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A Review On Pharmacological Activities Of Bioactive Compounds Of Mangifera Indica And Saraca Indica

Sabina Khatun 1*,Dr.Rajesh Kumar Sharma 2

1* PhD scholar,NIMS Institute of pharmacy,NIMS University Rajasthan

2. Associate Professor,Department of pharmacology, NIMS Institute of pharmacy,NIMS University Rajasthan

Abstract

Mangifera indica (family Anacardiaceae), commonly known as mango, is a pharmacologically, ethnomedically, and phytochemically diverse plant. Various parts of M. indica s.indica tree have been used in traditional medicine for the treatment of different ailments, and a number of bioactive phytochemical constituents of M. indica have been reported, namely, polyphenols, terpenes, sterols, carotenoids, vitamins, and amino acids, and so forth. S.indica have been reported phytoconstituents, such as Flavonoids, Steroids, Glycosides, Saponins, Carbohydrates, Proteins Several studies have proven the pharmacological potential of different parts of mango trees such as leaves, bark, fruit peel and flesh, roots, and flowers as anticancer, anti-inflammatory, antidiabetic, antioxidant, antibacterial, antifungal, anthelmintic, gastroprotective, hepatoprotective, immunomodulatory, antiplasmodial, and antihyperlipemic. Several studies have proven the pharmacological potential of different parts of saraca indica trees such as leaves, bark,stem and flowers as antihemorrhagic activity, anti microbial activity,uterine tonic, anti-helmintic activity,anti- inflammatory .antiarthritic effect, anti-diabetic property, antioxidant activity, anticancer effect, larvical activity. In the present review, a comprehensive study on, pharmacological activities, and bioactive compounds of M. indica and S.indica has been described.

KEYWORDS: Ashoka, Saraca asoca, Magnifera indica, Pharmacological activity, medicinal uses.

1.Introduction

M. indica L. is considered as one of the main tropical fruits in the world believed to be originated from Asia [1]. It has been reported that China, India, Brazil, Nigeria, Pakistan, Mexico, Thailand, and Philippine are well-known for mango cultivation with India being the highest mango cultivating country [2]. World production of mango is approximately 42 million tons.Mango is known by various names around the world, for example, Manja in Arabic, Mannko in Greek, Am or Ambi in Hindi, Amba in Sinhala, Mangue in French, Mango in Finnish, Mango in Dutch, Mangue in German, Mángguǒin in Chinese, and Mampalam in Tamil [3]. Mango

fruit peel and flesh are reported to be a rich source of fiber, vitamin C and A, essential amino acids, and polyphenols [4]. Mango seed has also been reported as a rich source of polyphenols [5]. Despites the common use of mango fruit as a food item, various parts of mango trees have also been used for medical purposes since ancient times, mostly in Southeast Asian and African countries [7].

Where as The Saraca asoca medicinal plants were thus one of the main plants used since ancient times. Asoka or Ashoka is a Sanskrit meaning, "no sadness" or "no pain." Ashoka is one of India's most mythical and holy trees. Ashoka, known as Saraca asoca or Saraca indica of the family Caesalpiniaceae. Universally recognized as the binomial Latino name.Saracaasoca is an evergreen shrub or small tree with a thick horizontal crown of up to 10 meters in height. The circumference of the bole may be 10cm. The tree is a key herbal medicine in Ayurveda. Bark is picked from the wild, and sold on local markets, alone and in a range of formulations. Saraca asoca is one of India's largest sacred trees, both Hindus and Buddhists, with beautiful flowers widely used to decorate temples. In certain parts thereof, this small tree has been affected largely by the loss of its habitat and over-exploitation[4-6] Much evidence is found in literature on pharmacological and ethnomedicinal uses of M. indica and S indica however, there is no complete review on phytochemicals, biological effects of phytochemicals, and pharmacological and ethnomedicinal properties of M. indica. Therefore, we present this review as an up-to-date and comprehensive evaluation which mainly includes some reported bioactivities of phytochemicals, and pharmacological properties of M. indica

Taxonomy and botanical description M. indica

The genus Mangifera belongs to the family Anacardiaceae. Genus Mangifera approximately contains 69 different species with M. indica being the most common species in the same genus [10, 11]. M. indica plant is an evergreen broad canopy tree which grows to a height of 8–40 m [12]. M. indica bark is a thick brown-gray colour and is superficially cracked [13]. Leaves are 15–45 cm in length with variable sizes [13]. Leaf petiole has a variable length from 1–10 cm [13]. M. indica leaves (Figure 1) possess different shapes (lanceolate, ovate-lanceolate, linear-oblong, roundish-oblong, oval, and oblong) [13]. Green, red, and yellow leaves are seen in some mango varieties and upper leaf surfaces are normally shiny [13, 14]. In case of M. indica flowers, male and hermaphrodite flowers are produced in the same panicle; its size can vary from 6–8 mm in diameter. There are about 4000–5000 small flowers in panicles with red/purple spots on petals [13, 14]. Even though a large number of flowers present in panicles, very few will be developed as fruits. Flowering season is mainly from January to April and most of the flowers are subsessile and have a sweet smell. M. indica fruit (Figure 1) is drupe with different sizes, shapes, and colours. Fruit peel is green, yellow, red, or orange. Seeds are ovoid- or oblong-shaped covered with a hard endocarp having a woody fiber covering [15].

Where as s. indica Parts used: such as Bark, leaves, Flower. 2.2 Externally: The medication is applied locally to treat a variety of poisonings and pain. 2.3 Internally : It is recommended for uncomfortable visceral conditions. 2.4 Systematic : a) Digestive system: in cases of dysentery, diarrhea, worm infestation, and thirst. b) Heart and circulatory system: Edema and hemorrhages are suggested by the flower. c) Menorrhagia, dysmenorrhoea, leucorrhoea, and other uterine illnesses are cases of the reproductive system. d) Urinary system: Powdered leaves are used to treat urinary tract stones and dysuria .: Bark has uterine sedative and strong astringent properties. It directly affects the uterine muscle fibers. It stimulates the ovarian tissue as well as the endometrium. It appears that the ketosterol found in Ashoka bark has androgenic properties. 2.6 Synonyms : Ashok, Shoknashan, Smaradhivas, Kankeli, Vanjuldrum, Raktapallava, Hempushpa, Nata, Pindapushpa, Gandhapushpa, Madhupushpa5 . 2.7 Vernacular Names : In Indian literature, this tree is known by several different names. The Ashoka tree goes by a few names. Latin name : Saraca indica Common name: Asoka, Hempushpa English name : Asoka5 Habitat It can be found throughout the Indian subcontinent. The Western Ghats and Deccan plateau are thought to be the tree's original habitat. The eastern and central Himalayas are also home to it. It can grow up to 750 meters above sea level, according to reports.

