Current Clinical and Medical Education

Received 12 Jan 2025 | Accepted 15 Feb 2025 | Published Online 15 Mar 2025

Published By: Vision Publisher

CCME 3 (3), 118-125

ISSN 2942-0792

Aqueous extract of tamarindus indica bark exhibits anti-hypergylcaemic activity

Uma Mandal[1], Neha Sagar[2]

[1]Department of Pharmacy, Six Sigma Institute of Technology and Science, Jafarpur, Uttarakhand

[2]Assistant Professor, Department of Pharmacy, Six Sigma Institute of Technology and Science, Jafarpur, Uttarakhand

Abstract:

Normal cellular metabolism produces reactive oxygen species (ROS) and reactive nitrogen species (RNS), which have various physiological functions. Oxidative stress causes cellular components to degrade, leading to diabetes and its complications. Diabetes mellitus (DM) is a chronic endocrine disorder causing blood glucose variations, affecting over 415 million people worldwide. Glucose control is crucial for maintaining pro-oxidant/antioxidant balance, and insulin secretagogues and sensitizers are used to control hyperglycaemia. Traditional medicine, including Tamarind, has been a foundation for centuries, with cultivation dating back to the first millennium BC.

Tamarind, an evergreen tree with pale yellow and pink blossoms, grows up to 24 meters tall and 7 meters in diameter. Found in Africa, Senegal, Ethiopia, Sudan, Mozambique, Madagascar, Thailand, Bangladesh, Indonesia, Mexico, and Costa Rica, it has industrial, commercial, and medical applications. Its fruit, tamarind, can be sweet or sour.

The Tamarindus indica tree, a moderate to big evergreen tree, can grow up to 24 meters tall and 7 meters in circumference. It is grown almost everywhere in the country except the Himalayas and arid western areas. Its compound leaves have 10-18 pairs of opposing leaflets, tiny hairs, and beautiful pale yellow or pinkish flowers on spikes.

Keywords: tamarindus indica

Corresponding Author: Uma Mandal†, Department of Pharmacy, Six Sigma Institute of Technology and Science, Jafarpur, Uttarakhand

Introduction

They have a variety of physiological functions at low-to-moderate doses, from pathogen defence to cellular signal transduction. Oxidative stress causes cellular components, DNA, carbohydrates, proteins, and lipids to degrade because of an excess of ROS and RNS on the one hand, and a lack of enzymatic and nonenzymatic antioxidant defences systems on the other. A terrible disease with a high morbidity and death rate that has been gradually rising globally, diabetes and its complications are thought to be caused by oxidative stress. Because fat and muscle are unable to absorb insulin-stimulated glucose, blood glucose levels stay elevated in those with diabetes or insulin resistance.

Tamarindus indicais an evergreen tree with pale yellow and pink blossoms that may grow up to 24 meters tall and 7 meters in diameter? Since it requires a dry environment, the area where it is most frequently found stretches from Africa to Senegal in the west, Ethiopia and Sudan in the east, and Mozambique and Madagascar in the south. The plant is also believed to have originated in Africa and travelled to India. Among the nations where this plant is most commonly found are Thailand, Bangladesh, and Indonesia in Asia, and Mexico and Costa Rica in America. Each portion of the T. indica plant—root, body, fruit, and leaves—has industrial and commercial significance in addition to its high nutritional content and wide range of medical applications. Depending on when it grows, tamarind may be the sweetest and sour fruit.

PLANT PROFILE

Tamarindus indica

Taxonomical -classification

Kingdom -Plantae

Phylum - Spermatophyte

Class - Angiosperm

Sub class -Dicotyledone

Family - Leguminosae

Subfamily– Caesalpiniaceae

Genus –*Tamarindus*

Species –*indica*

Vernacular names

- **(Assamese)**-Tetuli
- **(Bengali)**- Amli, Nuli, Textili Tentul.
- **(Gujarati)**- Amali, Ambali.
- **(Hindi)**- Ambli, Amli, Imli.
- **(Malayalam)**- Puli.
- **(Marathi)**- Amli, Chinch, Chitz.
- **(Oriya)**- Koya, Tentuli.
- **(Punjabi)**- Imli.
- **(Telugu)**- Chinta.

