

The versatile *tamarindus indica*: A peer review

A M Krupanidhi, Prakash Dabadi*, Renukaradhya M

Department of Pharmacology, Bapuji Pharmacy College, Davangere, Karnataka, India

Abstract

Tamarindus indica L. is a plant that can be used traditionally in wound healing, snake bite, abdominal pain, colds, inflammations, diarrhoea, helminth infections, and fever. It may also play a role as antimicrobial, antidiabetic, anti-inflammatory 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. indica* 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 *Tamarinds indica* commonly known as 'imli' has been recognized in different system of traditional medicines for the treatment of different diseases and ailments of human being. This review supports of all updated information on its pharmacognostical, pharmacological activity and traditional uses. Preliminary phytochemical screening of this plant revealed the presences of, flavonoids, steroid, glycoside alkaloid and Triterpenoids. It has been reported as anthelmintic, antimicrobial, antiseptic, antiviral, asthma, astringent, bacterial skin infections, constipation (chronic or acute), and diabetes.

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

Introduction

All over the world, plants were used as main source of medicines by ancestors. The rise of modern Western medicine was initially accompanied by a decline in the practice of herbalism in all cultures and it was believed that synthetic chemicals were best medicines to treat illness and cure disease. Herbal remedies can work without many of the unpleasant side effects of modern medicines [1].

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. 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. This plant has also antimicrobial and antidiabetic activity [2]. The quest for a healthier lifestyle has made people to once again recognize the healing power of herbs. Even in the west, natural products are now widely available and herbalism is again coming into lime light in a world which is becoming healthier and environmentally conscious [1]. It shows various applications of tamarind which can be used traditionally in wound healing, snake bite, abdominal pain, colds, inflammations, diarrhoea, helminth infections, and fever [2]. In Nigeria, particularly in the North western part, *T. indica* stem bark is being used pain relief in the treatment of fracture and dislocation of bone. In view of the traditional claim, *T. indica* stem bark was targeted for investigation to ascertain and document its therapeutic efficacy or otherwise, in treatment of pain and inflammation [3]

Taxonomical Classification [4,7]

Classification of the *Tamarindus indica* (Common name -

Imli, Family - Leguminosae): Kingdom – Plantae
Phylum – Spermatophyte
Class - Angiosperm
Order - Fabales
Family - Leguminosae
Genus - *Tamarindus*
Species – *Indica*

Vernacular Name [5,6]

Kannada: Hunase
Assam: Teteli
Bengal: Ambli, Tentul, Tinturi, Nuli
English: Tamarind tree
Gujarat: Ambli, Amlī
Hindi: Imli, Amlī
Malayalam: Amlam



Phytochemistry

Chemical constituents

- Phytochemical investigation carried out on *T. indica* revealed the presence of active constituent such as phenolic compound, cardiac glycosides, L- (-) mallic acid, tartaric acid, mucilage and pectin, arabinose, xylose, galactose glucose and uronic acid.
- Root bark of *T. indica* indicates presence of n hexaoxane, eicosanoic acid, β sitosterol, (+)-pinitol. Octacosanyl ferulate, 21-oxobehenic acid.
- Alkaloids, saponin hordenine and proanthocyanidin are to be found in bark of *Tamarind* [4].

- Seeds are rich in phenolic compounds, polymeric tannins, fatty acids, flavonoids, saponins, alkaloids, glycosides.
- The content of *T. indica* seed comprised only procynadine, represented mainly by oligomeric procynadine tetramer procynadine hexamer and procynadine pentamer with lower amount of procynadine B2, epicatechine^[8]
- Its pulp contains different organic acids like: tartaric acid, acetic acid, citric acid, formic acid, malic acid, and succinic acid and the rich source of micronutrients such as calcium, phosphorus, vitamin A, C and tartaric acid.

