

## PHYTOCHEMICAL AND ANTIMICROBIAL ACTIVITY OF *GMELINA ARBOREA* ROXB.

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### Abstract

*Gmelina arborea* Roxb. (White Teak) is a deciduous plant which belongs to the family Lamiaceae. This family is observed in Kyaing Tong University Campus area, Kyaing Tong Township. White teak is detected the morphological and organoleptic characters, medicinal uses, physicochemical properties, phytochemical constituents, elemental analysis and antimicrobial activity. Firstly, the morphological and organoleptic characters were presented. Medicinal and other uses were described from local people and practitioners. Secondly, the physicochemical properties showed that the solubility of the powdered samples was more soluble in ethanol, distilled water and methanol than other solvents. Phytochemical analysis of the powdered samples of leaves revealed the absence of steroid and others are presence in the different extract of the species. In the elemental analysis, percentage of calcium, silicon and potassium are higher than other elements. The antimicrobial activity against the tests organisms was founded. Especially pet ether, water extract and methanol extract were more effective than other solvent but possess the highest against on *Xanthomonas oryzae*, *Pseumonus fluorescens* and *Aspergillus flavous*. These investigations may be helpful in development of herbal formulations.

**Keywords:** *Gmelina arborea* Roxb., morphological, physicochemical properties, phytochemical constituents, elemental analysis, antimicrobial activity, medicinal uses

### Introduction

*Gmelina arborea* Roxb. (Verbenaceae) is native to Asia and known by various names, e.g. Yemane, Gamar, Gumhar and, Sor. This species has been introduced in several countries, particularly in West Africa and in Côte d'Ivoire and Nigeria, widespread in tropical and subtropical few temperate (Heywood, 1978). The family consist of 73 genera and over 3000 species and over 2600 species are herbs, shrubs, tree or climber. Often prickly and some are xerophytic in habit. The area of distribution includes Nepal, India, Pakistan, Bangladesh, Sri Lanka, Myanmar, Thailand, Laos, Cambodia, Vietnam and South China.

It has been introduced as a plantation species, and large plantations are found in South East Asia, West Africa and South America. (Ahiola, 2017).

*Gmelina arborea* is one of the important medicinal plants most widely propagated and cultivated species. It is one of the herbs mentioned in all ancient scriptures of Ayurveda. The medicinal plant is highly used from time immemorial because of its vast medicinal properties. It is extensively used traditionally as antihelminthic, antimicrobial, antidiabetic, diuretic, hepatoprotective and antiepileptic agent Indian medicinal plant, 2011).

Ethnobotanical studies report that the species is widely used to treat many diseases including diarrhoea, hypertension and malaria, among others (Sharma & Balakrishnav, 1993).

*Gmelina arborea* is one among the most highly treasured medicinal plant species which is being used in the treatment of fever, heart diseases, nerve disorders, a number of digestive and reproductive disorders (Pemiah, 2014). This deciduous tree, indigenous to the tropical and subtropical region of Southeast Asia has widespread medicinal values embedded in all of its parts. (Asolkar, 1992).

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In general, secondary metabolites are an important source with a variety of structural arrangement and properties. The plant derived compounds have a long history of clinical use, better patient tolerance and acceptance (Kirtiar & Basu, 1994).

Therefore, the present study was undertaken with the objectives to assess the morphological characters, physicochemical investigation, phytochemical analysis, organoleptic characters, elemental analysis of leaf of *Gmelina arborea* Roxb. and its medicinal uses were described.

### Materials and Methods

In the present study, specimen is collected during the field exploration. The field studies on both the season of flowering periods. The plant was identified at the Department of Botany, Kyaing Tong University, during from the February to May, 2019 with the help of available literatures (Hundley, H.G & Chit Ko Ko. 1961; Lawrence, 1969; Dassanayake, 1983; Burmitt, 1992; Hu Qi-ming, 2009).

The collected leaves were detached and washed with tap water and dried under shady place good ventilation for 15 days. Then the dried samples were powdered using kitchen blender and stored in air tight containers for further study. Physicochemical investigation of leaves was made according to The British Pharmacopoeia 1968.

The crude extracts were qualitatively tested for the presence of various secondary metabolites using standard established methods. The tests have been performed according to Trease and Evans, 2002.