3.. **Pharmacological Properties of M. indica**

A number of in vitro and in vivo studies have been carried out to reveal various pharmacological potentials of M. indica. Different parts of M. indica trees have been demonstrated to exert anticancer, anti-inflammatory, antidiabetic, antioxidant, antibacterial, antifungal, anthelmintic, gastroprotective, hepatoprotective, immunomodulatory, antiplasmodial and antihyperlipemic effects [69].

3.1. Antioxidant Properties of M. indica

Antioxidants are substances which inhibit/delay oxidative damage by trapping free radicals to a target molecule [70]. Several classes of natural compounds including polyphenols, phenolic acids, and flavonoids are reported as good free radical scavengers [71]. It has been reported that reactive oxygen species (ROS) and some other oxidants cause various disorders and diseases to human [71]. Humans possess antioxidative mechanisms which fight against reactive oxygen species (ROS) and some other oxidants by deactivating free radicals before they attack targets in human body [72]. Naturally occurring antioxidants have gained much attention recently as they possess a remarkable ability to fight against free radicals and reactive oxygen species [72]. As almost all the parts of the mango tree are reported to possess polyphenols, which are well-known antioxidants, most of the pharmacological studies have proven that antioxidant properties with extract(s) of various parts of the M. indica tree are related to polyphenolic content.

3.2. Anti-Inflammatory Effects of M. indica

Several naturally found polyphenols are reported to possess anti-inflammatory effects via inhibition of nuclear factor kappa-B (NF-κB) [84]. However, anti-inflammatory activities of these compounds depend on their chemical structures and their cellular targets [84]. Production of a large amount of proinflammatory cytokines (IL-1, 2 and 6 and TNF) increase the expression of enzymes such as COX-2 and iNOS which are associated with anti-inflammations [85]. Nuclear factor kappa-B (NF-κB), a transcriptional factor, is reported to control expression of proinflammatory cytokines [86]. Ulcerative colitis and inflammatory bowel disease are considered as main diseases that occur due to chronic inflammation [87]. Several studies have shown that mango extracts can exert anti-inflammatory effects in experimental models of ulcerative colitis. In a recent study, treatment with a mango beverage prepared from fruit (Mexican variety) which consists of polyphenols and vitamins has caused attenuation of colitis symptoms by expressing the PI3K/AKT/mTOR pathway [88]. Another study conducted by the same authors showed that the same mango polyphenols-rich beverage can inhibit the IGF-1R/AKT/mTOR pathway in ulcerative colitis [89].

3.3. Analgesic Effects

Analgesic effects of stem-bark aqueous extract of M. indica have been studied by Ojewole, 2005 [175]. Hot-plate and acetic acid test models of pain in mice have been used to study analgesic effects, and results of this study have demonstrated significant analgesic effects in mice with nociceptive pain. Islam et al. 2010 [176], have demonstrated analgesic effects of methanol extract of leaves of M. indica. Results have demonstrated a significant reduction in writhing response in an acetic acid-induced writhing response rat model. Garrido et al., 2001 [93], have shown possible analgesic effects of Vimang. Acetic acid-induced abdominal restriction and formalin-induced licking were used to test analgesia. Results of this study have shown that Vimang can exhibit antinociceptive effects in mice. Moreover, a considerable dose-dependent inhibition in formalin-induced pain was also observed in rats after administration of Vimang.

3.4. Immunomodulatory Effects of M. indica

Immunomodulation is a process that adjusts the immune system of an organism upon any change caused by a foreign agent [177]. Immunomodulation can be of two types, namely immunostimulation and immunosuppression [178]. Immunostimulation includes stimulation of the immune system with immunostimulating agents that activate components of the immune system (macrophages, certain T-lymphocytes and granulocytes) [178]. 2, COX-2, IL-1β, TNF-α, and colony-stimulating factor (GM-CSF) mRNA levels were found to decrease in experimental mice model(s) [181].

3.5. Antitumoral Effects of M. indica

Cancer is considered as one of the major causes of death in the world and any practical solution in fighting this dreadful disease would be very important in public health [185]. It is the main cause of death in economically developed countries and the second leading cause of death in economically developing countries [186]. Cancer is caused by several factors such as chemicals, radiations, tobacco, infectious microorganisms, hormones, gene mutations, and immune conditions [187]. Though, modern surgeries have considerably reduced the cancer death rates, use of radiotherapy, chemotherapy, and hormone therapy treatments cannot completely reduce the number of deaths due to cancer [188]. Plant-based treatments have been used in traditional medicine to treat different diseases including cancer since ancient times and a number of in vitro and in vivo studies have already been reported in literature to validate these uses [189]. Different organic extracts and decoctions prepared from parts of mango trees and compounds isolated from mango trees have shown anticancer effects.

and Haden, found in Brazil) have been evaluated in leukemia (Molt-4), lung (A-549), triple negative breast (MDA-MB-231), prostate (LnCap), and colon (SW-480) cancer cells by Noratto et al. 2010 [194]. Among the studied mango varieties, two (Ataulfo and Haden) were more sensitive to SW-480 and MOLT-4 cells. Moreover, apoptotic effects of Ataulfo and Haden varieties have also been studied in SW-480 cells in this study.

3.6. Antibacterial Effects of M. indica

Resistance to antibiotics has become one of the biggest problems worldwide [205]. Unnecessary use of antibiotics for viral infections, prolong use of antibiotics for diseases, wrong prescriptions given to patients without determining the exact cause of infection, and discontinuation of antibiotics without completing treatments by patients are some of the major causes for occurrence of antibiotic resistance [206]. Approximately half of all deaths in tropical countries are due to bacterial infections [207]. Therefore, discovery of novel antibacterial agents for drug resistant bacteria is essential. A number of studies have proven the antibacterial effects of certain plant crude drugs and natural compounds isolated against drug resistant bacteria [208]. Herbal remedies for bacterial infections have gained much attention recently as they are readily available, cause fewer side effects, and cheap.

3.7. Antifungal Effects of M. indica

Fungal diseases have been identified as an important health problem nowadays [228]. Candida, Aspergillus, and Cryptococcus species are known to causes many fungal diseases worldwide [228]. Candida albicans is reported to be the most common pathogen in fungal infections [229]. Although fungal infections are common, few antifungal drugs are currently used to treat infections [230]. Therefore, the identification of novel drugs as antifungal agents is necessary. Plant-based treatments and natural compounds derived from plants have been identified as ideal drug leads for fungal diseases. A number of pharmacological investigations have confirmed antifungal effects of organic/aqueous extracts of different parts of M. indica.

3.8. Anthelmintic Effects of M. indica

Helminth infections which are caused by parasitic worms are commonly seen in tropical regions [234]. They live either as parasites or in some cases in a free-living form [234]. Intestinal nematodes (IN) or soil-transmitted helminths (STH) are the most common types of nematodes [235]. It has been estimated that approximately 30% of world population is primarily infected with helminth parasites annually [236]. Development of resistance to helminth parasites has become a major problem in the treatment of the helminth infections [236].

