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A Brief Review on Antioxidant-Activity of Some Medicinal Plants

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ABSTRACT

A lot of medicinal plants, traditionally used for thousands of years, are present in a group of herbal preparations of the Indian traditional health care system (Ayurveda) named Rasayana proposed for their interesting antioxidant activities. Among the medicinal plants used in ayurvedic Rasayana for their therapeutic action, some of these have been throughly investigated. The plants described contain antioxidant principles, that can explain and justify their use in traditional medicine in the past as well as the present. In order to identify the plants with antioxidant activity in Ayurveda, a formulation of some rasayanas with well-defined antioxidant properties has been examined. In the present paper three plants (Emblica officinalis L., Curcuma longa L., Mangifera indica L.) are viewed for their historical, etymological, morphological, phytochemical and pharmacological aspects.

KEYWORDS: Antioxidants; Ayurveda; Indian medicinal plants.

INTRODUCTION: The traditional medicine all over the world is nowadays revalued by an extensive activity of research on different plant species and their therapeutic principles. Experimental evidence suggests that free radicals (FR) and reactive oxygen species (ROS) can be involved in a high number of diseases. As plants produce a lot of antioxidants to control the oxidative stress caused by sunbeams and oxygen, they can represent a source of new compounds with antioxidant activity. Ayurveda, the Indian traditional health care system (ayus= life, veda=knowledge, meaning science of life), is the oldest medical system in the world and is being revived in its complete form under the name of Maharishi Ayurveda. The World Health Organization has approved its efficacy (Za man, 1974). This system provides an approach to prevention and treatment of different diseases by a large number of medical procedures and pharmaceuticals. One of the clinical specialities of Ayurveda is Rasayana. Rasayana is not only a drug therapy but is a specialized procedure practised in the form of rejuvenating recipes, dietary regimen promoting good habit. The purpose of rasayana is two-fold: prevention of disease and counteraction of aging processes which result from optimization of homeostasis. The meaning of the word Rasayana (rasa=essence, water; ayana=going) essentially refers to nutrition and its acquisition, movement, circulation and perfusion in the body tissues. With regard to the Rasayana drug therapy Sharma et al. (1992) reported the strong antioxidant activity of any rasayana: these compounds were found to be 1000 times more potent than ascorbic acid, a-tocopherol, and probucol activity of any rasayana: these compounds were found to be 1000 times more potent than ascorbic acid, a-tocopherol, and probucol.

❖ **Some examples of plants with antioxidant activity:**

- Emblica officinalis L.
- Curcuma longa L.
- Mangifera indica L.
- Momordica charantia L.
- Santalum album L.
- Swertia chirata Buch-Ham
- Withania somnifera (L.) Dunal

A. Emblica officinalis L.

• **Family:** Euphorbiaceae.

• **Synonym:** Emblica officinalis Gaertn. Phyllanthus glomerata Wall. Dichelactina nodicauli Hance.

❖ **Miscellaneous**:

Linnaeus was the founder of the genus Phyllan thus (phyllon=‘leaf’, antho `s=‘flower’) with refer ence to the most important characteristic of these plants: their branches are curiously flat like leaves with flowers on the margins after blossoming. The Persian name of Emblica is amlah (from Sanskrit amla), but, as the Arabic amlaj suggests, probably in older Persian amlag, and hence Emblica. Garcia de Orta says it was called embelgi by the Arab physicians. The name of the family Euphorbiaceae comes from Euphorbus, physician to Juba, King of Mauritania. In Sanskrit Phyllanthus emblica has manysynonym:Dhatriphala(dhatri=‘female supporter’, ‘a nurse’; phala=‘fruit’); Vayahstha (= ‘strong’, ‘vigorous’, ‘being in the bloom of age’); Amritaphala (amrita=‘immortal’); Amala (= ‘pure’, ‘clean’); Amla (=‘sour’), all these synony mous words show how important this plant is in traditional Indian medicine, in fact, it is the most common ayurvedic plant. According to Indian mythology it is believed to be the first tree created in the universe. Emblica is represented in the traditional Indian jewelry. In Malaysia this plant is so renowned that a city and a river bear its name: Malacca. Fruits of Emblica are rasayana. Plants of this genus were imported in the western countries at the end of the 18th century. Dumont de Courset, French botanist, grew about ten species at Paris botanical garden. Targioni Tozzetti wrote to his French colleague: ‘fruits of this plant are available in Europe in any grocery as old medicament and they were once used as laxa tive’. On the contrary, Rumpf G. Everhard in his Herbarium amboinense says that they are used for dysentery, like astringent, and against cephalea and they are also eaten dried or candied.

