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Some Indian Traditional Medicinal Plants With Antioxidant Activity: A Review

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Abstract: Since the beginning of human civilization, a number of Indian medicinal plants have been used in the traditional system of medicine (Ayurveda), aiming to maintain health and to cure diseases. Oxidative stress has emerged as a key role player in the pathogenesis and pathophysiology of several diseases in humans as well as in experimental animal models. As plants produce a lot of antioxidants they can represent a source of novel compounds with promising antioxidant activity. Nowadays there has been an increasing interest worldwide to identify antioxidant compounds that are pharmacologically active with less or no side effects. In the present paper six plants (*Saraca indica*, *Lantana camara*, *Glycyrrhiza glabra*, *Vaccinium oxycoccus*, *Cinnamomum zeylanicum*, *Acacia arabica*) are viewed for their historical, morphological, phytochemical, and pharmacological aspects. These plants exhibit strong antioxidant activity that can explain their uses in traditional medicines in the past as well as present.

Keywords: medicinal plants, ROS, disorders, antioxidant, pharmacological.

I. INTRODUCTION

Experimental evidence suggests that free radicals and reactive oxygen species (ROS) can be involved in high number of disorders such as arthritis, connective tissue disorders, liver disorders, neurodegenerative disorders, diabetes, chronic inflammation, cancer and in the process of ageing (Waris and Ahsan, 2006). Several endogenous and exogenous causes like metabolism, chemicals and ionizing radiation leads to the formation of ROS. Oxidative stress occurs when there is an imbalance between generation of ROS and antioxidants defense mechanisms of a cell or a tissue. This causes irreversible oxidation of DNA, proteins and lipids, leading to the inactivation of many enzymes and cell death. Recent studies have proposed that cellular reactive oxygen species may mediate the mitochondria-initiated apoptosis (Jing *et al.*, 2002; Wang *et al.*, 2004). Antioxidants provide protection to the living organisms from the damage caused by uncontrolled production of ROS. Now-a-days, traditional medicines all over the world are reevaluated by an extensive activity of research on different plant species and their therapeutic principles. The 21st century has seen a paradigm shift towards therapeutic evaluation of herbal products in oxidative stress diseases by carefully synergizing the strengths of the traditional systems of medicine with that of the modern concept of evidence-based medicinal evaluation, standardization of herbal products and randomized placebo controlled clinical trials to support clinical efficacy. In the present review six plants (*Saraca indica*, *Lantana camara*, *Glycyrrhiza glabra*, *Vaccinium oxycoccus*, *Cinnamomum zeylanicum*, *Acacia arabica*) are viewed in detail for their historical, morphological, phytochemical, and pharmacological aspects.

II. SOME PLANTS WITH ANTIOXIDANT ACTIVITY

Among the different plants species six of them have been specifically investigated for their well demonstrated antioxidant activity:

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 2, Issue 12, December 2013

A. *Saraca indica*

Species- *Saraca indica*

Family - Fabaceae

Genus - *Saraca*

Synonyms- *Saraca asoca* Linnaeus

Vernacular names- **Sanskrit-** Sita- Ashoka; **Hindi-** Vand ichitrah; **English-** Ashoka; **Tamil-** Asogam; **Marathi-** Jasundi; **Malayalam-** Asokam; **Telugu-** Vanjulamu; **Bengali-** Oshok; **Kannada-** Ashanke, Kenkalimara.

Habitat- *Saraca indica* is grown in all over India and it occur up to the altitude 600 metres. It is cultivated in many gardens because of its decorative orange red flowers and evergreen beautiful foliage.

Parts used- Leaves, Flowers, Fruits, Bark.

Morphological characteristics-

Leaves- It is a peripinnate, alternate, distichous and 7-30 cm long and its petiolule 0.1-0.6 cm long and opposite leaflets, 4-6 pairs, narrow elliptic-oblong or lanceolate, and its apex acute to acuminate, base acute to rounded or subcordate, glabrous, midrib raised above and tertiary nerves reticulate [1].



(a)



(b)

Fig. 1. Parts of plant *Saraca indica* (a) Leaf (b) Bark.