3.9. Antiplasmodial Effects of M. indica

Complete eradication of malaria appears to be a major challenge in the world due to the development of resistance to antimalarial drugs [241]. Many parasites in genus Plasmodium cause malaria and Plasmodium falciparum is the most predominant in genus Plasmodium [242]. It has been estimated that malaria affects approximately 280–290 million people annually [242]. Quinine and artemisinin are naturally derived antimalarial drugs, which have been used for almost 400 years in the treatment of malaria [243]. However, P. falciparum has developed complete resistance to almost all the antimalarial drugs in clinical use [243]. Therefore, it is of paramount importance to investigate novel treatment methods/drugs which can target the malaria parasites..

3.10. Antihyperlipemic Effects of M. indica

Hyperlipidemia is considered as a major reason for atherosclerosis and coronary heart disease [247]. Coronary heart disease is the main cause of death in the world [247]. Scientific investigation of herbal remedies for antihyperlipemic effects will give a strong support for the development of drugs for hyperlipidemia. A recent study by Gururaja et al., 2017 [248], reported cholesterol lowering effects of a methanolic extract of M. indica leaves in albino Wistar rats. A significant decrease in plasma cholesterol levels has been observed in rats administrated with cholesterol in this study. Results of the studies conducted with aqueous extracts [249, 250] and ethanolic extracts [251, 252] of M. indica leaves have shown promising antihyperlipemic effects in hyperlipemic rat models.

3.11. Antidiabetic Effects of M. indica

Diabetes mellitus is a metabolic disease resulting from a defect in insulin action or secretion [255]. It has now become a major health problem affecting 442 million people worldwide [256]. 90% of diabetes cases are type 2 and the remainder is type 1 [257]. Blood glucose homeostasis is the key to prevent diabetes associated complications such as cardiovascular diseases, kidney diseases, eye problems, and peripheral neuropathy [258]. Several plant-based remedies have been used to treat type 2 diabetes in traditional medicine and a number of pharmacological studies have been conducted to validate these claims [259, 260]. Fruit peel, flesh, seed kernel, leaves, and bark of M. indica have been extensively studied for their antidiabetic properties. Gondi and Prasada Rao, 2015 [261] have showed that an ethanolic extract of mango fruit peel can successfully reduce blood glucose level in streptozotocin-induced diabetic rats. Significant decrease in fructosamine and glycated hemoglobin, which are considered as status indicators of diabetes, has also been observed after treatment with the ethanolic extract of mango peel.

3.12. Gastroprotective Effects of M. indica

Peptic ulcers are mainly present in the lining of stomach or in the duodenum [275]. Nonsteroidal anti-inflammatory drugs, mental or physical stress, alcohol, diet, life style, and antibiotics are considered as main causes of peptic ulcers [276]. Peptic ulcers are usually treated with proton pump inhibitors that reduce the secretion of gastric HCl [276]. As peptic ulcer cases are rising at an alarming rate worldwide, it is necessary to discover novel methods or drugs that can effectively reduce peptic ulcers. Assessment of gastroprotective

effects of different extracts of M. indica has been carried out. A study conducted by Lima et al. 2006 [277] found that a decoction prepared from M. indica flowers can significantly increase gastroprotective properties in an experimental rat model by reducing gastric juice volume and acidity.

4. Pharmacological activity of leaves and bark of Saraca Asoca

Numerous pharmacological properties are present in Saraca asoca, including antimicrobial, anticancer, antimenorrhagic, antioxytocic, antihelmintic, antitumor, antioxidant, anti-inflammatory, antihyperglycemic, central nervous system depressant, analgesic, antiinflammatory, antiarthritic, and cardioprotective properties. The following properties: antifungal, antiulcer, larvicidal, uterine tonic, and antidiabetic.A few of them are talked about here12 . 8.1

4.1 Anti-menorrhagic Activity

Saraca asoca is regarded as a woman's buddy due to its ability to heal a variety of gynecological conditions. In India, dried bark has been used to treat menorrhagia. In cases of uterine problems, females are administered dried bark and flower as a tonic. All disorders related to the menstrual period are also treated with the stem bark of Saraca asoca. Research on this leaf action is still possible12

4.2 Antimicrobial Activity By using the micro broth dilution experiment, different components of S. asoca were investigated for their antimicrobial activity against six different bacteria (P. aeruginosa, K. pneumoniae, S. aureus, E. coli, A. fumigatus, and A. flavus). By measuring the minimum inhibitory concentration and determining that plant internal tissue exposed to an external environment increased the synthesis of anti-infective molecules, it was determined that LHWE (leaves hot water extract) and RBHWE (renewed bark hot water extract) exhibited superior anti-microbial activity. The antimicrobial activity of S. asoca was attributed to the presence of catechin12,13

. 4.3 Uterine Tonic

Because of its stimulating effects on the endometrium and ovarian tissue, Saraca asoca is used as a plant as a uterine tonic. An herbal remedy called U-3107 was created using two distinct plant extracts, bark and leaf, which are beneficial for treating a range of menstrual diseases, including premenstrual syndrome, menorrhagia, dysmenorrhea, puberty, abnormal bleeding, and impending abortion12,13 . 8.4

4.4Anti-helmintic Activity

In Leaves: The human body becomes malnourished, feeble, and vulnerable to bacterial and viral illnesses when parasitic worms are present. It has been claimed that mature Indian earthworms can be killed or paralyzed by methanolic preparations of S. asoca leaves12,13 . The stem bark of the Saraca indica plant exhibits strong anthelmintic properties because it contains flavonoids, terpenoids, alkaloids, glycosides, saponins, and tannin12,13 .

4.5 Anti-inflammatory & Anti-arthritic effect

It has been demonstrated that the ethanolic and methanolic extracts of S. asoca's leaf and bark have anti-inflammatory potential by strongly preventing the binding of different transcription factors to their target DNA sequences, such as NF-kB, AP-1, GATA-1, etc., and so reducing the levels of proinflammatory cytokines.It has also been demonstrated that S. asoca extract lowers levels of TNF-alpha and IL-1, two pro-inflammatory cytokines13 . Several studies use the model system of Carageenan-induced paw oedema and brine shrimp assay to describe the antiarthritic potential of S. asoca leaves and bark13 .

4..6 Antidiabetic Property

In leaves: Studies have demonstrated that the flavonoid fraction of S. asoca flowers and leaves inhibits the type-2 diabetes-related enzymes alpha-glucosidase and alpha-amylase as well as prevents the oxidation of low-density lipoprotein (LDL)13,14 . In bark: Ashoka bark decoction is used to treat diabetes by taking two doses each day. When consumed with milk, dried powdered Saraca asoca herb has anti-diabetic properties13,14 .

