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TAMARIND: AMAZING SOURING AGENT WITH MULTIPLE BENEFITS

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ABSTRACT

Tamarind, scientifically known as *Tamarindus indica* and popularly known as imli, finds a large number of applications with medicinal values. When it comes to treating our taste buds with some sweet-and-sour flavor, tamarind can be the most delectable choice. Being scrumptious, it is used as a versatile condiment with a variety of dishes. On the other hand, it comes with a lot of nutritional as well as healing benefits too. There is absolutely no waste on the tamarind; every part has an importance to the body. The seeds, the leaves, the flowers, the pulp, the seed testa, the bark, kernel powders and the fruit itself have a lot of benefits to us. Starting from being a health resource to reducing acidity, treating sore throat, acting as antibacterial agents to finding use in treatment of Cancer and exerting hepatoprotective and antiasthmatic activity, it finds a lot of applications in field of Medicine. Its easy availability and affordability adds to its values making it easily accessible. This article provides an overview of its medicinal and health benefits in short.

Keywords: Tamarind, *Tamarindus indica*, chemical constituents, multiple benefits, health benefits.

INTRODUCTION

Tamarindus indica belonging to family: Fabaceae, subfamily: Caesalpinaceae, is a tropical evergreen tree native to fertile areas throughout the Africa and Southern Asia.[1] It is commonly called as tamarind and widely cultivated as an ornamental tree. Due to its acidic fruits it is used in making drinks and a popular component of many decoctions used as health remedies. Different parts of the plant such as leaves,

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fruits and seeds have been extensively used in traditional Indian and African medicines.[2] The aqueous extract of seed reduced blood sugar level showed hypolipidemic effect, reduced 14-17% of plasma lipid, total lipid cholesterol, lipoprotein and triglycerides.[3,4] Throughout Southeast Asia, the tamarind fruit poultice is applied to foreheads of fever sufferers [5]. The seeds of *T. indica* are reported to possess pharmacological activities such as antidiabetic and hypoglycemic, antioxidant, anti-ulcer, anti-venom, hepatoprotective, antibacterial, inhibition of nitric oxide production and serine proteinase inhibitor [6]. Fruits and leaves of *T. indica* are reported with antiasthmatic, hepatoprotective and antimicrobial activities [7].

Tamarindus indica is one of the auspicious, versatile tree species in the Indian subcontinent. It is estimated that Tamarind yields 150 to 500 kg of fruits per tree each year, with annual production in India of about 300,000 metric tons. A mature tree is capable of producing between 175- 250 kg tamarind fruit per year. This delicious pod-like fruit is loaded with minerals and a vitamin required in daily diet. In this era of increased concern on safety of chemical food additives, natural methods of preservation and natural preservatives are receiving increased attention. [8,9]

Chemical constituents of *Tamarindus indica*:

Phytochemical investigation carried out on *T. indica* revealed the presence of many active constituents, such as phenolic compounds, cardiac glycosides,[10] L(-)

mallic acid, tartaric acid, the mucilage and pectin, arabinose, xylose, galactose, glucose and uronic acid.[11,12] The ethanolic extract of *T. indica* showed presence of fatty acids and various essential elements like arsenic, calcium, cadmium, copper, iron, sodium, manganese, magnesium, potassium, phosphorus, lead and zinc.[13]

The pulp contains organic acids, such as tartaric acid, acetic acid, citric acid, formic acid, malic acid and succinic acid; amino acids; invert sugar (25-30%); pectin; protein; fat; some pyrazines (trans-2-hexenal); and some thiazoles (2-ethylthiazole, 2-methylthiazole) as fragrant; and the seed polysaccharides are found with a main chain consisting of β -1,4-connected glucose molecules together with xylose (α -1,6) and galactose; total protein; lipids with fatty oils; and some keto acids.[14] In the leaves of the plant, two triterpenes, lupanone and lupeol are found.[15]

The leaf oil contains 13 components among which linonene and benzyl benzoate are most predominant.[16] Phytochemical investigation of the root bark of *T. indica* showed the presence of *n*-hexacosane, eicosanoic acid, β -sitosterol, octacosanyl ferulate, 21-oxobehenic acid and (+)-pinitol. The presence of the bioactive compound (+)-pinitol in this plant is being reported for the first time.[17] The volatile constituents of the fruit pulp were furan derivatives (44.4%) and carboxylic acid (33.3%) of the total volatiles.[18] The major fatty acids of seeds are palmitic acid, oleic acid, linoleic acid and eicosanoic acid. The unsaponifiable matter from the seed oil of *T. indica* showed presence of β -amyryn,

compesterol, β -sitosterol and seven hydrocarbons.