Bark- The bark is dark brown or grey or almost black with warty surface. Stem bark are rough and uneven due to the presence of rounded or projecting lenticles and channelled, smooth with circular lenticles and transversely ridged [1]

Flowers- It is inflorescence dense corymbs, orange colour and sometimes white and fragrant.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 2, Issue 12, December 2013



Fig. 2. Parts of plant *Saraca indica* (a) Flowers (b) Fruits.

Fruits– It is a pod, flat, oblong and apiculate.

Chemical constituents– The **bark** of plant contain epicatechin, procyanidin p2, 11'-deoxyprocyanidin B, catechin, 24-methyl-cholesta-5-en-3 β -ol, 24-ethycholesta-5, 22-dien-3 β -ol, leucopelargonidin-3-O-p-Dglucoside, leucopelargonidin and leucocyanidin. The **flower** part of plant contain Oleic, linoleic, palmitic and stearic acids, P-sitosterol, quercetin, kaempferol-3-O-P-D-glucoside, quercetin-3-O-P-D-glucoside, apigenin-7-O-p-D-glucoside, pelargonidin-3,5-diglucoside, cyanidin-3,5-diglucoside, palmitic, stearic, linolenic, linoleic, p and y sitosterols, leucocyanidin and gallic acid. Seed and Pod contains oleic, linoleic, palmitic and stearic acids, catechol, (-) epicatechol and leucocyanidin. Five lignan glycosides, lyoniside, nudiposide, 5-methoxy-9- β -xylopyranosyl(-)-isolariciresinol, icariside E3, and schizandriside, and three flavonoids, (-)-epicatechin, epiafzelechin-(4 β →8)-epicatechin and procyanidin B2, together with β -sitosterol glucoside, were isolated from dried bark [1].

Pharmacological antioxidant activity: Many herbs and spices have been shown to impart antioxidant effects in food. There are several reports that the extracts (ethanolic, hydroalcoholic and acetone) of *Saraca indica* bark showed the antioxidant activity. Panchawat and Sisodia (2010) studied *in vitro* antioxidant activity of *Saraca asoca* roxb. de wilde stem bark by using DPPH (1,1-diphenyl-2-picrylhydrazyl) *in-vitro* model) and reported that the antioxidant property of the various extracts may be due to high phenolic component [2]. Evaluation of antioxidant and antihyperglycemic activity of the petroleum ether, chloroform and methanolic extract of *Saraca asoca* De wild leaves by streptozotocin induced model in mice and *in vitro* DPPH and H₂O radical scavenging model has been reported by Kumar *et al.* (2012). They concluded that the oral administration of the extract caused a significant reduction in blood glucose level in diabetic mice and showed significant antioxidant activity [3]. Comparative study of the *Saraca indica* and *Pterospermum acerifolium* with ascorbic acid in dose dependent manner on the basis of antioxidant activity by *in vitro* DPPH model was carried out by Amin *et al.*(2012). They determined that the processed *Saraca indica* and *pterosperrum acerifolium* exhibited potential antioxidant properties [4]. Patel *et al.*, (2013) studied cardioprotective effect of *Saraca indica* against cyclophosphamide induced cardiotoxicity in rats and determined that the free radical generated during treatment with cardioprotective cause membrane injury. The biochemical, ECG and histopathology reports supported the cardioprotective effect of *Saraca indica* which could be attributed to antioxidant activity [5].

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 2, Issue 12, December 2013

B. Lantana camara

Species- *L.camara*

Family- Verbenaceae

Genus- Lantana

Synonyms- *Lantana aculeate* L.

Vernacular names- **Sanskrit-** Chaturangi, Vanacchedi; **Hindi-** Raimuniya; **English-** Lantana; **Tamil-** Unnichedi;

Marathi- Tantani, Ghaneri; **Kannada-** Kakke, Natahu; **Telugu-** Pulikampa; **German-** Wandelroeschen.

Habitat– The species is native to India and grows in tropical and subtropical regions, wild and cultivated in India like Madhya Pradesh, Gujarat, Maharashtra, Andra Pradesh and Tamil Nadu etc. It also grows also in Mexico, Central America, Bahamas, Colombia and Venezuela. *L. camara* is a low erect or vigorous shrub which can grow to 2-4 meters in height.

Parts used– Flowers, Leaves, Stem, Fruits, Seeds.

