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AN OVERVIEW ON CHEMICAL INGREDIENTS AND PHARMACOLOGICAL ACTIVITIES OF *TAMARINDUS INDICA* L

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ABSTRACT

Tamarindus indica L. commonly known as tamarind is a medium sized fruit-tree belonging to the family Leguminosae (Fabaceae). Imli, often known as a "Indian date" is the name of the tamarind tree, also known as the "Assam tree". It grows well in both semi-arid and humid monsoon climates and can grow on a wide range of soil types. *Tamarindus indica* L. play a significant impact in human nutrition, particularly in underdeveloped nations. The predominant concentration of essential oil is found in leaves. The tamarind fruit is the most prevalent and valuable component utilized from the tamarind tree. Bark has certain properties such as antioxidant, antibiotic, anti-microbial, analgesic and spasmogenic activites. Leaves has certain properties such as Antiemetic activity and Protection of liver. Seed has anti-inflammatory activities effect on the control of satiety, having a potential for treatment or prevention of obesity. The *Tamarindus Indica* has the various pharmacological activities such as antidiabetic activity, hypolipidemic activity, antioxident, cytotoxic activity, etc.

KEYWORDS

Tamarindus indica, Human Nutrition, Antioxidant, Antibiotic, Antimicrobial, Analgesic and Spasmogenic Activities.

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INTRODUCTION

Tamarindus indica L. commonly known as tamarind is a medium sized fruit-tree belonging to the family Leguminosae (Fabaceae). It is a evergreen tree that can reach a height of 24m and girth of 7m and they have pale yellow and pink flowers[1]. *Tamarindus indica* L. multifunctional tree and practically every portion of it has some sort of utility, whether it be nutritional or medicinal. Although tamarind is native to tropical Africa, it has

been brought to and naturalised in more than 5 nations worldwide[2]. One of the native fruit tree species that historically supports both environmental stability and food security in sub-Saharan Africa is *Tamarindus indica* L. We assumed that the indigenous people of Eastern Uganda had long used T. indica and had created customs that favoured its preservation. We anticipated that the majority of them have planted the species and that they have a sophisticated indigenous knowledge (IK) system[3]. Imli, often known as a "Indian date" is the name of the tamarind tree, also known as the "Assam tree". The pulp's gummy acidity. The tamarind fruit has been used for long years as a culinary and medical ingredient. The pulp of the eatable fruits, in particular, can be used to make sherbet, curries, pickles, etc. or eaten raw[4]. The starch-containing seeds are consumed raw or boiled and are also used in textile factories. The fruit was sold for two dirhams per seer and was known as ambli during the reign of Akbar the Great, the Mughal King. Since practically all of a tamarind tree's parts have some value, it is a versatile kind of tree. The fruit has about the pulp (55.0%), seed (34.0%), shell (11.0%) and fibre in a pod. It is primarily grown for its fruit pulp, which is used to make beverages, flavour desserts, curries and sauces, as well as being recognized as a herbal remedy in many areas of the world. The reddish or purple-brown tamarind seeds are extremely tough, glossy and hard[5]. Its various parts such as seeds, root, leaves, bark and fruits have been extremely used in traditional India and African medication[6]. India is the world largest producer of tamarind, it is estimated that 300,000 tons are produced annually[7].

Habitat

It grows well in both semi-arid and humid monsoon climates and can grow on a wide range of soil types. It is a tree of the tropics; it can tolerate temperatures up to 47°C but is very sensitive to frost. It is mainly grown in areas with 500-1500mm rain/ year but tolerates down to 350 mm if irrigated at the time of establishment. In the wet tropics with over 4000mm rain, flowering and fruit setting is significantly reduced and in India it is not grown in areas receiving more than 1900 mm rain/year. Regardless of total annual rainfall, it produces more fruit when subjected to a fairly long dry period[12].