Morphological Characters

- *Tamarindus indica* is moderate to large size evergreen tree up to 24 m height and 7 m in girth with an exceptionally beautiful spreading crown and fragrant flower with wide range of geographical distribution in the tropic and subtropic areas except in the Himalayan and western country.^[6]
- It has short, thick and seldom straight trunk.
- Bark is brownish or dark grey longitudinally and horizontally fissured.
- Leaves alternate, compound, with 10-18 pairs of opposite leaflets; leaflets narrowly oblong, 12-32×3-11 mm, petiole and rachis finely haired, midrib and net veining more or less conspicuous on both surfaces.

Floral Characteristics

- Flowers are borne in a lax racemes, with attractive pale-yellow color with pink strips. Flower buds completely enclosed by 2 bracteoles, which fall very early; sepals 4, petals 5, the upper 3 well developed, the lower 2 minute.
- Flowers are bisexual. Fruit is a pod, indehiscent, subcylindrical, 10-18 ×4 cm, straight or curved, velvety, rusty-brown; the shell of the pod is brittle and the seeds are embedded in a sticky edible pulp.
- Seeds are 3-12, abovate, along exalbuminous and testa hard, shiny, and smooth.

Geographical Distribution

- *T. indica* is commonly known as "Tamarind" and "Imli" in Hindi^[9].
- It is used in traditional medicine in India, Sudan, Nigeria, Bangladesh, and almost of the tropical countries.
- Almost all part of the tree finds some use or other in food, chemical, pharmaceuticals and textile industries, fodder, timber and fuel^[8].

Medicinal Uses^[12]

- Tamarind is used to cure chronic or acute constipations, liver and gall bladder ailments, bilious vomiting, alcohol intoxications, fever, pharyngitis, stomatitis and hemorrhoids.
- It is used in scorpion sting, scurvy, bilious fever, splenomegaly.
- Fruit increases intestinal liquid volume and acts as aperients.
- It is also used to cure tuberculosis, asthma, bronchitis, leprosy, wounds, ulcers, inflammation, stomachaches, diarrhea, dysentery, burning sensation.

- Fruit increases intestinal liquid volume and acts as aperients, appetizing, laxative heating, tonic to the heart, heals wound and fracture, biliousness and bile disorder.

Traditional Uses

Tamarindus indica has uncountable use in traditional herbal medicine. The pharmacological value of tamarind responsible for its therapeutic efficacy are already mentioned in traditional Sanskrit literature. Tamarind products such as leaves, fruits and seeds have been extensively used in traditional Indian and African medicine^[4]. The bark of plant has been used as a tonic and in lotions or poultices to relieve sores, ulcers, boils and rashes. A decoction is used in cases of gingivitis, asthma and eye inflammations^[5], giddiness, vertigo, diabetes and amenorrhea. Tamarind pulp has been reported to be used in the treatment of a number of ailments, including the alleviation of sunstroke and the intoxicating effects of alcohol and cannabis. Tamarind gargling is very effective to cure aphthous sores and sore throats. Root is used to treat ankylostomiasis (hookworm) in some parts of Tanzania. *Tamarindus indica L.* was used as a traditional medicine for the management of diabetes mellitus^[4].

Pharmacological Activities

Anti-inflammatory activity

Plant-derived metabolites have been used for treating inflammation-related diseases for centuries, with extracts from the willow tree and *Ceratonia siliqua L.* being known to treat inflammation in Arab ethnomedicine. A study evaluated the anti-inflammatory properties of stem bark and root extracts of *Tamarindus indica L.* using the carrageenan-induced paw edema model of inflammation. The results showed that both root and stem bark extracts had promising anti-inflammatory activities, with ED₅₀ values of 118.1 and 154.5 mg/kg, respectively. The study supports previous research on the anti-inflammatory activities of the seeds, fruits, leaves, and seed coat of *Tamarindus indica*. The leaf extracts of the seed showed dose-dependent activity on carrageenan-induced inflammation in rats, while the methanol extract of the fruits had moderate anti-inflammatory activity. The root extracts of *Tamarindus indica* were rich in tannins, saponins, glycosides, flavonoids, and polyphenols, with anti-inflammatory action attributed to these phytochemicals. The findings of this study and other studies validate the use of the plant in ethnomedicine^[13].