Morphological characteristics–

Leaves- It is ovate or ovate oblong, 2-10 cm long and 2-6 cm wide, arranged in opposite pairs. Leaves are bright green, rough, finely hairy, with serrate margins and emit a pungent odour when crushed.

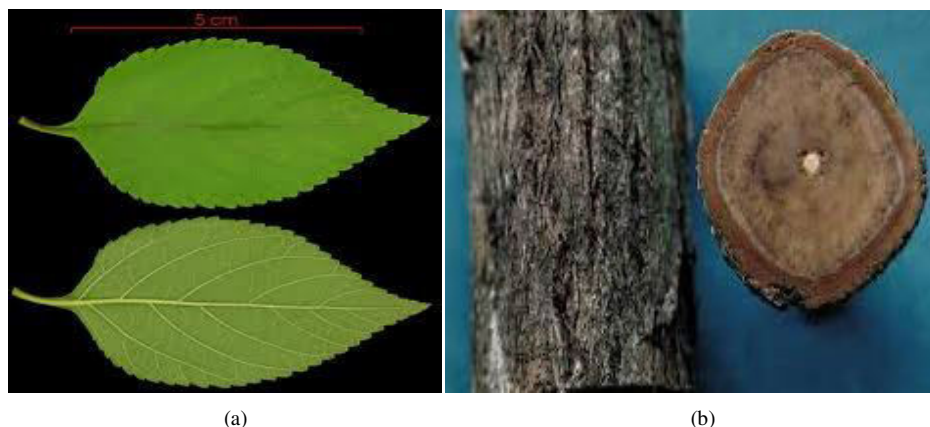


Fig. 3. Parts of plant *Lantana camara* (a) Leaves (b) Stem.

Stem- It is cultivated often in non- thorny and in weedy varieties with recurved prickles. It is woody, square in cross section, hairy when young, cylindrical and up to 15cm thick as it grows older. *Lantana* is able to climb to 15m with the support of other vegetation.

Flowers– It contains 20-40 flowers, usually 2.5cm across, the colour varies from white-cream or yellow to orange pink, purple or red. Flowering occurs between March to August, if adequate moisture and light are available.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 2, Issue 12, December 2013



(a)

(b)

Fig. 4. Parts of plant *Lantana camara* (a) Flowers (b) Fruits.

Fruits– It is a greenish blue-black colour, 5-7mm in diameter, drupaceous, shining, with two nutlets, seed setting takes place between September to May with 1-20 seeds on each flower head.

Seeds- Mature plants produce up to 12,000 seeds annually. Seed germination occurs when sufficient moisture is present. Germination is reduced by low light conditions. The root system is very strong with a main tap root and a mat of many shallow side roots.



(a)

Fig. 5. Part of plant *Lantana camara* (a) Seeds.

Chemical constituent- The **root and flowers** of *Lantana camara* L. contains iridoids: theveside, theviridoside, geniposide, 8-epiloganin, lamiridoside, shanzhside methyl ester, triterpenoids, oleanolic acid, lantanolic acid, 22 β -O-angeloyl-lantanolic acid, 22 β -O-angeloyl-oleanolic acid, 22 β -O-seneciroyl-oleanolic acid, 22 β -hydroxyoleanolic acid, 19 α -hydroxyursolic acid, lantaiursolic acid, naphthoquinones: diodantunezone, isodiodantunezone, 6-methoxydiodantunezone, 7-methoxydiodantunezone, 6-methoxyisodiodantunezone, 7-methoxyisodiodantunezone, besides, it also contains lantanoses A and B [6]. The **stem and leaf**s contains triterpenoids: lantadenes A, B, C, D, lantic acid, camaric acid, camarinic acid, camaryolic acid, methylcamaralate, camangeloyl acid, lantanolic acid, lantabetulic acid, oleanolic acid, oleanonic acid, betulonic acid, betulic acid, lantalonic acid, 3-ketourosolic acid, lantoic acid, lantanone, flavonoids, lantanoside, linaroside, phenylethanoid glycosides, acteoside [6].

