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Formulation and Evaluation of Anti-Oxidant Capsules from *Tectona Grandis* Leaves

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ABSTRACT

The Tectona grandis plant is topical species of the family lamiaceae. It has large,deciduous branches which are observed in the mixed hardwood forests. Tectona grandis has small, fragrant white flowers arranged intense clusters (panicles) at the end of branches. The ***tectona grandis L.*** *powder was converted into batches on the basis of their particle size. It has been observed that, batch B (Sieve # 80) passes all the preformulation parameters. This batch was finally used to prepare the antioxidant capsule with different concentration. Out of these, F2 batch was checked for weight variation, disintegration test & moisture content. It has been observed that, disintegration time of F1, F2, F3 & F4 was 9.48sec, 8.77sec, 8.71sec & 9.5sec respectively. Also, batch F2 passes the weight variation test. The antimicrobial test against E. Coli was performed and it shows zone of inhibition around 1.1cm after 24 hrs.*

Keywords: *Tectona grandis, teak leaves, antioxidant capsule, antimicrobial study, lamiaceae.*

INTRODUCTION

Teak (*Tectona grandis)* is topical hardwood tree species in the family *lamiaceae*. It is a large, deciduous tree that occurs in the mixed hardwood forests. *Tectona grandis* has small, fragrant white flowers arranged intense clusters (panicles) at the end of branches. *Tectona grandis* has been widely used in traditional Dai medicine. It mainly grows in tropical and subtropical southwestern China, India, Laos and northern Thailand. It is a large deciduous tree, measuring up to 40–50 m, with a deeply fluted trunk that can reach 2–2.5 m in diameter and a brown or gray bark. Previous phytochemical research reported that *T. grandis* was not only rich in flavonoids and quinones, but also contained phenolic, steroids, phenylpropanoids, fatty esters and other compounds.

In ethnomedicine, *T. grandis* is commonly used to treat wounds, pain, fever, malaria, inflammation, diabetes, liver disease, helminthic infection, bronchitis, tumors, cholelithiasis, jaundice, skin disease and bacterial infection. Pharmacological studies conducted on the methanolic extract of *T. grandis* bark and flowers established its hypoglycemic activities. The leaf extract of *T. grandis* has significant wound healing activity.Hydrochloric acid extract of *T. grandis* leaves exhibited antitumor activity in the female Swissmouse malaria model, thereby validating its traditional use in the treatment of tumors.

Traditional use of. *T grandis* as an antibacterial and anti-inflammatory medicine was validated by a study conducted by Bitchagno, who reported that the ethanolic extract from the fruit of *T. grandis* exhibited a remarkable inhibitory effect on four Gram negative bacteria, and the methanolic extract of *T. grandis* woods demonstrated significant analgesic activity and inhibited edema action in writhing test and paw edema test rats. In summary, *T. grandis* has a wide range of pharmacological properties.

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INTRODUCTION OF PLANT

Teak (***Tectona grandis***) is topical hardwood tree species in the family ***lamiaceae.*** It is a large, deciduous tree that occurs in the mixed hardwood forests. ***Tectona grandis*** has small, fragrant white flowers arranged intense clusters (panicles) at the end of branches.

Scientific Classification

- Name of the plant: Teak tree
- Scientific name*: tectona grandis*
- Kingdom: plantae
- Order: lamiales
- Division: Angiosperm
- Class: Mgnoliopsida
- Family*: lamiaceae*
- Genus: *Tectona*
- Species: *T.grandis*
- Common name of the plant: Teak, sagun,sagwan,Chinese
- Synonyms: Tectona theca Lour, *tectona grandis (l.f) Lan*, *tectona grandis* f. Pilosula moldenke