Antioxidant activity

The study investigated the antioxidant activity of stem bark and root extracts, which were found to be effective in scavenging free radicals and reactive oxygen species (ROS) during inflammation-associated cellular injuries. The extracts showed lower IC₅₀ values in both DPPH and hydrogen peroxide assays, indicating they were better scavengers of DPPH radicals than hydrogen peroxide. The total antioxidant capacity (TAC) was also determined, showing that both extracts were better scavengers of DPPH radicals than hydrogen peroxide. The total phenolic content (TPC) of the extracts was also found to be similar, suggesting a positive correlation between antioxidant activity and TPC. The results support the notion that phenolic compounds are generally good antioxidants^[13].

Antiobesity activity

The study investigates the effect of *Tamarindus indica* pulp aqueous extract (TIE) on obesity in Sprague-Dawley rats. The rats were divided into five groups and given TIE at different doses for 10 weeks. Results showed that TIE decreased plasma cholesterol, LDL, and triglyceride levels, increased HDL, reduced body weight, and enhanced antioxidant defense. It also showed antiobesity effects, reduced adipose tissue weights, and lowered hepatic steatosis. The extract also possessed hepatoprotective activity [14].

Anti Newcastle disease virus activity (NDV) activity

The anti-NDV activity demonstrated by *T. indica* indicates immense potentials towards harnessing active constituents of the plant for antiviral drugs. Although the antiviral constituent(s) of *T. indica* may have been active against hemagglutinin and/or neuraminidase thus, accounting for the absence of HA after *T. indica* treatment. Perhaps other components relevant for viral replication, including enzymes, were also impaired. However, this conclusion cannot be inferred with the findings of this work as further investigation is required. Nonetheless, it will be pertinent to isolate and characterize the active antiviral principles in *T. indica* as to ascertain novelty, and as well add to the existing body of knowledge [15].

Cardioprotective activity

The study reveals that the stem bark of *Tamarindus indica* Linn. Bark, derived from macroscopical, microscopic, and powder characters, contains pharmacologically active principles such as alkaloids, glycosides, and flavonoids, some of which have protective effects due to their antioxidant properties. Further research is needed to identify these active components [1].

Analgesic activity

The results of this study provide evidence for the analgesic effect of *T. indica* stem bark fractions thus supporting the validity of its use in the treatment of painful conditions associated with fractured and dislocated bones. Further work is suggested to isolate active compounds responsible for the analgesic activity and to elucidate the full mechanisms of action involved [3].

Antihypertensive activity

The study found that fruits of *T. indica* have a significant impact on the total lipid profile, lowering total cholesterol and LDL-cholesterol levels without altering HDL-cholesterol levels. This is due to the LDL-receptor, a transmembrane glycoprotein that recognizes apoB-100, the exclusive apoprotein of LDLs. Tamarind reduced total cholesterol levels, which may decrease intracellular cholesterol, leading to an upregulation of LDL-receptor. Pulverized pulp of *T. indica* also reduced diastolic blood pressure, but not systolic blood pressure or body weight. The study confirms the potential of *T. indica* fruits in lowering cholesterol and LDL-cholesterol levels, but further investigation is needed in larger populations [16].

Membrane stabilizing activity

The bark and leaves extracts showed maximum membrane stabilization activity at 2000 µg/ml, with butanol fraction showing 47.5±1.07 percent. The combined extract of

methanol bark and leaves showed 43.07±0.95 percent activity. Stabilizing erythrocyte membranes, similar to lysosomal membranes, can inhibit lysosomal constituent release, potentially indicating antiinflammatory activity of drugs or plant extracts [17].

Anti-Snake Venom activity

This study evaluated the effect of *Tamarindus indica* seed extract on the pharmacological and enzymatic effects of *V. russelli* venom in Indian traditional medicine. The extract inhibited major hydrolytic enzymes responsible for early envenomation effects, such as tissue damage, inflammation, and hypotension. It also neutralized the degradation of human fibrinogen and indirect hemolysis caused by venom. The extract may be used as an alternative treatment to serum therapy and as a potential inhibitor of PLA₂, metalloproteinases, serine proteases, hyaluronidases, and 5'-nucleotidases [18].