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 2, Issue 12, December 2013

Pharmacological antioxidant activity- Ethanolic extract of *Lantana camara* exhibited significant antioxidant activities using *in vitro* DPPH radical scavenging assay and nitric oxide free radical scavenging assay. Mayce *et al.*, (2011) determined that the extract of the plant exhibited potent antioxidant activity and it decreased the extent of lipid peroxidation in the kidneys of urolithic rats [7]. The leaves of *Lantana camara* contains Lantadenes, these are the pentacyclic triterpenoids. *In vitro* antioxidant activity and free radical scavenging capacity of lantadene A was evaluated by Chong *et al.*, (2012) using established *in vitro* models such as ferric reducing antioxidant power (FRAP), 2,2-diphenyl-picryl-hydrazyl (DPPH), hydroxyl radical (OH), nitric oxide radical (NO), superoxide anion scavenging activities and ferrous ion chelating assay. Interestingly, Lantadene showed considerable *in vitro* antioxidant, free radical scavenging capacity activities in a dose dependent manner when compared with the standard NO scavenging, superoxide anion radical scavenging and ferrous ion chelating assay [8]. Mahdi *et al.*, (2012) screened the extract for possible antioxidant activity by free radical scavenging activity, DPPH, xanthine oxidase inhibition activity and Griess–Ilosvay method. Their results showed significant antioxidant activity of the leaves extract of *L. camara* that was more effective than the other parts [9]. The methanolic extract of leaves of *L. camara* showed the antioxidant activity and the level of superoxide dismutase (SOD), catalase (CAT) and glutathione (GSH), were evaluated in normal, ulcer control and drug treated group. Thamocharan *et al.*, (2010) determined the dose dependent antioxidant activity of the extract in all three antiulcer models (superoxide dismutase, catalase, glutathione) [10].

C. Glycyrrhiza glabra

Species- *G. glabra*

Family- Leguminosae

Genus- Glycyrrhiza

Synonym- Glycyrrhiza Glandulifera

Vernacular Names- **Sanskrit-** Yashiti-madhu, Madhuka; **English-** Sweet wood, liquorice; **Hindi-** Mithilakdi, Mulathee, Kubas-susa, Jethi-madh; **Bengali-** Yashto-madhu; **Gujarati and Marathi-** Jash-timadh, Madhu; **Telgu-** Yashti-Madhukam, Athimathuram; **Tamil-** Ati-Maduram (root), Athimathurappal; **Kannada-** Jestamaddu [11].

Habitat- *Glycyrrhiza glabra* is a hard herb or under shrub attaining a height up to 6ft. It is distributed in southern Europe, Syria, Iran, Afghanistan, Russia, China, Pakistan, and N. India. And it is cultivated in Russia, UK, USA, France, Germany, Spain, China, N. India (Punjab and Sub-Himalayan tracts) and large scale commercial cultivation is seen in Spain, Sicily and England [11].

Part Used- Peeled Roots, Leaves, Flowers.

Morphological characteristics-

Leaves- It is a multi-foliolate and impair pinnate.



(a)



(b)

Fig. 6. Parts of plant *Glycyrrhiza glabra* (a) Leaves (b) Roots.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 2, Issue 12, December 2013

Flowers- It is a axillary spikes, lavender to violet in colour.

Roots- The diameter of the root varies from 0.75 to 2.5cm, grey-brown exterior and yellow interior and externally it is longitudinally wrinkled with patches of cork with a characteristic pleasant sweet taste [11].

Chemical Constituents- The chief constituent of liquorice is glycyrrhizin, which is present in the drug in the form of the potassium and calcium salts of glycyrrhizic acid, glycyrrhizinic acid, glabrin A and B, glycyrrhetol, glabrolide, isoglabrolide, isoflavones, coumarins, triterpene sterols etc. Liquorice also contains glucose (up to 3.8%), sucrose (2.4 to 6.5%), bitter principles, resins, mannite, asparagines (2 to 4%) and fat (0.8%) [11].