The aerial parts of this plant have demonstrated the presence of tartaric acid, acetic acid and succinic acid, gum, pectin, sugar, tannins, alkaloid, flavonoids, sesquiterpenes and glycosides.[19-22] *T. indica* seeds and pericarp contain phenolic antioxidants. The profile of polyphenolics in Tamarind pericarp was dominated by proanthocyanidins in various forms, such as apigenin, catechin, procyanidin B₂, epicatechin, procyanidin dimer, procyanidin trimer, along with taxifolin, eriodictyol, naringenin of total phenols, respectively. The content of Tamarind seeds comprised only procyanidins, represented mainly by oligomeric procyanidin tetramer, procyanidin hexamer and procyanidin pentamer with lower amounts of procyanidin B₂ epicatechin.[23].

Uses of various parts of *Tamarindus indica*

Fruits

Tamarind is valued mostly for its fruit and pulp, which are used for a wide variety of domestic and industrial purposes. Pulp is rich in pectin and reducing sugars and contains significant amounts of organic acids, 98% of which is tartaric acid. Tamarind is valued mostly for its fruit, especially the pulp, which is used for a wide variety of domestic and industrial purposes.[25] The acidic pulp is used as a favorite ingredient in culinary preparations, such as curries, chutneys, sauces, ice cream and sherbet in countries where the tree grows naturally [26–27]. In India, the pulp is also eaten raw and sweetened with sugar.[28] Tamarind pulp is often made into a juice, infusion or brine

from which a variety of products can be prepared [29].

Seeds

There has been considerable interest amongst chemists, food technologists and nutritionists in the study of the properties of tamarind seeds e.g. recent work on stabilisation of xyloglucans of the tamarind seed polysaccharide and the gelling behaviour of polyose from tamarind kernel powder so that pectin/polyosemixes can be recommended [30].

Wasted decorticated kernels contained 46 to 48% of a gel-forming substance. The name jellose has been suggested for this polysaccharide as it describes both its jelly forming properties and the carbohydrate character. [31-32] Tamarind seed is a by-product of the commercial utilization of the fruit, the seed comprises the seed coat or testa (20-30%) and the kernel or endosperm (70-75%).[33-34] However, it has several uses. It is commercially available as a food additive for improving the viscosity and texture of processed foods. [35]. The seed is also used in the vegetable and food processing industries to a great extent. Tamarind xyloglucan, commonly known as “tamarind gum”, is the major component of tamarind kernel powder, forms a stiff gel and is used for thickening, stabilising and gelling in food.[36] It has been recommended for use as a stabilizer in ice-cream, mayonnaise, and cheese and as an ingredient or agent in a number of pharmaceutical products, and the seed oil is said to be palatable and of culinary quality.[37] The oil is used for making varnish to paint idols [38] and light lamps.[39]. Tamarind seed protein has a very favorable amino acid balance;

hence it could be used not only to complement cereals but also to supplement legumes with lower methionine and cystine contents.

Flowers and Leaves

The leaves, flowers and immature pods of Tamarind are also edible. The leaves and flowers are used to make curries, salads, stews, and soups in many countries, especially in times of scarcity. [40] Tamarind leaves and flowers can be eaten as vegetables and are prepared in a variety of dishes. Before consumption, leaves are sometimes boiled in water and prepared as tamarind fruits [41-42]. Extracts of leaves and flowers are used as a treatment for hemorrhoids, dysentery and erysipelas. Flower, fruit and leaf juice of tamarind are used as an antiseptic and vermifuge.

Seed testa and bark

The seed comprises the seed coat or testa (20-30%) and the kernel or endosperm (70-75%) Tamarind seed is the raw material used in the manufacture of tamarind seed kernel powder (TKP), polysaccharide (jellose), adhesive and tannin. The seeds are also used for other purposes and are presently gaining importance as an alternative source of protein, rich in some essential amino acids. Unlike the pulp the seed is a good source of protein and oil. The seed testa contains 23% tannin, in leather tanning tests, Tamarind tannin gives harsh and highly colored leather, which could be used for heavy soles, suitcases, and others. The seed husk has also been found to be an effective fish poison.[43-44] Tamarind seeds are reported as a source of food or food ingredients due to the presence of proteins [45]. The crude protein and nitrogen free extracts comprise 15.5% and

59% of the seed, respectively. Pentose sugars constitute approximately 20% of the soluble sugars. Mannose (17- 35%) and glucose (11.80%) were the principal soluble sugars.[46-47].