➢ **Habitat** The species is native to India and it grows in tropical and subtropical regions, wild and cultivated (in India the most common cultivars are: ‘Chakaiya’, ‘Banarsi’, ‘Francis’). It grows also in Pakistan, Uzbekistan, Sri Lanka, SE Asia, China and Malaysia, to 1400 m.

➢ **Used parts:** Dried fruit and fresh fruit, seed, leaves, root bark, flowers (Nadkarni, 1993).

➢ **Morphological characteristics:** Emblica is a medium to large deciduous tree.

➢ **Leaves**: Simple, linear-oblong blunt, small, a hundred or more on each branchlet, arranged in two ranks and thus appearing to form a pinnate leaf, 8–10 mm or more long and 2–3 mm broad, stipolate, entire, obtuse or round at the base, subacute or apiculate apex, hairless, light green outside, pale green or often pubescent beneath, almost stalk less. Leaves fall in November-December and grow in February–March.

➢ **Flowers**: Blossom in March–May, minute, unisexual, 0.5–1.5 cm long, greenish yellow, in axillary fasci cles, often a portion of branchlet is naked below the leaves, with fimbriated bracts at the base. Male flowers on short and thin pedicels, sepals six, long 1.2 mm, oblong, obtuse, disco O, anthers three on a short central column. Few flowers female subsessile, sepals six, long 1.2 mm, oblong, obtuse, disk a lacerate cup. Ovary has three celled, styles connate at the base, double, with acute lobes.

➢ **Bark:** Thick to 12 mm, shining greyish brown or greyish green, peeling off in conchoidal flakes.

➢ **Fruits**: Ripen from November–February, nearly spher ical or globular, wider than long and with a small and slight conic depression on both apexes. Its size changes accordingly with the variety. Nor mally fruit is 18–25 mm wide and 15–20 mm long. Surface is smooth with 6 obscure vertical pointed furrow. When ripened the mesocarp is yellow and the endocarp is yellowish brown. The mesocarp is acidulous in fresh fruit and acidulous astringent in dried fruit.

➢ **Chemical constituents present in different parts of the plant:**

i.**Fruits**: Moisture 81.2%, protein 0.5%, fat 0.1%, min eral matter 0.7%, fiber 3.4%, carbohydrates 14.1%, Ca (0.05%), K (0.02%), Fe (1.2 mg/100g), nicotinic acid (0.2 mg/100g), phyllemblin, phyllemblic acid, gallic acid, emblicol, ellagic acid, pectin, two new hydrolysable tannins vitamin C-like called emblicanin A and B and not ascorbic acid as it was believed by mistake until 1996, punigluconin and pedunculagin.

ii.**Seeds:** A fixed oil, phosphatides, and a small quantity of essential oil. The fixed oil (yield 16%) has the following physical and chemical characteristics: acid value 12.7; saponification value 185; iodine value 139.5; acetyl value 2.03; unsaponifiable mat ter

3.81%; sterol 2.70%; saturated fatty acids 7%. Contain linolenic (8.78%), linoleic (44.0%), oleic (28.40%), stearic (2.15%), palmitic (2.99%) and miristic acid (0.95%). Proteolytic and lipolytic substances are present.

iii.**Leaves:** Gallic, ellagic, chebulic, chebulagic, chebulinic acids, a gallotannin called amlic acid, alkaloids phyllantidine and phyllantine.

iv.**Bark**: Leukodelphinidin, tannin and proan thocyanidin.

v.**Roots**:Ellagic acid and lupeol.

