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Tamarindus indica L. A plant with multiple medicinal purposes

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Abstract

Tamarindus indica is a plant that can be used traditionally in wound healing, snake bite, abdominal pain, colds, inflammations, diarrhea, helminth infections, and fever. It may also play a role as antimicrobial, antidiabetic, antiinflammatory and effects on the control of satiety, playing a potential role in the treatment or prevention of obesity and other chronic diseases. These effects are probably due to the presence of polyphenols as n-Hexacosane, eicosanoic acid, b-sitosterol, octacosanyl ferulate, 21-oxobehenic acid, and pinitol and phenolic antioxidants for proanthocyanidins. *T. indicus* includes a variety of bioactive compounds in the leaves, seeds, bark, pulp, and flowers with beneficial effects to human health and the possibility of application in the pharmaceutical industry.

Keywords: *Tamarindus indica*, anti-oxidant, anti-diabetic, anti-inflammatory and anti-obesity

1. Introduction

There is a growing trend in researches about medicinal plants due to their potential to cure many diseases, because of low costs and lower frequency of side effects when compared to synthetic drugs [1-3].

The *Tamarindus indica* L. is a fruit tree belonging to the Magnoliophyta, Order Fabales, Family Fabaceae (subfamily Caesalpinioideae). It is native to tropical Africa and its cultivation was widespread, developing well in all tropical continents [1-7].

There are different varieties of *T. indica* and they can be divided into acidic and sweet fruit. The sweet and sour at the same time in the fruit is unique and it is used popularly in cooking. In addition to the fruit, its various parts, as roots, wood, bark, and leaves, possess nutritional and pharmaceutical properties [7-12].

Figure 1 shows various applications of tamarind which can be used traditionally in wound healing, snake bite, abdominal pain, colds, inflammations, diarrhea, helminth infections, and fever. This plant has also antimicrobial and antidiabetic activity [10-13].

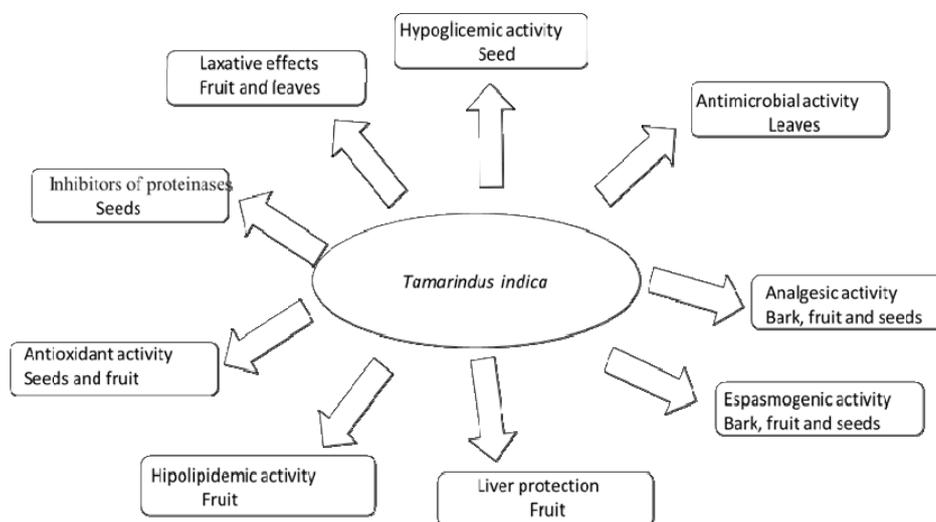


Fig 1: Properties of leaves, fruit and seed of *T. indica*.

The objective of this review was to investigate the properties and medicinal applications of the different parts of *Tamarindus indica* L.

2. Methods

This review was based on a literature survey of studies involving in vitro, humans or animal's models. The survey

was conducted from January to May 2016 and we used databases as Scielo, PMC, Pub Med, Medline and LILACS.

2.1 Properties of *Tamarindus indica* L.

Literature bring several studies about tamarind compounds and its effects. In Table 1 are found some properties of this plant, the part that are used and the active components.

Table 1: Properties and active components of different parts of *T. indica*.