Tamarindus indica

Chemical constituents of *T. indica*

Numerous active ingredients, including phenolic compounds, cardiac glycosides, L- (-) mallic acid, tartaric acid, mucilage and pectin, arabinose, xylose, galactose, glucose, and uronic acid, were found in T. indica by phytochemical analysis. Fatty acids and several critical elements, including arsenic, calcium, cadmium, copper, iron, sodium, manganese, magnesium, potassium, phosphorus, lead, and zinc, were found in the ethanolic extract of T. indica.

Organic acids, including tartaric, acetic, citric, formic, malic, and succinic acids; 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, which have a main chain made up of β-1,4-connected glucose molecules along with xylose (alpha-1,6) and galactose; total protein; lipids with fatty oils; and some keto acids.

There are thirteen components in the leaf oil, with linonene and benzyl benzoate being the most common. According to a phytochemical analysis of T. indica root bark, n-hexacosane, eicosanoid acid, b-sitosterol, octacosanyl ferulate, 21-oxobehenic acid, and (+)-pinitol were all present. For the first time, it has been discovered that this plant contains the bioactive chemical (+)-pinitol. Of the total volatiles in the fruit pulp, furan derivatives accounted for 44.4% and carboxylic acid for 33.3%. Palmitic acid, oleic acid, linoleic acid, and eicosanoic acid were the main fatty acids found in seeds. The unsaponifiable substance from T. indica seed oil contained seven hydrocarbons, β-amyrin, compesterol, and β-sitosterol.

Tartaric acid, acetic acid, succinic acid, gum, pectin, sugar, tannins, alkaloids, flavonoids, sesquiterpenes, and glycosides have all been found in the plant's aerial portions. Phenolic antioxidants are found in T. indica seeds and pericarp.

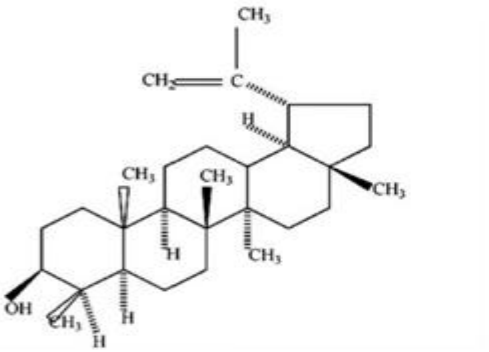


Fig.0.3 Lupeol

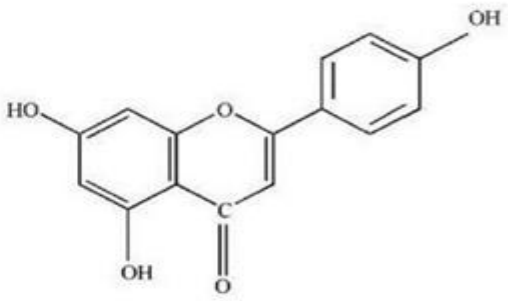


Fig.0.4 Apigenin

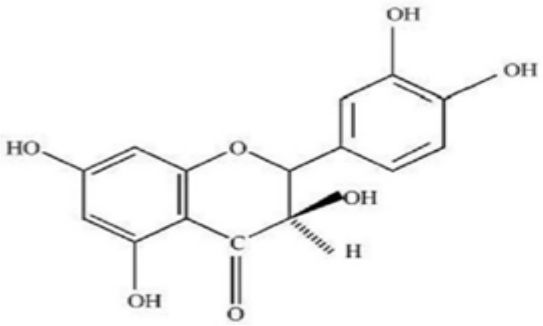


Fig.0.5Epicatechin

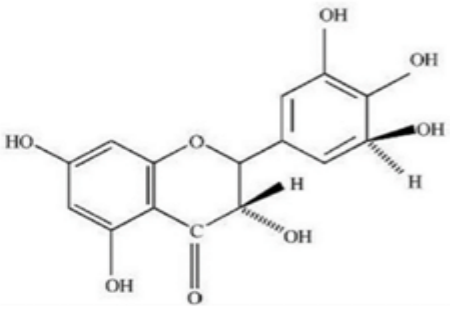


Fig.0.6 Taxifolin

Uses of various parts of *T. indica*

Fruit pulp

Tamarind, a native fruit, is valued for its pulp, used in domestic and industrial dishes like curries, chutneys, sauces, ice cream, and sherbet. In India, it's consumed uncooked and sweetened, and used in various industrial products.

