of genus Cordia leaves (C. francisci, C. martinicensis, C. myxa, C. serratifolia and C. ulmifolia). Four flavonoid glycosides, robinin, rutin, datiscoside and hesperidin, one flavonoid aglycone, dihydrorobinetin, two phenolic derivatives, chlorogenic and caffeic acid[49].

*Gymnema Sylvestre*

*Gymnema sylvestre* belongs to family Asclepiadaceae, is also known as ‘gurmar’ or ‘sugar destroyer’ (If the leaves of the plant are chewed, the sense of taste for sweet and bitter substances is suppressed)[50]. It is a woody, climbing traditional medicinal herb which has many therapeutic applications in Ayurvedic system of medicine. *Gymnema sylvestre* is a slow growing, perennial, medicinal woody climber found in southern part of China, Tropical Africa, Vietnam, Malaysia, and Srilanka and is widely available in Japan, Germany, USA, central and peninsular India (mostly in Rajasthan, Bihar, West Bengal)[51]. The bioactive compounds of plant have antidiabetic, atherosclerotic, antimicrobial, antiarthritic, antibiotic , hypolipidaemic, immunostimulatory, hepatoprotective, anti-hyperglycemic, antipyretic, diuretic, anti-inflammatory, wound healing and anticancer properties[52-54].

*Gymnema sylvestre* is a traditional medicinal plant, with reported use as a remedy for diabetes mellitus, stomachic and diuretic problems. Its use has been indicated in adenopathy, cough[50], asthma, alexipharmic, anthelmintic, astringent, biliousness, bronchosis, cardiopathy, conjunctivosis, cornea,

dysuria, digestive, emetic, expectorant, fever, furunculosis, glycosuria, hemorrhoid, hepatosplenomegaly, inflammation, jaundice, leukoderma, rheumatismopacities, ophthalmia, and worm[55]. The roots of *Gymnema sylvestre* has also been used in snake bite, boil, constipation, and water retention, epilepsy, pain, high cholesterol, IDDM, NIDDM and obesity[56].

The plant is a good source of a large number of bioactive substances. Its constituents include two resins, gymnemic acids, saponins, stigmasterol, quercitol; the amino acid derivative of betaine, choline and trim ethylamine and Gymnemagenin and gymnestogenin. Gymnemic acids, a group of triterpenoid saponins belonging to oleanane and dammarene classes. Oleanane saponins are gymnemic acids and gymnemasaponins, while dammarene saponins are gymnemasides. Gymnemic acids I-VI and gymnemic acids XV-XVIII were also isolated. Gymnemic acids VIII-XII have been elucidated as glucosideuronic acid derivatives of gymnemagenin[50, 57].

*Jatropha curcas*

*Jatropha curcas* a multipurpose, shrub or tree, drought resistant, perennial plant belongs to family 'Euphorbiaceae', is widely distributed in the wild or semicultivated areas in Central and South America, Africa, India and South East Asia[58]. Jatropha grows almost anywhere except waterlogged lands, even on gravelly, sandy and saline soils. The tree has a straight trunk and grey or reddish bark, masked by large white patches. Various parts of the plant are of medicinal value, its bark contains tannin, the flowers attract bees and thus the plant has a honey production potential. Its wood and fruit can be used for numerous purposes including fuel. It is easy to establish and grows relatively quickly[59].

The bioactive compounds of *Jatropha curcas* have antioxidant, antidiabetic, atherosclerotic, antimicrobial, antiarthritic, antibiotic, hypolipidaemic, immunostimulatory, hepatoprotective, anti-hyperglycemic, antipyretic, antifungal, diuretic, anti-inflammatory, wound healing, Nickel toxicity, and anticancer properties[60,61].

It is traditionally used in arthritis, gout, jaundice & as contraceptives, fish poison, toothache, gum inflammation, gum bleeding, pyorrhea, dermatomucosal diseases, allergies, burns, cuts and wounds, inflammation, leprosy, leucoderma, scabies and small pox, HIV, tumor and wound healing[62].

