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NATURAL ANTIOXIDANTS: THEIR EXISTENCE IN MEDICINAL PLANTS– REVIEW

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ABSTRACT

From antiquity, natural antioxidants had been used for various purposes throughout the world. Natural antioxidants are extensively found in medicinal plants and food. The effectual extraction and actual assessment of antioxidants from medicinal plants and food are vital to inspect the potential antioxidant natural sources and aids the application in pharmaceuticals, functional food and food additives. In this study, we reviewed different naturally occurring medicnal plants which are good source of antioxidants.

KEYWORDS: Antioxidants, Natural Sources, Free Radicals, Plant Extracts.

INTRODUCTION

Oxygen is the crucial element for our survival and growth, but after its metabolism is deregulated, which creates radical species, which consists at least one unpaired electron in their outer shells.[1] Oxygen has two unpaired electrons in the outer shell which is referred as biradical. Free radicals react with tissues which causes oxidative damage. Our body is defensive in front of these free radicals. Body is equipped with a composite system of antioxidant defense and endogenous enzymes. Although, under some conditions, is the imbalance caused by increase in production of free radicals or decrease in defense of antioxidant which is referred as oxidative stress which raises to many of the disease such as CVD, neurodegenerative disease, atherosclerosis, etc.[2]

What are free radicals?

Paired electrons are generally in the stable molecules. Although, there are various molecules which consists one unpaired electron, these species are called as free radicals. Free radicals

sate usually generated when a covalent single bond between two atoms which is break to give at least one electron in unpaired state. This reaction is referred as homolysis.[4] Some examples are such as chlorine atoms, hydroxyl radical, hydrogen peroxide, ground state oxygen, superoxide anion, etc.

Consequences of generation of free radicals

On the earth there is presence of oxygen in different concentration in different regions. Therefore, evolution has given organisms with difference in defense mechanism for survival in hazardous environment. Although, the defense systems are not that much protective and damage to various tissues recurrently occurs and it accumulates while aging as mechanism for damagecontrol becomes weak and least efficient.[4] during these conditions free radicals react with important cell components like proteins, nucleic acids and polyunsaturated fatty acids which leads to immense damage which alters ion transport, fluid mobility, inhibirion of enzyme activity, protein cross-linking, DNA damage, mutation, inhibition of protein synthesis, etc. which can worsen the condition and can lead to the cell death.[3,5]

Food and medicinal plants contains antioxidants as follows

Hydrosoluble antioxidants: phenolics, flavonoids, anthocyanins, stilbene and lignan, etc. Liposoluble antioxidants: alpha-carotene, beta-carotene, lycopene, lutein and zeaxanthin, etc.

Extraction methods for antioxidants such as:

- High voltage electrical discharges extraction
- Pulsed electric field extraction
- High hydrostatic pressure extraction
- Supercritical fluid extraction
- Pressurized liquid extraction
- Enzyme-assited extraction
- Microwave assited extraction
- Ultrasound-assited extraction

Multi-technology combines extraction

- Pulsed ultrasound-assited extraction
- Enzyme-based ultrasonic/microwave-assited extraction
- Enzyme-based high hydrostatic pressure extraction

- Enzyme assited supercritical fluid extraction
- Pressurised solvent-free microwave assited extraction
- Ultrasound-assited supercritical fluid extraction

Solvents used for extraction are such as:

For hydrosoluble anti-oxidants: water, ethanol, methanol, propanaol, acetone.

For liposoluble anti-oxidants: hexane, ethylacetate, benzene, petroleum ether, methanol, ethanol and acetone.

