PG and Research Department of Botany

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ORIGINAL ARTICLE

Investigation of Bioactive Compounds from Medicinally Important Herb *Byttneria herbacea* Extract Using GC-MS.

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ABSTRACT

The present study carried out the screening of the bioactive compounds present in Byttneriaherbacea whole plant extract using Gas Chromatography–Mass Spectrometry (GC-MS). The study, confirms presence of tannin, saponin, flavonoids, steroids, terpenoids, triterpenoids, anthraquinone, polyphenol, glycoside and coumarins. In the GC-MS investigation, twenty four compounds were identified and they were capable of various pharmacological activities like anti-inflammatory, anticancer, anti-arthritic, antiulcer and antimicrobial activity.

Key words: *GC-MS, Bioactive compound, pharmacological activities, Byttneria herbacea*

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INTRODUCTION

Plants are rich source of traditional medicine systems, food supplements, modern medicines, folk medicines, pharmaceutical intermediates and chemical entities for synthetic drugs due to presence of numerous bioactive phytochemicals, essential mineral elements and other pharmacological properties [1]. A small part of the higher plants that yields around 120 remedial measures of known chemical structure have been identified the major plants derived drugs arevinblastine, podophyllotoxin, camptothecin, vincristine, taxol, digitoxigenin, gitoxigenin, digoxigenin, capscicine, allicin, curcumin, artemesinin, tubocurarine, morphine, codeine, headache medicine, atropine, pilocarpine, capsicine, allicin, curcumin, artemesinin and ephedrine [2].

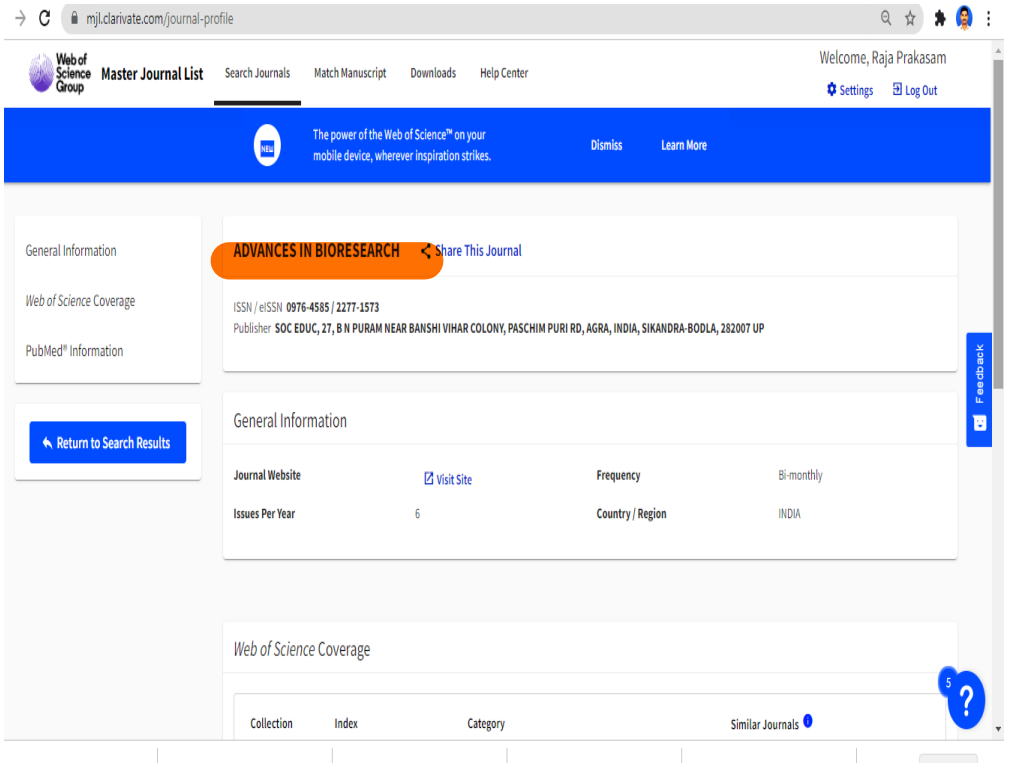
The family "Malvaceae" consist of approximately 244 genera and 4225 species [3]. It is one of the biggest families among the Angiosperms. Many plants of this family have been used in traditional systems of medicines from their ancient times. Still, there are certain medicinal plants whose medicinal properties have not been explored properly. Phytochemical screening is crucial for validating the traditional use of these medicinal plants.

GC-MS technique was used to measure of the active principles in plants [4].GC-MS analysis technique can be used to investigate traditional medicine and to characterize the compounds [5]. The present study aimed to make a preliminary phytochemical and GC-MS analysis of the bioactive compounds present in the *Byttneria herbacea*.

