A Review on Uses of Mangifera Indica [Mango]Leaves

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Abstract: Mangifera indica L. is a member of the Anacardiaceae family and belongs to genus Mangifera. Mangiferin, along many other phytochemicals including phenolic acids, benzophenones, and other antioxidants including flavonoids, ascorbic acid, carotenoids, and tocopherols, are responsible for the health advantages of studying mango leaves. The biological properties of mango leaf (ML) extracts, such as their anti-obesity, anti-microbial, anti-oxidant, and anti-cancer properties, have been investigated. We have discussed the nutritional and phytochemical characteristics of the MLs in detail in the current review. taking into account the positive benefits and phytochemical profile of the MLs. This fruit is significant and comes from Southeast and South Asia. Among the top manufacturing countries of Mangifera indica are India, Thailand (the land of smile), Indonesia (East Indie), Pakistan, Mexico, Bangladesh, Brazil, Nigeria, and the Philippines They can be applied to the creation of medicinal medications and functional meals. Ayurveda, several herbal literatures, and journals state that the mango tree possesses numerous medicinal virtues in its various portions. Mangifera leaves have anti-cancer qualities that prevent cancer cells from proliferating and spreading. Strong antioxidants found in Mangifera leaves help to counteract dangerous free radicals in the body, which is one of the plant's main health advantages. Mangifera leaves have demonstrated encouraging antibacterial efficacy against a range of diseases, such as viruses, fungus, and bacteria. Mangifera leaves may help control blood sugar levels due to their hypoglycemic properties. This makes them advantageous for those with diabetes.

Key Words: Mangifera indica, biological responses, Phenolic compounds with health benefits, oligosaccharides, Beneficial health outcomes.

INTRODUCTION

Natrium (Na), lime (Ca), Epsom salt (Mg), and supplements, viz. A, B, E, and C. A biomacromolecules present in Mangifera leaves is protein. MLs can be utilized as the mango, or Mangifera indica L., is a sweet stone fruit that is grown around the world, especially in tropical regions. It is a member of the Anacardiaceous family in the Sapindales order. It is the national tree of Bangladesh as well as national fruit of the Philippines and India.

There are more than a thousand mango types in the world. Mango fruits offer essential nutrients for normal human growth, development, and health, including energy, dietary fibre, carbs, proteins, lipids, and phenolic compounds.[1]

Various therapeutic characteristics and health advantages have been reported for mango trees, their blooms, fruits, seeds, leaves, and bark. Research has shown that various parts of the mango tree and its essential components have a variety of health benefits, such as the mitigation of long-term inflammatory conditions, antiviral and antibacterial properties, immunomodulatory, antispasmodic, and gastrointestinal health, as well as the prevention of chronic diseases mediated by metabolism.

CHEMICAL CONSTITUENTS

- Mangifera leaves (MLs) are the potential reservoir of mineral resources, viz. azote(n2), mineral salt(k), phosphorus, ferrum(fe), renewable sources of livestock diet in undeveloped countries for relieving the food scarcity for stock.
- A diverse range of phytochemicals, including polyphenols, terpenoids, polysaccharides, sterols, carotenoids, vitamins, fatty acids, and amino acids, are found in medicinal legumes (MLs). The most prevalent of these in ML are total phenolic compounds (TPC), which include flavonoids, xanthones, benzophenones, tannins, terpenoids, and phenolic acids.

PHYTOCHEMISTRY

MI's chemical components are always in curiosity. the many chemical components of the plant, particularly the triterpenoids, flavonoids, and polyphenolics.

Major bioactive components of xanthone glycosides include Mangiferin, isomangiferin, tannins, and derivatives of gallic acid. Protocatechic acid, catechin, Mangiferin, alanine, glycine, γ-aminobutyric acid, kinic acid, shikimic acid, and the tetracyclic triterpenoids are all said to be present in the bark. The C-24 epimers of cycloart-25 en 3β,24,27-triol and cycloartan-3β,24,27-triol are cycloart-24-en-3β,26-diol, 3-ketodammar-24 (E)-en-20S,26-diol.[2]

NUTRITIONAL COMPOSITION:

- Protein is one of the main biomacromolecules that has been researched in mango leaves. In addition to serving as the building blocks of cells, proteins are essential for cell growth, maintenance, enzyme regulation, cell signalling, and biocatalysis [3]. The effectiveness of ML protein as a fodder crop in meals given to animals such black Bengal goats and rabbits has been evaluated [4,5]. ML is a good source of vitamins, minerals, and additional protein.
- Mangos have a nice scent that varies depending on the variety, climate, and area of origin. Seven chemical elements were discovered in the machine learning operations profile: camphene, α-pinene, α-copaene, pinene, α-gurjunene, β-elemene, and α-humulene [6].