Hawthorn maple

Medicinal plants containing antioxidants

Hawthorn maple is the variation of the genus Acer(maple) with biological name *Crataegi folium* and belonging to the family Aceraceae. Tree is usually having the height about 10 meters and have rounded to broad spreading of the tree shape. It is a deciduous plant and leaves are ordered differently along the stems which are dark green in colour. In this tree, leaves and flowers are the important part which contains active constituents containing flavonoids, phenolic acids and oligomeric proanthocyanidins for their therapeutic action. Leaf is usually used for CVD such as congestive heart failure, arrythmias, coronary circulation problem by orally.[6] It is used to elevate the cardiac output reduced due to hypertension or pulmonary diseases, also supports hypotension, atherosclerosis, hyperlipidemia and Buerger's disease.[7] Topical used of the leaves is also done by preparing poultice for treating boils, sores and ulcers.[7] Solvent extraction with different solvents given various results amongst them highest and better phenolic extract was extracted using acetone extract followed by methanol and pure water. Water extract of leaves concluded with the highest antioxidant property. Antioxidant activity of extracts was regulated by free radical action scavenging activity. To determine total phenolic concentrations of extracts was done using Folin Ciocalteu procedures using gallic acid as equivalents. LC-ESI-MS (modified liquid chromatography-electro spray ionization-mass spectrometry) is used to obtain chromatographic profiles pf the phenolic constituents in the hawthorn plant.[6]

Bistorta

Bistorta is the herb with biological name as *Polygonum bistorta* belonging Polygonaceae family. It is tall perennial herb grows in moist condition, shady areas on the higher regions. Flowering season of herb is in two months May and June.[8] the roots of bistorta contains starch

and tannins in rich amount with rhizome which are odourless. Root of this herb shows demulcent, laxative, powerful astringent, diuretic, styptic and febrifuge. It is used internally as well externally in treating bleeding, diarrhoea, cholera and dysentery.[9] Also, it can be used internally for treating cystitis, peptic ulcers, ulcerative colitis, irritable bowel syndrome and excessive menstruation.[10] it also shows good free scavenging activity, due to presence of flavonoids and tannins. Flavonoids and tannins are phenolic constituents and it acts majorly as primary antioxidants.[11]

Linden

Linden is the flowering plant with biological name *Tilia argentea* belonging to Malvaceae Family. It is from Tilia genus which have been used in Europe and America like countries for treating anxiety and also for treating cold, bronchitis, influenza, fever and inflammation. Linden flowers are eminent for phytotherapy. They also give expectorant, diuretic, stomachic, sedative, diaphoretic, antispasmodic and for treatment of cough, migraine, nervous, tension, flu, ingestion problems, for different types of spasms and liver, gallbladder diseases.[12,13] These affirmed medicinal properties of plant are due to flavonoid, volatile oil and mucilage constituents.[14,15] extracts of the leaves and flower of this plant showed antioxidant activity. Flavonoids in them is responsible for antioxidant activity, which reacts with free radicals and scavenge them also they act on hydrogen peroxide and superoxide anions which leads to many diseases also including cancer like disease.[16] Among all the extracts, water extracts give eminent antioxidant activity due to presence of constituents such as ferulic, coumaric, procatechiuc, gallic and caffeic acids in higher amount.[6]

Nees

Nees is the plant with biological name *Pseuderanthemum palatiferum* belonging to Acanthaceae family.[17] It was first fond in Cuc Phuong forest located in Northern Vietnam.[18] It has capacity of treating various ailments and disease such as wounds, trauma, colitis, stomach aches, nephritis, diarrhoea and high blood pressure.[18,19,20] It is also used in veterinary practices. Chief constituents extracted from the leaves are beta-sitosterol, salicylic acid, 1-triacontanol and triterpenoid saponin. Methanolic, ethanolic, acetone and water extracts of leaves has given antioxidant activity.[21] Invitro antioxidant have been evaluated which indicates DPPH radical scavenging activity, lipid peroxidation inhibitory effects, reducing activity and protective effects induced haemolysis.[22]

Agnimantha

Agnimantha is the plant with biological name *Premna intergrifolia* belonging to the Lamiaceae family. It has length about 4-20 cm and width of 3-16 cm with leaves hold on opposite to each other. Margins of leaves are smooth and hairless, crushed leaves gives odour of cat's urine. Flowers are white in colour which has five corolla lobes. Fruits are almost round shape, hairless and black to dark ed in colour after maturation. Used in treatment of fever, diarrhoea, urine retention, dysentery, flatulence, dyspepsia, rheumatism and colic. Flavonoids are chiefly present in leaves such as flavonoids, luteolin, sterol and triterpene.[25] Roots contains alkaloids such as premnine, ganikarine and premnazole.[23,24] Iridoid glycosides and several diterpenoids are also present. Methanolic extract has given higher antioxidant activity. Antioxidant and radical scavenging activities were determined using reducing power and DPPH assays.[21]