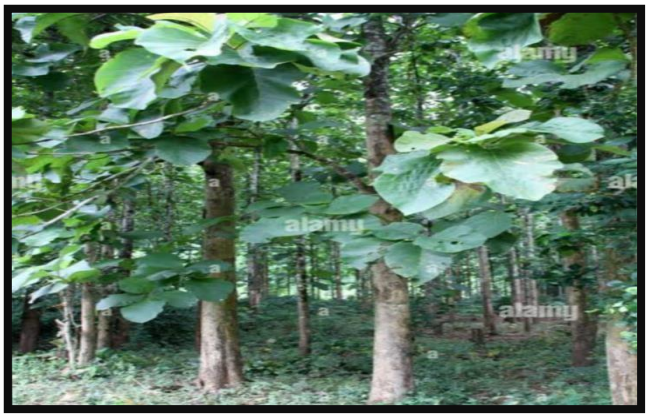

Fig. 1: Plant Tectona grandis

Chemical Constituents

- Naphthaquinones, anthraquinones, isoprenoid quinine, triterpenoids, steroids, lignans, fatty ester, phenolic compound and flavonoids.

Pharmacological activities show these plants

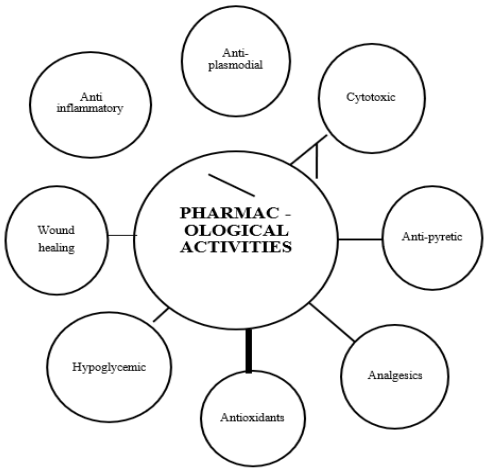

Fig. 2: Medicinal properties are present in these plantFlavonoids in teak leaves are responsible for its antioxidant activity.

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ANTIOXIDANT

A substance that protects cells from the damage caused by free radicals (unstable molecules made by the process of oxidation during normal metabolism). Free radicals may play a part in cancer, heart disease, stroke, and other diseases of aging. Antioxidants include beta-carotene, lycopene, vitamins A, C, and E, and other natural and manufactured substances.

Examples of antioxidants.

- Vitamins C and E
- Selenium
- Carotenoids such as beta-carotene
- Lycopene
- Lutein
- Zeaxanthin.