Origin and History

The geographical origin of Tamarindus indica has been subject to scholarly debate. While some sources suggest the Far East or Africa[13] or specifically Ethiopia[14], it is now widely accepted that tamarind is indigenous to Africa and was later introduced to Central America and the Asian subcontinent. The term "tamarind" is derived from the Persian "tamari hind," meaning "date of India." Interestingly, references to tamarind appear in the ancient Indian text Brahma Samhita, dating between 1200 and 200 BCE[15], which has led some botanists and historians, including Morton and Dowling (1987)[16], to suggest an Indian origin. Tamarind was likely introduced to Asia in the first millennium BCE. By 400 BCE, evidence shows that its cultivation was established in Egypt. Arab and Persian traders are believed to have facilitated its spread to Southeast Asia from the Indian subcontinent.

Tamarindus Indica Description and Morphology

Tamarindo

It is a tree of medium to large size, 10 to 25m high, evergreen or sub-deciduous and with a rounded, scattered and dense crown, low branches, the trunk is short, thick and straight[17,18] long-lived up to more than 200 years[19], leaves pale to dark green, alternate and paripinnate, 7 to 15cm long, have 10 to 20 pairs of leaflets, sessile, obtuse, oblong and opposite, 1 to 2.5cm long by 0.5cm wide, the midrib is visible above and below[20,21].

The flower buds of white, red or pink colors, with hermaphroditic flowers in clusters of 8 to 14 pale yellow flowers with red or orange veins, 2 to 2.5 and 5 to 10 cm in diameter and long[19], calyx with four sepals and five-petal corolla, three fertile stamens and a pistil[18,21], cross-pollinating and self-pollinating[22], flowering occurs from March - April and in October 17; in Mexico, it occurs from April to December 18 or from July to August[23].

The fruit is a pod, protruding, oblong, slightly curved and flattened, 7 to 20 cm long and 1 to 3cm wide[19], light gray or brown epicarp[24], indehiscent[18], mature 10 months after flowering and remain on the tree until the next flowering period[25].

The pulp is soft, thick, blackish brown, bittersweet and with a high content of sugars and acids; with 1 to 12 seeds[18,20]. The seeds are oval, compressed, smooth, with a lustrous brown teste, 1cm long, with a pair of thick cotyledons, a small and straight radicle[18]. The tamarind tree supports long-term dry seasons and temperatures between -3 to 47°C, it is vulnerable to frost[20,23], it adapts in rainfall ranges from 800 to 1500mm per year, and soils with a pH of 6.5 to 7.5, from 40 to 600 meters above sea level[18,21].

The tamarind is cultivated in 54 countries of the world; Thailand, Costa Rica, Mexico, Puerto Rico, Brazil, Guatemala, Belize and the United States are considered producing countries[26], the main producer is India, in 2018 it reached the production of 98,000 t of fruit[27], in 2019-2020 it exported 18,386.7 t[28]. In Mexico, tamarind is exploited under the backyard modality[24,29] and in 12 states cultivated areas are reported, where Jalisco occupies the first place with 3,868 ha, followed by Guerrero and Colima, with 1,329 and 946.5 ha respectively. Total national production is equivalent to 38,612.9 t, with a value of 264,946.9 pesos[30].

Nutritional Value

Tamarindus indica L. play a significant impact in human nutrition, particularly in underdeveloped nations[31]. The predominant concentration of essential oil is found in leaves. Thirteen components were found in the leaf oil of tamarind, with limonene at 24.4% and benzyl benzoate at 40.6% being the most abundant[32]. The tamarind fruit is the most prevalent and valuable component utilized from the tamarind tree. The pulp comprises 30 to 50% of the mature tamarind tree. The pulp comprises 30 to 50% of the mature fruit. The shell and fiber constitute 11 to 30%, while the seed comprises approximately 25 to 40%[33]. Distribution of metabolites classes in percentage in tamarind fruit pulp in show in Figure No.1.

The commercially available dried tamarind pulp has 8 to 18% tartaric acid (2, 3-dihydroxybutanedioic acid C4H6O6, a dihydroxy carboxylic acid) and 25 to 45% reducing sugars, with glucose constituting 70% and fructose 30%[34]. Tamarind pulp contains significant mineral content, including potassium (62 to 570mg per 100g), calcium (81 to 466mg per 100g), phosphorus (86 to 190mg per 100g) and iron (1.3 to 10.9mg per 100g). Some scientists indicate that magnesium content ranges from 25.6 to 30.2mg per 100g, while sodium ranges from 23.8 to 28.9mg per 100g; in contrast, copper (0.8 to 1.2mg per 100g) and zinc (0.8 to 0.9 mg per 100 g) are present in modest quantities (Parvez *et al*, 2003)[35]. It is rich in riboflavin and a substantial source of niacin and thiamin, while containing modest levels of vitamin C and vitamin A[36]. The detail of Food value of *Tamarindus indica* shows in Table No.4[37] and there graph is shows in Figure No.2[36].

