International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Impact Factor (2012): 3.358

Mangiferaindica: Ethnopharmacology of Mangiferin from its Leaf Extract

Sheetal Sharma

Abstract: ***This review details the vernacular names, origin, distribution, taxonomy and variety of Mangiferaindica L. (Anacardiaceae), a medicinal plant traditionally used in tropical regions. This article is presented to compile all the updated information on its phytochemical and antimicrobial activities. Studies indicate that mango possesses antidiabetic, anti-oxidant, anti-viral, cardiotonic, hypotensive, anti-inflammatory properties.These studies are very encouraging and indicate this herb should be studied more extensively to confirm these results and reveal other potential therapeutic effects.***

Keywords: *Mangiferaindica*, mangiferin, antimicrobial, phytochemistry, plant extract.

1. Introduction

Mangiferaindica, also known as mango, aam, has been an important herb in the Ayurvedic and indigenous medical systems for over 4000 years. The genus *Mangifera* belongs to the order Sapindales, Anacardiaceae family. Mangiferin, being a polyphenolic antioxidant and a glucosylxanthone, it has strong antioxidant, anti lipid peroxidation, immunomodulation, cardiotonic, hypotensive, wound healing, antidegenerative and antidiabetic activities.

2. Literature survey

2.1 Origin and distribution

Native from Southern Asia, especially Eastern India, Burma and the Andaman Islands, *M. indica* has been cultivated, praised and even revered in its homeland since ancient times. Buddhist monks are believed to have taken the plant on voyages to Malaya and Eastern Asia in the 4thand 5thCenturies BC. Persians are said to have taken mangoes to East Africa around the 10thCentury AD. The fruit was grown in the East Indies before the earliest visits of the Portuguese who apparently introduced it to West Africa and Brazil in the early 16th Century. *M.indica* was then carried to the West Indies, being first planted in Barbados about 1742 and later in the Dominican Republic; it reached Jamaica in about 1782 and, early in the 19th Century, reached Mexico from the Philippines and the West Indies (Morton 1987). In this day and age, *M. indica* resides in most tropical biotopes in India, Southeast Asia, Malaysia, Himalayanregions, Sri Lanka, Africa, America and Australia (Calabrese 1993; Kirtika and Basu 1993; Sahni 1998).

2.2 Taxonomical Classification

- Kingdom : Plantae
- Class :Mangoliopsida
- Phylum :Mangoliophyta
- Order :Sapindales
- Family :Anacardiaceae
- Genus :*Mangifera*
- Species :*Indica*

2.3 Common names

- Sanskrit: Ambrah; Madhuulii; Madhuula; Madhuulaka
- English: Mango
- Hindi: Aam
- French: mangot;mangue; manguier
- Portuguese: manga; mangueira
- Dutch: manja
- Tamil: Ambiram; Mambazham; Mambalam; Mangai
- Punjabi: Amb; Wawashi
- Gujarati: Ambo, Keri; Marvo (unripe)

2.3.1 Uses of Mangiferaindica

Mango has long been recognized as more than just edible ripe fruit. The edible uses of the fruit include non-ripe fruit, seed, and processed products such as achars, chutneys, preserves, etc. The fruit is eaten for its nutritional value, its medicinal value, and for its pleasant flavor. (Ian & Bally, 2006). Following are some of its medicinal values:

1. The insoluble fibre, present in mangoes, helps the elimination of waste from the colon and prevents constipation.
2. The tartaric acid, malic acid, and a trace of citric acid found in the fruit help to maintain the alkali reserve of the body.
3. A milk-mango shake used in the summers help people gain weight.
4. Extracts of leaves, bark, stem and unripe mangoes are believed to possess antibacterial properties against some micro-organisms
5. Dried mango flowers are used in the treatment of diarrohoea, chronic dysentery and some problems of the bladder.
6. The stone (kernal) of the mango fruit is used widely in Ayurvedic medicines for treatment of different ailments
7. Antioxidants present in the mango fruits are believed to play an important role in the prevention of cancer and heart disease.
8. Some of the flavonoids present in the fruit are believed to strengthen the immune system of human body.