Seed

Tamarind seed, a by-product of commercial fruit use, is a food ingredient that enhances meal texture and viscosity. Its edible seed oil is used in cheese, mayonnaise, ice cream, and therapeutic goods. It also makes varnish for lamps and statues. The term "jellies" refers to the seed polysaccharide's jelly-making ability.

Flowers and leaves

Tamarind leaves, blossoms, and pods are consumed in various cuisines, particularly during scarcity. They are used in Thai cuisine for their unique scent and sourness, and in Gambia for chewing gum. They also serve as mordants in dyeing and in hat-making in the Philippines.

Seed testa and bark

The seed testa contains 23% tannin, in leather tanning tests, Tamarind tannin gives harsh and highly coloured leather, which could be used for heavy soles, suitcases, and others. The seed husk has also been found to be an effective fish poison.

Wood

Tamarind wood, also known as Madeira mahogany, is used in various industries such as toys, oil presses, and furniture. It is also used for gunpowder, animal skin removal, and cleaning copper and brass containers.

Tamarind kernel powder

Tamarind Kernel Powder (TKP), a carbohydrate source used in paper, textiles, weaving, jute goods production, and Indian textile printing, can turn rancid if not stored properly, improving its colour and storage capacity.

Medicinal and pharmacologic properties

Antimicrobial activity

T. indica has been found to have a wide range of antibacterial properties, including methanolic leaf extracts that showed strong antibacterial activity against Burkholderia pseudomallei and Klebsiella pneumonia. Concentrated extracts, including aqueous, ethonolic, and acetone extracts, also showed strong antibacterial properties against Staphylococcus aureus, Bacillus subtilis, Salmonella typhi, and Salmonella paratyphi. Other studies suggest potential antimicrobial activity from T. indica, including ripe fruit extracts and medicinal plants.

Antioxidant properties

T. indica seeds and pericarp contain phenolic antioxidant compounds, with Soxhlet methanolic extract showing potential cancer chemo preventive properties. Tested against linoleic acid emulsion systems, all extracts showed good antioxidant activity (64.5-71.7%). The Thai Tamarind seed coat showed the highest peroxide value. The seed coat, a by-product of the tamarind gum business, could be a cheap and safe source of antioxidants.

Laxative properties

Tamarind fruit is traditionally used as a laxative due to its high malic and tartaric acids and potassium acid content. In Madagascar, children are given whole Tamarind fruits for breakfast to overcome constipation. In Senegal, it's prepared into Bengal sweetmeat, mixed with lime juice or honey. In Burkina Faso, pulp is used.

Abdominal pain

Abdominal discomfort, caused by constipation or diarrhoea, is a common issue in rural Nigeria. The Fulani people consume soaked fruits to alleviate constipation. T. indica leaves, macerated fresh bark, and roots are used in East Africa to treat stomach-aches and uncomfortable abdomens, despite their unusual properties.

Wound healing

T. indica is commonly used for treating cuts, wounds, and abscesses. It is applied externally as a decoction, powder, or poultice. In Dakar's medicinal market, bark is sold for wound healing, while leaves are essential for cleaning wounds from Guinea worm infections.

Malaria and fever

Fruits of Tamarind are known as a febrifuge in Madagascar; in Ghana, malaria is treated with *Tamarind* leaves, and the fruit pulp is used as a febrifuge and laxative.

Antidiabetic activity

T. indica seeds extract showed potent antidiabetogenic activity in Streptozotocin-induced diabetic male rats, significantly reducing hyperglycaemia and hyperlipidaemia, potentially shedding light on ancient herbal therapy in India.

Effect on cardiovascular system and blood

The study in Bangladesh evaluated the effects of T. indica fruits on lipid profile, blood pressure, and body weight. It found that the crude extract from pulp reduced atherosclerosis risk in humans and hamsters.

Antivenom activities

A study on the pharmacologic and enzymatic activity of T. indica seed extract in Indian traditional medicine found it inhibited venom enzyme activities, neutralized fibrinogen degradation, and prolonged clotting time. It also significantly neutralized myotonic effects, making it an alternative for serum therapy.