The elemental analysis was analysed by using Energy Dispersive X-ray Florescence (EDXRF) spectrophotometer in URC, Monywa University.

Antimicrobial activities of crude extracts of sample were tested on six pathogenic microorganisms by using paper disc diffusion method described by Cruickshank, R. 1975.

### Results

Scientific Name	- <i>Gmelina arborea</i> Roxb.
Vernacular Name	- Ye-ma-ne
Family Name	- Lamiaceae
English Name	- White teak, Comb tree

Perennial deciduous large tree about 20 m high. Leaves simple, opposite and decussate, petiole long, glabrous, lamina broadly ovate, 10 - 25 × 7 - 17cm, cordate or truncate at the base with 2 glands at insertion of leaves, strongly toothed along the margin with young, margin entire, long acuminate at the apex, densely fulvous with stellate hair beneath. Inflorescences terminal and axillary paniculate cymes, peduncles 7 - 40 cm long. Flowers yellow to orange brown, about 2.5cm in diameter, fragrant. Sepals broadly campanulate, equally 5 toothed, densely fulvous-tomentose hair, tube with 2 glands without, teeth triangular, acute. Petals 5, funnelform, bilabiate, deeply 5 lobed, showy, fragrant, brownish yellow without and bright yellow within, 4 - 3.8cm long, oblique funnel form at throat, lobed unequal, upper lip orange pink, deeply divided 2 oblong, lower lip lemon yellow, about as long or twice as long as the upper and 3-lobed, ovate middle lobe much longer and broader than the ovate- rounded lateral ones. Stamens 4, didynamous, filament stout, yellow, anther ditheous, oblong- lanceolate. Style slender, stigma short, bifid.

**Uses**

The wood is used making for light construction and for pulp. Several parts of the tree are used for medicine.

The plant has been traditionally used for the treatment of various ailments. Leaves paste is applied to relieve headache and juice is used wash for ulcers and sunburn. Leaves juice are treat to leprosy and blood disorders. A juice made from the leaves is used to treat cough, diabetes, hypertension and skin diseases. Young leaves juice to cure diabetes. The seeds and leaves juice are considered a tonic for the heart, throat and for a variety of purposes. The paste made of leaves is applied to painful swelling and skin diseases.



**Figure 1** Inflorescence



**Figure 2** Flowers and petal



**Figure 3** Sepal



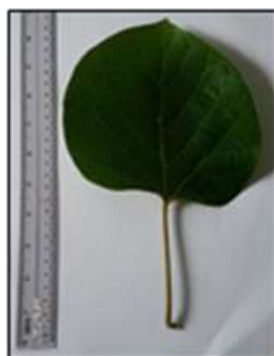
**Figure 4** Stamen



**Figure 5** Style and stigma

**Organoleptic characters of leaves of *Gmelina arborea* Roxb.**

In the present study the powdered leaves of *Gmelina arborea* Roxb was greenish brown in colour, the odour was pungent and taste was tasteless and the fracture fibrous was investigated.



**Figure 6** Leaves



**Figure 7** Powdered

### Determination of plant secondary metabolites

*Gmelina arborea* Roxb. revealed the presence of phytochemical constituents such as alkaloids, reducing sugar, glycosides, phenol, saponin, tannin, flavonoid, terpenoid and polyphenol were present and steroid was absent. Table (1)

**Table 1 Preliminary phytochemical analysis from leaves of *Gmelina arborea* Roxb.**

No	Test	Extract	Test Reagent	Observation	Result
1	Alkaloid	1 % HCl	Dragendorff's reagent	Orange ppt	+
2	Glycoside	H <sub>2</sub> O	10% Lead acetate solution	White ppt	+
3	Flavonoid	EtOH	Mg. turning Conc. HCl acid	Pink color	+
4	Phenol	H <sub>2</sub> O	5% Ferric chloride	Greenish black	+
5	Tannin	H <sub>2</sub> O	1% Gelatin Solution	Green color	+
6	Reducing Sugar	H <sub>2</sub> O	Fehling's solution	Brick red ppt	+
7	Saponin	H <sub>2</sub> O	Distilled water	Frothings	+
8	Polyphenol	H <sub>2</sub> O	1% FeCl <sub>3</sub> , 1% K <sub>3</sub> Fe (CN) <sub>6</sub>	Greenish blue	+
9	Steroid	P. E	EtOH, Conc H <sub>2</sub> SO <sub>4</sub> , CHCl <sub>3</sub>	No change in color	-
10	Terpenoid	P. E	CHCl <sub>3</sub> , Conc H <sub>2</sub> SO <sub>4</sub>	Reddish brown	+