4.7 Antioxidant Activity

In Leaf, Jayita Saha and colleagues investigated the antioxidants found in several Saraca asoca sections. In an in-vitro model for DPPH radical scavenging, the antioxidant activity of methanol extracts was evaluated at various doses. By comparing the IC50 values of the various plant sections of S. asoca, antioxidant activity was demonstrated. The asoca plant's methanol extract of the leaves had an IC50 value of 28.6 _ 0.62 mg/ml, which was slightly higher than the IC50 values of the plant's flower and bark, which were 6.83 _ 0.07 mg/ml and 6.6 _ 0.10 mg/ml, respectively14 .

Navneet Kumar et al. investigated the in-vitro antioxidant activity of a bark extract from Saraca indica in stem bark. It was discovered that plant phenolic compounds exhibit potent free radical scavenger action by preventing lipid peroxidation through the neutralization of peroxyl radicals produced during lipid oxidation15,16 .

8.8 Anticancer effects

The cytotoxic activities of various extracts of Saraca indica L. leaves were screened, and the results showed that the total ethanolic extract was active against MCF-7, HEPG-2, and HCT-116 (IC50 ≤ 30 μg/mL [20]) and inactive against the HeLa cell line; on the other hand, the EtOAc extract demonstrated potent cytotoxic activity against HCT-116, as well as active against MCF-7, HEPG-2, and HEPG-2, with IC50 values of 0.038, 3.29, 10.14, and 19.21 ug/ml, respectively, in comparison to standard doxorubicin, which was found to be 0.175, 0.155, 0.9, and 0.69 ug/ml15-17 .

. 8.9 Larvicidal Activity

Fighting the threat posed by insects like mosquitoes is crucial in the fight against infectious diseases including dengue, filariasis, malaria, and others. It has been demonstrated that the bark, leaves, and flowers of S. indica, when extracted using petroleum ether and chloroform, dramatically reduced the population of the mosquito Culex quinquefasciatus, so preventing the reproduction of insect vectors21,22 .

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References

1. Hirano R., Oo T. H., Watanabe K. N. Myanmar mango landraces reveal genetic uniqueness over common cultivars from Florida, India, and Southeast Asia. Genome. 2010;53(4):321–330. doi: 10.1139/G10-005. [PubMed] [CrossRef] [Google Scholar]

2. Saúco V. G. Mango production and world market: Current situation and future prospects. Acta Horticulturae. 2004;645:107–116. doi: 10.17660/ActaHortic.2004.645.7. [CrossRef] [Google Scholar]

3. Torres-León C., Rojas R., Contreras-Esquivel J. C., Serna-Cock L., Belmares-Cerda R. E., Aguilar C. N. Mango seed: Functional and nutritional properties. Trends in Food Science & Technology. 2016;55:109–117. doi: 10.1016/j.tifs.2016.06.009. [CrossRef] [Google Scholar]

4. Reddy P. V. R., Sreedevi K. Economic and Ecological Significance of Arthropods in Diversified Ecosystems. Singapore: Springer; Arthropod communities associated with mango (Mangifera indica L.): diversity and interactions; pp. 271–298. [Google Scholar]

5. Ghuniyal J. Ethanomedical, chemical, pharmacological, toxicological properties of mangifera indica: a review. International Journal of Pharma Research & Review. 2015;4(10):51–64. [Google Scholar]

6. Siddiq M., Akhtar S., Siddiq R. Mango processing, products and nutrition. Tropical and Subtropical Fruits: Postharvest Physiology, Processing and Packaging. 2012:277–297. doi: 10.1002/9781118324097.ch15. [CrossRef] [Google Scholar]

7. Ajila C. M., Bhat S. G., Rao U. J. S. P. Valuable components of raw and ripe peels from two Indian mango varieties. Food Chemistry. 2007;102(4):1006–1011. doi: 10.1016/j.foodchem.2006.06.036. [CrossRef] [Google Scholar]

8. Ignat I., Volf I., Popa V. I. A critical review of methods for characterisation of polyphenolic compounds in fruits and vegetables. Food Chemistry. 2011;126(4):1821–1835. doi: 10.1016/j.foodchem.2010.12.026. [PubMed] [CrossRef] [Google Scholar]

9. Mukherjee S. K. The mango-its botany, cultivation, uses and future improvement, especially as observed in india. Economic Botany. 1953;7(2):130–162. doi: 10.1007/BF02863059. [CrossRef] [Google Scholar]

10. Mukherjee S. K. Origin of mango (Mangifera indica) Economic Botany. 1972;26(3):260–264. doi: 10.1007/BF02861039. [CrossRef] [Google Scholar]

11. Slippers B., Johnson G. I., Crous P. W., Coutinho T. A., Wingfield B. D., Wingfield M. J. Phylogenetic and morphological re-evaluation of the Botryosphaeria species causing diseases of Mangifera indica. Mycologia. 2005;97(1):99–110. doi: 10.3852/mycologia.97.1.99. [PubMed] [CrossRef] [Google Scholar]

12. Litz R. E. The Mango: Botany, Production And Uses. CABI; 2009. [CrossRef] [Google Scholar]

13. Nandwani D. Grafting of mango cultivars (Mangifera indica l.) in the u.s. virgin islands. Their Culture, Environment, and Use. 2006:441–461. [Google Scholar]

14. Nurul Huda A., Che Salmah M. R., Abu Hassan A., Hamdan A., Abdul Razak M. N. Pollination services of mango flower pollinators. Journal of Insect Science. 2015;15(1, article no. 113) doi: 10.1093/jisesa/iev090. [PMC free article] [PubMed] [CrossRef] [Google Scholar]

15. Sivakumar D., Jiang Y., Yahia E. M. Maintaining mango (Mangifera indica L.) fruit quality during the export chain. Food Research International. 2011;44(5):1254–1263. doi: 10.1016/j.foodres.2010.11.022. [CrossRef] [Google Scholar]

16. Parvez G. M. M. Pharmacological activities of mango (Mangifera Indica): A review. Journal of Pharmacognosy and Phytochemistry. 2016;3:1. [Google Scholar]

17. Wauthoz N., Balde A., Balde E. S. d., Van Damme M., Duez P. Ethnopharmacology of Mangifera indica L. bark and pharmacological studies of its main C-glucosylxanthone, mangiferin. International Journal of Biomedical and Pharmaceutical Sciences. 2007;1(2):112–119. [Google Scholar]

18. Bekoe E., Kretchy I., Sarkodie J., et al. Ethnomedicinal survey of plants used for the management of hypertension sold in the makola market, Accra, Ghana. European Journal of Medicinal Plants. 2017;19(3):1–9. doi: 10.9734/EJMP/2017/32342. [CrossRef] [Google Scholar]