MATERIAL AND METHODS

Collection and Preparation of Sample

The aerial part of *B. herbacea* was collected from Narthamalai Hills of Pudukkottai District, Tamil Nadu. The collected plant-parts were washed in running tap-water to remove the adhering soil particles.They were later washed with sterile distilled water. The cleaned plant-parts were shade-dried, powdered with electric blender and preserved for further investigations. The powder sample was extracted by soxhlet apparatus with different solvents such as Methanol, Acetone, Chloroform, Ethanol and Water.



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A study on preliminary phytochemical screening and antioxidant activity of *Capparis divaricata* L.

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Abstract
Plants are being played an important role by their medicinal values in food and pharmaceutical industries for human welfare like disease prevention and treatment. The currents study characterises the preliminary Phytochemical and antioxidant activity of *Capparis divaricata* by using colorimetric, and spectrophotometric assays. Results revealed that the methanolic leaf extracts of *C. divaricata* (Caperbush) displayed the highest content of total phenols (26.6 mg gallic acid per gram of plant dry weight), flavanoid (52.6 mgRE/g extracts), and tannins (16mg GAE/g DW). The highest antioxidant capacity was measured by DPPH, hydrogen radical scavenging activity, and total antioxidants (26.29µg/ml, 161.26gDMSO/g extract, 17.61 mg GAE/g DR respectively) methods were also obtained in *C.divaricata* leaf extracts. Such potent antioxidant activity of *C.divaricata* leaves can be attributed to the presence of different types of phenolic compounds and the high content in tannins, phenolic, and flavonoids were found to be dominant. Consequently, despite the well-known antioxidant properties of these plant species, our study suggests *C.divaricata* leaf can be used more valuable plant source of natural bioactive molecules for developing novel functional food-pharma ingredients for the betterment of human society.

Keywords: *Capparis divaricata*, antioxidant activity, phytochemical, caperbush

Introduction
India is known to be a rich repository of Medicinal Plants. Plants have been used even from prehistoric times for therapeutic purposes. The ancient cultures-figures like Unani Hakims, Indian Vaids, European and Mediterranean leaves used Medicinal Plants based on customary practice. As herbs are natural drugs they are free from side effects, eco-friendly and cost-effective, and easily available. They save us from the blind dependence on synthetic drugs naturally society is returning to the natural herbs with faith in their security and safety. But the optimum commercial production of herbal drugs is still limited. Population rise, inadequate supply of herbal drugs, the prohibitive cost of treatments, side effects of several synthetic drugs and develop resistance to current drugs for infectious diseases, etc., have contributed to the greater emphasis on the use of plant materials as sources of medicine.
Capparis divaricata is a native plant of the Mediterranean region and is commonly known as Caperbush C. divaricata belongs to the Capparidaceae family and it is a type genus of the family consisting of more than 80 species. Different parts of the plant exhibit pharmacological properties like Antirheumatic, Expectorant, Tonic, Antipyretic and Antispasmodic analgesics (Tilli *et al*, 2011; Patel and Sharma, 2015; Mollica *et al*, 2017) [13, 11, 9]. Phytochemical screening of *C.divaricata* reveals that it consists of various functional Phyto-compounds such as glycosides, saponins, flavonoids, alkaloids, phenols, and tannins (Khandare *et al*, 2012; Hirare and Kondawar, 2016) [5, 3].
The bark extract of *C.divaricata* pounded with leaves of *Erythrina variegate* ginger, garlic, and turmeric mixed with goat's milk is given orally for the treatment of trypanosomiasis (Umberto, 2012). Free radicals are responsible for the damage to lipids, proteins, and nucleic acids in cells. Natural antioxidants have gained importance in the Pharmaceutical and food industry to limit the use of synthetic antioxidants; they have side effects (Namiki, 1990). The biological property of Phenolic compounds is commonly impulsed by metabolism (Hollman, 2001) [6]. It was found that colonic microflora extensively changes most dietary phenols into different molecules (Olthof *et al*, 2003) [16], modifying their chemical structures is not so easily predictable ways (Eddouks *et al*, 2005) [2]. Such changes are very important as they indicate changes in biological properties like antioxidant activity, which are known to be structure-dependent (Flora, 2009) [3]. Phenolic compounds can serve as antioxidants through different mechanisms, like terminating free radicals, reducing oxygen concentration, transforming primary products of oxidation into non-oxidant molecules, or acting as metal chelators (Shahidi and Naczk, 2004). The present investigation aimed to estimate the antioxidant property of methanolic extracts of *Capparis divaricata*.