Properties of *Tamarindus Indica*

Some properties of this plant, the part that are used and the active components are as follows

Bark

It has certain properties such as antioxidant, antibiotic, anti-microbial, anti-analgesic and spasmogenic activites. The active components found are rich in tannins and polyphenols, b-sitosterol, 21 oxobehenic acid and (+)-pinitol and phenolic antioxidant of proanthocyanidins in several ways: procyanidin B2, procyanidin trimer, procyanidin tertramer, procyanidin pentamer, procyanidin hexamer along the taxifolin, apigenin, eriodicytol, luteolin and naringenin[38].

Leaves

It has certain properties such as antiemetic activity and protection of liver. The active components found are source of proteins fiber, lipids and vitamins like riboflavin, ascorbic acid and beta carotene composed by 13 essential oils in which limonene, benzoate and benzyl are the most important compounds followed by pentadecanol and hexadecanol[39].

Stem bark

The tea is used for sore throat. Spasmogenic, analgesic, antimicrobial hypoglycemic activities.

The active components are saponin, flavonoids, cardiac glycosides, alkaloids and tannins[40].

Seeds

Anti-inflammatory activities effect on the control of satiety, having a potential for treatment or prevention of obesity. The active components are they are sources of protein and starch, sulphur amino acids and phenolic antioxidants are proanthocyanidins, epicatechin, inhibitor of proteinases[41].

Phytochemistry of Tamarind

Procyanidin B2, procyanidin C2, isoquercetin, quercetin, luteolin, rutin, taxifolin, eriodyctiol, kaempferide, hydroxybenzoic acid, protocatechuic acid, protocatechuic acid methyl and ethyl esters derivatives, flavonoids, and (+)-catechin/(−)-epicatechin are among the 14 substances[42].

Leaves

Pulps contain invert sugar, citric acid, pipecolic acid, nicotinic acid, 1-malic acid, volatile oils (geraniol, limonene), lupanone, lupeol, orientin, isoorientin, vitamin B3, vitamin C, vitexin, isovitexin, benzyl benzoate (40.6%), cinnamates, serine, pectin, beta alanine, proline, phenylalanine, leucine, potassium, 1-malic acid, tannin and glycosides[43].

Fruits

Fruits containing carboxylic acid and furan derivatives. Citrus, tartaric, apple, grape, succinic, pectin, phenol tannins and invert sugar acids[44].

Seeds

Campesterol, palmitic acid, oleic acid, linoleic acid, β-amyrin, β-sitosterol and eicosanoic acid. Additionally discovered were uranic acid, glucose, arabinose, xylose, galactose pectin, and mucilage[28]. From the seed, two novel bufadienolides were identified: uzarigenin-3-O-βDxylopyranosyl (1-2)-α L rhamnopyranoside and Scilliroside 3-O-β-D glucopyranosyl-(1-2)-Lrhamnopyranoside, a cardioid29. Amyloids, cellulose, albuminoid, phytohemagglutinins, and chitinase[45].

Stem Bark

Lipids, glycosides, tannins, saponins and peroxidase[46].

Roots

The compounds 21-oxobehenic acid, β-sinosterol, (+)-pinitol, n-hexacosane, eicosanoic acid, and octacosanyl ferulate[47].