Tamarind Kernal Powder

The major industrial use of the seeds is in the manufacture of Tamarind Kernel Powder (TKP). TKP produced from the seeds is another commercial product and is often reported in commercial digests.[48] The TKP will become rancid and brown if stored inadequately and the storage ability and color will be better if it is defatted.[49] In India, TKP is used as a source of carbohydrate as the adhesive or binding agent in paper and textile sizing, and weaving and making jute products, as well as textile printing.[50]

Health Benefits of Tamarind

One of the most known health benefit of tamarind is its use as medicine since the ancient times. The following is an in-depth outline of the various health benefits of Tamarind:

Treating or Managing Constipation

Consumption of tamarind promotes smooth digestion and prevents digestion troubles. It also treats dysentery substantially. This nutritious fruit effectively expels harmful worms out of your digestive system and treat various bile disorders. Also, eating these sour fruit acts as an appetite stimulant and is a great cure to combat appetite loss. Tamarind is useful for treating constipation since it acts like a laxative helping loosen stool and help prevent or treat constipation. [51]

Strengthening and Cleaning of Teeth

Tamarind seed powder is rubbed on the gums and teeth, if teeth are weak. This is

beneficial for heavy smokers with heavy nicotine deposits or tar and plaque caused by lack of dental and oral hygiene and consumption of soft drinks. This also removes stain caused by tea, coffee, soda and smoking.

Treating Bile Disorders

For years, tamarind has proven to be particularly useful for treating liver and gall disorders and has been studied severally on the role it plays in treating bile problems. [52]

Reduces high cholesterol

Tamarind has shown to assist reduce cholesterol levels accountable for common heart problem, just like heart attack and stroke. As a result, including tamarind in your everyday nutrition may help enhance heart health, stopping likelihood of heart disease. [53]

Managing Pain and Inflammation

Tamarind is particularly useful for managing pain and inflammation on joints. It has been seen that leaves and pulp crushed and applied on swollen joints provides great relief and reduces inflammation. When the mixture of pulp, leaves, flowers are utilized over swollen or painful joints, it offers immediate comfort. Tamarind leaves smash in water can be used to deal with swollen part. [54]

Treating Sore Throat

Tamarind is used for treating sore throat. It is either gargled or drunk as tamarind juice to help relief pain and discomfort of sore throats. Taking some tamarind gives great relief by gargling a glass of tamarind water [55].

Diuretic and Jaundice Remedy and Prevention of Colds and Fever

Tamarind is used as a remedy for jaundice and associated diuresis problem [55]. Tamarind is a potent agent for

reducing inflammation and is therefore useful for management of colds and fever. It helps in protecting from colds by just taking a glass of tamarind in boiled water [56].

Rich Source of Vitamin C and Immunomodulator

Tamarind contains high amounts of Vitamin C. So, eating it prevents the risk of development of scurvy and strengthens body's defense mechanism. This vitamin C rich fruit also treats common cold and fever and eliminates all harmful toxins from your body. Tamarind seeds contain immunity boosting properties that protects from many diseases and disorders [56].

Good Source of Antioxidants

Tamarind is full of anti-oxidants and helps body combat free-radical activity effectively. Abundant supply of antioxidants protects body from cell damage and DNA damage [51].

Reduces fever

Tamarind has shown to have incredible therapeutic powers. Its leaves have calming effects in body, even though the bark is commonly utilized to assist in decreasing flu's as well as repeated fever.

Treatment of Ulcers

To deal with ulcers, the decoction is made by boiling tamarind in water and also ingesting twice a day may offer efficient results [56].

AntiCancer Treatment

Tartaric acid present in tamarind acts as a powerful antioxidant that protects the body from harmful free radicals, which can increase risk of cancer. Tamarind is an important source of antioxidants that help in fighting cancer by reducing the increase of free radicals that predispose to cancer. Also, the fibre present in this fruit protects the mucal membrane of the colon from the

attack of cancer-causing chemicals by binding with the toxins thereby preventing you from colon cancer [57].