Fig.1 Emblica officinalis L.

➢ **Pharmacological action**: Fruits of P. emblica have been used for thousands of years in the traditional Indian medicine for the treatment of several diseases. For many years the therapeutic potential of the fruits was attributed to their high content of ascorbic acid: about1gofvitamin C per 100 ml of fresh juice.Because of the presence of certain tannins it did not oxidate even in dried fruit maintaining the antiscorbutic capacity unchanged.In fact amla was used with a great success during the famous famine of Hissar (1939–40) and also in another case of scorbutus which affected the Indian army at Nassirdab in 1837 in Rajputana (Srinivasan, 1944). All the studies published after that time were based on comparison between ascorbic acid and P. emblica the latter was discovered to be more effective than ascorbic acid whether in vitro or in vivo.

B. Curcuma longa L.

• **Family:** Zingiberaceae.

• **Synonym:** Curcuma domestica Valeton Amomum curcuma Jacq. Curcuma xanthorrhiza Naves.

➢ **Miscellaneous:**

Curcuma is a Latin name derived from Kourk oum, a word of Arabic origin meaning saffron. Curcuma is also the name of the species chosen by Linnaeus in 1737 for this kind of monocotyle donous herbs of India. Curcuma rhizome is one of the most common spices for its special taste and colour. In fact the powder of this plant is used for many Hindu rituals especially in wedding cere monies where ladies use it to make a beauty-spot on the forehead. People living in north India on the mountains use this plant to protect the skin against the sun rays. In chemical laboratories an alcoholic extract of curcuma is used to test boric acid and borate. In sanskrit there are about 46 synonymous of curcuma: Haridra (hari=‘yellow’; dra=‘to run’, ‘make haste’) because it dyes tex tiles very quickly; Harita (=‘yellowish’) o Pita (=‘yellow’), Gauri (=‘brilliant’) because of the color of its rhizome; Haladi (hala=‘a plough’, ‘name of a country and people in the north’, ‘water’; di=‘to shine’, ‘be bright’) because it dyes the plough of bright yellow if cut and it releases colour if put in water. Turmeric is also used, by the mountain people, to protect the skin from the sun rays; Ranjana (=‘to colour’); Yamira o Yamini, Nisa, Rajani (=‘night’) because rhi zomes are gathered in the night time; Yashi tapriya (Yoshita=‘women’, ‘wife’; priya=‘beloved’, ‘dear to’) o Yuvati (=‘a girl’, ‘young woman’) because it is used during wedding ceremonies and as make up.

➢ **Vernacular names:** Sanskrit, Haridra, Harita, Pita, Haladi, Ran jana, Yamira, Yamini, Yoshitapriya, Yuvati; Hindi, Haldi; English, Turmeric, Indian saffron; Italian, Curcuma; German, Gelbwurzel kurkuma; French, Curcuma; Japanese, Ukon; Chinese, Yii chin; Tibetan, Skyer-rtsa.

- **Habitat**: India, in particular Madras, Bengal and Bombay, Pakistan, China, Asiatic SE.
- **Used parts**: Rhizomes.
- **Morphological characteristics**: It is a perennial herb 60–100 cm high with a short stem and large sheathing leaves.
- **Leaves**: Very large, elliptic blade, in tufts up to1mor longer, stem is as long as the blade, tapering at the base.