Hypolipidemic and Hypoglycemic activity

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 [2].

Fluoride toxicity

Aqueous extracts of *T. indica* fruit pulp (100 mg/kg body weight) and *M. oleifera* seeds (50 mg/kg body weight) orally once daily for 90 days lowered plasma fluoride concentrations in rabbits receiving fluorinated drinking water (200 mg NaF/ Liter water). Cortical indices and metaphyseal width in animals receiving extracts also revealed beneficial effects of plant extracts. Changes in plasma biochemistry suggested less hepatic and renal damages in animals receiving plant extracts along with fluorinated water in comparison to that receiving fluorinated water alone. Preliminary results revealed these plant extracts have some potential to mitigate fluoride toxicity [19].

Hepatotoxicity

The protective effect of *Tamarindus indica* Linn was tested on rats by intoxicating them with paracetamol for seven days. After administering aqueous extracts of fruits, leaves, and seeds, biochemical estimations were recorded. Results showed a significant hepatoregenerative effect for the extracts [20].

Hyperlipidemia and Hyperglycaemia activity

This study investigates the efficacy of aqueous extract of seed of *T. indica* in correcting diabetic type (SD) and non-insulin diabetic type (MD) diabetes. The extract showed antihyperglycemic potency in SD and MD rats, as indicated by serum insulin assays. It also attenuated the effect on experimental SD and MD, confirming its hypolipidemic effect. The extract also decreased serum TC and TG levels in SD and MD rats, possibly due to low cholesterol biosynthesis enzymes and low lipolysis control. The extract also attenuated LDLc and HDLc levels, strengthening its hypolipidemic effect. The extract's antihyperglycemic action appears to be both pancreatic and extra pancreatic, with the

extra pancreatic effect focusing on the recovery of glucose-6-phosphatase activity in MD rats. It also corrects dyslipidemia, which is noted in diabetic conditions, possibly due to elevation in HDLc levels. Further investigations are ongoing to understand the detailed mechanisms of hypoglycemic and hypolipidemic effects in IDDM and NIDDM [21].

Antibacterial activity

The study examines the antibacterial properties of aqueous pulp extract from *T. indica*, a plant known for its traditional medicine. The extract contains alkaloids, saponins, and glycosides, which have antibacterial properties. It is useful in preserving food items against contamination by *E. coli* and other gram-negative bacteria. The extract's inhibitory effect may be due to its detergent and anti-inflammatory properties [22].

Antimicrobial activity

Tamarinds indica L., a plant used in folk medicine, has been found to have antimicrobial properties against both Gram-negative and positive bacteria. The extract, extracted from dried powdered leaves, showed the most significant effect. The extracts showed the lowest MIC and MBC against *Klebsiella pneumoniae* and *Micrococcus luteus*, while the highest MIC and MBC against *Pseudomonas aeruginosa* and MRSA. This suggests that *T. indica* could be a potential new antibiotic class for infectious disease treatment [23].

Antinociceptive Activity

The study investigated the anti-inflammatory and antinociceptive potential of a hydroethanolic extract of *Tamarindus indica L.* leaves (HTI). Results showed that HTI reduced carrageenan-induced hind paw oedema in Wistar albino rats, inhibited acetic acid-induced writhing, and increased basal reaction time in the hot plate and tail flick models. These findings support the anti-inflammatory and antinociceptive claims of *T. indica*, as mentioned in Indian traditional and folklore practices [24].

Anthelmintic Activity

The study evaluated the anthelmintic activity of *Tamarindus indica* Linn's leaves and bark extract on *Pheretima posthuma* and *Tubifex* worms. Results showed significant anthelmintic activity, reducing paralysis and death times, supporting its use as an anthelmintic agent [25].