Pharmacological Antioxidant Activity- The relative antioxidant activity of ethanolic extracts of *Centella asiatica*, *Punica granatum*, *Glycyrrhiza glabra* Linn. *Areca catechu* was determined by Ashawat *et al.*, (2007). Using individual extract as well as their combination with equal amount of ascorbic acid, increased absorbance of the reaction mixture indicated increased antioxidant activity via reducing power with reference to equal amount of standard ascorbic acid [12]. Antioxidant and antiulcer activity of GutGard™ that is a standardized extract of *Glycyrrhiza glabra* using *in vitro* and *in vivo* model like pylorus ligation, cold-restraint stress and indomethacin induced gastric mucosal injury for antiulcer activity and Oxygen Radical Absorbance Capacity (ORAC) assay for antioxidant activity. Mukherjee *et al.*, (2010) determined the GutGard™ exhibited potent antiulcer and antioxidant activity [13]. Kanimozhi *et al.*, (2011) determined the ethanolic extract of *G. glabra* leaves showed potent antioxidant activity in 1,4-dichlorobenzene induced liver carcinogenesis in albino rats [14]. The essential oil of *G. glabra* was obtained by hydrodistillation and its phytochemical composition was determined by Gas Chromatography–Mass Spectrometry (GC-MS) analysis. Enas (2013) determined the oil of *G. glabra* was showed antioxidant activity by *in vitro* DPPH model in dose dependent manner and also showed antifungal, anticancer, and antiaflatoxicogenic activity [15]. The methanolic root extract of *G. glabra* showed antimutagenic activity by *in vivo* DNA fragmentation test and antioxidant activity by use of β -carotene spray against cyclophosphamide drug. Al-terehi *et al.*, (2012) determined the extract inhibit accumulation effect of mutagenicity and oxidation activity of the cyclophosphamide [16].

D. Vaccinium oxycoccos

Species- *V. oxycoccos*

Family - Ericaceae

Genus- Vaccinium

Synonym- *V. erythrocarpum*, *V. macrocarpon*, *V. microcarpum*.

Vernacular names- Sanskrit- karmard; Hindi- karaunada; English- Cranberry; Tamil- kalakai; Marathi- karvinda;

Malayalam- karakka; Telugu- Vakkay; Bengali- karamcha; Kannada- karjige.

Habitat- *V. oxycoccos* a very hardy and drought tolerant plant, it thrives well throughout the tropical and subtropical climates, wild and cultivated in India (like Madhya Pradesh, Gujarat, Maharashtra, Andra Pradesh, Tamil Nadu etc.). It grows also in Japan, Central America, Srilanka, Myanmar, and Malacca. Heavy rainfall and waterlogged conditions are not desirable. It can be grown on a wide range of soils including saline and sodic soils. *V. oxycoccos* is commonly grown from seeds. Vegetative methods- air-layering and stem (hard wood) cuttings are feasible but not very common. Fresh seeds are sown in nursery during August-September. One year old seedlings are transplanted, air-layering is very successful.

Parts used- Leaves, Flowers, Fruits.

Morphological characteristics–

Leaves- The leaves are oblong and conical, 4-6 inch long and 2-3 inch wide, green on the top and brown below.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 2, Issue 12, December 2013



(a) (b)
Fig. 7. Parts of plant *Vaccinium oxycoccos* (a) Leafs (b) Flowers.

Flowers- White or yellowish flowers are found in groups.

Fruits- They are avoided with 5-1 hard angles curving up wards, glabrous with five to seven wings, woody and fibrous.



(a)
Fig. 8. Part of plant *Vaccinium oxycoccos* (a) Fruits.

Chemical constituents- The *Vaccinium* fruit is a rich source of iron and contains a fair amount of vitamin c. It is a source of polyphenol antioxidants, phytochemicals under active research for possible benefits to the cardiovascular system and immune system, and as anti-cancer agents. Cranberry contains tannin and flavonoids like Proanthocyanidins, flavonols and quercetin [17].

Pharmacological antioxidant activity- *Vaccinium* ranks high among fruit in both antioxidant quality and quantity because of its substantial flavonoid content and a wealth of phenolic acids. Youdim *et al.*, (2002) and Yan *et al.*, (2002) reported that the *oxycoccos* extracts inhibit oxidative processes including oxidation of low-density lipoproteins and oxidative inflammatory damage to the vascular endothelium [18, 19]. The antioxidant level of different fruits, juices, and vegetables were estimated by CUPRAC (Cupric Reducing Antioxidant Capacity) assay by Holly *et al.*, (2010). They reported that antioxidant activity found by the CUPRAC assay positively correlated with increased protection in a model of *in vitro* ischemia reperfusion. Finally results of the CUPRAC test showed that cranberry juice had the highest level of antioxidant activity [20]. Biosafety, antioxidant status and metabolites in urine after 8 week consumption of dried *oxycoccos* juice on 65 healthy young women were determined by Katerina *et al.*, (2007). Throughout the trial 400 mg/day amount of dried juice had no influence on the various parameters tested. Studies with 1200 mg/day amount of

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 2, Issue 12, December 2013

dried cranberry juice showed significant decrease in serum level of advanced oxidation protein products [21]. Susan *et al.*, (2006) determined the antioxidant activity of cranberry fruits and reported decrease risk of heart disease and cancer in healthy human volunteers [22].