Pharmacological Activity

The *Tamarindus Indica* has the various pharmacological activities which are mentioned below:

Antidiabetic and Hypolipidemic Activity

Pulp and fruit extracts of tamarind show hypolipidemic and antioxidant activities in rats fed a cholesterol-rich diet[48]. Ethanolic extract (50mg/kg) of tamarind fruit pulp showed a significant decrease in body weight, serum cholesterol, triglycerides, and increased HDL cholesterol in cafeteria diet and sulpiride-induced obese rats[49]. Hyperglycemia, hyperlipidemia and obesity are the main consequences of diabetes mellitus, metabolic syndrome and cardiovascular problems. These metabolic abnormalities are controlled by tamarind[50]. Aqueous methanolic leaf extract showed significant protection and lowered the blood glucose level to normal. In alloxan-induced diabetic rats, the maximum reduction in glucose was observed after 6 hours at a dose level of 200mg/kg of body weight. The significant antidiabetic activity of tamarind leaf may be due to inhibition of free radical generation and subsequent tissue damage induced by alloxan or potentiation of the plasma insulin effect by increasing pancreatic secretion of insulin from remaining beta cells[51]. Effect of tamarind seed extracts, recovered from subcritical water extraction (SWe), on testosterone production in male rats, under a high-fat diet, which leads to hypo-androgenic conditions. The authors reported that the tamarind seed extract prevented the harmful effects caused by a prolonged diet rich in fats, thus providing health benefits for endocrine function[52].

Effect on Cardiovascular System and Blood

The effect of pulp crude extract in hypercholesterolemic hamsters was studied on lipid serum levels and atherosclerotic lesions. Tamarind extract has a high potential for reducing the risk of atherosclerosis in humans[53]. In Bangladesh, tamarind fruits were evaluated for their effects on

the lipid profile, systolic and diastolic blood pressure, and the body weight of humans. Another experimental study on hamsters has shown that the hydroalcoholic extract of tamarind pulp influences the mediator system of inflammation[54].

Antioxidant Activity

Sudjaroen *et al*, studied that the seed and pericarp of *Tamarindus indica* contain phenolic antioxidant compound[55]. All the extracts exhibited good antioxidant activity against the linoleic acid emulsion system compared to synthetic antioxidants like butylated hydroxyl ascorbic acid and anisole[56]. Martinelli studied that the ethanolic extract of fruit pulp showed significant antioxidant and hypolipidemic activity in hypercholesterolemic hamsters[57]. Antioxidant activity of ethanolic extract of seed coat was also assessed by DPPH (2, 2-diphenyl-1-picrylhydrazyl) free radical scavenging method using ascorbic acid as a standard. This activity of extract may be attributed to its free radical-scavenging ability[58].

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[59]. 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[60]. In order to study structure-activity relationships of its analogs, 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-isomer[61].

Laxative Properties

The fruit is used traditionally as a laxative, due to the presence of high amounts of malic and tartaric acids and potassium acid[62]. Children in Madagascar are given whole Tamarind fruits for breakfast to overcome constipation. The laxative can be taken in the form of a sweetmeat, called Bengal by the Wolof people of Senegal, prepared from the unripe fruit of Tamarind and sometimes mixed with lime juice or honey[63]. Abdominal pain is not a specific disorder but a complaint, which refers to a painful abdomen and which may have a wide variety of causes, including constipation or diarrhea. Soaked fruits are also eaten by rural Fulani in Nigeria, to relieve constipation[64]. Roots, prepared as an extract, are used in the treatment of stomach ache or painful abdomen, mainly in East Africa[65].

Wound Healing Activity

The ability of the polysaccharide from the tamarind seed (xyloglucans) to repair corneal wound healing might depend on its influence on the integrin recognition system (in vitro, with cultured human conjunctival cells)[66]. Tamarind is frequently cited in the literature regarding the treatment of cuts, wounds, and abscesses. Tamarind bark or leaves are most commonly used on the spot, either externally, alone or in combination with other species[67]. Other tamarind plant parts are also used in wound healing medicine, such as fruit, leaf powder, pod husks, or gum[68]. A decoction of tamarind leaves was one of the most important agents for cleaning wounds caused by Guinea worm infections. A decoction of the leaves may be used to wash wounds, ulcers, lesions, or sores in the mouth[69]. Tamarind seeds showed significant wound healing activity on epidermal circular wounds, with enhancement of wound closure and antioxidant function[70].