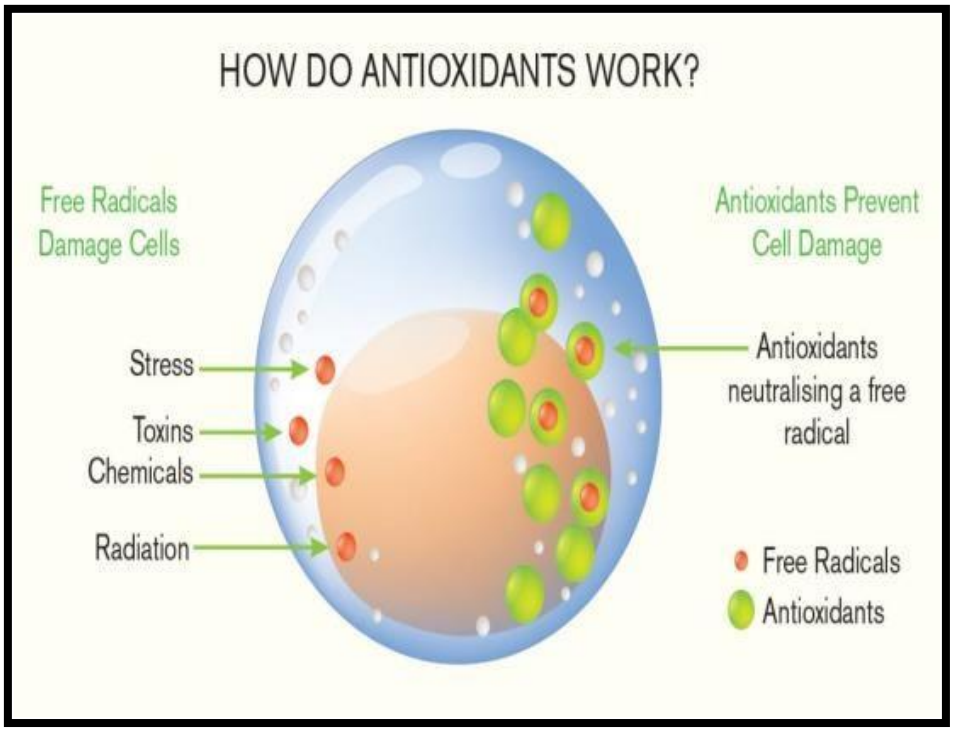

Fig. 3: Work of Antioxidants

Benefits of antioxidants

- They reduce oxidative stress.
- They support disease prevention.
- They support eye health.
- They aid in brain function.
- They can contribute to mental health improvements.
- They can reduce inflammation.
- They support healthy aging processes.

Function of Antioxidants

Antioxidants are substances that may protect your cells against free radicals, which may playa role in heart disease, cancer and other diseases. Free radicals are molecules produced when your body breaks down food or when you're exposed to tobacco smoke or radiation.

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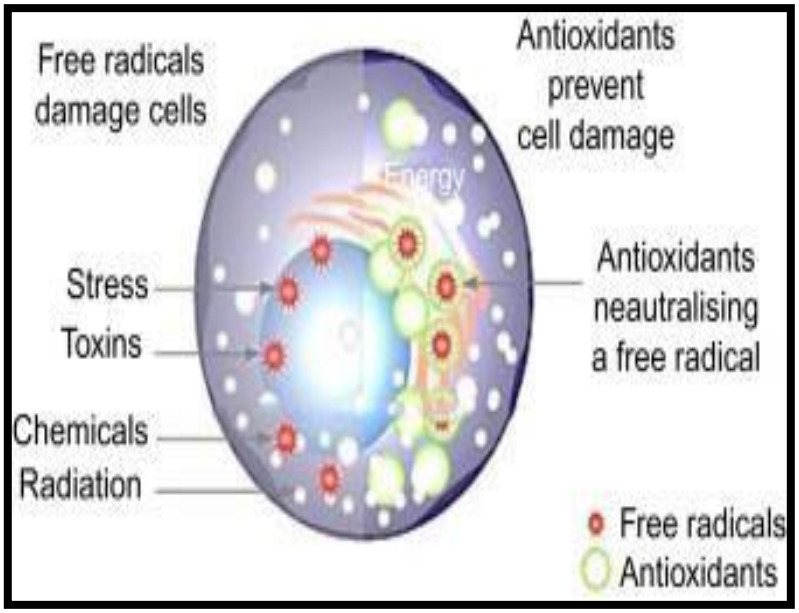

Fig. 4: Functions of antioxidants

Capsule

A capsule is a type of container that is commonly used in the medical and pharmaceutical industries. It is usually made of two parts: a shell and a cap. Capsules are used to hold medications, supplements, or other substances in a convenient and easy-to-swallow form. They come in different sizes and can be made from various materials, such as gelatin or vegetarian alternatives. Capsules are designed to dissolve or break down in the body, releasing the contents for absorption.

Fig. 5: Capsules

Types of Capsule

1) Hard Gelatin Capsules
2) Soft Gelatin Capsules

MATERIAL & METHOD

Materials

1) Teak leaves powder
2) Wetting agent (Sodium lauryl sulphate)
3) Binding agent (starch)
4) Colouring agent

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Apparatus

1) Weighing balance
2) Capsule filling machine
3) Autoclave
4) Hot air oven

Teak Leaves Powder

Teak leaves are known to contain several bioactive phytocomponents like tannins, phenolic acids and flavonoids which play a crucial role as scavengers of free radicals.

Fig. 12: Teak leaves powder

Wetting Agents

These are substances that lower the advancing contact angle and aid in spreading the powder in the aqueous phase by replacing the air. Ex. Sodium lauryl sulphate.