❖ **Chemical constituents present in different parts of the plant:**

i. **Rhizome:** 1,7-bis(4-hydroxy-3-methoxyphenyl)-1,6-hepta diene-3,5-dione (1.11%) called curcumin, feruloyl (4-hydroxycinnamoil)-methane (0.86%) called desmethoxycurcumin, bis-(4-hydroxycinnamoil) methane (1.62%) called bisdesmethoxycur cumin, 2-(hydroxymethyl)anthraquinone, 1,7-bis (4-hydroxy-3-methoxyphenyl)-1-heptene-3,5-dione called dihydrocurcumin, diferuloilmethane, feru loil-p-cumaroilmethane, di-p-cumaroilmethane, a and b-turmerones, a-pinene, b-pinene, camphene, limonene, terpinene, caryophyllene, curcumene, linalool, borneol, isoborneol, eugenol, cineole, curdione, curzerenone, curlone, campesterol, stig masterol, b-sitosterol, cholesterol and fatty acids.

Fig. 2 Curcuma Longa.

❖ **Pharmacological action:**

Curcumin and its sodium salt have been shown to have a strong anti-inflammatory activity in carragenin- and caoline-induced edema, forma line-induced arthritis with a corticosteroid-like and a strong antioxidant activity. Also natural occurring analogues of curcumine like feruloyl-(4 hydroxycinnamoyl)-methane and bis-(4-hydrox ycinnamoyl)-methane have been shown to have similar effects. Sodium curcuminate antagonizes several spasmogens. Turmeric powder protects the gastric mucosa against irritants. Curcumin pre vents flatulence (Ammon and Wahl, 1991). Cur cumin and the related p-coumaroyl(feruoyl)methane and compounds di-p-cou maroylmethane have a protective effect on liver against CCl4 and D-galactosamine (Yoshinobu et al., 1983). It increases the bile production. Cur cumin and its derivates inhibit aggregation of platelets in vitro as well as in vivo (Ammon and Wahl, 1991). It has been observed that curcumin decreases high cholesterol levels like statine. Cur cumin and its derivatives have shown antitumor activity in in vitro tests (Kuttan et al., 1985). Some polysaccharides (arabino-galactans) named ukonan A, B, C, D (Japanese name of turmeric is ukon) show remarkable activity on the reticulo endothelial-system (Gonda et al., 1990, 1992, 1992a). The extract of turmeric has shown an timutagenic activity (Azuine et al., 1992). TAP (turmeric antioxidant protein) has been isolated from aqueous extract of turmeric. TAP prevents Ca-ATPase from inactivation in presence of pro moters of lipid peroxidation (LPO) as well as the depletion of thiol (SH) content during peroxida tion. The antioxidant activity is probably medi ated through the protection of the SH group of P. Scartezzini, E. Speroni / Journal of Ethnopharmacology 71 (2000) 23–43 29 the enzyme. Similar results have been obtained through reagents which reduce thiol groups (Sel vam et al., 1995). A mixture of curcuminoids such as curcumin, demethoxycurcumin, bis demethoxycurcumin protects normal human ker atinocytes from xanthine/hypoxanthine oxidase injury.

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C. Mangifera indica L.

- **Family:** Anacardiaceae.

- **Synonyms:** Mangifera anisodora Blanco, Mangifera fragrans F.-Vill. , Mangifera rostrata Blanco, Mangifera syl6atica F.-Vill.

❖ **Miscellaneous:**

Mangifera comes from Tamil man-kay or man-gay, which becomes manga in Portuguese, and from Latin fer-fero i.e. to produce. It has been grown in India for 4000 years, not only for the fruit but also because it creates a lot of shadow. Buddha used to rest under the mango tree. The plant has an important symbolic mean ing: its scented flowers are used in Shiva wor shipping. The Moghul Emperor Akbar the Great (Jalalad-Din Muhammad Akbar 1542–1605) cre ated a big garden of 100 000 mango trees at Darbhanga, north India. It was extraordinary at that time because intensive cultivation was un known. Thanks to the Chinese Hwen T'sang, who lived in the 7th century, mango became famous also outside of India. In the first half of 18th century the mango was exported to the other tropical countries by the Portuguese (Cal abrese, 1993). In Sanskrit there are many syn onymous of mango: Kamaphala (kama='desire', 'love', 'wish'; phal='fruit'), Kamavallabha (vallabha='favorite', 'lover'), Kamayudha (yudh='fighter', 'hero', 'warrior'), which means fruit of love, aphrodisiac; Kireshta (kira='a parrot'; stha='to stand'); Kokilavasa, Kokilananda, (kokila='indian cuckoo'; vasa= 'dwelling', 'residence'; nanda='joy', 'happiness') Pikavallabha (pika='indian cuckoo'; vallabha= 'favourite', 'lover') because cuckoos and parrots used to stay on this tree. A mango tree in Chandigarh, the capital of Punjab, has a trunk of 9.6 m girth and a crown spread of 2250 m2 with annual output of 17 tones of fruits.