Anthelmintic Activity

Leaf and bark extracts of tamarind have anti-helminthic activity. Alcoholic extract of the bark of tamarind caused paralysis at 22.33 minutes and times of death at 45.00 minutes for Pheritima posthuma, and 14.66 minutes as paralysis time, and 20.66 minutes as times of death for Tubifex tubifex worms, respectively. The aqueous fraction treatment of Pheritima posthuma and Tubifex tubifex worms resulted in a paralysis time of 58.33 and 23.00 minutes, respectively[71]. Tamarind leaf juice has an anthelmintic effect against Pheretima posthuma, as a test worm. Various concentrations

(100%, 50% and 20%) of tamarind leaf juice were tested in the assay, which involved the determination of paralysis (P) and death (D) of worms. It shows a shorter time of paralysis (P=23.5 min) and death (D=62 min) in 100% concentration, while the time of paralysis and death will increase in 50% concentration (P=26 min and D = 65 min.) and 20% concentration (P=30 min and D=72 min.), respectively, as compared to piperazine citrate (10mg/ml) used as a standard drug (P=23 min. and D=60 min.)[72].

In tropical countries, diarrhea is one of the major health problems and often occurs during rainy weather. There appears to be a rare difference between West and east Africa in the cure of diarrhea. For West Africa, literature only mentions the use of the bark. It can be applied as a decoction, pulped with lemon, or macerated in milk. In east Africa, it is not the bark but the leaf that is used, made into a juice or beverage, or prepared in a concoction with Sterculia Africana. In Kenya, the use of ground seeds has been recorded, and in Tanzania, the root is used to treat dysentery[73]. Tamarind pulp with lemon is used to treat diarrhea (anti-diarrheal activity), and the root is used to treat dysentery (anti-dysentery activity). 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 a risk of dehydration and death[74].

Anti-Bacterial Study

T. indica is a valuable plant with a variety of biological activities reported from its extracts and even nanoparticles prepared from its extracts[75,76]. The current findings report the synthesis of AuNPs (Gold nanoparticles) from alcoholic seeds to extract of T. indica and also shed light on the antibacterial effects of plant seeds extract compared to corresponding AuNPs. The various secondary metabolites present in the crude extract are responsible for the preparation of stable AuNPs from seeds of T. indica. The AuNPs showed an effective antibiotic activity against Gram-negative as well as Gram-positive bacterial strains. It has been proved experimentally that synthesized AuNPs from seeds extract of T. indica showed effective anti-bacterial activity against K. pneumonia, B. subtilis and S. epidermidis in the form of the zone of inhibition ranging from 10 to 12mm as shown in (Table No.5). However, the temperature at which the AuNPs showed high antibiotic activity was 60 °C rather than at room temperature, which might be due to their smaller size. There is a big difference between the cell wall structure of Gram-positive and Gram-negative bacteria; the Gram-positive bacteria have a thick layer of peptidoglycan, which causes the rigidity of the structure and causes difficulty in penetration of AuNPs as compare to the Gram-negative bacteria, which possess thin penetration layer. This high antibiotic activity of AuNPs is due to the cationic form of Au, which acts as an antibacterial agent. Similar to our results, AuNPs are a good antibacterial activity in several plants[77,78].

Sedative Potential

The crude extract from seeds of T. indica and synthesized AuNP's (Gold nanoparticles) were also subjected to sedative activity determination. The results of the sedative effect are presented in (Table No.6). The maximum sedation activity was shown by diazepam. It was significantly ($P < 0.001$) different when compared with the saline control group. The crude extract from seeds of T. indica showed mild sedative activity ($P < 0.05$) at doses of 50 and 100 mg/kg when compared with diazepam. The AuNPs likewise showed significant ($P < 0.01$) sedative potential at doses of 5 and 10mg/kg in comparison with the standard drug (diazepam). Thus, the synthesized AuNPs from roots extract of T. indica showed excellent sedative effects at 10 times lower dose level than crude seeds extract of T. indica as shown in (Table No.6). Similarly, Au-Euphorbia milii produced significant antinociceptive effect at doses of 10 and 20mg/kg as compared to the crude E. milii methanolic extract[79].