Fig.1 Mango tree with fruits

Fig.2 Mango leaves with fruits

Fig.3 Mango leaves powder

USES OF MANGIFERA INDICA LEAVES

- Rich in anti-oxidants
- Strenthen blood vessels
- May have anti-inflammatory properties
- Promotes skin health
- Act as a stomach tonic
- To treat gall and kidney stones
- Respiratory problems
- May have anti-cancer properties
- Treat stomach ulcers
- Cures dysentery
- Treat hiccups and throat problems
- Protect against fat gain
- May help combat diabetes
- Beneficial for hair growth
- Anti-viral and anti-bacterial

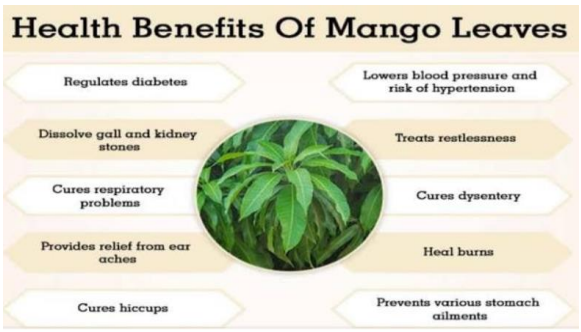

Fig .4 Health benefits of mango leaves.

1. ANTI OXIDANT:

Mangifera and mango leaf extract have been shown in numerous studies to possess strong antioxidant and free radical scavenging properties. Additionally, the antioxidant capacity of these substances is markedly increased in pro-inflammatory and inflammatory circumstances such as infection and diabetes states [7-19]. Mangiferin's four hydroxyl groups scavenge harmful oxygen free radicals, exhibiting exceptional antioxidant qualities. It is a strong iron chelator that shields against UV (ultraviolet) light and stops harmful hydroxyl radicals from being produced in Fenton-type reactions [20]. Dar et al. employed the DPPH assay to show that Mangiferin (EC50 5.8±0.96(μg/ml) had strong antioxidant activity, similar to that of rutin, a strong antioxidant that is used in medicine [9]. In human peripheral blood lymphocytes, it reduces lipid peroxidation generated by hydrogen peroxide in a dose-dependent manner.

Higher antioxidant activity was observed in the hydroalcoholic MLs extract cultured with Lactobacillus casei or with useful bacteria. Additionally, the study demonstrated that lipopolysaccharide-generated reactive oxygen species were reduced by fermented extracts [21]. An advanced

investigation discovered that MLs extract might be used as a green antioxidant to extend the shelf life of biodiesel [22]. In conclusion, a number of intriguing findings suggested that MLs extract has broader potential applications as an antioxidant in the food, packaging, and other industries.

2. ANTI INFLAMMATORY PROPERTIES:

Numerous studies have shown that Mangiferin has the ability to reduce inflammation in a variety of animals. Pan et al. looked into the molecular mechanism of Mangiferin against acute liver injury and inflammation caused by lipopolysaccharide (LPS) and D-galactosamine. Mangiferin suppressed hepatic lipid peroxidation and oxidative stress in addition to serum ALT, AST, IL-1β, TNF-α, MCP-1, and RANTES (regulated on activation, normal T cell produced and released). Additionally, Mangiferin prevented LPS-stimulated primary hepatocytes from producing TNF-α and IL-1β. Mangiferin enhanced the declaration of Nrf2 and HO-1 in a dose-related manner. Furthermore, Mangiferin inhibited LPS/d-GalN-induced hepatic NLRP3, ASC, and caspase-1, IL-1β and TNF-α expression. Thus, Mangiferin protected against the liver injury by activating the Nrf2 pathway and regulating NLRP3 inflammasome activation [23].

Gong et al.'s study on a pulmonary inflammation model showed that Mangiferin can lessen acute lung injury and death caused by cecal ligation and puncture, as evidenced by a decrease in both systemic and pulmonary inflammatory responses. Furthermore, Mangiferin demonstrated its capacity to reduce inflammatory mediators in sepsis-induced acute lung injury by inhibiting sepsis-activated MAPK and NF signaling. In the pulmonary tissues of septic mice, Mangiferin was shown to dose-dependently upregulate HO-1. Szandruk et al. showed that Mangiferin might protect animals from 2,4,6-trinitrobenzensulfonic acid (TNBS)-induced colitis. Mangiferin significantly decreased both microscopic and macroscopic damage, as well as the colon's MDA level. Additionally, the levels of TNF-α and IL-17 were decreased, and the colon tissues' SOD activity was increased. Therefore, by enhancing anti-inflammatory and antioxidant activity, Mangiferin considerably shielded mice from TNBS-induced inflammation and colitis.