Fig. 13: Wetting agent

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Binding agent
Substance that makes a loose mixture stick together. For example, binding agents can be used to make solid pills from loose powders. *Ex. Starch*

Fig. 14: Binding agent

METHOD

- **Preparation method of capsule**
- **The process typically involves the following steps:**

1) **Selection of Ingredients:** Choose the active ingredient(s) and any necessary excipients or fillers
2) **Mixing**: The ingredients are carefully blended together to ensure uniform distribution.
3) **Encapsulation**: The mixture is then filled into empty capsule shells using specialized equipment.
4) **Capsule sealing:** The two halves of the capsule shells are joined together, usually by mechanical or heat-sealing methods.
5) **Quality control:** The finished capsules undergo quality testing to ensure they meet the required standards for potency, purity, and uniformity.

PREFORMULATION STUDY

1) Bulk density
2) Tapped density
3) Porosity
4) Carr`s index
5) Hausner`s ratio
6) Angle of repose
7) % Ash Value
8) Solubility
9) Antimicrobial study

Bulk Density
The bulk density of a powder is the ratio of the mass of an untapped powder sample and its volume including the contribution of the inter-particulate void volume.

$$Bulk\ Density\ = \frac{Mass}{Bulk\ Volume}$$

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Tapped Density

The tapped density is an increased bulk density attained after mechanically tapping a container containing the powder sample.

$$Tapped\ Density = \frac{Mass}{Tapped\ Volume}$$

Porosity

Porosity or void fraction is a measure of the void (i.e. "empty") spaces in a material, and is a fraction of the volume of voids over the total volume, between 0 and 1, or as a percentage between 0% and 100%.

$$\%\ Porosity = (\text{Bulk Volume} - \text{Tapped Volume})/(Bulk\ Volume)\ \text{x } 100$$

Carr's Index

Carr's Index of any solid is calculated for compressibility of a powder which is based on true density and bulk density.

$$Carr'sIndex = \frac{(TAPPED\ DENSITY - BULK\ DENSITY)}{Tapped\ Density}\ x\ 100$$

Hausner`S Ratio

Hausner ratio is defined as the ratio of a powder's tapped bulk density to its poured(loose) bulk density.

$$Hausner'sRatio = \frac{Tapped\ Density}{Bulk\ density}$$

Angle of Repose

Angle of repose powder poured from a vessel forms a cone-like pile. The angle of repose the angle between the slope of the pile and the horizontal correlates with the strength of particle-particle interactions and, therefore, is measured to infer flow ability.

$$\theta = \tan - 1\left(\frac{h}{r}\right)$$

% Ash Value

The ash values usually represent the inorganic residues such as phosphates, carbonates and silicates present in herbal drugs

$$\%ASH = \frac{(W2 - W0)}{W1}\ X\ 100$$

Where,

W2: weight of crucible + ash
W0: weight of crucible
W1: weight of sample

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Solubility
Solubility is the ability of a solid, liquid, or gaseous chemical substance (referred to as the solute) to dissolve in solvent (usually a liquid) and form a solution. We are going to check solubility of our sample in water, acidic and alkaline solution.

Antimicrobial Study
We have to check the antimicrobial property of our sample by suing different antimicrobial agents like *E. Coli, S. Aureus* & *Candida albicans.*

GRANULATION PROCESS
Granulation, a technique of particle enlargement by agglomeration, is one of the most significant unit operations in the production of pharmaceutical dosage forms, mostly tablets and capsules. During the granulation process, small fine or coarse particles are converted into large agglomerates called granules.

Granules are produced to enhance the uniformity of the API in the final product, to increase the density of the blend so that it occupies less volume per unit weight for better storage and shipment, to facilitate metering or volumetric dispensing, to reduce dust during granulation process to reduce toxic exposure and process-related hazards, and to improve the appearance of the product.