Treatment of Diarrhea and Dysentery

Tamarind is useful for treating diarrhea and dysentery and helps as a good stomach ache relief. Tamarind seed covering is the useful part for treatment or management of diarrhea.

For a Healthy Skin by eliminating body smell

The concentrate helps in eliminating the body smell. Using the concentrate towards the sweaty areas shuts the pores, therefore stopping the body odor.

Treatment of Ear Infections

Warm concentrate of tamarind is usually suggested by grandmas to relieve the pain experienced with the ears. The anti-biotic property of the concentrate offers rid from ear infections.

Good appetizer

The recipe of tamarind, jaggery, salt and chilies are good appetizer and also effective for digestion. Its pulp is soften in water and consumed to enhance appetite.

Cosmetics

Extracts of tamarind seeds contain xyloglycans, which is used in many cosmetics. They are topically used for treating minor skin rashes. Tamarind juice is also used in cosmetics such as tamarind face mask and face scrub.

Treatment of Fracture and Piles

A thick paste of tamarind seeds is applied on broken bones to cure fractures. Tamarind flower juice is used in healing Piles [58].

Nerve Function

One of the most significant vitamin elements of tamarind is the B complex. Thiamine, one of the most important parts of that vitamin family, is found in high

quantities within tamarind. Thiamine is responsible for improving nerve function, as well as muscle development, which can help remain active, maintaining reflexive and stay strong [59].

Weight Loss

One of the unique compounds that can be extracted from tamarinds or gained as a benefit from it when used as a spice is called hydroxycitric acid (HCA). HCA is connected to weight loss because it has been shown to inhibit an enzyme in the body that specifically helps store fat. Furthermore, tamarind has been known to suppress the appetite by increasing the serotonin neurotransmitter. Research is still ongoing in these respective areas, but it shows promising signs as a weight loss supplement. Tamarind juice boosts the metabolism that in turn is an excellent way to reduce weight loss [51].

Treatment of Malaria, fever and Helminthes infections

Fruits of Tamarind are known as a febrifuge in Madagascar; in Ghana, malaria is treated with *Tamarind* leaves [60,61]. Tamarind leaves are used in the extraction of Guinea worms and afterward in the treatment of wounds, left by the parasite, macerate of the seeds is used as vermifuge and also the fruits are used for this purpose. An extract of the leaves and the root is used to treat ankylostomiasis (hookworm) in some parts of Tanzania.

Reduces Acidity

Tamarind can be used to reduce the acidity in the body especially the one produce by the bile. Too much acidity exerts more stress to the body in that the body strains to carry out some of its functions. Acidity may also affect our bones and teeth because acid erodes the outer covering making them weak and brittle.

Nerve Health

Tamarind is rich in Thiamine, which is a part of Vitamin B complex. Thiamine helps in strengthening the nervous system and promoting muscle development. Consuming thiamine helps in keeping nerve reflexes at its best.

Rheumatism

The anti-inflammatory property of tamarind comes into picture while treating rheumatism. Mixing two teaspoon of tamarind pulp with a teaspoon of salt and applying on the affected area gives quick relief.

Hepatoprotective and antiasthmatic activity

The methanolic extract of leaves of *T. indica*, exhibited significant antihistaminic, adaptogenic and mast cell stabilizing activity in laboratory animals.[62] Protective effect of *T. indica* was evaluated by injecting the rats with paracetamol. The aqueous extracts of different parts of *T. indica*, such as fruits, leaves and unroasted seeds were administered and a significant hepatoregenerative effect was observed for the aqueous extracts of Tamarind leaves, fruits and unroasted seeds as judged from the parameters studied [63].

Antimicrobial activity

T. indica has a broad spectrum of antibacterial activity. The methanolic leaf extract of *T. indica* was assessed for antibacterial activity against *Burkholderia pseudomallei* and its name *in vitro* inhibitory potential suggests further animal studies to understand the role of *T. indica* in treating melioidosis.[64] Methanol and acetone extracts of *T. indica* have showed significant antimicrobial activity against *Klebsiella pneumoniae* the antibacterial activity was done by agar disk diffusion

method. The activity was compared with standard antimicrobials *Amikacin* and *Piperacillin*. [65] The antimicrobial activity of the concentrated extracts (aqueous, ethanolic, acetone extract) were evaluated by determination of the diameter of zone of inhibition against both gram-negative and gram-positive bacteria and fungi using the paper disk diffusion method. These have potent antimicrobial activity against *Salmonella paratyphi*, *Bacillus subtilis*, *Salmonella typhi* and *Staphylococcus aureus*. tested [66-68].