E. Cinnamomum zeylanicum

Family- Lauraceae

Genus- Cinnamomum

Species- *C. saigonicum*, *C. laurus*, *C. aromaticum*

Synonyms- *C. Saigonicum*, *C. Cassia*, *C. Aromaticum*, *C. Laurus*, *C. Verum*.

Vernacular Names- English- Cinnamomum; **Sanskrit-** Gudetvak; **Hindi, Punjabi, Gujrati, Bengali, Marathi and kannada-** Dalacini; **Telgu, Tamil-** Lowangapatta; **Malayalam-** Kulit manis; **Germani-** Zimmt; **Indonesia-** Kayu Manis; **Chinese-** Yuh/Juh.

Habitat- Indigenous to Ceylon and S.India, also in some parts of Burma in tropical and Subtropical regions, at a temperature of 32°c and above.

Part used- Bark, Leaves.

Morphological Characteristics- It is a hardy plant, raised on an annual rainfall of 200-250cm. It is a bushy evergreen tree.

Bark- The dried bark of the shoot of trees is deprived of cork and most of its cortex. The individual pieces of bark are not more than 0.5 mm thick and of a dull pale brown in colour.



(a)

(b)

Fig. 9. Parts of plant *Cinnamomum zeylanicum* (a) Bark (b) Leaves.

Leaves- The leaves are kind of oval in shape and are around 5-20 cm long.

Chemical constituents- The oil from bark and leaves contain 70-80% eugenol and rest is cinnamic aldehyde. The oil is yellow in colour and lighter than water. Cinnamon sticks and whole bark contain 77.0 mmol/100ga. Antioxidant content and also contain terpenes, mucilage and its active Components are cinnamaldehyde (tranquilizer) and 2-Methoxycinnamaldehyde [23].

Pharmacological antioxidant activity- Cinnamon is reported for its anti-oxidant, anti-ulcer, anti-microbial, anti-diabetic and anti-inflammatory activity in scientific literature. The active principles are phenolics, sterols, tannins, bioflavanoids, present as the chemical constituent are responsible for anti-oxidant activity of the plant. It was found safe in acute toxicity studies in animals. Vaibhavi *et al.*, (2010) reported that cinnamon contains a good amount of phenolic antioxidants. This counteracts the damaging effects of free radicals and may protect against mutagenesis. It has also been reported that mitochondrial dysfunction, decrease in ATP formation, oxidation and free radical

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 2, Issue 12, December 2013

generation can fasten the aging process [26]. Murcia *et al.*, (2004) have investigated the antioxidant properties of cinnamon compared with those of the common food antioxidants, butylated hydroxyanisole (BHA) (E-320), butylated hydroxytoluene (BHT) (E-321) and propyl gallate (E-310). The cinnamon exhibited a higher percentage of inhibition of oxidation as tested by the lipid peroxidation assay. It was a better superoxide radical scavenger with capacity approximately equal to that of propyl gallate. It was also found that one-half millilitre of cinnamon leaf has free radical scavenging ability with an EC₅₀ of 53µ/ml and has a total phenolic content of 420 mg/g as the major chemical composition [27].

F.Acacia Arabica

Species- *A. Arabica*

Family- Fabaceae

Genus- Acacia

Synonyms— *Acacia nilotica* (Lam.), *Acacia scorpioides*, *Mimosa Arabica*, *Mimosa nilotica*.

Vernicular names- **Sanskrit-** Babbula; **English-** Thorny acacia, Black Babul, Indian Gum Arabic tree; **Spanish-** Goma Arabica; **French-** Gommier; **Gujrati-** Babaria, baval; **Hindi-** Babul, Kikar; **Kan-** Gobbli, Karijali; **Malayalam-** Karivelan, Karuvelum; **Marathi-** Babhul, Babhula; **Punjab-** Sak; **Tamil-** Kaluvelamaram, Karrivelei, Karuvel, Karuvelam; **Telgu-** Nallatamma, Tumma, Tuma [28].