➢ **Vernacular names**: Sanskrit, Alipriya, Amra, Bhramavapriya, Kamaphala, Kamayudha, Kamavallabha, Kok ilavasa, Kires, Kokilananda, Pitavallabha; Hindi, Am; Italian, Mango; English, Mango tree, Spring tree; French, Abricotier de St. Domingue, Ambo, Loubi, Freycinet, Manguier, Saint Michel; German, Mango; Chinese, An Lo Kuo; Nepalese, Angp

➢ **Habitat**: India, south-east of Asia, Malaysia, Hi malayan regions, Sri Lanka, Africa, America, Australia and, in general, in tropical and mon soon climate. Fruits ripen in hot and dry season.

➢ **Used parts:** Ripe and unripe fruits, root, bark, leaves, f lowers, resin from bark.

➢ **Morphological characteristics:** A large evergreen tree, longlived, 10–45 m high with a strong trunk and heavy crown.

➢ **Leaves**: Evergreen, coriaceous, 10–30 cm long and 5 10 cm wide, at the end of the branches, alternate, oblong or lanceolate, entire, the margins often undulate, shining, green bright up and yellow-greenish down, pinkish when young, petiole 2–5 cm long, swollen at the base.

❖ **Chemical constituents present in different parts of the plant:**

a.**In whole plant:** Friedelin, b-sitosterol, mangiferin (6.9%) mp. 278°, molecular weight 422.35, catechin, protocat echuic acid, ellagic acid, gallic acid, m-digallic acid, trigallic acid, gallotannin, butin, fisetin, leu cocyanidin, quercetin, triterpenic acid-mangifer olic acid mp.181°-, isomangiferolic hydroxymangiferolic acid, mangiferonic acid, hy droxymangiferonic acid, ambonic acid and am bolic acid, exudate from stem yield gum (16.0%) and resin (81.0%), a triterpenoid pentacyclic-ho pan-1b, 3b,22-triol- and four tetracyclic triter penoids 3a, 22(R/S)-, 3b, 22(R/S)-, 3b, 23(R/S)-, 3a, 27-dihydroxycycloart-24(E)-en-26-oic acids.

b. **Fruits**: Cycloartenol, 3b-hydroxycycloart-24-en-26-al, 24-methylene-cycloartan-3b,26-diol, C-24 epimers of cycloart-25-en-3b,24-diol, a-amyrin, b-amyrin, dammarenediol II, C-taraxastane-3b, 20-diol, ocotillol, methyl mangiferonate, methyl mangifer olate, methyl isomangiferolate, sitosterol, a mix ture of 5-(12-cis-heptadecenyl)- and 5-pentadecyl-resorcinols, vitamins A and C.

c.**Roots**: Friedelin, friedelan-3b-ol, a-amyrin, b-amyrina, cycloartenol, b-sitosterol.

d. **Leaves**: Flavonoids, phenolic, glucose, galactose, ara binose, xylose, rhamnose, tannins, leucine, tyrosine, valine, protocatechuic acid, catechin, mangiferin, alanine, glycine, g-aminobutyric acid, kinic acid, shikimic acid, methylic, ethyl, propyl, butyl, amyl and iso-butyl alcohols, a-pinene, b pinene, camphene, myrcene, car-3-ene, limonene, b-ocimene, g-terpinene, a-terpinolene, linalool, es tregole, d-elemene, b-elemene, a-cubebene, methyleugenol, b-caryophyllene, humulene, al loaromadendrene, a-guaiene, b-bulnesene, a-far nesene, d-cardinene, elemicin, chinomin, protocatechuic acid, gallic acid, methylchinomin, isochinomin, quercetin, hyperin, taraxerone, taraxerol, friedelin, lupeol, b-sitosterol.