Materials and Methods
Plant Material
Fresh leaves, fruit, seed, and bark of *C.divaricata* were collected during March 2019 from the Lembalakkudi, Pudukkottai District, Tamil Nadu, India (Latitude: 10.244033; Longitude: 78.747514). The plant samples were brought to the laboratory immediately. The plants were washed thoroughly with tap water to remove dust and exogenous particles. The samples were shade-dried at room temperature until a constant weight was obtained and ground in an electric blender. The powdered samples were stored in the refrigerator for further use.

Preparation of Extract
The various parts of *C.divaricata* were powdered and extracted for 72 h in methanol at room temperature. The

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Isolation and identification of stigmasterol from *Byttneria herbacea* Roxb. using methanol extract

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Abstract
Phytosterols a group of steroidal alcohol, play an important role in the structure and stability of the cell membrane. The present study deals with characterizing the phytosterol from methanolic extract of *Byttneria herbacea* Roxb. The phytochemical was subjected to physical, chemical, and spectral identification using UV- Vis Spectrophotometer, FTIR, ^{1}H-NMR, and ^{13}C-NMR. Based on the spectral data analysis and chemical reactions, the compounds have been recognized as Stigmasterol.

Keywords: phytosterol, stigmasterol, *Byttneria herbacea*, UV-Vis spectrophotometer

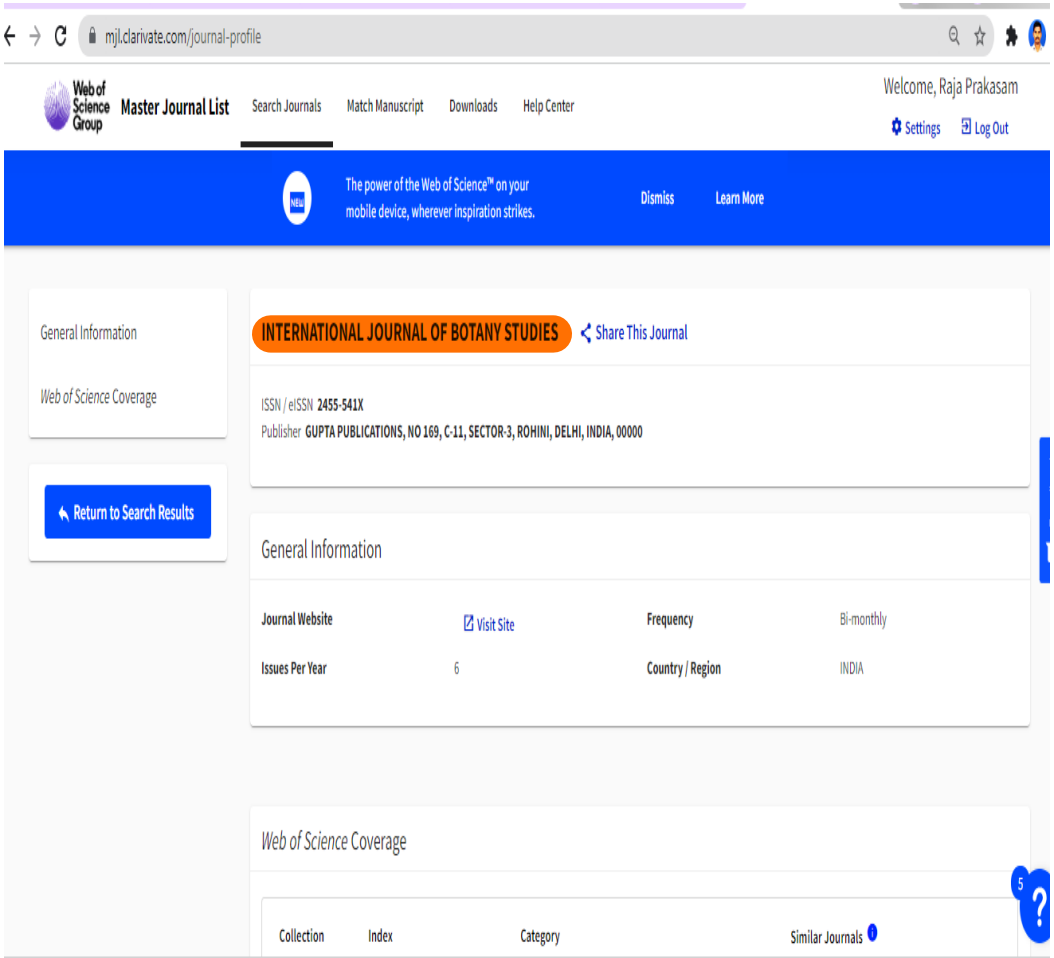
Introduction
The contribution of plants to the life of all living things on earth especially to humans is seen as vital. Various parts of the plant are used as food or medicines without side effects in the treatment of various diseases. Herbal remedies have long been used to treat many ailments (Asila *et al.*, 2018) [1]. Plants are being investigated extensively for their pharmacological potential as a source of raw material for drug discovery. Crude extract of medicinal plants was being used to treat various infectious diseases in traditional medicine systems (Singh *et al.*, 2015 and Hemavathy *et al.*, 2019) [16, 13]. According to the World Health Organization, over 80% of the world's people rely on traditional medicine for their primary healthcare needs (Sasidharan, 2011) [30].
Byttneria herbacea Roxb. Belonging to the Malvaceae family is commonly found in peninsular India (Gujarat, Tamil Nadu, Odisha, and Bihar) (CSIR 1988, Saxena *et al.*, 1994, Tarun *et al.*, 2019) [5, 34, 39]. *B. herbacea* has been described on anti-asthmatic activity (Sharma *et al.*, 2018; Bharathi *et al.*, 2016) [35, 2], anti-inflammatory activity (Sarkar *et al.*, 2013) [31], anti-edematogenic activity (Sarkar *et al.*, 2012) [30], and antioxidant activity (Somkuwar *et al.*, 2014) [37].
Stigmasterol, also known as Stigmasterin or Wuhren anti-stiffness factor is an unsaturated plant sterol present in various plants. It is being used to design synthetic and semi-synthetic compounds in the pharmaceutical industry (Navpreet *et al.*, 2011) [25]. It acts as a forerunner in the synthesis of progesterone and acts as an intermediately in the biosynthesis of androgens, estrogens, corticosteroids, or corticoids (Sundararaman *et al.*, 1977) [38]. It also plays a vital role in the synthesis of vitamin D3 (Kametani *et al.*, 1987) [17].
It has been previously reported in *Physostigma venenosum* (Wind, 1907) [41], *Emilia sonchifolia* (Gao *et al.*, 1993) [8], *Parkia speciosa* (Jamaluddin *et al.*, 1994) [16], *Eclipta alba* (Zhang *et al.*, 1996) [44], *Eclipta prostrate* (Han *et al.*, 1998) [11], *Gypsophila oldhamiana* (Yang *et al.*, 1999) [42], *Croton sublyratus* (De-Eknamkul *et al.*, 2003) [6], *Aralia cordata* (Peng 2005) [29], *Akebia quinata* (Liu *et al.*, 2005) [21], *Heracleum rapula* (Liu *et al.*, 2006) [23], *Ficus hirta* (Li *et al.*, 2006) [22, 19], *Eucalyptus globules* (Yang *et al.*, 2007) [43] and *Desmodium styracifolium* (Li *et al.*, 2007) [7, 20]. Since the stigmasterol has been isolated from various plant species, the present study has been made in *B. herbacea* because the species is locally available and grows as a woody plant.