*Jatropha curcas* have shown the presence of various bioactive constituents such as Amyrin, sitosterol, taraxerol, cyclic triterpenes (stigmasterol, stigmast-5-en-3, 7 diol, stigmast-5-en-3,7 diol, cholest-5-en-3,7 diol, campesterol, sitosterol, 7-keto--sitosterol as well as the d-glucoside of sitosterol), Flavonoids (apigenin, vitexin, isovitexin). Leaves contain the dimer of a triterpene alcohol and two flavonoidal glycosides. Latex contain curcacycline A, a cyclic octapeptide curcain. Seeds contain curcin, a lectin Phorbolesters Esterases and Lipase, saponins and a trypsine inhibitor. Roots contain sitosterol and its d-glucoside, marmesin, propacin, the curculathyranes A and B and the curcusones A–D, diterpenoids jatrophol and jatropholone A and B, the coumarin tomentin, the coumarino-lignan jatrophin as well as taraxerol[63, 64].

*Leptadenia pyrotechnica*

*Leptadania pyrotechnica* is a typical desert plant belongs to the Asclepiadaceae family, commonly known as Khimp, Kheep or Khip. It is leafless, erect, ascending, shrub up to 0.5 meter to 2.6 meter high with green stem and pale green alternating bushy branches with watery sap erect and evergreen shrub[65]. *Leptadenia pyrotechnica* occurs throughout the state of Rajasthan and found in dry habitats particularly in desert zones. In India it is commonly found in Punjab, Banswara, Palod, Dungarpur, Kota and Western Uttar Pradesh. It is native to Mediterranean regions, semi-arid deserts of African and Asian countries[66].

*Leptadenia pyrotechnica* possess significant antioxidant, anti-inflammatory, antibacterial, anthelmentic, antilipoxygenase, cytotoxic, antifungal, anticancer, wound healing, antidiabetic, hepatoprotective, antitumour, hypolipidemic and anti atherosclerotic activity. The fiber of Leptadenia pyrotechnica is used as antihistaminic and expectorant[67,68].

It is traditionally used in fever, cough, kidney disorders, stones, urinary disease. Fresh juice of the plant is used for abortion. Plant sap is applied to eczema and other skin disease and is also given in diabetes. The latex or the leaf paste is applied over the thorn injury for thorn removal. Whole plant infusion is mixed with buttermilk and given for uterine prolapsed and stomach disorders in sariska region of Rajasthan. It is used to cure constipation and is considered good for health in Bikaner region of Rajasthan[69].

*Leptadenia pyrotechnica* have shown the presence of bioactive constituents such as steroidal glycoside, cardiac glycosides, cardenolides, alkaloids, flavonoids, triterpenes tannins, saponins and poloxypregnane derivatives[70].

*Salvadora oleoides*

*Salvadora oleoides* is a small, multipurpose tree commonly known as jhal, badapilu, pilu, vridhpilu and khakan, belongs to family Salvadoraceae . The tree is primarily sourced for its fruits known as desert grapes. This species is decreasing very rapidly due to over exploitation, indiscriminate collection, low rate of seed set, poor viability and inefficiency of propagation by vegetative means[71, 72]. *Salvadora oleoides* grows on dry, saline and desert areas of Rajasthan, Haryana, Andhra Pradesh, West Bengal, Karnataka, Tamil Nadu, Punjab, Gujarat, and Madhya Pradesh. The tree species is known to tolerate a very dry environment with mean rainfall of less than 200 mm in Barmer,

Jalore, Jodhpur and Pali districts of Rajasthan. It grows well in the sand dunes of deserts to heavy soils, non-saline to highly saline soils and dry regions to marshy semi-arid and waterlogged areas[73,74].

*Salvadora oleoides* possesses anti-oxidant, anti-inflammatory, analgesic, anti-ulcer, anthelmintic, diuretic, hypoglycemic, hypolipidemic, antimicrobial, larvicidal, cytotoxicity activities.