Anti Snake Venom Activity

Tamarind seed extract inhibited the PLA (2), protease, hyaluronidase, l amino acid oxidase and 5' nucleotidase enzyme activities of venom in a dose dependent manner. Furthermore, the extract neutralizes the degradation of the beta chain of human fibrinogen and indirect hemolysis caused by venom. It was also observed that the extract exerted a moderate effect on the clotting time, prolonging it only to a small extent. Edema, hemorrhage and myotoxic effects including lethality, induced by venom were neutralized significantly when different doses of the extract were preincubated with venom before the assays [68].

Used in Sunstroke as Detoxicator, Blood purifier

It imparts a cooling effect to body temperature. Hence, the drink is to be consumed to cure sun strokes in the tropical regions. Tamarind pulp water provides relief to mild sunstroke. Tamarind can be used as a home remedy in detoxifying body. Tamarind juice made by soaking it in water then drinking it detoxes or cleans system. Detoxifying involves getting rid of unwanted toxins which at

times lead to illness and thus making body function properly. It contains acids, minerals, dietary fiber and Vitamin C which is a good blood purifier.

Treating anemia and Cures Rashes

Tamarind is a rich source of iron. Adding a pod of tamarind to daily diet can address more than ten percent of body's iron requirement for the day. Those with anemia can consume a teaspoon of tamarind paste or eat a fresh tamarind pod. Making a pulp out of tamarind and applying, not only helps in treating and clearing the rashes and swellings but it also has a soothing and calming effect on face in case the rashes were causing itchiness.

Ophthalmic use in Treating Conjunctivitis

There are many eye drops that have been used for years to treat inflammation of the conjunctiva in the eye and the primary ingredient is tamarind. The study showed that use of tamarind seed polysaccharide in the eye drops and it showed significantly better result of relieving several key subjective symptoms of dry eye syndrome—namely, trouble blinking, ocular burning and sensation of having something in one's eye [69].

Acaricidal activity

The crude-extract of *T. indicus* with water and 10% ethanol in water were tested for the acaricidal activity on the engorged female cattle tick (*Boophilus microplus*) by dipping method. The mature tamarind fruits taking off the seeds were extracted by water or 10% ethanol in the ratio of 1:2 and 1:5 W/V for 7 days. The organic acids in tamarind fruits (oxalic, malic, succinic, citric and tartaric acids) were also bioassayed the acaricidal activity by dipping method [70].

For mobilization of deposited fluoride from bones

The effect of tamarind on ingestion and whether it provides additional beneficial effects on mobilization of fluoride from the bone after children provided defluoridated water were studied. The main changes in urinary components (volume, pH, fluoride, calcium, copper and magnesium) after tamarind ingestion by the children in the fluoride endemic area, in the control and experimental groups were compared. The results shows that was a significant increase ($P < 0.01$) in fluoride excretion and urinary pH, and a significant decrease in urinary calcium ($P < 0.01$) and copper ($P < 0.05$) excretion, in the experimental group as compared with the control group. Additionally, Tamarind plant extracts were reported to have anti-nematodal activity against *Bursaphelenchus xylophilus* and Extracts from tamarind fruit pulp have shown molluscicidal activity against *Bulinus truncatus* snails. This is probably due to the presence of saponins in the fruit [71,72].

Wound healing activity

Exploited the role of a natural polysaccharide from the tamarind seed (xyloglycan) and the integrin-substrate recognition system (in vitro, with cultured human conjunctival cells) and on repair of corneal wounds in rabbit (in vivo). The results concluded the ability of the polysaccharide (xyloglycan) to promote corneal wound healing might depend on its influence on the integrin recognition system [73].

CONCLUSION

Almost every part of *Tamarindus indica* (roots, leaves, flowers, bark, testa, fruit kernel and fruits) has either nutritional or medicinal value, with a number of industrial and profitable applications. There is no waste on the tamarind; every part has an importance to the body. Multipurpose health benefits such as Anti-oxidant, anti-inflammatory, anti-microbial and anti-fungal activity has been documented from several plant parts.

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