Table No.1: Vernacular names[8-10]

S.No	Language/ Country	Vernacular Names
1	English	Indian date, Tamarind tree
2	Hindi	Amli, Imli
3	Urdu	Imli
4	Arabic	Ardeib, Aradeib
5	Persian	Ambalah
6	Sanskrit	Amlika, Chincha, Tinthidi, Chukra
7	Kannada	Hunise, imli
8	Bengali	Tetula, Nuli, Tintil, Tinturi
9	Assamese	Tamar, Tenteli
10	Gujarati	Amali, Ambali
11	Marathi	Ambali, Amli, Chinch
12	Malayalam	Puli, Valampuli, Kolpuli
13	Oriya	Tentuli
14	Punjabi	Imli
15	Telugu	Chinta, Chintachettu, Chintapandu
16	Tamil	Amilam, Puli, Puliamavam
17	Burmese	Magyee, Majee-pen
18	French	Tamarinde, Tamarinier
19	Indonesian	Asam, Asamjawa, Tambaring
20	Italian	Tamarindo
21	Nepali	Imli
22	Spanish	Tamarin, Tamarindo
23	Thai	BakhamMakham, Somkham
24	Vietnamese	Me, Trai me
25	Sind	Amri, Gidamri
26	Mysore	Asam, Hunese
27	French	Tamarindien
28	German	Tamarindenbaum

Table No.2: Scientific classification[11]

Domain	Eukaryota
Kingdom	Plantae
Phylum	Spermatophyta
Subphylum	Angiospermae
Class	Dicotyledonae
Order	Fabales
Family	Fabaceae
Subfamily	Faboideae
Genus	*Tamarindus*
Species	*indica*

Table No.3: Geographic Origin and Spread of *Tamarindus Indica*

S.No	Region	Role in Tamarind History	References
1	Africa (Ethiopia)	Accepted native origin	Troup (1921)[14], Coates-Palgrave (1988)[13]
2	India & South Asia	Early adoption, cultural references (Brahma Samhita)	El-Siddig (2006)[15], Morton and Dowling (1987)[16]
3	Middle East	Trade route for tamarind to Asia	Historical trade records
4	Central America	Introduced via Spanish/Portuguese explorers	Post-Columbian period
5	Egypt (400 BCE)	Evidence of early cultivation	Historical accounts

Table No.4: Concentrations of elements detected in *Tamarindus indica* L, in Sindh, Pakistan

S.No	Elements	Symbol	Mg/Kg
1	Manganese	Mn	25.9
2	Calcium	Ca	20.2
3	Phosphorus	P	30.4
4	Sodium	Na	10.9
5	Arsenic	As	54.25µg
6	Iron	Fe	14. 07
7	Zinc	Zn	8.52
8	Potassium	K	7.16
9	Lead	Pb	0.27
10	Cadmium	Cd	3.36
11	Copper	Cu	0.76
12	Magnessium	Mg	60.1

Table No.5: Zone of inhibition determination for antibacterial effects of crude extract and synthesized AuNPs

S.No	Bacterial strain	Crude exact (mm)	Gold nano particles (mm)	DMSO (mm)	Streptomycin (mm)
1	*K. pneumonia*	08	10	0	24
2	*B. subtilis*	10	12	0	26
3	*S. epidermidis*	08	10	0	24

Table No.6: Sedative activity of seeds extracts from t. indica and aunps in the open field test (locomotive activity)

S.No	Treatment	Dose (Mg/kg)	No. of lines crossed in 10 min.
1	Distilled Water	10	125 ± 1.14
2	Diazepam	0.5	6 ± 0.13
3	Methanolic crude extract	50	121.44 ± 2.76
		100	112.43 ± 2.45
4	Gold Nanoparticles	5	98.24 ± 0.86
		10	84.53 ± 1.89