Materials and Methods:
Plant Collection
Byttneria herbacea was collected from the Narthamalai hills, Pudukkottai District, Tamil Nadu, India. The plant material was identified by the Department of Botany, St. Joseph College (Autonomous), Tiruchirappalli, Tamil Nadu, India and the herbarium voucher specimen had been deposited at the PG and Research Department of Botany, J.J. College of Arts and Science, Pudukkottai, Tamil Nadu, India. The fresh plant was collected and dried at room temperature. The dried material was fine powdered by an electric blender and stored in an airtight container.

Extraction
The powdered plant material was extracted with methanol (60-80° C) in the Soxhlet apparatus. The elute was dried and refluxed with water for 8 hrs. The methanol extract was filtered and concentrated using a rotary vacuum evaporator and the dried extract was stored in an airtight container.

Chromatographic Analysis
The methanol extract of *B. herbacea* was subjected to Thin Layer Chromatography (TLC) using silica gel as stationary phase and chloroform: methanol (1:1) as mobile phase. The chromatograms were developed in Iodine chamber. Column chromatography of *B. herbacea* methanol extract (10g) was conducted by wet packing method using silica gel (Mesh 100-200). The column was run using chloroform, methanol successive by gradient elution technique, and obtained fractions were further studied. A white crystal was formed in any one of the eluates. The crystal was named compound X.