Wound healing activity

Fabiyi J P *et al.*, studied on a decoction of *T. Indica* leaves and resulted, it is one of the most important agents to clean wounds caused by Guinea worm infections [26]. *Tamarindus indica* is frequently cited in the literature regarding the treatment of cuts, wounds, and abscesses. *indica*, bark or leaves are most commonly used, is applied externally on the spot, either as a decoction or as a powder or poultice, alone or in combination with other species [27]. Tamarind bark is mostly sold for wound healing purposes [28], sporadically other Tamarind plant parts are found in wound healing medicine, such as the fruit [29], the pod husks or the gum [30].

Antihistaminic activity

Tayade identified the antihistaminic potential of the leaves of *Tamarindus indica Linn.* In isolated goat tracheal chain

preparation and guinea pig ileum, this is found to be beneficial in asthma [31].

Anti-pyretic activity

Tamarind also possesses antipyretic activity. A polysaccharide obtained from *Tamarindus Indica* pulp had been shown to possess antipyretic activity against yeast induced pyretic rats and lipopolysaccharide (*E. coli*) induced pyrexia in mice [32].

Anti-malarial activity

The Fruits of *T. indica* are known as a febrifuge in Madagascar [33], whereas; in Ghana, Tamarind leaves are used for the treatment of malaria [34].

Ophthalmological activity

Tamarindus indica showed significant activity as ophthalmic preparation. The seed polysaccharide of *T. Indica* caused as eye drops give result of relieving important problems of eyes such as dry eye syndrome, ocular burning, trouble blinking, and sensation of having something in one's eye [35].

Cytotoxic activity

Al-Fatemi *et al.*, reported that methanolic extracts of *Tamarindus indica* showed remarkable cytotoxic activity against FL-cells, a human amniotic epithelial cell line, with IC50 values below [36]. Sano M *et al.*, was examined the carcinogenic potential of tamarind seed polysaccharide in both sexes of B6C3F1 mice. The results demonstrated that its polysaccharide is not carcinogenic in B6C3F1 mice of either sex. Bioassay-guided fractionation of methanolic extract of tamarind seeds led to the isolation of L-di-n-butyl maleate which is having pronounced cytotoxic activity against sea urchin embryo cells [37]. In order to study structure-activity relationships of its analogues, L-di-n-pentyl maleate was the most effective inhibitor to the development of the fertilized sea urchin eggs, and significant inhibitory activity was not in the esters of D-isome.

Conclusion

This study focuses on the different types of activities of *Tamarindus indica linn* and its pros and cons in medical field. The plant's bioactive compounds show promise for potential therapeutic applications in treating various diseases and promoting human health. *Tamarindus indica*, a fruit tree native to tropical Africa, has various applications in human health, including wound healing, snake bites, abdominal pain, colds, inflammations, diarrhoea, helminth infections, and fever. Its roots, wood, bark, and leaves possess nutritional and pharmaceutical properties, as well as antimicrobial and antidiabetic activity. *Tamarindus indica L.* has a wide range of traditional medicinal uses and pharmacological activities, including anti-inflammatory, antioxidant, anti-obesity, anti-viral, cardioprotective, analgesic, and antihypertensive effects. The plant's pharmacological classification includes phenolic compound, cardiac glycosides, mallic acid, tartaric acid, mucilage and pectin, arabinose, xylose, galactose glucose, and uronic acid. The plant's root bark contains n hexaoxane, eicosanoic acid, β sitosterol, (+)-pinitol, octacosanyl ferulate, 21-oxobehenic acid, and alkaloids. The plant's traditional claim of pain relief in Nigeria's North Western part is supported

by its stem bark. The plant's therapeutic efficacy in treating pain and inflammation is being investigated for its potential benefits in further research.