The physicochemical properties showed that the solubility of the powdered samples was more soluble in ethanol, distilled water and methanol than other solvents. (Table 2)

**Table 2 Physicochemical investigation of leaves of *Gmelina arborea* Roxb.**

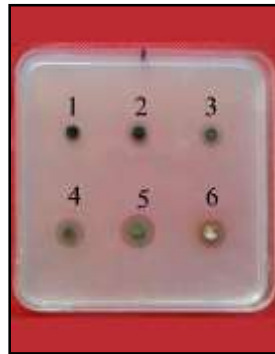
No	Physicochemical properties	Leaves Average %
1	Petroleum ether soluble content	2.0
2	Ethyl Acetate soluble content	6.0
3	Acetone soluble content	4.0
4	Methanol soluble content	8.0
5	Ethanol soluble content	15.0
6	Distilled water-soluble content	10.0

**Table 3 Antimicrobial activities of leaves of *Gmelina arborea* Roxb.**

Solvents	Organisms					
	<i>Bacillus subtilis</i>	<i>Aspergillus flavous</i>	<i>Pseudomonas fluorescens</i>	<i>Xanthomonas Oryzae</i>	<i>Candida albicans</i>	<i>E. coli</i>
Pet-ether	8mm(+)	14mm(+)	12mm(+)	16mm(+)	10mm(+)	10mm(+)
Acetone	8mm(+)	8mm(+)	8mm(+)	8mm(+)	8mm (+)	8mm(+)
MeOH	8mm(+)	12mm(+)	12mm(+)	14mm(+)	14mm(+)	8mm (+)
EtOAc	8mm(+)	10mm(+)	10mm(+)	10mm(+)	8mm (+)	10mm(+)
EtOH	8mm(+)	10mm(+)	12mm(+)	12mm(+)	10mm(+)	12mm(+)
D/W	12mm(+)	12mm(+)	14mm(+)	14mm(+)	14mm(+)	14mm(+)



**Figure 8** *E. coli*



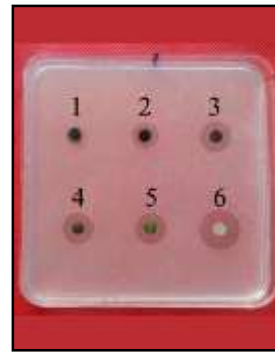
**Figure 9** *Aspergillus flavous*



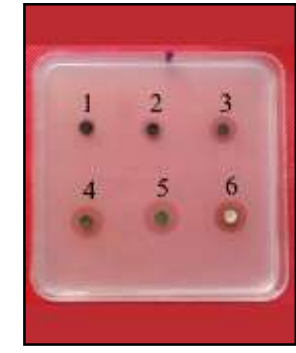
**Figure 10** *Bacillus subtilis*



**Figure 11** *Candida albicans*



**Figure 12** *Pseudomonas fluorescens*



**Figure 13** *Xanthomonas Oryzae*

- |            |          |
|------------|----------|
| 1. Acetone | 4. MeOH  |
| 2. EtoAc   | 5. P/E   |
| 3. EtOH    | 6. Water |

## EDX Report

Report No.