Test for Steroid
The compound X has been tested against Liebermann Buchard and Salkowski reagent for the conformation of the



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A study of preliminary and GC-MS analysis of *Curcuma pseudomontana* J. Graham

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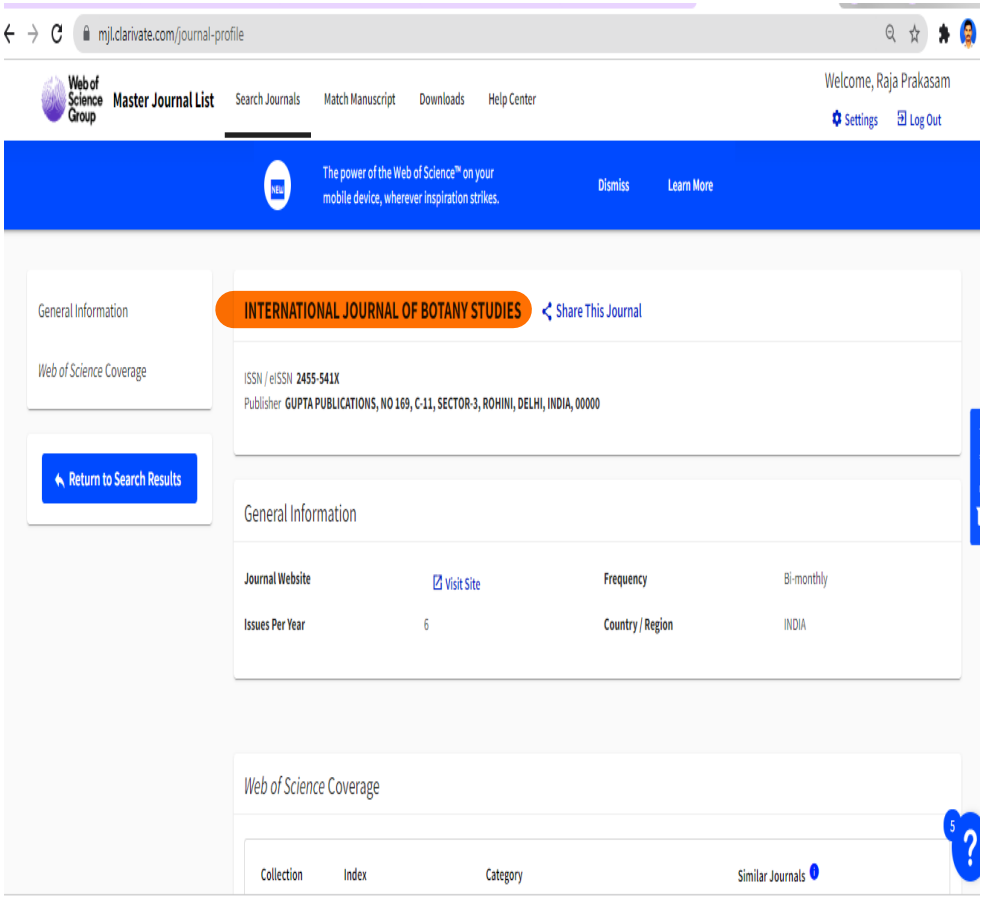
Abstract
Curcuma pseudomontana is one of the plant species reported from the Western Ghats of India, belonging to the family *Zingiberaceae*, with ethno botanical values. In the present investigation, methanol extract of *C.pseudomontana* rhizome was analyzed by preliminary phytochemical and gas chromatography-mass spectrometry (GC–MS) to identify the important phytochemical constituents. The preliminary phytochemical analysis revealed the presence of tannins, flavonoids, alkaloids, glycosides, reducing sugars, and sterol from rhizome extracts. The GC–MS analysis of ethyl acetate and methanol extracts from methanol extract from rhizomes of *C.pseudomontana* detected the presence of 104 phytochemical compounds. The results of the present study will create a way for the invention of herbal medicines for several ailments by using *C.pseudomontana* plants, which may lead to the development of novel drugs.

Keywords: *Curcuma pseudomontana*, rhizome extracts, GC–MS, phyto-chemical

Introduction
India is one of the mega-diversity centers harboring a multitude of medicinal plant species each presumably studied with yet unknown genetic and chemical variations of economic importance. Out of an estimated 17,000 higher plant species present in India, more than 1000 species are used over several centuries in the traditional systems of medicine *viz.* Ayurveda, Siddha, and Unani. The native people and tribal folks spread across the world make use of more than 7000 plant species for their medicinal purposes (Pushpangadan *et al.*, 1997) [18]. Nearly 75% of the herbal drugs that have been used in the world are available in their natural state in India (Jain, 1979) [10]. Plants are the traditional medicinal sources for many chemicals used as pharmaceuticals, bio-chemicals, fragrances, food colors, and flavors (Leung, 1980) [14]. Medicinal plants are the best area of interest to the researcher in the field of phytochemistry, pharmacology and biotechnology, etc., Most of the drug industries depend in part of plants for the production of active pharmaceutical compounds. In modern health care systems, secondary metabolites of plants constitute an ever more important source of modern pharmaceutical drugs, and they are becoming an increasingly valuable commodity in expanding market for herbal remedies. Investigations into the chemical and biological activities of the plant during the past two centuries have yielded numerous compounds for the development of modern synthetic phytochemistry and the emergence of medicinal chemistry as a major route for the discovery of novel and more effective therapeutic agents (Alan Sheeja *et al.*, 2012; Shabir *et al.*, 2013) [3, 19]. The identification of active compounds is an essential requirement for quality control and dose determination of plant-based drugs. Research in the pharmacognosy of medicinal plants has also involved assays of bio-activity, determination of the potential mode of action, and target site for active compounds (Briskin, 2000; Ahmad *et al.*, 2011; Charles *et al.*, 2013) [7].
The *Curcuma* is a genus of economically and medically important. Despite its economic importance, the genus is poorly understood, botanically and chemically. In addition to *C.longa*, the genus includes other economically important species such as *C.aromatica*, *C.pseudomontana*, *C. ochrorhiza*, *C. pierreana*, *C. sedoaria*, and *C. caesia*, etc., used in folk medicines of the Southeast Asian nations. The Latin name *Curcuma* is derived from the Arabic word kurkum, which meant Saffron in olden times. Saffron and Turmeric were the most popular yellow dye-yielding plants in the ancient world, commercially important for dying clothes, fibers, food. Turmeric is popularly known as Indian Saffron in many vernacular languages.