3. SKIN HEALTH:

Mangiferin, a C-glucoside xanthone, is the primary phytomarker of all the sections of the mango (peel, leaves, twigs, and bark), and polyphenols are in fact the primary substances found in mangos [24,25]. Higher plants have a large distribution of Mangiferin, which protects against various static and dynamic stressors, including pathogenic microbes [26]. Furthermore, preclinical tubo studies have demonstrated that the ethanolic fraction derived from Mangifera indica leaves and kernels is a promising anti-acne agent because of its strong free-radical scavenging properties, inhibition activity against C. acnes, and effects on pro-inflammatory cytokines linked to acne [27,28,29].

However, there has been little research done on the biological activity of Mangifera indica leaves. More information is required, particularly in a clinical context, to determine the true efficacy of Mangifera indica extracts as active ingredients in anti-acne treatments [30,31,27].

4. TREAT LIVER AND GALBLADDER DISORDER:

The molecular mechanisms by which Mangiferin protects against lead-induced liver injury and cellular death were studied by Pal et al. [32]. It was discovered that Mangiferin (100 mg/kg, taken orally for 6 days) lowers the levels of serum marker enzymes like ALT and ALP and suppresses the generation of ROS. Overall, it was shown that Mangiferin acts through pathways that are dependent on MAPK/NF-κB/mitochondria to exhibit antioxidative and antiapoptotic effects [32]. When Mangiferin (30 mg/kg) is pretreated intraperitoneally, it has a more comprehensive protective effect than silymarin, a common hepatoprotective medication, by lowering serum levels of alanine and aspartate aminotransferases, alkaline phosphatase, bilirubin, and the inflammatory mediator TNF-β [33]. These findings imply that Mangiferin has strong hepatoprotective effects on liver damage caused by CCl-4 in mice [33].

Additionally, Mangiferin dose-dependently upregulates the expression of Nrf2 and HO-1 in acute liver damage produced by LPS and D-galactosamine (D-GalN). Moreover, inflammatory factors generated by LPS/D-GalN, such as caspase-1, IL-1β, TNF-α, NLRP3, and apoptosis-associated speck-like protein containing a CARD, are significantly inhibited by

Mangiferin [34]. In fructose-fed spontaneously hypertensive rats (SHR), Mangiferin therapy reduces fatty liver by blocking hepatic DGAT2, which catalyzes the last stage of triglyceride production [35]. When treating fatty liver, Mangiferin may improve the synthesis and oxidation of de novo fatty acids. Additionally, the rat bile duct drainage experiment showed that Mangiferin (20 mg/kg) significantly raises the amount of bilirubin and bile secretion. Furthermore, at a dose of 10 mg/kg [36], gallbladder smooth muscle spasms are suppressed.

5. ANTI-TUMOUR ACTIVITY:

The MTT assay is a reliable and simple technique that yields valuable quantitative information about the antiproliferative and anticancer properties of natural extracts. [37,38] Several mango cultivars' whole fruits, fruit juices, or fruit peel extracts were hazardous to cancer cell lines, including those from the breast (MDA-MB-231 and MCF 7), cervical (HeLa cells), colon (SW-480 and SW-620), lung (A-549), prostate (LnCap), and renal (786-0) cancers. They showed no toxicity effect on the lung fibroblast normal cell line (CCD-25 Lu) and low cytotoxicity against normal cell lines, such as breast (MCF-10A) and colon (CCD-18Co) normal cell lines.

They showed no toxicity effect on the lung fibroblast normal cell line (CCD-25 Lu) and low cytotoxicity against normal cell lines, such as breast (MCF-10A) and colon (CCD-18Co) normal cell lines. [39,37,38,40] This study made use of mango leaf. All investigated cancer cell lines (ductal carcinoma, bronchogenic carcinoma, liver hepatoblastoma, gastric carcinoma, and colon adenocarcinoma) were cytotoxically affected by the leaf extract at high doses (IC50 >200 μg/ml). On the other hand, there was no hazardous effect, particularly an increasing effect toward skin fibroblast normal cell line, at that high dose, as demonstrated by the toxicity on lung fibroblast normal cell line. Mango extracts may have antiproliferative properties because of the synergistic activities of their bioactive components. [38] One naturally occurring xanthone that was taken from mango trees is called Mangiferin. It has been demonstrated to suppress cancer cell lines from the liver, breast, prostate, colon, and nasopharynx. [41,42] According to the results, Mangiferin did not exhibit appreciably high toxicity against any of the examined cancer cell lines. The earlier study also found that tested cancer cell lines were only suppressed by high doses of mangiferin.[41] According to this study, Mangiferin may also improve skin and lung normal cell lines' chances of surviving.