Fig. 16: Granule

Evaluation Parameters of Capsule

a. Official Test

1. Weight variation test
2. Disintegration test
3. Moisture content

b. Unofficial Test

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1) General appearance
2) Size
3) Shape
4) Colour
5) Odour

Fig. 17: Capsule Prepared

RESULT AND DISCUSSION

Procurement

Procurement of Sample: The teak leaves has been collected from Sawargaon, Dist-Nanded. The starch, sodium lauryl sulphate & colouring agent from JK Enterprises pvt ltd. Nanded.

Authentification

The sample was authentified by Dr. S. V. Mandage, HOD (Botany Dept.) of Shri SantGadge Maharaj college, Loha, Nanded.

Pre−Formulation Table

Table No. 1BATCH	A	B	C	D
1. Bulk density	0.25g/ml	**0.22g/ml**	0.21g/ml	0.21g/ml
2. Tapped density	0.37g/ml	**0.28g/ml**	0.28g/ml	0.24g/ml
3. Porosity	0.32	**0.21**	0.22	0.10
4. Carr`s index	32%	**21%**	25%	1.24%
5. Hausner`s ratio	1.48	**1.27**	1.33	1.14
6. Angle of repose	24'44°C	**27'21°C**	23'70°C	90'99°C
7. % Ash Value	41 %	**40%**	34%	37%

In this pre−formulation study we observed that, the **Batch B (sieve # 80)** has good flow properties than other batches.

Solubility

Table No. 2

BATCH	Solubility in water	Solubility in NaOH (0.1N)	Solubility in HCl (0.1N)
A	Sparingly soluble	Sparingly soluble	Poorly soluble
B	**Sparingly soluble**	**Sparingly soluble**	**Sparingly soluble**
C	Insoluble	Poorly soluble	Sparingly soluble
D	Insoluble	Poorly soluble	Insoluble

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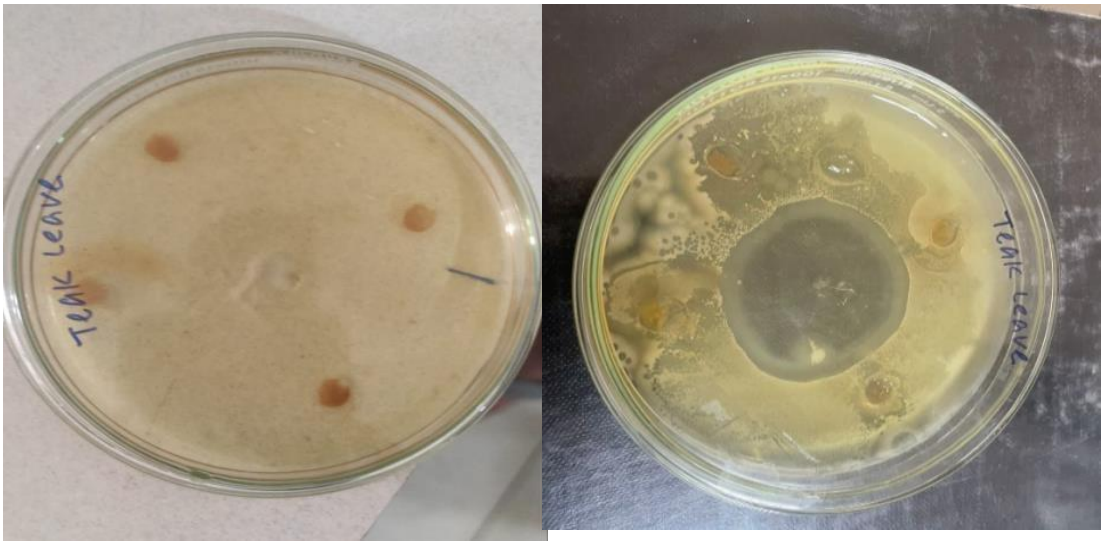
From above solubility study we observed that, batch B shows good solubility in all liquids.