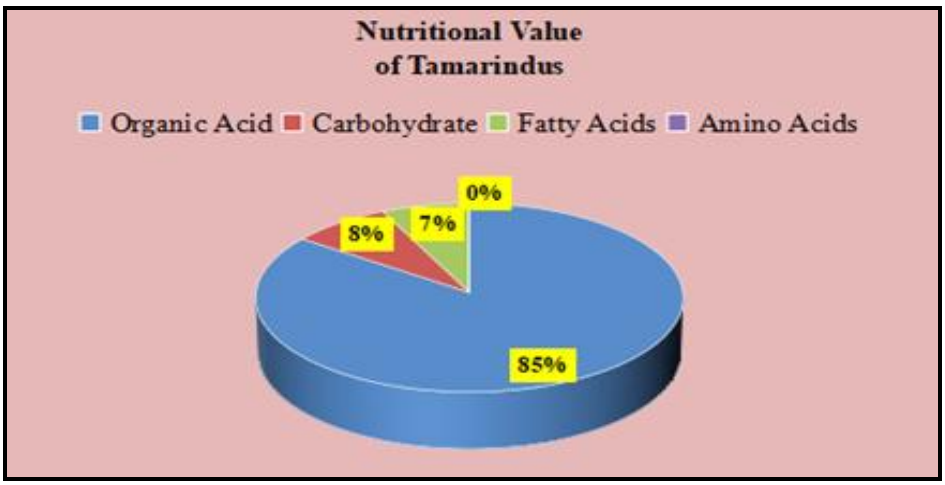

Figure No.1: Distribution of metabolites classes in percentage in tamarind fruit pulp

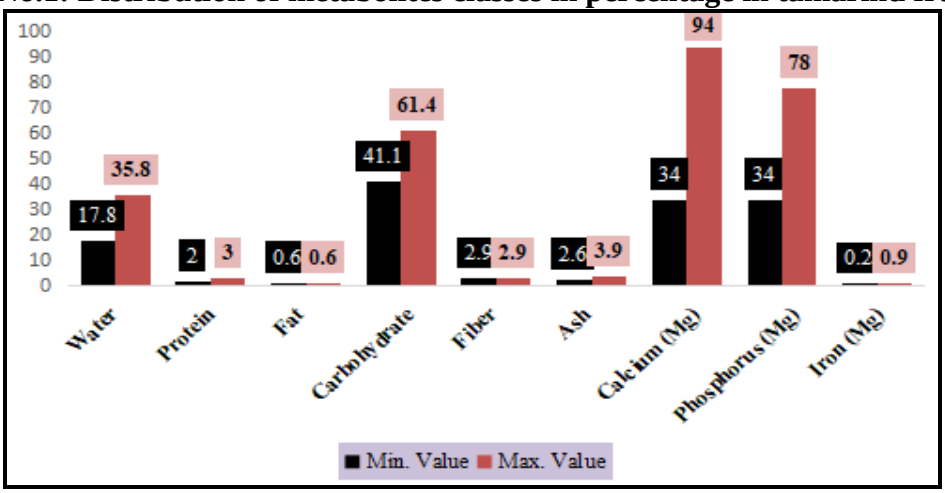

Figure No.2: Food Value of Tamarind Fruit (Per 100gm of Edible Portion)

Figure No.3: Different Parts of *Tamarindus Indica*
(A) Fruits, (B) Leaves, (C) Flowers, (D) Stem Bark

Figure No.4: Leaves of Tamarind

Figure No.5: Fruits of Tamarind

Figure No.6: Seeds of Tamarind

Figure No.7: Bark of Tamarind

Figure No.8: Roots of Tamarind

CONCLUSION

This review gives a broad information about the bioactive constituents and ethnopharmacology along with the scientifically claimed medicinal uses. *Tamarindus Indica* possess large range of medicinal application in human health care it also possesses a large amount of vitamin B and C which is responsible for the enhancement of immune system. Several, carbohydrates, fat, proteins and tannins, amino acids, minerals have been reported to be present in different parts of T indica. The plant shows various types of activities such as antidiabetic, hypolipidemic, antioxidant, hepatoprotective, antimicrobial, sedative potency, anthelmintic activity, wound healing activity which may be due to the presence of the investigated active chemical constituents. It also uses as a flavoring agent to impart flavor to various dishes and beverage a impart flavor to the pharmacological studies so far have been performed in both *vitro* and *in vivo*. Therefore, there is a need for investigation and quantification of different phytoconstituents present and its pharmacological profile.

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CONFLICT OF INTEREST

We declare that we have no conflict of interest.

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