Curcuma pseudomontana J. Graham
This species is a rhizomatous herbaceous perennial, which is found in usually moist shady places on the fringes of wet forests or grasslands, in riparian areas, at moderately high latitude along the western side of the Western Ghats (Mangully and Sabu, 1987) [16]. The taxon occurs both in moist deciduous forests and semi-evergreen forests (Molur *et al.*, 1997) [17]. This plant should be included in belonging to the family-Zingiberaceae, order-Zingiberales. This plant is commonly called Hill Turmeric. In Tamil it is called Kattu Manjal, Hindi-Kachura, Malayalam-Kattu Manjal, Telugu-Adavi Pasupu. The present study is aimed to analyze the phytochemical constituents of the rhizome and find to analyze the bioactive compounds using GC-MS of the rhizome of *Curcuma pseudomontana*.

Materials and Methods
The phytochemical screening of *C. pseudomontana* was performed; the dried powdered rhizome was extracted using



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Research Article

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Green synthesis of silver nanoparticles using *Indigofera cordifolia* leaf extract and their pharmacological potential

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ABSTRACT

Biologically the silver nanoparticles were synthesized from *Indigofera cordifolia* leaves extract. The absorbance of the silver nanoparticles centered at four hundred and twenty nm, with respect to the surface plasmon resonance of silver nanoparticles wavelength. X'RD method proves, biosynthesized NPs would retain the face centered cubic (fcc) structure. In TEM image analysis, silver NPs morphology was spherical in shape. Composition of the silver nanoparticles was obtained by EDAX analysis method. FTIR analysis concluded that biosynthesis Ag NPs was observed at 1384 cm^{-1}, with respect to –NO_3 stretching arises from $AgNO_3$. Ten types of bands are present in the broad emission because of organic matrix bound to silver nanoparticles, which reveals as the result of photoluminescence measurements. The silver NPs possess more antibacterial activity as compared to the standard drug, Amoxicillin.

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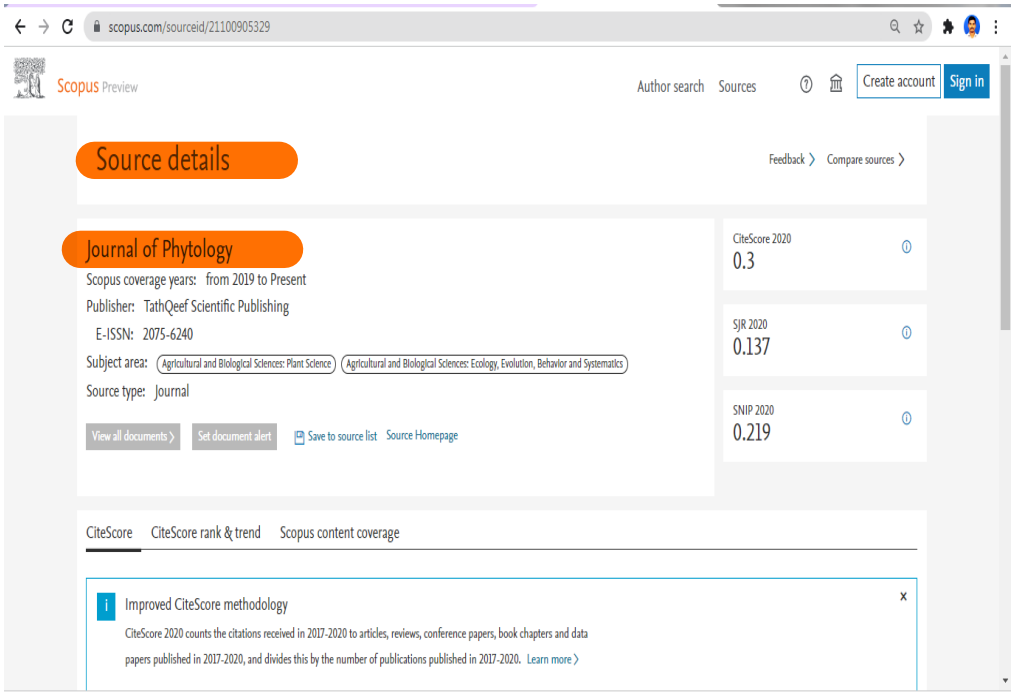
KEYWORDS: *Indigofera cordifolia*, Silver nanoparticle, Green synthesis, Plasmon resonance, X-Ray Diffraction, Antibacterial activity