Effect on cellular system

T. indica fruit extract significantly affects the cellular system, cytotoxic ting sea urchin embryo cells. The unique structure of the chemical is linked to its toxicity. Swiss albino mice show higher cell proliferation in their descending colon. A polysaccharide from T. indica exhibits immunomodulatory characteristics.

Hepatoprotective and antiasthmatic activity

Experimental research shows T. indica has hepatoprotective and antiasthmatic properties, with methanolic extracts showing antihistaminic, adaptogenic, and mast cell stabilizing properties. Aqueous extracts of T. indica, fruits, and seeds also showed substantial hepatoregenerative effects.

Diarrhea and dysentery

Tamarind is also used for treating diarrhea and dysentery. Dysentery is a type of diarrhea containing mucus or blood, usually caused by an infection of the intestine. When diarrhea is not treated properly, the patient has risks of dehydration and death. The Tamarind pulp with lemon is used to treat diarrhea,and the root is used to treat dysentery.

Material and Methods

Plant Material

T. indica seeds were collected freshly from Udham Singh nagar district in the month of 2024.

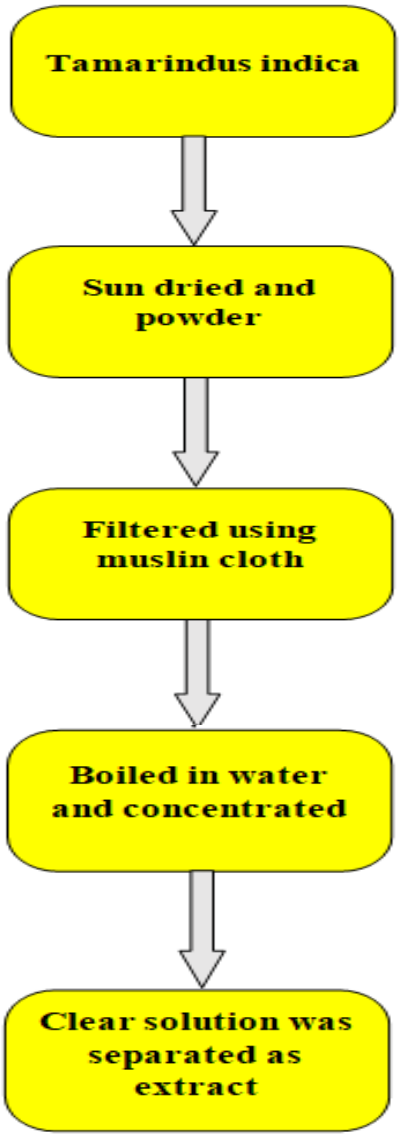
Preparation of Powder from T. Indica

Fresh bark of T. indica were dried in an incubator for 2 days at 40 ºC, crushed in an electrical grinder to have powdered. These T. indica powder was used for all experiments.

Chemical and Reagent

The experiments utilized chemicals of analytical reagent (AR) grade, including potassium hydroxide, iodine, methanol, chloroform, n-hexane, petroleum ether, iso-propanol, ethanol, and phenolphthalein indicator, sourced from S.D. Fine-chem limited, India.

Powder of T. Indica



Extraction processes of *Tamarindus indica*

Conclusion

At low-to-moderate dosages, they perform a range of physiological tasks, including cellular signal transduction and pathogen defence. Because of an excess of ROS and RNS on the one hand, and a deficiency of enzymatic and nonenzymatic antioxidant defence systems on the other, oxidative stress leads to the degradation of cellular components, DNA, carbohydrates, proteins, and lipids. Oxidative stress is assumed to be the cause of diabetes and its complications, a horrible disease with a high morbidity and death rate that has been steadily increasing internationally. Blood glucose levels remain high in those with diabetes or insulin resistance because fat and muscle cannot absorb insulin-stimulatedglucose.
The evergreen Tamarindus indica tree can reach a height of 24 meters and has pale yellow and pink blooms.