19. Khare C. P. Indian Medicinal Plants: An Illustrated Dictionary. Springer Science & Business Media; 2008. [Google Scholar]

20. Williams C. Vol. 3. Rosenberg Publishing; 2002. Medicinal Plants in Australia: Plants, Potions and Poisons; p. 226. [Google Scholar]

21. Tirtha S. S. Natural Secrets to Healing, Prevention, and Longevity. Sat Yuga Press; 2007. The Ayurveda Encyclopedia. [Google Scholar]

22. Agarwal T., Kochar G., Goel S. Impact of iron supplementation on anemia during pregnancy. Age. 2008;4500(7000):10. [Google Scholar]

23. Khandare M. S. Mango (Mangifera indica Linn) A medicinal and holy plant. Journal of Medicinal Plants Studies. 2016;4(4):44–46. [Google Scholar]

24. Etuk E. U., Bello S. O., Isezuo S. A., Mohammed B. J. Ethnobotanical survey of medicinal plants used for the treatment of Diabetes mellitus in the north western region of Nigeria. Asian Journal of Experimental Biological Sciences. 2010;1(1):55–59. [Google Scholar]

25. Ene A. C., Atawodi S. E. Ethnomedicinal survey of plants used by the Kanuris of North-eastern Nigeria. Indian Journal of Traditional Knowledge. 2012;11(4):640–645. [Google Scholar]

26. Memon A. H., Rind F. M. A., Laghari M. G. H., et al. Common folk medicinal and ethnomedicinal uses of thirty medicinal plants of districts Dadu and Jamshoro, Sindh, Pakistan. Sindh University Research Journal (Science Series) 2008;40(2):89–108. [Google Scholar]

27. Nisar M. F., Ismail S., Arshad M., Majeed A., Arfan M. Ethnomedicinal flora of District MandiBahaudin, Pakistan. Middle-East Journal of Scientific Research. 2011;9(2):233–238. [Google Scholar]

28. Bussmann R. W., Sharon D. Traditional medicinal plant use in Northern Peru: Tracking two thousand years of healing culture. Journal of Ethnobiology and Ethnomedicine. 2006;2, article no. 47 doi: 10.1186/1746-4269-2-47. [PMC free article] [PubMed] [CrossRef] [Google Scholar]

29. Jayaweera D. M. A. Medicinal plants (Indigenous and exotic) used in Ceylon. National Science Council of SriLanka; 1980. [Google Scholar]

30. Barreto J. C., Trevisan M. T. S., Hull W. E., et al. Characterization and quantitation of polyphenolic compounds in bark, kernel, leaves, and peel of mango (Mangifera indica L.) Journal of Agricultural and Food Chemistry. 2008;56(14):5599–5610. doi: 10.1021/jf800738r. [PubMed] [CrossRef] [Google Scholar]

31. Berardini N., Fezer R., Conrad J., Beifuss U., Carl R., Schieber A. Screening of mango (Mangifera indica L.) cultivars for their contents of flavonol O- and xanthone C-glycosides, anthocyanins, and pectin. Journal of Agricultural and Food Chemistry. 2005;53(5):1563–1570. doi: 10.1021/jf0484069. [PubMed] [CrossRef] [Google Scholar]

32. Nayan V., Onteru S. K., Singh D. Mangifera indica flower extract mediated biogenic green gold nanoparticles: Efficient nanocatalyst for reduction of 4-nitrophenol. Environmental Progress & Sustainable Energy. 2017 doi: 10.1002/ep.12669. [CrossRef] [Google Scholar]

33. Ichiki H., Miura T., Kubo M., et al. New antidiabetic compounds, mangiferin and its glucoside. Biological & Pharmaceutical Bulletin. 1998;21(12):1389–1390. doi: 10.1248/bpb.21.1389. [PubMed] [CrossRef] [Google Scholar]

34. Ma X., Wu H., Liu L., et al. Polyphenolic compounds and antioxidant properties in mango fruits. Scientia Horticulturae. 2011;129(1):102–107. doi: 10.1016/j.scienta.2011.03.015. [CrossRef] [Google Scholar]

35. Dreosti I. E. Antioxidant polyphenols in tea, cocoa, and wine. Nutrition Journal . 2000;16(7-8):692–694. doi: 10.1016/S0899-9007(00)00304-X. [PubMed] [CrossRef] [Google Scholar]

36. Rocha Ribeiro S. M., De Queiroz J. H., Lopes Ribeiro de Queiroz M. E., Campos F. M., Pinheiro Sant'Ana H. M. Antioxidant in mango (Mangifera indica L.) pulp. Plant Foods for Human Nutrition. 2007;62(1):13–17. doi: 10.1007/s11130-006-0035-3. [PubMed] [CrossRef] [Google Scholar]

37. Martin M., He Q. Mango bioactive compounds and related nutraceutical properties-A review. Food Reviews International. 2009;25(4):346–370. doi: 10.1080/87559120903153524. [CrossRef] [Google Scholar]

38. Arts I. C. W., Van De Putte B., Hollman P. C. H. Catechin contents of foods commonly consumed in The Netherlands. 1. Fruits, vegetables, staple foods, and processed foods. Journal of Agricultural and Food Chemistry. 2000;48(5):1746–1751. doi: 10.1021/jf000025h. [PubMed] [CrossRef] [Google Scholar]

39. Delgado-Vargas F., Jiménez A. R., Paredes-López O. Natural pigments: carotenoids, anthocyanins, and betalains—characteristics, biosynthesis, processing, and stability. Critical Reviews in Food Science and Nutrition. 2000;40(3):173–289. doi: 10.1080/10408690091189257. [PubMed] [CrossRef] [Google Scholar]

40. Woodall A. A., Lee S. W.-M., Weesie R. J., Jackson M. J., Britton G. Oxidation of carotenoids by free radicals: Relationship between structure and reactivity. Biochimica et Biophysica Acta (BBA) - General Subjects. 1997;1336(1):33–42. doi: 10.1016/S0304-4165(97)00006-8. [PubMed] [CrossRef] [Google Scholar]

41. Gil A. M., Duarte I. F., Delgadillo I., et al. Study of the compositional changes of mango during ripening by use of nuclear magnetic resonance spectroscopy. Journal of Agricultural and Food Chemistry. 2000;48(5):1524–1536. doi: 10.1021/jf9911287. [PubMed] [CrossRef] [Google Scholar]

42. Jungalwala F. B., Cama H. R. Carotenoids in mango (Mangifera indica) fruit. Indian Journal of Chemistry. 1963;1(1):36. [Google Scholar]

43. Chen F., Tholl D., Bohlmann J., Pichersky E. The family of terpene synthases in plants: A mid-size family of genes for specialized metabolism that is highly diversified throughout the kingdom. The Plant