2.3.2 Chemical composition of *Mangiferaindica*

Chemical composition of *Mangiferaindica* is always of an interest. The different chemical constituents of the plant include polyphenolics, flavonoids, triterpenoids, Mangiferin

(a xanthone glycoside is its major bioactive constituent), isomangiferin, tannins and gallic acid derivatives. The bark is reported to contain protocatechic acid, catechin, mangiferin, alanine, glycine, kinic acid, shikimic acid and the tetracyclic triterpenoids cycloart-24-en-3β,26 diol, 3-ketodammar-24(E)-en-20S,26-diol, C-24 epimers of cycloart-25 en 3β,24,27-triol and cycloartan-3β,24,27-triol (Scartezzini and Speroni, 2000).

Indicoside A and B, manghopanal, mangoleanone, fridelin, cycloartan-3β-30-diol and derivatives, mangosterol, manglupenone, mangocoumarin, n-tetacosane, n-heneicosane, n-triacontane and mangiferolic acid methyl ester and others isolated from stem bark of Mangiferaindica (Khan et al.,1993). Mangostin, 29-hydroxy mangiferonic acid and mangiferin have been isolated from the stem bark together with common flavonoids. The flower yielded alkyl gallates such as gallic acid, ethyl gallate, methyl gallate, n-propyl gallate, n-pentylgallate, n-octylgallate, 4-phenyl gallate, 6-phenyl-n-hexyl gallate and dihydrogallic acid (Khan and Khan, 1989). Root of mango contains the chromones, 3-hydroxy-2-(4'-methylbenzoyl)-chromone and 3-methoxy-2-(4'-methyl benzoyl)-chromone. The leaf and flower yield an essential oil containing humulene, elemene, ocimene, linalool, nerol and many others. The fruit pulp contains vitamins A and C, β-carotene and xanthophylls (Ross 1999). An unusual fatty acid, cis-9, cis-15-octadecadienoic acid was isolated from the pulp lipids of mango (Shibahara et. al., 1993).

2.3.3 Botanical description:

Mango is a long-lived evergreen tree that can reach height of 15–30 m (50–100 ft). Mango trees typically branch 0.6–2 m (2–6.5 ft) above the ground and develop an evergreen, dome-shaped canopy. The leaves are spirally arranged on branches, linear-oblong, lanceolate - elliptical, pointed at both ends, the leaf blades mostly about 25-cm long and 8-cm wide, sometimes much larger, reddish and thinly flaccid when first formed and release an aromatic odour when crushed. The inflorescence occurs in panicles consisting of about 3000 tiny whitish-red or yellowish - green flowers. The fruit is a well known large drupe, but shows a great variation in shape and size. It contains a thick yellow pulp, single seed and thick yellowish - red skin when ripe. The seed is solitary, ovoid or oblong, encased in a hard, compressed fibrous endocarp.

3. Pharmacology and methodology

Although a lot of pharmacological investigations have been carried out based on the ingredients present but a lot more can still be explored, exploited and utilized. A summary of the findings of these studies is presented below:

3.1 Antibacterial activity

The leaf extract of *Mangiferaindica* has been reported to possess antibacterial activity against *E. coli* and other bacteria in the family enterobacteriaceae. The bioactive component mangiferin isolated from *M. indica* is reported to possess remarkable antibacterial activity (Neon, 1984). The presence of phyto constituents in the leaf extract may be responsible for the antibacterial activity of the plant (Marjorie 1999). Eight pathogenic bacterial isolates were used for the screening of antibacterial activity. They were procured from The Microbial Type Culture Collection and Gene Bank (MTCC), at Institute of Microbial Technology (IMTECH), Chandigarh. Following are the details of these test organisms.