Antimicrobial Study



E.Coli Inoculation *Antimicrobial Study of Teak leaves powder*

Fig. 18: Anti-microbial study against E. Coli

We have performed the anti-microbial study against E. Coli and found that our sample shows 1.1 cm zone of inhibition after 24hrs.

Formulation Table

Table No. 3

INGREDIANTS	F1	F2	F3	F4
Teak leaves powder(API)	250 mg	**240mg**	230mg	225mg
Wetting agent (Sodium lauryl sulphate)	2.5mg	**5mg**	7.5mg	10mg
Binding agent (Starch)	2.5mg	**5mg**	7.5mg	10mg
Colouring agent	Quantity sufficient	**Quantity sufficient**	Quantity sufficient	Quantity sufficient

We have prepared all batches having 260 mg wt, and concentration were changed to prepare F1, F2, F3 and F4 batches.

Evaluation Table

Table No. 4

TEST	F1	F2	F3	F4
Disintegration test	9.48 Sec	8.77 Sec	8.71 Sec	9.5 Sec
Weight variation test	FAIL	**PASS**	FAIL	FAIL
Moisture Content	17.51%	**14.61%**	16.41%	13.95%

From above evaluation study we observed that batch F2 qualified all the evaluation tests.

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Organoleptic Character

Table no. 5

PARAMETER	OBSERVATION
Size	0
Shape	Cylindrical
Colour	Light brown granule
Odour	Characteristic odour

CONCLUSION

From current research work we come to know that the ***tectona grandis L.*** *powder* can be converted to antioxidants capsule and having good organoleptic properties. We are also identifying that **batch B (sieve # 80)** has good flow property, bulk density, tapped density, porosity, carr's index, hausner's ratio, angle of repose, % ash value, weight variation, disintegration test was performed. We also performed antimicrobial study of ***Tectona grandis linn*** leaves powder to prepare its solid unit dosage form (capsule) which will be more stable. After that, we have used this batch B (sieve # 80) for final preparation. We have again prepared 4 batch by using batch B. Then, we come to the conclusion that, batch F2 qualifying all the evaluation test like weight variation test, disintegration test, moisture content, etc.

Future Prospective

We can continue this project by changing its dosage form and performing animal study.

REFERENCE

1) Yenty surtyanti, triana maningsih, soerya Dewi marliyana "Identification of active compounds and Anti-oxidant Activity of teak *(tectona grandis*) leaves" Journal of biological diversity 21(3), 2020. Biodiversitas 21:941-947.
2) K Amutha, R sagaya, Ayyanar Giri "GC-MS, Anti-oxidant, Anti-diabetics and Anti-fungal potential of dye extract obtained from tectona grandis leaves" Journal of Eco-friendly agriculture 19(1), 2024, 41-48.
3) Rajkumar S Bagali, sunil S Jalalpure, SS Patil "In-vitro Anti-oxidant and In-vivo Hapatoprotective activity of ethanolic extract of tectona grandis bark against CCl4 indused liver injury in rats". Pharmacognosy journal 12(3),2020.
4) Mei Han, fenxian yang, kun zhang, jiyan Ni, xia zhao, yumai zhang, jinglu" Anti-oxidant, Anti-Inflammatory and Anti-Diabetic Activities of Tectona grandis Methanolic Extracts, Fractions and Isolated compounds". Antioxidants 12 (3, 664, 2023.
5) Lutfor Rahman, Jutika Goswami, Bijoy Goswami"Assessment of anti-oxidant activity of Physiochemical properties of polymeric bio-composites using natural extract for active food packaging application". journal of Thermoplastic composite materials 36(5), 2120-2125, 2023.
6) Meetu singh, Neerja Sharma,Amit sarin, sujit keshavani, Gaurav Dwivedi, Tikendra Nath verma "Influence of irridation and addition of anti-oxidant jathropha, phogamia and Tectona grandis biodiesels"international journal of Ambient Energy 43(1) , 2023,7006-7019.
7) Krishna MS, Nair JA. 2010. Antibacterial, cytotoxic and antioxidant potentials from different extracts of leaves, bark and wood of Tectona grandis. Int J Pharma Sci Drug Res. 2(2):155–158.
8) Ramachandran S, Rajasekaran A, Kumar MKT. 2011. Antidiabetic, hyperlipidemic and antioxidant potentials of methanol extract of Tectona grandis flowers in

Journal of Advancement in Pharmacognosy
Volume 4 Issue 1, 2024
ISSN: 2582-8401

streptozotocininduced diabetic rats. Asian Pac J Trop Med. 4(8):624–631.10.1016/S1995-7645(11)60160.