Journal. 2011;66(1):212–229. doi: 10.1111/j.1365-313X.2011.04520.x. [PubMed] [CrossRef] [Google Scholar]

44. Hernández-Sánchez G., Sanz-Berzosa I., Casaña-Giner V., Primo-Yúfera E. Attractiveness for Ceratitis capitata (Wiedemann) (Dipt., Tephritidae) of mango (Mangifera indica, cv. Tommy Atkins) airborne terpenes. Journal of Applied Entomology. 2001;125(4):189–192. doi: 10.1046/j.1439-0418.2001.00510.x. [CrossRef] [Google Scholar]

45. Lalel H. J. D., Singh Z., Tan S. C. Aroma volatiles production during fruit ripening of 'Kensington Pride' mango. Postharvest Biology and Technology. 2003;27(3):323–336. doi: 10.1016/S0925-5214(02)00117-5. [CrossRef] [Google Scholar]

46. Ruiz-Montañez G., Ragazzo-Sánchez J. A., Calderón-Santoyo M., Velázquez-De La Cruz G., Ramírez De León J. A., Navarro-Ocaña A. Evaluation of extraction methods for preparative scale obtention of mangiferin and lupeol from mango peels (Mangifera indica L.) Food Chemistry. 2014;159:267–272. doi: 10.1016/j.foodchem.2014.03.009. [PubMed] [CrossRef] [Google Scholar]

47. Engels C., Knödler M., Zhao Y.-Y., Carle R., Gänzle M. G., Schieber A. Antimicrobial activity of gallotannins isolated from mango (Mangifera indica L.) kernels. Journal of Agricultural and Food Chemistry. 2009;57(17):7712–7718. doi: 10.1021/jf901621m. [PubMed] [CrossRef] [Google Scholar]

48. Ornelas-Paz J. D. J., Yahia E. M., Gardea-Bejar A. Identification and quantification of xanthophyll esters, carotenes, and tocopherols in the fruit of seven Mexican mango cultivars by liquid chromatography-atmospheric pressure chemical ionization-time-of-flight mass spectrometry [LC-(APcI+)-MS] Journal of Agricultural and Food Chemistry. 2007;55(16):6628–6635. doi: 10.1021/jf0706981. [PubMed] [CrossRef] [Google Scholar]

49. Kozubek A., Tyman J. H. P. Resorcinolic lipids, the natural non-isoprenoid phenolic amphiphiles and their biological activity. Chemical Reviews. 1999;99(1):1–26. doi: 10.1021/cr970464o. [PubMed] [CrossRef] [Google Scholar]

50. Ediriweera M. K., Tennekoon K. H., Samarakoon S. R., Adhikari A., Thabrew I., Dilip de Silva E. Isolation of a new resorcinolic lipid from Mangifera zeylanica Hook.f. bark and its cytotoxic and apoptotic potential. Biomedicine & Pharmacotherapy. 2017;89:194–200. doi: 10.1016/j.biopha.2017.01.176. [PubMed] [CrossRef] [Google Scholar]

51. Singh R., Singh S. K., Maharia R. S., Garg A. N. Identification of new phytoconstituents and antimicrobial activity in stem bark of Mangifera indica (L.) Journal of Pharmaceutical and Biomedical Analysis. 2015;105:150–155. doi: 10.1016/j.jpba.2014.12.010. [PubMed] [CrossRef] [Google Scholar]

52. Ediriweera M. K., Tennekoon K. H., Adhikari A., Samarakoon S. R., Thabrew I., De Silva E. D. New halogenated constituents from Mangifera zeylanica Hook.f. and their potential anti-cancer effects in breast and ovarian cancer cells. Journal of Ethnopharmacology. 2016;189:165–174. doi: 10.1016/j.jep.2016.05.047. [PubMed] [CrossRef] [Google Scholar]

53. Harwood M., Danielewska-Nikiel B., Borzelleca J. F., Flamm G. W., Williams G. M., Lines T. C. A critical review of the data related to the safety of quercetin and lack of evidence of in vivo toxicity, including lack of genotoxic/carcinogenic properties. Food and Chemical Toxicology. 2007;45(11):2179–2205. doi: 10.1016/j.fct.2007.05.015. [PubMed] [CrossRef] [Google Scholar]

54. Telang M., Dhulap S., Mandhare A., Hirwani R. Therapeutic and cosmetic applications of mangiferin: A patent review. Expert Opinion on Therapeutic Patents. 2013;23(12):1561–1580. doi: 10.1517/13543776.2013.836182. [PubMed] [CrossRef] [Google Scholar]

55. Jyotshna, Khare P., Shanker K. Mangiferin: A review of sources and interventions for biological activities. BioFactors. 2016;42(5):504–514. doi: 10.1002/biof.1308. [PubMed] [CrossRef] [Google Scholar]

56. Calderón-Montaño J. M., Burgos-Morón E., Pérez-Guerrero C., López-Lázaro M. A review on the dietary flavonoid kaempferol. Mini-Reviews in Medicinal Chemistry. 2011;11(4):298–344. doi: 10.2174/138955711795305335. [PubMed] [CrossRef] [Google Scholar]

57. Ribeiro S. M. R., Barbosa L. C. A., Queiroz J. H., Knödler M., Schieber A. Phenolic compounds and antioxidant capacity of Brazilian mango (Mangifera indica L.) varieties. Food Chemistry. 2008;110(3):620–626. doi: 10.1016/j.foodchem.2008.02.067. [CrossRef] [Google Scholar]

58. Schieber A., Berardini N., Carle R. Identification of flavonol and xanthone glycosides from mango (Mangifera indica L. cv. “Tommy Atkins”) peels by high-performance liquid chromatography-electrospray ionization mass spectrometry. Journal of Agricultural and Food Chemistry. 2003;51(17):5006–5011. doi: 10.1021/jf030218f. [PubMed] [CrossRef] [Google Scholar]

59. Anjaneyulu V., Radhika P. The triterpenoids and steroids from Mangifera indica Linn. Indian Journal of Chemistry - Section B Organic and Medicinal Chemistry. 2000;39(12):883–893. [Google Scholar]

60. Shah K., Patel M., Patel R., Parmar P. Mangifera indica (mango) Pharmacognosy Reviews. 2010;4(7):42–48. doi: 10.4103/0973-7847.65325. [PMC free article] [PubMed] [CrossRef] [Google Scholar]

61. Scartezzini P., Speroni E. Review on some plants of Indian traditional medicine with antioxidant activity. Journal of Ethnopharmacology. 2000;71(1-2):23–43. doi: 10.1016/S0378-8741(00)00213-0. [PubMed] [CrossRef] [Google Scholar]