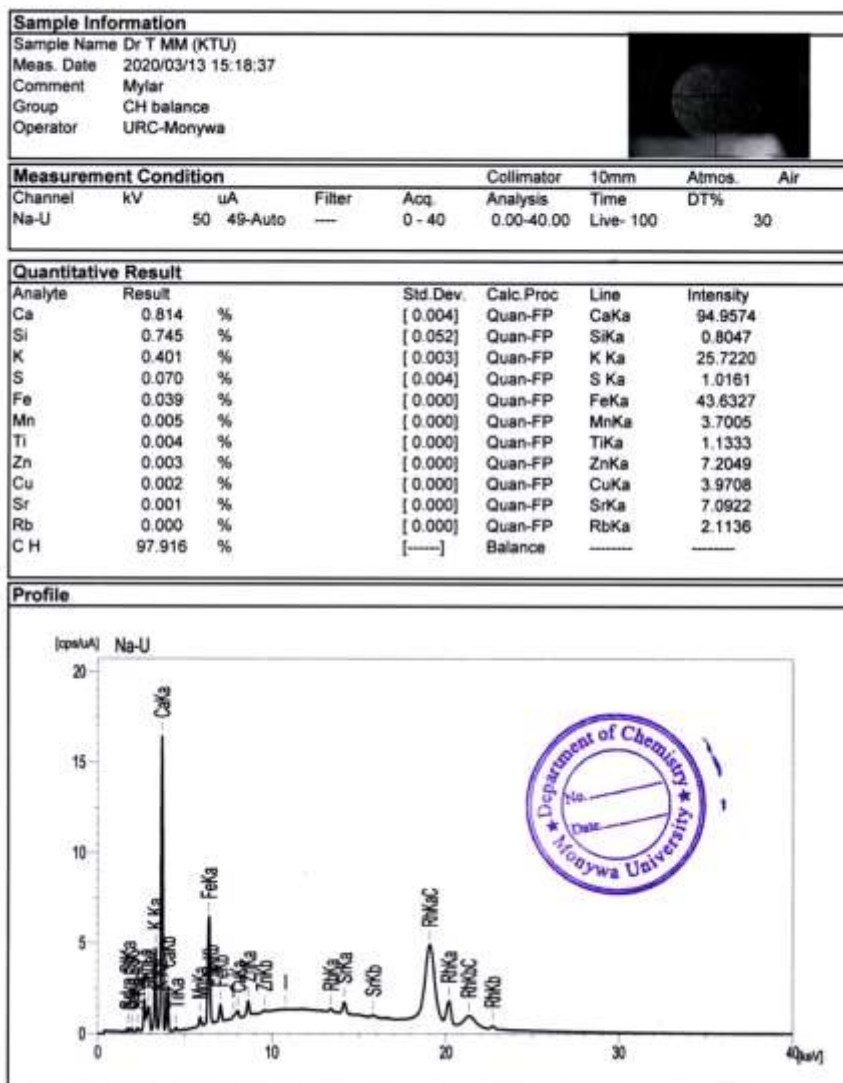


Figure 14 EDXRF Spectrum of leaves of *Gmelina arborea* Roxb.

In the elemental analysis of select plant, Ca, Si, K, S and Fe were present various percentages than another Mn, Ti, Zn, Cu and Sr in EDXRF spectrum. Toxic minerals such as Hg, Pb, Cd and as were not found.

### Discussion and Conclusion

In the present study, morphological studies, organoleptic characters, physicochemical properties phytochemical constituents, elemental analysis, antimicrobial activity and uses of medicinal are described on leaves of *Gmelina arborea* Roxb. was carried out.

Leaves simple, opposite and decussate, densely fulvous with stellate hair beneath. Inflorescences terminal and axillary paniculate cymes. Flowers yellow to orange brown, fragrant. Sepals broadly campanulate, toothed, densely fulvous-tomentose hair, tube with 2 glands without. Petals funnel form, bilabiate, showy, fragrant, brownish yellow without and bright yellow within, oblique funnel form at throat. Stamens are didynamous, filament stout, yellow. Style slender, stigma bifid. These characters agreed with Hundley, H.G & Chit Ko Ko. 1961; Lawrence, 1969; Dassanayake, 1983; Burmmitt, 1992; Hu Qi-ming, 2009.

Leaves paste is applied to relieve headache and juice is used wash for ulcers and sunburn. Leaves juice are treat to leprosy and blood disorders. A juice made from the leaves is used to treat cough, diabetes, hypertension and skin diseases. Leaves juice are treat to leprosy and blood disorders. Young leaves juice to cure diabetes.

According to Navreet, 2018, leaves are used for treatment of headache and stomach ulcers, leprosy, hypertension, fruits are used as diuretic and for treatment of anaemia, leprosy and sexual debility in males.

The powdered leaf of *Gmelina arborea* Roxb was greenish brown in colour, the odour was pungent and taste was tasteless and the fracture fibrous was investigated.

The physicochemical properties showed that the solubility of the powdered samples was more soluble in ethanol, distilled water and methanol than other solvents.