Part of the plant	Properties	Active components	References
Bark	Antiallergic, antimicrobial, antibiotic, antityrosinase, antioxidant, analgesic and spasmogenic activities.	Rich in tannins and polyphenols: N-Hexacosane, eicosanoic acid, b-sitosterol, octacosanyl ferulate, 21-oxobehenic acid, and (+) - pinitol and phenolic antioxidants for proanthocyanidins in several ways: catechin, procyanidin B2, epicatechin, procyanidin trimer, procyanidin tetramer, procyanidin pentamer, procyanidin hexamer along the taxifolin, apigenin, eriodictyol, luteolin and naringenin.	[17 – 19]
Seed	Antiinflammatory activity; Effects on the control of satiety, having a potential for treatment or prevention of obesity; gastroprotective effects.	Source of protein and starch, sulfur amino acids and phenolic antioxidants as proanthocyanidins and epicatechin. Inhibitors of proteinases.	[8, 9, 15, 17, 20]
Leaves	Antiemetic activity and protection for the liver.	Source of protein, lipid, fiber and vitamins like thiamine, riboflavin, niacin, ascorbic acid and β -carotene. Composed by 13 essential oils, in which limonene benzoate and benzyl are the most important compounds, followed by pentadecanol and hexadecanol.	[6, 12, 18, 21]
Fruit/ Pulp	Hypolipidemic activity, antioxidant, anti fluorose, analgesic, hepatoregenerativa and antispasmodic.	B vitamins, minerals, 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).	[8, 10, 16, 18, 23]
Stem bark	The tea is used for sore throat. Spasmogenic, analgesic, antimicrobial and hypoglycemic activities.	Flavonoids, cardiac glycosides, alkaloids, saponins and tannins.	[18, 23, 24, 25, 26]

The flowers may also be used as regular food and are good sources of amino acids, fatty acids and minerals. [10, 21]

2.2 Antioxidant properties

The antioxidant activity is generally related to the presence of phenolic compounds that show specific common structures that allow them to be reducing agents, hydrogen donors and singlet oxygen scavengers, among other reaction mechanisms. At the cellular level, several antioxidant compounds are known to be capable of stabilizing or destroying free radicals, thereby preventing damage to cell structures. Its significance in human health has been described extensively and many studies have shown they may play various roles as protection against cardiovascular disease (reducing chronic inflammation and improving endothelial function), certain types of cancer and cytotoxic effects [8, 10, 18, 23-28].

Fruits, leaves and seeds are natural sources of antioxidants and several studies have bet on this alternative to replacing synthetic antioxidants [12–21].

Sandesh *et al.* [21] studied the effects of methanol extract of the seed coat of *T. indica* in Wistar rats and observed decreased activity of superoxide dismutase (55%), catalase (73%) and peroxidase (78%), and they also observed this extract protects and restore hepatic architecture. Authors suggest that this product could be studied as a health supplement and nutraceutical as well as a possible application for the preservation of food products.

Other authors showed that the crude extract of tamarind pulp has phenolic compounds with antioxidants properties which have improved the efficiency of superoxide dismutase, catalase and glutathione peroxidase in animals [10, 29, 30].

There are also antioxidant activity in the ethanol extract of the seed coat that is a byproduct of the tamarind gum industry, and could be used as a source of safe and inexpensive antioxidants [27, 31].

The tamarind leaves are rich in lipids, fatty acids, vitamins and flavonoids. Due to the presence of this high number of components, the leaves have enormous potential as a source of medicinal products, even with the presence of saponins, which are well known for their metabolites that can stimulate cell lysis. In the other hand, Escalona *et al.* [15] investigated the pharmacological effects and the toxicity from the extract of tamarind leaves in erythrocyte and their results showed that despite the presence of saponin, no adverse effects were found and observed that the extract worked as a protector of the cells, probably due to their antioxidant mechanisms and flavonoid content [12, 21, 27, 31].

The study conducted by Razali *et al.* [32] identified the presence of polyphenolic compounds in the seed extract. They foun caffeic acid as the most active compound with respect to antioxidant activity therefore capable of protecting cells against lipid peroxidation that has been identified in aging and

in many diseases such as cancer, cardiovascular disease, diabetes and inflammatory diseases.

According with Soradech *et al.* [33] the tamarind seed coat also contains active antioxidants, as phenolics, tannins and flavonoids, and its extracts possess lipid peroxidation reduction, antityrosinase collagen stimulating, antimicrobial, antiinflammatory, antidiabetic and antihyperlipidemic activities.