62. Rai S., Basak S., Mukherjee K., Saha B., Mukherjee P. K. Oriental medicine mangifera indica. Oriental Pharmacy and Experimental Medicine. 2007;7(1):1–10. doi: 10.3742/OPEM.2007.7.1.001. [CrossRef] [Google Scholar]

63. Ribeiro S. M. R., Schieber A. Bioactive compounds in mango (Mangifera indica L.) Bioactive Foods in Promoting Health. 2010:507–523. doi: 10.1016/B978-0-12-374628-3.00034-7. [CrossRef] [Google Scholar]

64. Kabir Y., Shekhar H. U., Sidhu J. S. Phytochemical Compounds in Functional Properties of Mangoes. Handbook of Mango Fruit: Production, Postharvest Science, Processing Technology and Nutrition; 2017. [Google Scholar]

65. Kalita P. An overview on mangifera indica: importance and its various pharmacological action. PharmaTutor. 2014;2(12):72–76. [Google Scholar]

66. Dasgupta A., Banerjee P., Malik S. Use of microwave irradiation for rapid transesterification of lipids and accelerated synthesis of fatty acyl pyrrolidides for analysis by gas chromatography-mass spectrometry: study of fatty acid profiles of olive oil, evening primrose oil, fish oils and phospholipids from mango pulp. Chemistry and Physics of Lipids. 1992;62(3):281–291. doi: 10.1016/0009-3084(92)90065-W. [CrossRef] [Google Scholar]

67. Augustin M. A., Ling E. T. Composition of mango seed kernel. Pertanika. 1987;10(1):53–59. [Google Scholar]

68. Wang H. W., Liu Y. Q., Wei S. L., Yan Z. J., Lu K. Comparison of microwave-assisted and conventional hydrodistillation in the extraction of essential oils from mango (Mangifera indica L.) flowers. Molecules. 2010;15(11):7715–7723. doi: 10.3390/molecules15117715. [PMC free article] [PubMed] [CrossRef] [Google Scholar]

69. Lauricella M., Emanuele S., Calvaruso G., Giuliano M., D'Anneo A. Multifaceted health benefits of mangifera indica L. (Mango): The inestimable value of orchards recently planted in sicilian rural areas. Nutrients. 2017;9(6):525. doi: 10.3390/nu9050525. [PMC free article] [PubMed] [CrossRef] [Google Scholar]

70. Oroian M., Escriche I. Antioxidants: characterization, natural sources, extraction and analysis. Food Research International. 2015;74:10–36. doi: 10.1016/j.foodres.2015.04.018. [PubMed] [CrossRef] [Google Scholar]

71. Nijveldt R. J., van Nood E., van Hoorn D. E. C., Boelens P. G., van Norren K., van Leeuwen P. A. M. Flavonoids: a review of probable mechanisms of action and potential applications. American Journal of Clinical Nutrition. 2001;74(4):418–425. [PubMed] [Google Scholar]

72. Giampieri F., Alvarez-Suarez J. M., Tulipani S., et al. Photoprotective potential of strawberry (Fragaria × ananassa) extract against UV-A irradiation damage on human fibroblasts. Journal of Agricultural and Food Chemistry. 2012;60(9):2322–2327. doi: 10.1021/jf205065x. [PubMed] [CrossRef] [Google Scholar]

73. Thambi P. A., John S., Lydia E., Iyer P., Sarah Jane Monica S. J. Antimicrobial efficacy of mango peel powder and formulation of recipes using mango peel powder (Mangifera indica L.) nternational Journal of Home Science. 2016;2:155–161. [Google Scholar]

74. Abbasi A. M., Liu F., Guo X., Fu X., Li T., Liu R. H. Phytochemical composition, cellular antioxidant capacity and antiproliferative activity in mango (Mangifera indica L.) pulp and peel. International Journal of Food Science & Technology. 2017;52(3):817–826. doi: 10.1111/ijfs.13341. [CrossRef] [Google Scholar]

75. Sultana B., Hussain Z., Asif M., Munir A. Investigation on the antioxidant activity of leaves, peels, stems, bark, and kernel of Mango (Mangifera indica L.) Journal of Food Science. 2012;77(8):C849–C852. doi: 10.1111/j.1750-3841.2012.02807.x. [PubMed] [CrossRef] [Google Scholar]

76. Kim H., Moon J. Y., Kim H., et al. Antioxidant and antiproliferative activities of mango (Mangifera indica L.) flesh and peel. Food Chemistry. 2010;121(2):429–436. doi: 10.1016/j.foodchem.2009.12.060. [CrossRef] [Google Scholar]

77. Dorta E., Lobo M. G., Gonzalez M. Reutilization of mango byproducts: study of the effect of extraction solvent and temperature on their antioxidant properties. Journal of Food Science. 2012;77(1):C80–C88. doi: 10.1111/j.1750-3841.2011.02477.x. [PubMed] [CrossRef] [Google Scholar]

78. Septembre-Malaterre A., Stanislas G., Douraguia E., Gonthier M.-P. Evaluation of nutritional and antioxidant properties of the tropical fruits banana, litchi, mango, papaya, passion fruit and pineapple cultivated in Réunion French Island. Food Chemistry. 2016;212:225–233. doi: 10.1016/j.foodchem.2016.05.147. [PubMed] [CrossRef] [Google Scholar]

79. Afifa K., Kamruzzaman M., Mahfuza I., Afzal H., Arzina H., Roksana H. A comparison with antioxidant and functional properties among five mango (Mangifera indica L.) Varieties in Bangladesh. International Food Research Journal. 2014;21(4):1501–1506. [Google Scholar]

80. El-Baroty G. S., Khalil M. F., Mostafa S. H. A. Natural antioxidant ingredient from by-products of fruits. American journal of Agricultural and Biological Sciences. 2014;9(3):311–320. doi: 10.3844/ajabssp.2014.311.320. [CrossRef] [Google Scholar]

81. Norshazila S., Zahir I. S., Suleiman K. M., Aisyah M. R., Rahim K. K. Antioxidant levels and activities of selected seeds of Malaysian tropical fruits. Malaysian Journal of Nutrition. 2010;16(1):149–159. [PubMed] [Google Scholar]

82. Pitchaon M. Antioxidant capacity of extracts and fractions from mango (Mangifera indica Linn.) seed kernels. International Food Research Journal. 2011;18(2):523–528. [Google Scholar]

83. Mohan C. G., Deepak M., Viswanatha G. L., et al. Anti-oxidant and anti-inflammatory activity of leaf extracts and fractions of Mangifera indica. Asian Pacific Journal of Tropical Medicine. 2013;6(4):311–314. doi: 10.1016/s1995-7645(13)60062-0. [PubMed] [CrossRef] [Google Scholar]

84. Beg A. A., Baldwin A. S. The I kappa B proteins: multifunctional regulators of Rel/NF-kappa B transcription factors. Genes & Development. 1993;7(11):2064–2070. [PubMed] [Google Scholar]