INTRODUCTION

The green synthesis methods which are eco friendly methods in the field of science and technologies are very much popular in the future and these methods are essential to minimize the issues in agriculture (Thuesombat *et al.*, 2014). The biological production of silver nanoparticles consist of three major stages, the process must studied on the basis of green chemistry perspective, they are selection of solvent medium, reducing agent that are environmentally non invading tumors, and nontoxic substances for the stability of Ag NPs.

Indigofera tinctoria L. belongs to the family Fabaceae, its synonym is *Indigofera zumatrana* Gaertn. Leaves of the plant are medicinally related. The plant is a shrub, flowering occurs in August to December. The plant is empirical in tainted forest areas and scrub jungles, also in the plains. The plant is spread in Paleotropics, widely cultivated in every districts of Kerala. Local names are Amari, Neelayamari. It is a subshrub, originate in moist deciduous forests and also in plains, the plant is widely cultivated (Jasidharan, 2004). *Indigofera tinctoria* is used in constipation, liver disease, heart palpitation and gout (Amrithpal , 2006). The roots, stems and leaves are used for treating chronic bronchitis, asthama, ulcers, skin diseases and is useful for promoting growth of hair. The juice extracted from the leaves is useful in the treatment of hydrophobia. An extract of the plant is high-quality for epilepsy and neuropathy. The plant possesses anti-toxic property (Warrier *et al.*, 2007). The flavonoid fraction of *Indigofera tinctoria* had chemopreventive effect against benzeo pyrene induced lung cancer (Ravichandran & Ravichandran, 2008). The tangential analgesic possessions of *Indigofera tinctoria* was reported Saravanakumar, 2009. The methanolic extract of the entire plant possessed antihelmintic activity against *Pheretima posthuma* (Gunasekaran, *et al.*, 2009). The ethanolic leaf extract *Indigofera tinctoria* have the ability to inhibit the growth of gram positive bacteria namely *Bacillus pumilus*, *Staphylococcus aureus* and *Streptococcus pyrogens*. Strong antioxidant activity was experiential both qualitatively and quantitatively. The cytotoxic effect of *Indigofera tinctoria* leaf extract on lung cancer cell line NCIH69 was studied. The proportion cell viability of cells was found to decrease at increasing attentiveness (Ramukadevi & Sultana, 2011). present work, AgNPs are synthesized *Indigofera cordifolia leaf* extract using a green approach. We identified the morphological



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Green synthesis, characterization and antibacterial activity of silver nanoparticles using *Curcuma pseudomontana*

