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Heavy Metal and Phytochemical Studies of Crude Leaf Extract of Tamarind (*Tamarindus indica*)

Gomathinayagam S.[1,*], Brij B. Tewari[2], G. Rekha[3]

[1]Faculty of Agriculture and Forestry, University of Guyana, Berbice Campus, Tain, Guyana
[2]Faculty of Natural Science, University of Guyana, Turkeyen Campus, Guyana
[3]Department of Microbial Technology, School of Biological Sciences, Madurai Kamaraj University, Madurai, Tamil Nadu, India

Abstract Plants have served humankind as sources of medicinal agents since its earliest beginnings. In fact, natural products once served as the source of all the drugs. Tamarind (*Tamarindus indica* L) is a leguminous tree in the family Fabaceae indigenous to tropical Africa. The genus Tamarindus is a monotypic taxon, having only a single species. The tamarind tree produces edible, pod-like fruit which is used extensively in cuisines around the world. Other uses include traditional medicine and metal polish. The wood can be used in carpentry. Because of the tamarind's many uses, cultivation has spread around the world in tropical and subtropical zones [1]. Tamarind (*Tamarindus indica* L.) is a multipurpose tropical tree used primarily because its fruits and leaves have eatable properties. Both parts of the plant have also medicinal uses, but in the specific case of the leaves, little information about their chemical composition is available. In this paper, we explore the tamarind leaves' composition of dry crude leaf matter to subject to heavy metals, NPK and phytochemical analysis by standard methods. Crude leaves matter employing Gas Chromatography/Mass Spectrometry (GC/MS), and total Kjeldahl digests by UV-VIS spectrophotometry and K analysis was done in Kjeldal digests by Flame photometry method. Results confirm the production of essential oils, free and conjugated fatty acids, flavonoids, and other compounds, but also indicated the presence of seven heavy metals (Zn, Cu, Ni, Mn, Fe, Ca, and Mg) and N.P.K. compounds for this part of the plants.

Keywords Phytochemical, Heavy metal, Leaf extract, *Tamarindus indica*

1. Introduction

Tamarindus indica L. or tamarind as it is commonly known, is a medium-sized tree that belongs to the *Caesalpinaceae* family. It is a multipurpose tropical tree used primarily for its fruits, which are eaten fresh or processed. The fruit is also used as a seasoning or spice and make medicinal beverages [2]. In fact, Tamarind fruits are the most studied and valuable medicinal part of the plant, which has often been reported as curative in several pharmacopoeias [3]. This millenary tree has been taken into consideration from ancient times; documented evidence about its cultivation appear in Egypt around 400 BC, and it is mentioned in the Indian Brahma Samhita Scripture between 1200-200 BC. Also about 370-287 BC Theophrastus wrote on plants and two descriptions refer to tamarind, even though not by name [4].

Tamarindus indica L is probably indigenous to tropical Africa, [5] but has been cultivated for so long on the Indian subcontinent that it is sometimes also reported to be indigenous there [6]. It grows wild in Africa in locales as diverse as Sudan, Cameroon, Nigeria and Tanzania [7]. In Arabia, it is found growing wild in Oman, especially in Dhofar, where it grows on the sea-facing slopes of mountains. It reached South Asia likely through human transportation and cultivation several thousand years prior to the Common Era. [8, 9]. It is widely distributed throughout the tropical belt, from Africa to South Asia, Northern Australia, and throughout Oceania, Southeast Asia, Taiwan and China [10].

In the 16th century, it was heavily introduced to Mexico, and to a lesser degree to South America, by Spanish and Portuguese colonists, to the degree that it became a staple ingredient in the region's cuisine. [11]. Today, India is the largest producer of tamarind. [12] The consumption of tamarind is widespread due to its central role in the cuisines of the Indian subcontinent, South East Asia and the Americas, particularly in Mexico.

Thai traditional medicine recognizes *T. indica* fruit as digestive, carminative, laxative, expectorant and blood tonic [13]. Many other properties have been also reported like hypolipemic and antioxidant [14], anti-inflammatory [15], antimicrobial [16], cytotoxic [17], against gastrointestinal spasms [17] and modifying the complement system [18].

These extraordinary properties of tamarind fruits along with the interest on the polysaccharide and antioxidant seed compounds, keep the attention of the scientific community on the tamarind tree, leaving relegated to a secondary level

* Corresponding author:
directorugbc@uog.edu.gy (Gomathinayagam S)
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the other parts of the plant.

On the other hand, tamarind leaves retain a more empiric use. Like the fruit, tamarind leaves are also edible and are used to make curries, salads, stews and soups in many countries, but especially in times of scarcity, even when their protein ratios (4,0-5,8%) [9] are not too far from those reported for fruits (2,0-7,1%) [19]. In fact, most of the chemical studies of tamarind leaves are focused on their edible properties, with flavonoid compounds as the only exception, which have been reported with certain frequency [20, 21]. Other classes of compounds reported are the triterpenoids lupanone and lupeol [22], and some essential oils with benzyl benzoate and limonene as major compounds [23].