The leaves were used as a cooling agent, blood purifier, low fever, laxative, piles, chest disease, relief of abdominal pain, expectorant,. Leaf juice can also be used for anemic patients. Fruits are sweet with cooling effect and employed in the treatment of rheumatism, low fever, piles, tumor, bronchitis, child birth and snake bites[75]. Seed oil is widely used in commercial production of cosmetics, paints, varnish, lubricants and as an ointment base for the treatments of rheumatism (Goodman, 1992). The whole plant is used as cooling herb, wound healing herb and nerve tonic, in the treatment of various uterine and skin disorders by the local people of Kachchh region[76].

Various qualitative chemical tests revealed the presence of carbohydrates, alkaloids, steroids, glycosides, saponins, tannins, triterpenes, mucilage, fats and oils in the leaf and stem extracts[77]. Fruits contain glucose, fructose, sucrose and are good source of calcium. The seeds have flavonoids like quercetin, rutin and its seed fat contains lauric, capric, malic acid, myristic, palmitic, oleic, linolenic acid, dibenzyl urea and proteins. Salvadorin, a new dimeric dihydroisocoumarin has been isolated from the chloroform fraction of *S. oleoides*. Its chemical structure was established as 8-benzyl-6-[6-(6-ethyl-7-methyl-5, 8-dihydro-2- naphthalenyl)-1-oxo-3, 4-dihydro-1H-isochromen- 8yl]-3,4-dihyro-1H-isochromen-1-one, through spectroscopic techniques and chemical analysis[78]. A new compound, heptadecanoyl-2-methyl-heptanoate has been isolated from stem bark.

*Ziziphus mauritiana*

*Ziziphus mauritiana* is a tropical fruit tree belongs to the family 'Rhamnaceae', locally known as 'Ber'. It is a spiny, evergreen shrub or small tree up to 15 m high, spreading crown and many drooping branches. The fruit is of variable shape and size. When slightly unripe, this fruit is a bit juicy and has a pleasant aroma. The fruit's skin is smooth, glossy, thin but tight. Fruits are eaten in other forms, such as dried, candied, pickled, as juice, or as ber butter. It is the most commonly found in the tropical and sub-tropical regions. Originally native to India it is now widely naturalized in tropical region from Africa to Afghanistan and China, and also through Malaysia , Australia and in some pacific regions[79].

Jujubosides (saponin) isolated from Ziziphus reported to have haemolytic, sedative, anxiolytic and sweetness inhibiting properties. Whereas, cyclopeptide alkaloids found to have sedative, antimicrobial, hypoglycemic, antiplasmodial, anti-infectious, antidiabetic, diuretic, analgesic, anticonvulsant and anti-inflammatory activities[80].

Plant pacifies vitiated pitta, kapha, obesity, fever, burning sensations, cough, wound, skin disease, ulcers, stomatitis, diarrhea, sexual weakness, and general debility. The dried fruits are used as anodyne, anticancer, pectoral, refrigerant, sedative, stomachache, styptic and tonic. They are considered to purify the blood and aid digestion. The root is used in the treatment of dyspepsia. A decoction of the root has been used in the treatment of fevers[81,82].

*Z mauritiana* having tremendous medicinal properties, attributed by a diverse group of secondary metabolites such as alkaloids, flavonoids, terpenoids, saponin, pectin, triterpenoic acids and lipids.

It is a rich source of cyclopeptide alkaloids lupane and triterpenes. It have 14-membered ring cyclopeptides to be the largest subgroup of alkaloid obtained, whereas only one 13-membered macrocyclic alkaloid isolated from this plant. It also contain protein ,carotene and vitamin C. Ripe fruits contains 20 to 30% sugar, up to 2.5% protein and 12.8% carbohydrates[83].

## 3 Conclusion

In Rajasthan, several plants were used for maintaining the health and treatment of several ailments. These plants possess anticancer, nephroprotective, hepatoprotective, antimicrobial, antioxidant, anti-diabetic, radio-protective, anti-HIV, anti-hepatoprotective, contraceptive etc. The medicinal plants displayed in this article required immediate steps to be taken for their conservation and sustainable utilization. Thus, there is a great need for manufacturing newer herbal drugs from these medicinal plants.

## 4 Conflict of interests

The authors have no current conflict of interests in this work.

## 5 Author's contributions

GKG, TJ, KM and AC carried out literature review and draft the manuscript. All authors read and approved the final manuscript.

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