85. Mercurio F., Zhu H., Murray B. W., et al. IKK-1 and IKK-2: cytokine-activated IκB kinases essential for NF-κB activation. Science. 1997;278(5339):860–866. doi: 10.1126/science.278.5339.860. [PubMed] [CrossRef] [Google Scholar]

86. Schreiber S., Nikolaus S., Hampe J. Activation of nuclear factor κB inflammatory bowel disease. Gut. 1998;42(4):477–484. doi: 10.1136/gut.42.4.477. [PMC free article] [PubMed] [CrossRef] [Google Scholar]

87. Itzkowitz S. H., Yio X. Inflammation and cancer, IV. Colorectal cancer in inflammatory bowel disease: the role of inflammation. American Journal of Physiology-Gastrointestinal and Liver Physiology. 2004;287(1):G7–G17. doi: 10.1152/ajpgi.00079.2004. [PubMed] [CrossRef] [Google Scholar]

88. Kim H., Banerjee N., Barnes R. C., et al. Mango polyphenolics reduce inflammation in intestinal colitis-involvement of the miR-126/PI3K/AKT/mTOR axis in vitro and in vivo. Molecular Carcinogenesis. 2016;56(1):197–207. doi: 10.1002/mc.22484. [PMC free article] [PubMed] [CrossRef] [Google Scholar]

89. Kim H., Banerjee N., Ivanov I., et al. Comparison of anti-inflammatory mechanisms of mango (Mangifera Indica L.) and pomegranate (Punica Granatum L.) in a preclinical model of colitis. Molecular Nutrition & Food Research. 2016;60(9):1912–1923. doi: 10.1002/mnfr.201501008. [PMC free article] [PubMed] [CrossRef] [Google Scholar]

90. Márquez L., Pérez-Nievas B. G., Gárate I., et al. Anti-inflammatory effects of Mangifera indica L. extract in a model of colitis. World Journal of Gastroenterology. 2010;16(39):4922–4931. doi: 10.3748/wjg.v16.i39.4922. [PMC free article] [PubMed] [CrossRef] [Google Scholar]

91. Jiang Y., You X.-Y., Fu K.-L., Yin W.-L. Effects of extract from Mangifera indica leaf on monosodium urate crystal-induced gouty arthritis in rats. Evidence-Based Complementary and Alternative

Medicine. 2012;2012:6. doi: 10.1155/2012/967573.967573 [PMC free article] [PubMed] [CrossRef] [Google Scholar]

92. Garrido G., González D., Lemus Y., et al. In vivo and in vitro anti-inflammatory activity of Mangifera indica L. extract (VIMANG) Pharmacological Research. 2004;50(2):143–149. doi: 10.1016/j.phrs.2003.12.003. [PubMed] [CrossRef] [Google Scholar]

93. Garrido G., Gonzalez D., Delporte C., et al. Analgesic and anti-inflammatory effects of Mangifera indica L. extract (Vimang) Phytotherapy Research. 2001;15(1):18–21. doi: 10.1002/1099-1573(200102)15:1<18::AID-PTR676>3.0.CO;2-R. doi: 10.1002/1099-1573(200102)15:1<18::AID-PTR676>3.0.CO;2-R. [PubMed] [CrossRef] [CrossRef] [Google Scholar]

94. Garrido G., Delgado R., Lemus Y., Rodríguez J., García D., Núñez-Sellés A. J. Protection against septic shock and suppression of tumor necrosis factor alpha and nitric oxide production on macrophages and microglia by a standard aqueous extract of Mangifera indica L. (VIMANG): role of mangiferin isolated from the extract. Pharmacological Research. 2004;50(2):165–172. doi: 10.1016/j.phrs.2003.12.020. [PubMed] [CrossRef] [Google Scholar]

95. Martnez G., Delgado R., Prez G., Garrido G., Nez Sells A. J., Len O. S. Evaluation of the in vitro antioxidant activity of Mangifera indica L. extract (Vimang) Phytotherapy Research. 2000;14(6):424–427. doi: 10.1002/1099-1573(200009)14:6<424::AID-PTR643>3.0.CO;2-8. doi: 10.1002/1099-1573(200009)14:6<424::AID-PTR643>3.0.CO;2-8. [PubMed] [CrossRef] [CrossRef] [Google Scholar]

96. Siswanto S., Arozal W., Juniantito V., Grace A., Agustini F. D. The effect of mangiferin against brain damage caused by oxidative stress and inflammation induced by doxorubicin. HAYATI Journal of Biosciences. 2016;23(2):51–55. doi: 10.1016/j.hjb.2016.02.001. [CrossRef] [Google Scholar]

97. Wattanathorn J., Muchimapura S., Thukham-Mee W., Ingkaninan K., Wittaya-Areekul S. Mangifera indica fruit extract improves memory impairment, cholinergic dysfunction, and oxidative stress damage in animal model of mild cognitive impairment. Oxidative Medicine and Cellular Longevity. 2014;2014:7. doi: 10.1155/2014/132097.132097 [PMC free article] [PubMed] [CrossRef] [Google Scholar]

98. Kawpoomhae K., Sukma M., Ngawhirunpat T., Opanasopit P., Sripattanaporn A. Antioxidant and neuroprotective effects of standardized extracts of Mangifera indica leaf. Thai Journal of Pharmaceutical Sciences. 2010;34(1):32–43. [Google Scholar]

99. Ahmad S., Sukari M. A., Ismail N., et al. Phytochemicals from Mangifera pajang Kosterm and their biological activities. BMC Complementary and Alternative Medicine. 2015;15(1, article no. 83) doi: 10.1186/s12906-015-0594-7. [PMC free article] [PubMed] [CrossRef] [Google Scholar]

100. Semaming Y., Pannengpetch P., Chattipakorn S. C., Chattipakorn N. Pharmacological properties of protocatechuic acid and its potential roles as complementary medicine. Evidence-Based Complementary and Alternative Medicine. 2015;2015 doi: 10.1155/2015/593902.593902 [PMC free article] [PubMed] [CrossRef] [Google Scholar]

101. Naasani I., Seimiya H., Tsuruo T. Telomerase inhibition, telomere shortening, and senescence of cancer cells by tea catechins. Biochemical and Biophysical Research Communications. 1998;249(2):391–396. doi: 10.1006/bbrc.1998.9075. [PubMed] [CrossRef] [Google Scholar]

102. Zhu Y., Hu J., Shen F., Shen H., Liu W., Zhang J. The cytotoxic effect of β-elemene against malignant glioma is enhanced by base-excision repair inhibitor methoxyamine. Journal of Neuro-Oncology. 2013;113(3):375–384. doi: 10.1007/s11060-013-1136-0. [PubMed] [CrossRef] [Google Scholar]