Sundaram *et al.* [34] showed that the seed extract improved arthritis by regulation of bone degeneration mediators and cartilage inflammation and oxidative stress. This disease is related to enzymatic degradation of articular cartilage by matrix metalloproteinases, hyaluronidases, and exoglycosidases. The use of tamarind seed extract inhibits the elevation of the activity of these enzymes.

Tamarind seeds also possess xyloglucan which is a natural polysaccharide used in food and medicine industry. Together with gallic acid, this compound exhibits strong antioxidant, antimutagenic and anticarcinogenic activity [35].

2.3 Hypolipidemic and hypoglycemic properties of *T. indica*

Hyperglycemia, hyperlipidemia and overweight or obesity are the main consequences of diabetes mellitus, metabolic syndrome and cardiovascular problems, that are the main causes of death worldwide. In modern medicine there is no therapy efficient enough to cure these diseases, and the existent drugs are expensive and present undesirable side effects. Some authors have shown the importance of *T. indica* in the control of these metabolism abnormalities (Table 2) [5, 36].

Table 2: Effects of extracts of *T. indica* on glycemia, lipid profile, and body weight.

Type of extract and administration	Type of model	Effect	References
Aqueous extract of the seed orally	Rats and humans	Improvement in the hyperlipidemia, hyperglycemia, and lipid peroxidation and improvement in the antioxidant defense system efficiency.	[5, 31, 37, 38, 39]
Crude extract	Rats	Hypoglycemic activity.	[26]
Aqueous extract of the pulp orally	Hypocolesterolemic hamster	Hepatoprotective activity. Hypocolesterolemic and antioxidant properties. Potential protection against oxidative damage.	[29-30, 40 – 41]
Ethanol extract of the pulp orally	Obese rats and hypocolesterolemic hamster	Decrease in body weight, on serum cholesterol and triglycerides and increase in HDL-c levels (treatment of obesity induced by a cafeteria diet).	[10, 18]
Extract of the seed coat	Rats	Antioxidant, anti-inflammatory, anti-diabetic and anti-hyperlipidemic activities.	[33, 36, 39, 42]
Alcoholic extracts of stem barks	Rats	Hypoglycemic and protection against oxidative stress.	[43]

3.4 Other applications for *T. indica* L.

Besides the above properties of *t. indica*, Table 3 shows other possibilities of application of this plant.

Table 3: Other properties of *T. indica*.

Part of the plant	Effect	References
Methanolic leaf extract	Inhibition of <i>Burkholderia pseudomallei</i> , <i>Klebsiella pneumoniae</i> , <i>Salmonella paratyphi</i> , <i>Bacillus subtilis</i> , <i>Salmonella typhi</i> , and <i>Staphylococcus aureus</i> .	[6, 10, 44-45]
Acetone, ethanol and water extracts stem bark	Activity against both gram positive and gram negative bacteria.	[44 -45]
Fruit and leaves	Laxative effects.	[10]
Aqueous extract of the pulp	Satisfactory against tuberculosis induced by oxidative damage in rat liver.	[16, 18, 41]

Sharma *et al.* [8] studied the pectin extracted from the pulp and observed that it has antioxidant potential higher than apple pectin, commercial pectin, guar gum, derivatives sulfates, oligosaccharides, and xanthan, demonstrating that the physico-chemical, and rheological potential may be used as an excipient in pharmaceutical and food products.

Tamarind leaves extract is also an efficient material for the synthesis of spherical nanoparticles of gold that play a vital role in human health. [46]

4. Conclusion

We may conclude that *T. indicus* includes a variety of bioactive compounds in the leaves, seeds, bark, pulp, and flowers with beneficial effects to human health and the

possibility of application in the pharmaceutical industry. The drugs normally used to regulate glycaemia, dyslipidemia and other metabolic disorders are costly; if we consider that these diseases have reached epidemic proportions in many countries, it is necessary to find non-allopathic alternatives that minimize the risk factors of these diseases and help in the treatment or in the prevention of further complications and death.

Further studies are necessary in order to elucidate all the properties of the tamarin in order to obtain information enough to provide validation for its medical use.

Conflict of interests

Authors declare no conflict of interests.

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