In recent years, the description of the pharmacological potential of tamarind leaves is coming out. The hepatoprotective and the antimicrobial activity look like the most prominent activities, both associated with flavonoid and/or phenol presence. Owing to the relative poor knowledge about the chemical composition of tamarind leaves, no specific association compound/activity is suggested, giving rise to this investigation in which an exploration of the phytochemical analysis is proposed.

2. Material and Methods

Plant material:

Tamarind leaves were collected in May 2016 from a Tamarind tree in Black Bush Polder, Region 6, Guyana. The collected leaves were shadow dried and then powdered by using Thomas-Wiley Laboratory Mill Model 4 at Central Chemistry Laboratory, Department of Chemistry, Faculty of Natural Science, University of Guyana, Turkeyen Campus. The powdered samples (100g) were stored in airtight brown coloured bottles in dry conditions throughout the experiments.

Phytochemical analysis:

The preliminary phytochemical analysis of leaf extracts of *Tamarindus indica* were performed by [24] were evaluated for the presence of phytochemicals such as alkaloids, flavonoids, saponins, phenols, steroids, tannins, triterpenoids, glycosides, carbohydrates, phlobatannins, thiols, anthroquinone, protein and amino acids, resins, fixed oils & fats and phytosterols. The qualitative determination of these secondary metabolites was carried out by standard methods [25]. Chromatographic study of the different extracts was also done using standard methods [26].

Heavy metals and N.P.K. analysis:

Crude leaves powder was used in Gas Chromatography/ Mass Spectrometry (GC/MS) to analyse heavy metals such as Zn, Cu, Ni, Mn, Fe, Ca, and Mg at acceptable levels. The Nitrogen (N), Phosphorous (P) quantitative test was done by total Kjeldal digests by UV-VIS spectrophotometry and Potassium (K) in Kjeldhal digest by Flame photometry method at Central Agricultural Laboratory, Guyana Sugar Corporation Inc. La Bonne Intention (LBI), Guyana.

3. Result and Discussion

Qualitative estimation of phytochemicals was performed in leaves of *T. indica*. The results were tabled and represented as '+' for presence and '–' for absence of the phytochemicals in Table 1. Quantitative analysis was done to determine in the presence of heavy metals in leaves of *T. indica* by using Gas Chromatography/Mass Spectrometry (GC/MS). Heavy metals estimated in mg per kg in Table 2, and analysis N.P.K in % Table in 3.

Table 1. Phytochemical analysis in the leaves of *T. indica*

Plant Name	Part used	Phytochemicals names	Presence (+)/Absence (-)
Tamarindus indica	Leaves	Alkaloids	+
		Flavonoids	+
		Tannins	+
		Thiols	-
		Amino acids	+
		Carbohydrates	+
		Phenols	+
		Glycosides	-
		Triterpenoids	+
		Fixed oils, fats	-
		Proteins	+
		Saponins	+
		Steroids	-
		Phlobatannins	-
		Anthroquinone	-
		Resins	+
		Phytosterols	+

Qualitative estimation of phytochemicals in leaves of *T. Indica* shows that Alkaloids, Flavonoids, Tannins, Aminoacids, Carbohydrates, Phenols, Triterpenoids, Saponins, Resins and Phytosterols are present, whereas Thiols, Glycosides, Fixed oils, fats, Steroids, Phlobatannins and Anthroquinone phytochemicals are absent.

Table 2. Heavy metal analysis in Tamarind *(T. indica)* leaves in mg/ kg

Name of plant	Used part	Parameter	Mg/kg
Tamarind *(T. indica)*	Leaves	Zn	**32.87**
		Cu	**3.59**
		Ni	**Nd**
		Mn	**19.64**
		Fe	**228.69**
		Ca	**184.42**
		Mg	**347.80**

Nd = Not detected

Heavy metal analysis was done in leaves of *T. indica* by using Gas Chromatography/Mass Spectrometry (GC/MS). It shows the highest amounts was that of Mg (347 .80 mg/kg), followed by Fe (228.69mg/kg), whereas the least amount was that of Cu (3.59 mg/kg). GC/MS did not detect Ni.

Table 3. N.P. K. analysis in Tamarind *(T. indica)* leaves in percentage (%)

Name of plant	Used part	Parameter	(%)
Tamarind *(T. Indica)*	Leaves		
		N	**2.24**
		P	**0.20**
		K	**0.65**

N.P.K. analysis shows the highest percentage was that of nitrogen in *T. Indica* leaves, followed by potassium; the least percentage of Phosphorus.

4. Conclusions

The antioxidant and antimicrobial activity of *T. indica* leaves has been reported worldwide, but it has not been possible to establish a relationship with the chemical composition due to the scarcity information availed. In this study, we detected seven components of heavy metals not previously reported, and confirmed the high Mg and Fe presence in *T. indica* leaves. In addition high percentage of nitrogen and some useful phytochemcials are available in *T. indica* leaves. This information give light to the present intention to find chemical proof that supports the pharmacological activities of *T. indica* leaves.

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