References

1. Chaturvedi, *et al.* Pharmacognostical, Phytochemical and Cardioprotective Activity of *Tamarinds Indica* Linn. Bark IJPSR,2011;2(11):3019-3027.
2. Journal of Pharmacognosy and Phytochemistry *Tamarindus indica* L. a plant with multiple medicinal purposes,2016;5(3):50-54.
3. Ukwuani AN*, Hassan FF. Analgesic properties of *Tamarindus indica* linn stem bark fractions in albino rats Sky Journal of Biochemistry Research,2014;3(2):024-027.
4. Soni N, Singh V K. Traditional, Nutraceutical and Pharmacological approaches of *Tamarindus indica* European J of Biological Res,2019;9(3):141-54.
5. Soni N, Singh V K. Efficacy and Advancement of *Terminalia arjuna* in Indian Herbal Drug Research Trends in Applied Sciences Res,2019;14(4):233-42.
6. Kiranamai K, Babu A N, Padmavathi B, Gayathri Y, Naveen. Phytopharmacological Properties of *Tamarindus indica*: An Overview Int. J.Pharm. Sci. Rev. Res,2021;67(1):108-14. Article No.1.
7. El-Siddig K, Gunasena HPM, Prasad BA, Pushpakumara DKNG, Ramana KVR, Vijayanand P, *et al.* *Tamarind -Tamarindus indica* L. Fruits for the future 1. Southampton Centre for Underutilized Crops, Southampton, UK, 2006, 188.
8. Soni N, Singh VK. Screening of molluscicidal potential of indigenous medicinal plants *Terminalia arjuna* and *Tamarindus indica* against fasciolosis vector: *Lymnaea acuminata*. Asian J Sci Tech,2017;8(8):5256-61
9. Rana M, Sharma P. Proximate and phytochemical screening of seed and pulp of *Tamarindus indica*. J MedPlant Stud,2018;6(2):111-5.
10. Tailor CS, Goyal A. Antioxidant Activity by DPPH Radical Scavenging Method of *Ageratum conyzoides* Linn. Leaves. American Journal of Ethnomedicine,2014;1(4):244-49.
11. Daniele S, Giovanna D, Maurizio M, Mario S, Angela F. Determination of Free Radical Scavenging Activity of Plant Extracts through DPPH Assay: An EPR and UV-Vis Study. Food Anal. Methods, 2011.
12. Uthra B, Brian M, Paris V, Cody E, Christopher M, *et al.* Pancreatic cancer cell lines as patient-derived avatars: genetic characterization and functional utility,2018;67(3):508-20.
13. Lawrence Sheringham Borquaye, *et al.* Anti-inflammatory and anti-oxidant activities of ethanolic extracts of *Tamarindus indica* L. (Fabaceae), Cogent ChemistryM,2020;6(1):1743403, DOI: 10.1080/23312009.2020.1743403
14. Khairunnuur Fairuz Azman Antiobesity effect of *Tamarindus indica* L. pulp aqueous extract in high-fat diet-induced obese rats J Nat Med DOI 10.1007/s11418-011-0597-8
15. Omobola O Okoh, Grace E Obiiyeke, Uchechukwu U Nwodo, Anthony I Okoh. Ethanol extract and chromatographic fractions of *Tamarindus indica* stem bark inhibits Newcastle disease virus replication, Pharmaceutical Biology,2017;55:1:1806-1808, DOI: 10.1080/13880209.2017.1331364
16. ASM Maruf Iftekhhar, Israt Rayhan, Mohiuddin Abdul Quadir, Sharif Akhteruzzaman. Abul Hasnat Effect of *Tamarindus indica* fruits on blood pressure Pak. J. Pharm. Sci,2006;19(2):125-129.
17. Deepak Kumar, *et al.* J. Pharm. Sci. & Res,2017;9(1):44-48.
18. S Ushanandini, S Nagaraju, K Harish Kumar, M Vedavathi, DK Machiah, K Kemparaju, *et al.* Girish the Anti-snake Venom Properties of *Tamarindus indica* (Leguminosae) Seed Extract Phytother. Res,2006;20:851-858. DOI: 10.1002/ptr