Manasa *et al*, 2017, described that ethanol soluble extractive value 12.14%, alcohol soluble extractive value 1.14%, and water-soluble extractive value 11.03%. Shukla, 2010 *et al*, stated that root and leaves of *Gmelina arborea* were investigated and the methanolic extract and ethyl acetate fraction (4.0%, 5.5%) were used for evaluating the pharmacological activity.

Phytochemicals are non-nutritive compounds (secondary metabolites) that contribute to plants immunity, flavour and colour. In a general definition, they are the plant chemicals that protect plant cells from environmental hazards such as pollution, stress, drought, UV exposure and pathogenic attack (Gibson,1998, Mathai, 2000).

In this study, phytochemical tests demonstrated the absence of steroid and glycosides, phenol, polyphenol, saponin, reducing sugar, terpenoid, alkaloid, flavonoid, tannin were present. Leaves of *Gmelina arborea* have phenolic compounds such as flavonoids contribute to increase plasma antioxidant capacity, decreased oxidative stress makers and reduced total and LDL cholesterol. It has potential to therapeutic effects in diabetes induced diabetic rats (Kalaivani, 2014).

In this study, the highest antimicrobial activity of pet ether, water and methanol extract was observed on *Xanthomonas oryzae*, *Pseudomonas fluorescens* and *Aspergillus flavous*. Deepthi *et al*, 2015, Walter, 2017 stated that study of leaf extracts showed significant activity against *E coli*, *Candida albicans*, *Xanthomonas oryzae*, *Klebsiella pneumoniae*, *Pseudomonous dysmetria* and *Salmonella typhi*.

Sevilla, 1999 stated that *Gmelina arborea* are non-toxic concentrations of tannic acid and coumarin as indicated by normal haematological values among sheep fed. All over the world, there is increasing interest in the importance of dietary minerals in the prevention of several diseases. Minerals are of critical importance in the diet, major minerals are those required in amounts greater than 150 mg per day and they represent 1% or less of body weight (Brook and Caldwell, 1954).

These include calcium, potassium, phosphorous, sulphur, chloride and magnesium. Essential trace elements are zinc, iron, copper, fluoride, iodine, chromium. The body required these minerals and vitamins for vital processing (Brooks and Caldwell, 1954).

According to EDXRF elemental analysis, Calcium (Ca), Potassium (K), Sulphur (S) and Iron (Fe) are found in powdered leaves. Percentage of calcium and potassium are higher than other elements.

Julian 1979, stated that nitrogen, phosphorous, zinc and boron level decreased and calcium and iron levels increased in the leaf.

Mineral matter is another essential class of food. Calcium is the most abundant mineral in the body. Ninety- nine percent of the calcium of the body is in the bones and teeth in the form of

chemical compounds which also contain phosphorus. The remaining one percent of this mineral is found in the blood stream and in the soft tissues. Calcium helps to maintain the normal functions of the nerves and muscles, including the regular beating of the heart. This mineral is necessary in the prevention of rickets. Approximately 99 percent of the body calcium is stored in the bones and teeth.

Potassium ions are necessary for the function of all living cells, Potassium ions shifts across nerve cell membranes are necessary for normal nerve transmission: potassium depletion or excess can result in numerous abnormalities, including an abnormal heart rhythm and various electrocardiographic (ECG) abnormalities (Kipping, 1951).

Since this plant is claimed to be useful in the treatment of rheumatism, it is said to possess anti-inflammatory action (Craig, 2009).

It was concluded that the selected plant possesses various potent bioactive compounds and is recommended as a plant of phytopharmaceutical importance. Continuous research and studies of potential herbs and medicinal plants are important as natural products from plant origin will continue to be in demand.