e.**Unripe fruits:** Polysaccharides, a triterpene, acetates of cy cloartanol, amyrin, lupeol, homomangiferin-2C-b D-glucopyranosyl-3-methoxy-1,6,7-trihydroxyxan thone.

f. **Bark:** Protocatechuic acid, catechin, mangiferin, ala nine, glycine, g-aminobutyric acid, kinic acid, shikimic acid, tetracyclic triterpenoids, cycloart 24-en-3b,26-diol, 3-ketodammar-24(E)-en-20S,26 diol, C-24 epimers of cycloart-25-en-3b,24,27-triol and cycloartan-3b,24,27-triol.

g. **Seeds**: Stearic acid, a-pinene, b-pinene, myrcene, limonene, oleic (86,0%), arachidonic, linoleic, lino lenic and palmitic acids.

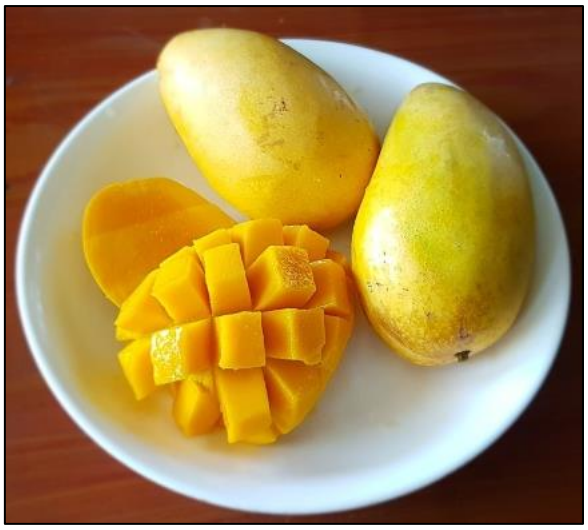

Fig. 3 Mangifera Indica.

❖ **Pharmacological action**: Mangiferin is a C-glucosylxanthone and it has cardiotonic and diuretic properties. Gallic acid and quercetine show a strong antiviral activity. Mangiferin stimulates after 48 h the proliferation of thymocytes and spleenic lymphocytes with a peak response at 5.0 mg/ml and 20.0 mg/ml, respec tively (Rastogi and Mehrotra, 1993). Mangiferin has a remarkable anti-inflammatory activity. Mangiferin is an antioxidant at different levels of oxidation sequence able to:

- prevent the lipoperoxidation by decreasing the O2 concentration and generating mangiferin phenoxy radicals.
- Bind metal ions like Fe3+,Fe2+ preventing the generation of hydroxyl radicals and/or oxo-ferryl groups.
- Regulate the polymer chain initiation by inter action with ROS to produce feebly-reactive oxo-radical.
- Act like a scavenger to lipid peroxy and alkoxy radicals and prevent the abstraction of H from cellular lipids.
- Maintain the balance of cellular oxidant/antioxidant.

CONCLUSION: Many studies have been performed to identify antioxidant compounds with pharmacologically activity and a limited toxicity. In this context, ethnopharmacology represents the most important way possible of finding interesting and therapeutically helpful molecules. The phytochemical analysis of rasayana has revealed a large number P. Scartezzini, 39 of compounds including tannic acid, flavonoids, tocopherol, curcumin, ascorbate, carotenoids, polyphenols, etc. which have been shown to have potent antioxidant properties.The herbal mixture preparations of Indian traditional medicine may have an antioxidant activity arising from their content of plants with antioxidant principles, that act probably in a synergistic way. This hypothesis along with the lack of toxicity can be important to understand their use in the past as well as nowadays.

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