Matrimony vine

Matrimony vine is the plant with biological source *Lycium barbarum* belonging to the Solanaceae family. From ancient period, these plants fruits were used in traditional Chinese herbal medicine.[26] Fruits are of reddish orange colour is derived from a group of carotenoids. Fruits have constituents which have ability to give biological activities and pharmacological functions and plays vital role in preventing and treating diseases such as cancer, diabetes, hyperlipidemia, hepatitis, hypo-immunity function, thrombosis and male infertility.[26,27] Chief carotenoid is zeaxanthin which exists as dipalmitate which is also known as physalien or physalin. This carotenoid comprises about 1/3rd to ½ of the total carotenoids. Many small molecules as betaine, beta-sitosterol, p-coumaric acid, cerebroside, also many vitamins and minerals are also present. The documentations suggested that this plant is being effective for anti-aging activity as well as nourishment of eyes, kidneys and livers. Anti-aging activity is due to polysaccharides isolated from red coloured fruits and evaluated from different models.[28,29,30,31,32] TEAC (Trolox equivalent antioxidant capacity and ORAC (oxygen radical absorbance capacity) assays were used for assessing total antioxidant capacity.[33]

Darawnaj

Darawnaj is the plant with biological name *Doronicum hookeri* belonging to family Asteraceae. It is important medicinal plant which distributed in Himalayas region. Root of this plant is widely used and commonly known as Darunaj-aqrabi in Unani and Leopards bane in English. They are traditionally used as cardiac, nervine tonics and act as stomachic and dissolves trapped gases.[34] Antibacterial and antifungal activities have also been reported of roots.[35,36]

Methanolic extract of root contains phenolic constituents and so have higher reducing activity and free radical scavenging activity. It showed scavenging and antioxidant activity in DPPH scavenging assay.[37]

Nunaakai

Noni is the tree with biological name *Morinda citrifolia* belonging to Rubiaceae family. Also known as Great morinda, Indian mulberry, noni, mengkudu, beach mulberry, cheese fruit belongs to the family same as of coffee. It is mostly found in Southeast Asia and Australia regions. Also is native in Polynesia and is traditional fold medicinal plant over their used for treatment of diabetes, high blood pressure, eye problems, cancer and many other problems.[38] fruits of the tree contain many antioxidants such as beta-sitosterol, beta-carotene, ascorbic acid, carotene, ascorbic acid, terpenoids, alkaloids, polyphenols as flavonoids, rutin, flavone glycosides, etc. Extraction of the fruits can be done using ultrasonication with high pressure at 10 Mpa using various solvents as ethanol, ethyl acetate and further dried under vacuum, oven and spray dryer. Antioxidant activity was analysed by peroxide value method and DPPH radical scavenging method. This tree can be major source of natural antioxidant.

Cats claw

Cats caw is the tree with biological name *Uncaria tomentosa* belonging to Rubiaceae family.[39] Pervuian tribes used this plant because of its magical healing power and for treating asthma, cirrhosis, cancer, gastritis, diabetes, fevers, rheumatism, dysentery, inflammation in urinary tract and many more diseases.[40,41,42] Using bark of these tree decoctions are prepared which are highly used as potent radical scavenger and possess antioxidant activity and also have capacity to reduce the free radical DPPH, anion, peroxyl, hydroxyl radicals, hypochlorous acid, hydrogen peroxide and superoxide ions.[43]