19. Ranjan, *et al.* *Tamarindus indica* L. and *Moringa oleifera* M. extract administration ameliorates fluoride toxicity in rabbits Indian J Exp Biol,2009;47(11):900-5.
20. Pimple, *et al.* Protective Effect of *Tamarindus indica* Linn Indian J. Pharm. Sci,2007;69(6):827-831.
21. Rajkumar Maiti, Uttam Kumar Das, Debidas Ghosh. Attenuation of Hyperglycaemia and Hyperlipidemia in Streptozotocin Induced Diabetic Rats by Aqueous Extract of Seed of *Tamarindus indica* Biol. Pharm. Bull,2005;28(7):1172-1176.
22. MG Abukakar, *et al.* Phytochemical screening and antibacterial activity of *Tamarindus indica* pulp extract Asian journal of Biochemistry,2008;3(2):134-138.
23. Gungumjee, *et al.* antimicrobial activities and chemical properties of *Tamarindus indica* L leaves extract African Journal of Microbiology Research,2012;6(32):6172-6181.
24. SS Bhadoriya, *et al.* Anti-Inflammatory and Antinociceptive Activities of a Hydroethanolic Extract of *Tamarindus indica* Leaves. Sci Pharm,2012;80:685-700.
25. Das, *et al.* Anthelmintic Activity of *Tamarindus Indica* Linn Indian J. Pharm. Sci,2011;73(1):104-107.
26. Fabiyi JP, Kela SL, Tal KM, Istifanus WA. Traditional therapy of dracunculiasis in the state of Bauchi, Nigeria. Dakar Medical,1993;38:193-5.
27. Diallo D, Sogn C, Samaké FB, Paulsen BS, Michaelsen TE, Keita A. Wound healing plants in Mali, the Bamako region. An ethnobotanical survey and complement fixation of water extracts from selected plants. Pharmaceutical Biology,2002;40:117-28.
28. Tignokpa M, Laurens A, Mboup S, Sylla O. Popular medicinal plants of the markets of Dakar (Senegal). Integrative Journal of Crude Drug Research,1986;24:75-80.
29. Tapsoba H, Deschamps JP. Use of medicinal plants for the treatment of oral diseases in Burkina Faso.Journal of Ethnopharmacology,2006;104:68-78.
30. Inngjerdigen K, Nergard CS, Diallo D, Mounkoro PP, Paulsen BS. An ethnopharmacological survey of plants used for wound healing in Dogonland Mali, West Africa.Journal of Ethnopharmacology,2004;92:233-44
31. Ayade P, Borde SN, Jagtap SA, *et al.* Effect of *Tamarindus indica* Linn. Against isolated goat tracheal and guinea pig ileum preparation. International Journal of Comprehensive Pharmacy, 2010, 2.
32. Izquierdo T, Garcia-Tamayo F, Soto C, Castrillon LE. A *Tamarindus indica* Linn.pulp Polysaccharide inhibits fever *in vivo* and IL-1 β release by murine peritoneal exudates cells. Pharmaceutical Biology,2007;45:22-30.

33. Norscia I, Borgognini Tarli SM. Ethnobotanical reputation of plant species from two forests of Madagascar: A preliminary investigation. *South African Journal of Botany*,2006;72:656-60.
34. Asase A, Oteng-Yeboah AA, Odamtten GT, Simmonds MSJ. Ethnobotanical study of some Ghanaian anti-malarial plants. *Journal of Ethnopharmacology*,2005;99:273-9.
35. Sahelian R. Health Benefit of Tamarind: Tamarind Seed Eye Drops, *BioMedical Central–Ophthalmology*, 2007, 29.
36. Al Fatimi M, Wurster M, Schroder G, Lindequist U. Antioxidant, Antimicrobial and cytotoxic activities of selected medicinal plants from Yemen. *Journal of Ethnopharmacology*,2007;111:657-666.
37. Sano M, Miyata E, Tamano S, *et al.* Lack of Carcinogenicity of Tamarind Seed polysaccharide.in B6C3F1 Mice. *Food Chemical Toxicology*,1996;34(5):463-467.