Test organisms used for antibacterial screening

Organism	*Nature of the organism*	*Accession No.*
Bacillus cereus	Gram positive	MTCC 430
B. subtilis	Gram positive	MTCC 441
Escheria coli	Gram positive	MTCC 40
Enterococcus faecalis	Gram positive	MTCC 439
Klebsiella pneumonia	Gram negative	MTCC 109
Pseudomonas aeruginosa	Gram negative	MTCC 1934
Pseudomonas alcaligenes	Gram negative	MTCC 493
Staphylococcus aureus	Gram positive	MTCC 3160

The plant extract was found to exhibit significant antibacterial activity against all the test organisms but highest antibacterial activity was exhibited against *E. coli*.

3.2 Antifungal activity

The leaf extract was screened against three pathogenic fungi; *Aspergillusniger* (MTCC 281), *Candida albicans* (MTCC 183) and *Penicilliumchrysogenum* (MTCC 6795). All the cultures were obtained from MTCC, IMTECH, Chandigarh. The plant extract was found to exhibit significant antifungal activity against all the test organisms but highest antifungal activity was exhibited against *P. chrysogenum*.

4. Conclusion

The extensive survey of literature revealed that *Mangiferaindica* is an important source of many pharmacologically and medicinally important chemicals such as mangiferin, mangiferonic acid hydroxymangiferin, polyphenols and carotenes. Many different pharmacological activities, antioxidant, radioprotective, immunomodulatory, anti-allergic, anti-inflammatory, antitumor, antidiabetic, lipolytic, antiboneresorption, monoamine oxidase-inhibiting, antimicrobial and antiparasitic, have been reported for mangiferin. All these studies indicate that a wide part of activities acknowledged to preparation based on *Mangiferaindica*bark could be attributed to this C-glucosylxanthone (mangiferin). Based on the knowledge of the many properties of mangiferin, phytomedicines should be adequately standardized regarding this active compound. *Mangiferaindica* has been used successfully in ayurvedic medicine for centuries, more clinical trials should be conducted to support its therapeutic use.

5. Summary

Mango has become naturalized and adapted throughout the tropics and subtropics. Much of the spread and naturalization has occurred in conjunction with the spread of human populations, and as such, the mango plays an important part in the diet and cuisine of many diverse cultures. There are over 1000 named mango varieties

throughout the world, which is a testament to their value to humankind. Mango is a common garden tree throughout the tropics. When ripe, this delicious dessert fruit is particularly high in vitamin A. The fruit is also eaten green, processed into pickles, pulps, jams, and chutneys, and is frozen or dried. The fruit is also an important source of sustenance for birds, bats, insects, and mammals. According to ayurveda, varied medicinal properties are attributed to different parts of mango tree. Mango possesses antidiabetic, anti-oxidant, anti-viral, cardiotonic, hypotensive, anti-inflammatory properties. Various effects like antibacterial, anti fungal, anthelmintic, anti parasitic, anti tumor, anti HIV, antiboneresorption, antispasmodic, antipyretic, antidiarrhoeal, antiallergic, immunomodulation, hypolipidemic, anti microbial, hepatoprotective, gastroprotective have also been studied. Pharmacologically and medicinally important chemical such as mangiferin, being a polyphenolic antioxidant and a glucosylxanthone, it has strongantioxidant, anti lipid peroxidation, immunomodulation, cardiotonic, hypotensive, wound healing, antidegenerative and antidiabetic activities.

6. Future Prospects

The *M. indica* long history of use has been substantiated by many researches; modern phytomedicines based on its bark are worthy of further investigation to precise their major fields of use. The present extent of diabetes in developing countries (so-called coca-colonization) makes it a choice preparation to develop. Based on the knowledge of the many properties of mangiferin, phytomedicines should be adequately standardized regarding this active compound.

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Author Profile

Sheetal Sharma, M. Phil in Biotechnology from the University of Jammu, Jammu and Kashmir, India. Presently she is serving in J&k Education Department.