Houseleek

Houseleek is the flowering plant with biological name *Sempervivum tectorum* belonging to Crassulaceae family. It is popular plant in traditional uses of medicine for the treatment of inflammation in ear. Chemical constituents present in the plant are mostly flavonoids, kaempferol, glycosides (mono, di, tri), polysaccharides and phenol-carboxylic acids were detected. They were analysed with strong inhibition of chemiluminescence, which indicates a non-specific free radical scavenging activity with chemiluminescence. Extract has capacity to scavenge the superoxide ion in a cell free by DPPH assay. This also indicates that it can act as direct scavenger of superoxide anion in biological samples. It deceases the oxidative

injuries and enhances the defence mechanism in against free radicals. Flavonoids and kaempferol are the constituents which are responsible for antioxidant activity.[44]

Donax

Donax is the plant with biological source *Donax grandis* belonging to the Marantaceae family. Also have synonyms as D. canniformis and Clinogyne grandis. Leaves are large and wide with ovate to oval shape and have white flowers. Fruits of the tree are round in shape, smooth in texture and green in colour when they are unripe after ripening, they turn to yellow. Propagation of plant can be done easily by rhizome or seed.[45] Decoction of leaves and roots is taken in bath to lower the body temperature during fever and stem juice is effective against snake bite. Also used for eyes refreshment by the poultice formulation of the leaves and stem.[46] Phytochemical components in the plant are such as alkaloids, tannins, phenolic compounds and flavonoids, which give physiological action on system of body.[47] Plant extracts shows radical scavenging activity against DPPH radical determined using UV spectrophotometry at 517nm.[48]

Labernum

Labernum is the tree with biological name *Cassia fistula* belonging to Fabaceae family. Its mostly popular as ornamental tree due to its beautiful bunches of yellow flowers. And the flowers are used traditionally as medicine for various uses. It has been reported that these flowers extract can be used as abortifacient, laxative, hypoglycaemic, anticolic, antifertility, anticancer, antipyretic, antimicrobial, smooth muscle stimulant, antitussive, purgative, analgesic, antiarthritic, antiviral, hepatoprotective and estrogenic. For antioxidant activity, hydroalcoholic extract of dried (In shade) flowers was used primarily. With modern methods, plant indicated the presence of phenolic compounds such as flavonoids, tannins, fatty acids and glycosides. Antioxidant activity was done using DPPH assay, ferrous reducing capacity, total phenolic content.[49]

Kadam

Kadam tree is with biological name *Anthocephalus indicus* belonging to the family Rubiaceae family. It is the plant used from the ancient time in Indian and have literature in Ayurveda. Ayurveda literature have the remedy of this plant having antidiarrheal, detoxifier, analgesic and aphrodisiac properties.[50,51] This plant is available in India at low level and wet places. Traditionally, warm aqueous extract of the leaves was used to reduce pain and swelling, for cleaning and healing of the wounds also for the treatment of menorrhagia. This plants bark

decoction is effectual in diarrhoea, dysentery and colitis. Root extract is excellent in urinary ailments like calculi, glycosuria and dysuria. Leaves and heartwood of the tree consists of components such as cadambine, isomers of dihydrocadambine and isodihydrocadambine.[52,53] Bark of the stem consist of cadambagic acid and also quinovic acid and sitosterol.[54]Presence of antioxidant substances is due to phenolic and flavonoids compounds which reduces the radicals.

Jambul

Jambul is the tropical tree with flowering plant having biological name *Syzygium cumini* belonging to family Myrtaceae. This plant has many medicinal uses. Taste of the bark has astringent and sweet. It has carminative, digestive, febrifuge, stomachic, anthelmintic, constipating and antibacterial action. Seeds and fruits are usually used to treat diabetes, urethrorrhea, spleenopathy, pharyngitis and infections due to ringworm. Leaves of the tree are intensively used for treatment of diabetes, stomchalgia, fever, constipation, gastropathy, dermopathy, strangury and stops the blood discharge in the faeces.[55] it contains chemical constituents such as acetyl oleanolic acid, ellagic acid, triterpenoids, quercetin, isoquercetin, myricetin and kaempferol in different concentrations.[57] most of the compounds show antioxidant and radical scavenging action.[58] extract of leaves have been investigated using DPPH free radical scavenging and FRAP(ferric-reducing antioxidant power) assays and promising results were obtained.[59]