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### References

- Ahiola. O, A. A. Mako. (2017). **Evaluation of nutrient contents of *Gmelina arborea* leaves as animal feed in the tropics.** Nigerian Journal of Animal Science.
- Asolkar LV, Kakkar KK and Chakre OJ. (1992). **Second Supplement to Glossary of Indian Medicinal Plants with Active Principles Part I (A-K).** Publications and Informations Directorate (CSIR). New Delhi.
- British Pharmacopoeia. (1968). **The Pharmaceutical Press**, London and Brad ford, 17 Bloomsbury Square, London.
- Brooks, K. G and E. Caldwell. (1954.) **The Fundamentals of College Chemistry.**
- Burmmitt, R. K. (1992). **Vascular Plants Families and Genera.** Royal Botanical Garden, Kew, Printed and bound by Whitstable Litho. Ltd., Great Britain.
- Craig, W.J. Health promoting properties of common herbs. (2009). **The American Journal of Clinical Nutrition;** 70: 491-499.
- Cruickshank. R.J.P. (1975). **Medicinal Microbiology;** London. Livingstone Ltd.
- Dassanayake. M. D. (1983). **Flora of Ceylon.** Vol. IV. University of Peradeniya. Dept. oagriculture, Sri Lanka Natural Resources, United Kingdom.
- Deepthi P., A. Harini., Prakash H., Dr. (2015). **A Review on Gambbari (*Gmelina arborea*).** Journal of Pharmacognosy and Phytochemistry.
- Gibson EL, Wardel J, and Watts CJ. (1998). **Fruit and Vegetable Consumption-Nutritional Knowledge and Beliefs in Mothers and Children.** Appetite 31: 205-228.
- Heywood, V.H. (1978). **Flowering plants of the world.** Oxford University, Press London.
- Hundley, H.G & Chit Ko Ko. (1961). **List of Trees, Shrubs, Herbs and Principle** (Limbers of Burma. (3rd.ed). Rangoon: Government Printing Press.
- Hu Qi-ming. (2009). **Flora of Hong Kong. Vol. 3.** Agriculture, Fisheries and Conservation Department, Government of the Hong Kong Special Administrative region.
- Julian Evans. (1979). **The effect of leaf position and leaf in foliar analysis of *Gmelina arborea*.** Plant and soil. Springer Nature Switzerland.



- Kalaivani R., Kumaresan P., Jeyanthi KA. (2014). **Biochemical evaluation of anti-diabetic activity of aqueous extract of *Gmelina arborea* in Alloxan-induced albino rats.** International Journal of Herbal Medicine.
- Kipping, F S and F. Kipping. (1951). **Organic Chemistry**, W and R Chambers Ltd London.
- Kirtikar, K R. Basu, BD. (1994). **Indian Medicinal plants**. Dehra Dun, India, Dehra Dun Publisher.
- Lawrence, G.H.M. (1969). **Taxonomy of vascular plants**. (10<sup>th</sup> ed). New York:
- Manasa K., Shrikanth P., Ravikrishna S., Suchittha P. (2017). **Pharmacognostic and Phytochemical study of leaf of Gambhari (*Gmelina arborea* Roxb.)**. International Ayurvedic Medical Journal.
- Mathai K. (2000). **Nutrition in the Adult Years in Krause's Food, Nutrition, and Diet Therapy**, Edn 10, 271, L.K. Mahan and S. Escott-Stump.
- Medicinal Plants Unit Indian Council of Research (2011). **Quality Standards of Indian Medicinal Plants. Vol VI, Indian Council of Medicinal Research**, New Delhi.
- Navrett Kaur & Sarabjit Kaur. (2018). **Pharmacognostic and phytochemical evaluation of *Gmelina arborea* roxb.** Journal of Pharmacognosy and phytochemistry.
- Pemiah B and Chellappan DR. (2014). **Pharmacognostical, phytochemical and in vivo gastro-protective investigation of *Gmelina arborea***. International Journal of Pharmacy and Pharmaceutical Sciences.
- Sevilla, C. C. Meriales. (1999). **Utilization of *Gmelina arborea* leaves and fruits as feed for sheep *Ovis aries* Linn.** Los Banas, college, Laguna, Philippines. Inst. Of animal Science. Food and Agriculture Organization of the United Nations.
- Sharma BP. and Balakrishnav NP. (1993). **Flora of India 2**. India: Botanical Survey of Calcutta
- Trease, G.E & Evans, W. (2002). **Pharmacognosy**. (11<sup>th</sup> ed). London. Cassell Collier Macmillan Publishers Ltd.
- Walter L. (2017). **Antimicrobial, Anthelmintic and Traditionally Used for Treating Infectious Disease in the Similipal Biosphere Reserve, Odisha, India**. North Orissa University, Baripada, Indi