9) Rao KNV, Aradhana R, David B, Chaitanya RS, Kumar A. 2011. In-vitro anti-oxidant and free radical scavenging activity of various extracts of Tectona grandis Linn leaves. J Pharm Res. 4(2):440–442.
10) Abdel-Hameed ES, Salih AB, Mohamed MS, Mortada ME, Eman AE. Phytochemical studies and evaluation of antioxidant, anticancer and antimicrobial properties of Conocarpus erectus L. growing in Taif, Saudi Arabia. European Journal of Medicinal Plants, 2(2), 2012, 93-112
11) Ayed MM, Salah AA, Hanan AE, Mahfouz MA, Maher MA, El-Sayed SA, Waffa SA, Ezzat EA. Evaluation of Antioxidant and Antimicrobial Activities of Certain Cassia Species. Australian Journal of Basic and Applied Sciences, 5(9), 2011, 344-352.
12) Shabbir G, Anwar F, Sultana B, Khalid ZM, Afzal M, Khan MQ, Ashrafuzzaman M. Antioxidant and antimicrobial attributes and phenolics of different solvent extracts from leaves, flowers and bark of Gold Mohar [Delonix regia (Bojer ex Hook.) Raf.]. Molecules, 16, 2011, 7302-7319.
13) Zheng W, Wang S. Antioxidant activity and phenolic composition in selected herbs. Journal of Agricultural and Food Chemistry, 49, 2010, 5165-5170.
14) Rao KNV, Aradhana R, David B, Chaitanya R, Anil KA. In vitro antioxidant and free radical scavenging activity of various extracts of Tectona grandis Linn leaves. Journal of Pharmacy Research, 4, 2011, 440-442.
15) Pyo YH, Lee TC, Logendrac L, Rosen RT. Antioxidant activity and phenolic compounds of Swiss chard (Beta vulgaris subspecies cycla) extracts. Food Chemistry, 85, 2004, 19-26.
16) Rice-Evans C, Miller N, Paganga G. Structure-antioxidant activity relationships of flavonoids and phenolic acids. Free Radical Biology and Medicine, 20, 1996, 933-956.
17) Shon MY, Choi SD, Kahng GG, Nam SH, Sung NJ. Antimutagenic, antioxidant and free radical scavenging activity of ethyl acetate extracts from white, yellow and red onions. Food and Chemical Toxicology, 42, 2004, 659-66.
18) Mahesh SK, Jayakumaran NA. Antibacterial, Cytotoxic and Antioxidant Potential of Different Extracts from Leaf, Bark and Wood of Tectona grandis, Internat J Pharmaceut Scie and Drug Res 2010; 2(2): 155-158.
19) Rao KNV, Aradhana R, David B, Chaitanya RS, Anil Kumar A. InVitro Anti-Oxidant and Free Radical Scavenging Activity of Various Extracts of Tectona grandis. Linn Leaves, J Pharm Res 2011; 4(2): 440-442.
20) Jagetia GC, Baliga MS. The evaluation of nitric oxide scavenging activity of certain Indian medicinal plants in vitro: a preliminary study. Naturwissenschaften. 1984; 71(11): 581-582.
21) C.P. Khare. Indian Medicinal Plants, (An illustrated dictionary, Springer internations, New Delhi, 2004) pp. 649-650.
22) The Wealth of India, A dictionary of Indian Raw materials and Industrial Products, (NISCAIR, CSIR publications, New Delhi, 2004) Vol.-V, pp.195-197.
23) W.V. Sandermann and M.H. Simatupang. On the Chemistry and Biochemistry of Teak wood (Tectona grandis L.). Jg. Heft mai. 190-199 (1966).
24) R.M. Khan and S.M. Mlungwana. 5-hydroxylapachol a cytotoxic agent from Tectona grandis. Phytochemistry. 50(3): 439- 442 (1999).
25) P.K. Gupta and P. Singh. A naphthoquinone derivative from Tectona grandis (Linn.). J Asian Nat Prod Res. 6(3): 237- 40 (2004).
26) Ahmed A, Rajendaran K, Jaiswal D, Singh HP, Mishra A, Chandra D, Yadav IK, Jain DA (2010). Anti-snake venom activity of different extracts of Pouzolzia indica against Russel