Cocklebur

Cocklebur is the annual plant with biological name *Xanthium strumarium* belonging to the family Asteraceae. It is locally known as Ghagra and Chota dhatura in hindi. It grows as an amiable weed in fallow paddy fields and using canal or ditch banks too. This plant has medicinal properties such as diaphoretic, CNS depressant, styptic and sudorific. Decoction of the plant is used for curing urinary and renal complaints, leucorrhoea, menorrhagia and gleet. Seeds of the fruits are used to treat inflammatory swellings. Root of the plant is used for treating scrofulous tumours and cancer. Fruits are rich with vitamin B and are used as demulcent and also effectual against in treatment of small pox, herpes and bladder infections. Plant also contains alpha and beta tocopherols, polyphenols, glycosides, xanthonolides and xanthostrumarin as the chief constituents.[60] antioxidant activity was determined using various methods such as scavenging free radicals such as DPPH, superoxide, nitric oxide, hydrogen peroxide and total reducing power.[61]

Bidaarikand

Bidaarikand is perinnial climber with biological name *Pueraria tuberosa* belonging to Leguminosae family. It has palmately arranged leaves with blue coloured flowers and half inched thick bark.[62] it grows mostly in moist and coastal region. It is a tuberous root appears in brown colour and which is slightly curved, its used clinically for rejuvenation therapy. Chief chemical constituents include flavones, isoflavones(puerarone), epoxychalcanol, pterocarpanoids, tuberosin and coumstan (tuberostan and puerarostan).[63] Powder of root-tuber are used as antiaging and also as tonic, demulcent, aphrodisiac, purgative, lactogogue, cholagogue and after biting sting of scorpion. Antioxidant capacity of drug is determined using alcoholic extract for scavenging monocations, ABTS radical, superoxide radical, metal chelation property and lipid peroxidation.[64]

Sickle senna

Sickle senna is a wild crop with biological name *Cassia tora* belonging to the Caesalpiniaceae family.[65] It is usually used for treating constipation, hypertension, conjunctivitis, liver damage, hypercholesterolemia and also sometimes they are consumed like vegetables.[66] According to Ayurveda writings, leaves and pods of senna re acrid, laxative, anthelmintic, antiperiodic, ophthalmic, cardiotonic, liver tonic and expectorant. They are also used in flatulence, leprosy, ringworm infection, dyspepsia, sough, bronchitis, colitis and cardiac disorders.[65] chief constituents of senna re glycosides mainly anthraquinone glycosides such as emodin, chrysophenol, obtusin, and its derivatives, also naphthopyrones, rubrofusarin, nor-rubrofusarin, toralactone, torachrysone and rubrofusaringentiobioside.[67,68] total phenolic and flavonoid content showed antioxidant activity. It was assayed using DPPH, ABTS, nitric oxide, superoxide, ferric reducing antioxidant power, hydroxyl radical scavenging assay and total antioxidant capacity.[69]

Bakul

Bakul is the evergreen tree with biological name *Mimusops elengi* belonging to Sapotaceae family. It is mostly found in India, Bangladesh and Pakistan.[60] It has many therapeutic uses such as cardiotonic, stomachic, anthelmintic, alexipharmic and astringent using bark.[60,70] Fruit and bark of the plant are also used in treatment for diarrhoea and dysentery. Decoction of the bark is used for gargles.[66,71] Powdered seeds paste with oil is used for treating obstinate constipation. From dried flowers, pillow stuffing is made which induces nasal discharge and relieves headache.[71] Chemical constituents are found such as taraxerol, taraxerone, betulinic

acid, ursolic acid, W-sitosterol, V-spinosterol, lupeol, mixture of triterpenoid saponins and alkaloid isoretronecyl tiglate.[72] Methanolic extract of leaves produces antioxidant activity and its evaluated using DPPH scavenging assay, total antioxidant capacity and reducing power.[73]

Vasaka (Adulsa)