Habitate- *A. arabica* originated from Africa, the Arabian Peninsula and the Indian subcontinent. It is now commonly found or cultivated with in 30°N and 20°S in almost all tropical and subtropical areas of Africa, Asia, Australia and the Caribbean. (*Ecocrop*, 2012; *Orwa et al.*, 2009; *Fagg et al.*, 2005).

Part used- Seeds, Flowers, Leaves, and Root.

Morphological character—

Leaves— It is a twice compound they consist of 5-11 feather like pairs of pinnae and each pinna is further divided into 7-25 pairs of small, elliptic leaflets that can be bottle to bright green in colour and its stalks are heavy and contain very small gland almost no noticeable with the naked eye can be found at the base of most of the upper pinnae pairs.



(a) (b)
Fig. 10. Parts of plant *Acacia Arabica* (a) Leaves (b) Flowers.

Flowers- The flower stalks are hairy. It flowers mainly from September-January, but it depends on the rainy season. The pods are very characteristic, resembling a beaded necklace. The pods are flat, straight or slightly curved, and fleshy when young with reddish hairs. The pods are sweetly scented when crushed and contain a sticky fluid.

Fruits- The fruits are linear, flattened, narrow indehiscent pods, 4-22 cm long and 1-2 cm broad, dark-brown to grey in colour and glabrous or velvety.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 2, Issue 12, December 2013



Fig. 11. Parts of plant *Acacia Arabica* (a) Fruits (b) Seeds.

Seeds- Seeds are depressed, subglobular. A deep woody tap root with several branching surface laterals.

Chemical constituents- *A. arabica* contains gallic acid, m-digallic acid, chlorogenic acid, gallolyated flavan-3, 4-diol, robidandiol (7,3,4,5-tetrahydroxyflavan-3-4-diol), androstene steroid, D-pinitol carbohydrate, and catechin-5-galloyl ester [29].

Leaves- Leaves contain 2.2–2.6% N, 16.9–20.0% NDF (Neutral Detergent Fiber), 13.3–14.1% ADF (Acid Detergent Fiber), 7.2–8.7 MJ/kg energy, 10–21% crude fibre and 6–9% condensed tannins [28].

Seeds- Seeds contain 1.6–2.2% N, 10 MJ/kg energy, 12–18% crude fibre and 4–7% condensed tannins [28].

Pharmacological antioxidant activity- Antioxidant activity of ethyl acetate soluble fraction of *A. arabica* bark by *in vitro* lipid peroxidation model was carried out by tertiary butyl hydroperoxide induced lipid peroxidation and the most active fraction were identified by TLC and *in vivo* experiment in most active fraction were carried out with 50, 100 and 150 mg/kg oral dose in carbon tetra chloride induced hepatotoxicity in rats and it is hypothesized that flash chromatographic fraction of ethyl acetate extract exhibited maximum activity with *in vitro* lipid peroxidation and 150 mg/kg dose of carbon tetra chloride shows marked liver protection in *in vitro* model [30].

III.CONCLUSION

There are evidences suggesting that free radicals and reactive oxygen species (ROS) can be involved in high number of diseases including cancer. Many synthetic antioxidants used in processed foods exhibit side effects and are carcinogenic (Ito *et al.* 1983, Mishra *et al.* 2011). Several indigenous antioxidants may be useful in preventing the deleterious effects of oxidative stress. This has led to considerable interest in assessing the antioxidant capacity of foods, botanicals and other nutritional antioxidant supplements. In the present work *Saraca indica*, *Lantana camara*, *Glycyrrhiza glabra*, *Vaccinium oxycoccos*, *Cinnamomum zeylanicum*, *Acacia arabica* are reviewed for their antioxidant properties. The phytochemical analysis of these medicinal plants have revealed a large number of compounds including flavonoids and phenolics which have shown potent antioxidant activity. These compounds have been used as anti-oxidant, anti-carcinogenic, antifungal, antibacterial, anti-spasmodic, anti-inflammatory and anti-diabetic.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 2, Issue 12, December 2013

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