6. ANTI –DIABETIC ACTIVITY:

Two hours prior to the administration of the glucose solution, the consumption of plant extracts considerably reduced the increase in blood glucose levels in the disease control group. Additionally, in diabetic rats, the plant extract stopped the rise in fasting blood glucose. Mango leaves contain a variety of phytochemicals that are assumed to be the cause of their anti-hyperglycemia properties. It has previously been demonstrated that foliamangiferosides, like Mangiferin, work against diabetes by raising insulin sensitivity and reducing the activity of alpha-glucosidase [43]. It has also been reported that iriflophenone 3-C-β-D-glucoside has anti-diabetic properties.

When administered with glucose at the same time as the extracts, Mangifera indica leaf and stem bark extracts significantly reduced hyperglycemia in type 2 diabetic model rats. In type 2 rats, a single oral dose of 250 mg/kg body weight had a significant and potent hypoglycemia impact.[45].

Ahmad Muhtadi et al., 35 employed normoglycemic, glucose-induced hyperglycemia, and STZ-induced diabetic mice to study the effects of M. indica L. leaf extract on diabetic characteristics. There is hypoglycemic action in the aqueous extract of M. indica L. leaves.[46].

7. TO TREAT RESPIRATORY PROBLEMS:

The impact of an aqueous extract of the stem bark of M. indica (mangiferin) on rats' trachea contracted by histamine and acetylcholine was investigated by Gbeassor et al. in 2005. These tests revealed that the M. indica (mangiferin) aqueous extract could inhibit the muscarinic and histaminic receptors on the rat trachea, indicating that it may be used to treat asthma [47].

According to Rivera DG et al. (Rivera et al., 2011), Mangiferin can reduce the amount of Th2 cytokines, IL-4 and IL-5, in lymphocyte culture supernatant and BALF, hence having an anti-asthmatic effect. In our earlier research, we discovered that Mangiferin had an anti-asthmatic impact through the STAT6 signaling pathway, which balanced Th1/Th2 cytokines (Guo et

al., 2014). We were surprised to see that Mangiferin treatment also changed the levels of additional non-Th1/Th2 cytokines.

Mice were given oral treatments of M. indica extract (50, 100, or 250 mg/kg) or Mangiferin (50 mg/kg) in an allergic murine experimental paradigm from day 0 to day 24. The findings showed that Mangiferin significantly reduces immunoglobulin (Ig)E levels, lymphocyte proliferation, and airway inflammation surrounding arteries and bronchi. Furthermore, it has been shown that Mangiferin suppresses the generation of IL-4 and IL-5 cytokines in lymphocyte culture supernatant and bronchoalveolar lavage fluid [48]. These studies could constitute a significant portion of the pre-clinical work required before Mangiferin is used to treat respiratory illnesses.

8.ANTI-BACTERIAL ACTIVITY:

Mango leaves and stems extracts in ethanol and water at 50 and 25 mg/mL have been shown to have adequate antibacterial activity against Staphylococcus aureus, Enterococcus faecalis, Candida albicans, Pseudomonas aeruginosa, Streptococcus pyogenes, and Streptococcus pneumoniae [49]. The antibacterial properties of the extract were also seen against Escherichia coli, Listeria monocytogenes, and Salmonella enterica [50].

9.ANTI-MICROBIAL ACTIVITY:

Leaf extract exhibited a sufficient degree of antibacterial activity against Gram-positive bacteria, but no or minimal activity was detected against Gram-negative bacteria [51].

10.PROTECT AGAINST FAT:

Due to food habits, a sedentary lifestyle, and stress, obesity is one of the most common problems in the world. These factors encourage a number of pathological conditions and cardiovascular diseases.

The consumption of MLs tea at the concentration of 24.7 mL/day resulted in increased antioxidant activity along with anti-inflammatory effects. Therefore, increased total antioxidant activity and concentration of interleukin10, decreased abdominal fat accumulation, increased expression of PPAR-γ, and lipoprotein lipase and reduction in the expression of fatty acid synthase [52].

CONCLUSION

MLs have remarkable biological, therapeutic, and metabolic qualities. Phenolic chemicals, flavonoids, benzophenones, sesquiterpenes, saponins, xanthones, tannins, terpenoids, and alkaloids are among the several bioactive substances found in the MLs. Strong anti-proliferative activity of MLs extract was observed against human colon carcinoma, breast, pancreatic, and other cancer types. Mango leaves contain a variety of essential chemicals that are necessary for carrying out a range of metabolic, bacteriostatic, and antibacterial functions. It has also been discovered that the Mangiferin found in MLs reduces oxidative stress, which is important in the treatment of several diseases. Thus, MLs have promise as a low-cost source of nutrient-dense food supplements and components for enhancing human health and treating both acute and chronic illnesses.

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