Vasaka is the evergreen shrub with biological name *Adhatoda vasica* belonging Acanthaceae family. It is available all over India. It is used as expectorant, bronchodilator, antispasmodic, uterine stimulant, antihistaminic, treatment of menstrual disorders, skin diseases, eye infections, sore throat, bleeding diarrhoea and also has sedative properties.[74] leaves are very medicinally important and are collected while flowering of the plant and they are rich in Vitamin C. Leaves do possess hypoglycaemic and antiulcer activity.[75,76] Antioxidant property of plant was determined using DPPH radical scavenging assay. Major constituents are alkaloids such as vasicine, vasicinone, vasicinol and maiontone from leaves and roots. Flavonoids are also present like apigenin, astragalin, kaempferol, etc. triterpenes such as daucosterol from flowers are being extracted.[77,78,79] It also showed bronchodilatory, thrombopoietic, hypotensive, antihistaminic, uterotonic, anti-inflammatory activities.[80] DPPH radical scavenging assay is being used for determination of antioxidant property.

Tamarind

Tamarind is the perennial herb with biological name *Tamarindus indica* belonging to family Leguminosae. Height of the tree is about 20-25m and about 1m in diameter. It has wide spread crown and short stout trunk. It has average lifespan of 80-200 years. It is well adapted to semiarid tropical regions also grows in humid tropical areas. Its well-known for its fruits. Tamarind pulp is used for treatment of various ailments including reduce of sunstroke., datura poisoning, intoxicating effects of alcohol and cannabis. Gargle of tamarind can be used for sore throats. Dressing of wounds and also aids the restoration of sensation in the paralysed cases. It is also said that it can cure malarial fever.[81] fruits have antifungal and antibacterial activity.[82] antioxidant activity of extracts was tested by assay of FRAP (ferric reducing/antioxidant power). Pulp of tamarind also increases the bioavailability of ibuprofen in humans.[83]

Karanj

Karanj is the medicinal plant with biological name *Pongamia pinnata* belonging to Fabaceae family. It is traditionally used for piles, leaves are effectual in medicated baths and rheumatic pain and seeds are used for bronchitis, cough, hypertension, whooping, skin diseases and

rheumatism.[84,85,86] Roots of karanj are used for cleaning teeth's and gums, and also for ulcer, it effective against gonorrhoea.[87,88] It has been used in Ayurvedic and Unani medicinal practices, it shows anti-spasmodial, anti-noneceptive, anti-inflammatory, antihyperglycemic, antidiarrheal, antilipodoxidative, antiulcer, antioxidant and anti-hyper ammonic. Antioxidant activity was determined using DPPH assay.

Fluted Pumpkin

Fluted pumpkin is the sturdy perennial vine with biological name *Telfairia occidentalis* belonging to Cucurbitaceae family. It grows approx. 10m in length. Fruits are pale green in colour which weighs about 3 – 10 kg, and 25cm in diameter approx. For vegetables, Young succulent shoots and leaves are used. Leaves contains saponin, tannins and alkaloids and rich in vitamins, amino acids and minerals. Extract done using water contains much phenolic content, free radical scavenging ability and reducing power.[89] It also prevents oxidative stress induced by garlic. It also prevents abdominal pain, dermatitis, small intestine obstruction, asthma and enhanced bleeding due to garlic. Antioxidant property was determined and evaluated using TLC and DPPH assay.

Tulsi

Tulsi is the sacred herb of India with biological name *Ocimum sanctum* belonging to Lamiaceae family. Tulsi is also considered as "Queen of Herbs". It is an upright softy hairy aromatic herb which is available all over the India. Flowers, leaves, stem, roots, seeds, etc. of the plant do possess therapeutic use. Whole herb is useful for the medicinal purpose. It has expectorant, antidiabetic, anticancer, analgesic, antiasthmatic, diaphoretic, antiinfertility, hypotensive, hepatoprotective, hypolipidemic and anti-stress activities. This herb reduces lipid peroxidation and enhances the activity of superoxide dismutase.[90] hydroalcoholic extract of tulsi has showed antioxidant property. It also showed antiulcer activity in animal's models of peptic ulcer. It has also used for treatment of fever, arthritis, bronchitis, convulsions, etc.[91] using different assay it was being evaluated such as hydroxyl radical scavenging assay, DPPH assay and superoxide radical scavenging assay.[92]