Reactive oxygen species (ROS) and reactive nitrogen species (RNS) are produced during normal cellular metabolism and serve a variety of physiological purposes. Degradation of cellular components brought on by oxidative stress results in diabetes and its consequences. Over 415 million individuals worldwide suffer from diabetes mellitus (DM), a chronic endocrine condition that causes fluctuations in blood glucose levels. Pro-oxidant/antioxidant equilibrium depends on glucose regulation, and insulin secretagogues and sensitizers are employed to manage hyperglycaemia. Tamarind has been used in traditional medicine for ages;

REFERENCES

1. Cvetanović, A., Uysal, S., Pavlić, B., Sinan, K.I., Llorent-Martínez, E.J. and Zengin, G., 2020. Tamarindus indica L. seed: Optimization of maceration extraction recovery of tannins. *Food Analytical Methods*, *13*, pp.579-590.
2. Panchal, B., Deshmukh, S. and Sharma, M., 2014. Optimization of oil extraction and characterization from Tamarindus indica Linn seed oil. *International Journal of Oil, Gas and Coal Engineering*, *2*(1), pp.1-6.
3. Reis, P.M.C.L., Dariva, C., Vieira, G.Â.B. and Hense, H., 2016. Extraction and evaluation of antioxidant potential of the extracts obtained from tamarind seeds (Tamarindus indica), sweet variety. *Journal of Food Engineering*, *173*, pp.116-123.
4. Mansingh, B.B., Binoj, J.S., Sai, N.P., Hassan, S.A., Siengchin, S., Sanjay, M.R. and Liu, Y.C., 2021. Sustainable development in utilization of Tamarindus indica L. and its by-products in industries: A review. *Current Research in Green and Sustainable Chemistry*, *4*, p.100207.
5. Fagbemi, K.O., Aina, D.A. and Olajuyigbe, O.O., 2021. Soxhlet extraction versus hydrodistillation using the clevenger apparatus: A comparative study on the extraction of a volatile compound from Tamarindus indica seeds. *The Scientific World Journal*, *2021*(1), p.5961586.
6. Martins, C.M., Ferro, D.M., de Brito, E.S. and Ferreira, S.R.S., 2020. Industrial relevance of Tamarindus indica L. by-products as source of valuable active metabolites. *Innovative Food Science & Emerging Technologies*, *66*, p.102518.
7. Bhadoriya, S.S., Mishra, V., Raut, S., Ganeshpurkar, A. and Jain, S.K., 2012. Anti-inflammatory and antinociceptive activities of a hydroethanolic extract of Tamarindus indica leaves. *Scientia pharmaceutica*, *80*(3), p.685.
8. Naeem, N., Nadeem, F., Azeem, M.W. and Dharmadasa, R.M., 2017. Tamarindus indica–A review of explored potentials. *International Journal of Chemical and Biochemical Sciences*, *12*(2017), pp.98-106.
9. Yeasmen, N. and Islam, M.N., 2015. Ethanol as a solvent and hot extraction technique preserved the antioxidant properties of tamarind (Tamarindus indica) seed. *Journal of Advanced Veterinary and Animal Research*, *2*(3), pp.332-337.
10. Kumar, S., Sharma, S. and Kalra, P., 2011. Antiulcer effect of the methanolic extract of Tamarindus indica seeds in different experimental models. *Journal of pharmacy and bioallied sciences*, *3*(2), pp.236-241.
11. T.D. Hong, S. Linnington, and R.H. Ellis, “Seed storage behaviour: A compendium,” Hand book for genebanks No.4 international plant genetic resources institute, Rome, 1996.
12. K.El-Siddig, G. Ebert, and P. Ludders, “Emergence and early seedling growth of Tamarindus indica L. from geographically diverse populations in the Sudan,” Angewandte. Botanik 2000, 74 (1/2): 17-20.

13. Yusue, B.M. Mofio, and A.B. Ahmed, “Proximate and mineral composition of Tamarindus indica Linn 1753 seeds,” Sci. World. J 2007, 2: 1-5.
14. M.F. Ramadan, G. Sharanabasappa, Y. N. Seetharam, M. Seshagiri, and J.T. Moersel, “Characterization of fatty acids and bioactive compounds of Kachnar (Bauhinia purpureas (L.) seed oil,” Food. Chem 2006, 98 (2): 359-365.
15. T. Wang, “Soybean oil. In: Gunstone FD (Ed.), Vegetable oils in food technology: composition,” Properties and uses, blackwell scientific publications inc., Oxford, UK, 2000, PP 24-25.