Journal of Advancement in Pharmacognosy
Volume 4 Issue 1, 2024
ISSN: 2582-8401

viper venom. Int J ChemTech Res 2: 744- 751.
27) Ameen NA, Salihu T, Mbaoji CO, Anoruo-Dibia CA, Adedokun RAM (2015). Medicinal plants used to treat snake bite by Fulani herdsmen in Taraba state, Nigeria. Int J Appl Agric Apicult Res 11: 10-21.
28) Naira N, Karvekar MD. Isolation of phenolic compounds from the methanol extract of Tectona grandis, Res J Pharmaceutic, Bio and Chem Sci 2010; 1(2):221-225.
29) Pahup S, Sunita J, Sangeeta B. A 1,4-Anthraquinone derivative from Tectona grandis, Phyrochem 1989; 28(4):1258-1259.
30) Khan Z, Ali M, Bagri P. A new steroidal glycoside and fatty acid esters from the stem bark of Tectona grandis Linn. Nat Prod Commun 20; 5(3): 427-430.
31) Lacret R, Varela RM, Molinillo JM, Nogueiras C, Macías FA. Anthratectone and naphthotectone, two quinones from bioactive extracts of Tectona grandis. Int J Ayurveda Res. 2010; 1(4):211-215.
32) Neamatallah A, Yan L, Dewar SJ, Austin B. An extract from teak (Tectona grandis) bark inhibited Listeria monocytogenes and methicillin resistant Staphylococcus aureus, Lett in Applied Microbio, 2005; 41: 94–96.
33) Didry N, Dubreuil L, Pinkas M. Activity of anthraquinonic and naphthoquinonic compounds on oral bacteria. Pharmazie 1994; 49: 681–683.
34) Cai L, Wei GX, van der Bijl P, Wu CD. Namibian chewing stick, Dispyros lycioides, contains antibacterial compounds against oral pathogens. J Agric Food Chem 2000; 48: 909–914.
35) Darout IA, Skaug N. Chewing sticks: timeless natural toothbrushes for oral cleansing. J Periodontal Res 2001; 36: 275–284.
36) Purushotham KG, Arun P, Jayarani JJ, Vasnthakumari R, Sankar L, Bijjam RR. Synergistic In Vitro Antibacterial Activity of Tectona grandis Leaves With Tetracycline, Int J Pharm Tech Res 2010; 2(1): 519-523.
37) Mahesh SK, Jayakumaran NA. Antibacterial, Cytotoxic and Antioxidant Potential of Different Extracts from Leaf, Bark and Wood of Tectona grandis, Internat J Pharmaceut Scie and Drug Res 2010; 2(2): 155-158.
38) "MM Ghaisas, VV Navghare, AR Takawale, VS Zope, AD Deshpande Pharmacologyonline 3, 296-305, 2008".
39) Manisha Sahay, Richa Sharma International Journal of Innovative Science, Engineering & Technology 2 (11), 906-908, 2015.
40) Stanley Chijioke Eluu, Augustine Okpani Oko, Ukwueze Calistus Kelechi Ugwu Daniel Onyedikachi Interdisciplinary Science Reviews 14 (2), 90-96, 2018.