Curry leaves

Curry leaves are the aromatic adolescent shrub with biological name *Murraya koenigii* belonging to Rutaceae family. It is mostly used in Asian-Indian cuisine and its leafy spice and used in little quantity due to its specific aroma as well for preservation use. Its small herb, which grows approx. 4-6m tall. Leaves are pinnate, each leave has 11-21 leaflets, and each of

the leaflet is about 2-4cm long and 1-2cm broad. This plant is intensely aromatic. Flowers of curry leaf plant are tiny, white and it gives fragrant. Small black shiny berries of curry leaves are edible. Seeds of the berries are poisonous. Chemical constituents present such as mahanimbine, murrayanol and mahanine give antioxidant activity.[93,94] Antioxidant activity was determined using DPPH assay. In ISOM it used for many ailments.[95,96] leaves of the plant is used for treatment of itching, inflammation, piles, fresh cuts, vomiting, dysentery, dropsy and burses. Roots or the plant are slight purgative, stimulant and body aches, bark is used for treating snake bite. Leaves used for treating diabetes, amoebiasis and hepatitis in Ayurveda.

Rose periwinkle

Periwinkle is the flowering plant with biological name *Catharanthus roseus* belonging to Apocyanaceae family. Its an assembled parallel herb or under shrub which contains latex and also known as *Vinca rosea*. From ancient times, it is being used for treating wide range of diseases. It is an ornamental plant and evergreen shrub grows upto 1m tall. Leaves of the plant are oval to oblong. Extracts of the plant is used for treatment of malaria, diabetes, sore throat, leukaemia, eye irritations, infections and to stop bleeding. It has expectorant, astringent and diuretic property. Antioxidant property is due to vinca alkaloids presence and tannins. This plant also possess anticancer, antibacterial, antifungal, antimicrobial and antiviral activity. Antioxidant activity was determined using DPPH assay.[92]

Neem

Neem is the tree with biological name *Azadirachta indica* belonging to Meliaceae family. It is evergreen tree and branches are wide spread. Tree is fairly dense crown is oval and diameter about 15-20m. It is most eminent and useful traditional medicinal plant all over India. Every part of the neem tree is medicinal and commercial susceptible. Neem oil, leaves and bark extracts are therapeutic and used for treatment of leprosy, respiratory diseases, skin infections and constipation. Antioxidant helps to reduce diabetes and obesity due to oxidative stress. Leaves and bark contain flavonoids and phenolic compounds which possess antioxidant activity by reducing lipid free radicals and hydroperoxide ions to free radicals. Antioxidant activity was determined using various assay such as DPPH assay and hydroxyl radical scavenging assay.[92]

Fenugreek

Fenugreek is the annual plant with biological name *Trigonella foenum graecum* belonging to Leguminosae family. Leaves and seeds of the plant is used for different ailments and can be used as health tonic. It is familiar spice agent which helps to prevent ageing, impart immunity, labour pain, improve mental function and addition of vitality to the body. Used for treatment nervous diseases, inflammation, ulcer, dyspepsia, hyperglycaemic, tumours and cholesterolemic.[97] Plant mainly contains trigonelline alkaloid. Leaves of fenugreek is rich with vitamin A and B. Seeds contains Vitamin A. It gives many activities such as anti-fertility, antifungal, anti-diabetic, analgesic, antipyretic, anti-inflammatory and immunomodulatory.[98,99] Antioxidant activity is determined using DPPH radical scavenging assay.

CONCLUSION

With enhancement in impulsion on research in medical science and especially in findings remedies using natural resources has been ncresed, studies on antioxidants have been enhanced ienormously. Medicinal plants use is not only done by herbalists but also chemists are more in touch with the chemical consituents present oin medicnal plants. The connection between herbalist and chemist have been given new innivations and researches in phytochemistry field, for which antioxidants have become more pertinent with the novel sources of antioxidants being unearths almost everyday.

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