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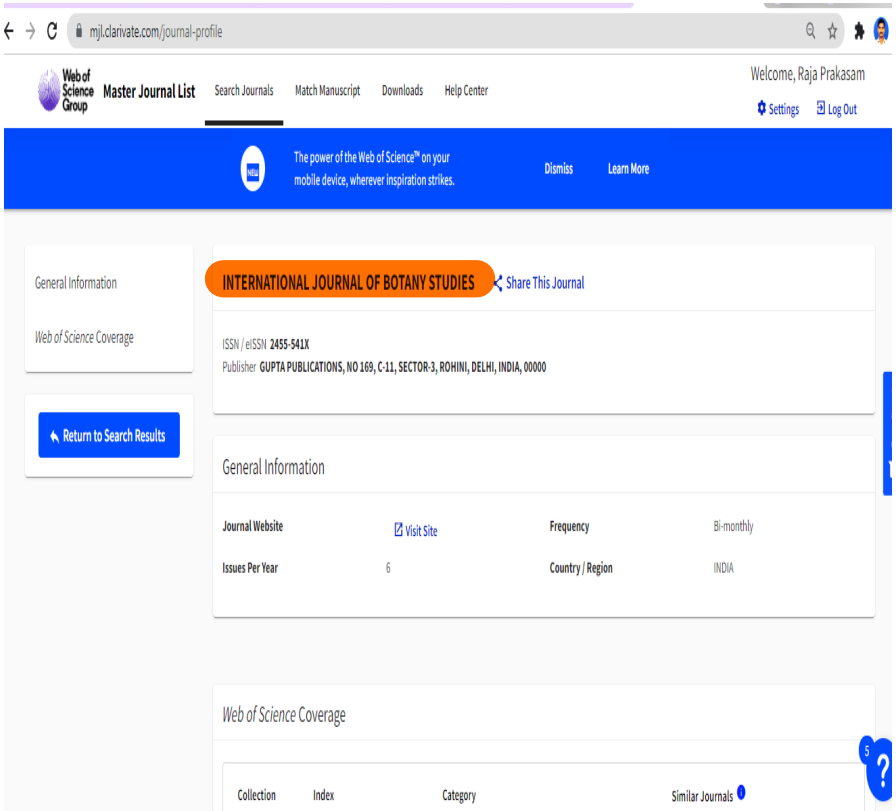
Abstract
The rapid biological synthesis of silver nanoparticles using *Curcuma pseudomontana* leaves extract provides eco-friendly, simple and efficient route for synthesis of benign nanoparticles. The size were bigger as the nanoparticles were surrounded by a thin layer of protein and metabolites such as terpenoids having functional groups of amines, alcohols, ketones, aldehydes, etc., which were found from the characterization using UV-Vis spectrophotometer, SEM, XRD, and FTIR techniques. The size of the nanoparticles in different concentrations was also different which depend on the reduction of metal ions.

Keywords: silver nanoparticles, *Curcuma pseudomontana*, green synthesis, antibacterial activity

Introduction

Due to swift industrialization and urbanization our environment is undergo huge smash up and a large amount of perilous and superfluous chemical, gases or substances are released. Nanotechnology applications are highly suitable for biological molecules, because of their exclusive properties. Metals nanoparticles have a high specific surface area and a high fraction of surface atoms (Amarendra *et al.*, 2010) [1]. Nanoparticles can be synthesized using various methods including chemical, physical, and biological. Chemicals used for nanoparticals synthesis are toxic and non-eco friendly byproduct. Plant provide a better platform for green nanoparticles synthesis as they are free from chemicals as well as provide natural capping agent. Since, there are several experimental performed on the synthesis of silver nanoparticles using medicinal plants such as *Oryza sativa, Helianthus annuus, Saccharum officinarum, Sorghum bicolour, Zea mays, Basella alba, Magnolia kobus, medicago sativa* (Alfalfa), *Cinamomum camphora, and Geranium sp* (Ankanwar *et al.*, 2005; Iravani *et al.*, 2014; Cassandra *et al.*, 2014) [2, 8, 9]. The bactericidal properties of silver nanoparticles are expressed by release of silver ions from the particles, which exhibit the antimicrobial activity. Nanotechnology is rapidly growing field and there importance in a number of such as health care, cosmetic, food and feed, environment health, mechanics, optics, biomedical sciences, chemical industries, electronics, space industries, drug-gene delivery, energy science, optoelectronics, catalysis, reprography, single electron transistors, light emitter, nonlinear optical devices and photo electrochemical applications (Yaqoob Sundas Bahar *et al.*, 2020) [10]. Nanomaterials are seen as solution in the field of solar energy conversion, catalysis, medicine and water treatment. Generally the nanoparticles are designed with surface modifications tailored to meet the needs of specific applications. The enormous diversity of the nanoparticles arising from their wide range of active chemical compounds shape and morphologies (Ibrahim Khan *et al.*, 2019) [3]. The medium in which the particles are present, the state of dispersion of the particles and most importantly, the numerous possible surface modification the nanoparticles can be subjected to make this an important active field of science now-a-day. Nanoparticles can be broadly grouped into two, namely, organic nanoparticles which including carbon nanoparticles (Fullerenes) which, some of the inorganic nanoparticles include nanoparticles (Jeevanandam *et al.*, 2018) [6]. Inorganic nanomaterial have been widely used for cellular delivery due to their versatile features like wide availability, rich functionality, good compatibility, capability of targeted drug delivery and controlled release of drug. The presence of surfactants comprising functionalities for interaction with particle surface can stabilize particle growth and protect particles from sedimentation, agglomeration or losing their surface properties (Burdette and Frossard, 2021) [4]. Biological methods can be used to synthesize silver nanoparticles without the use of any toxic and expensive chemical substances. It was suggested that the phytochemicals are involved directly in the reduction of the ions and formations of silver nanoparticles. Biosynthesis of nanoparticles is a kind of bottom up approach where the main reaction occurring is reduction / oxidation. Green synthesis provides advancement over chemical and physical method as it is cost effective, environment friendly, easily scaled up for large scale synthesis not required, high pressure, energy, temperature and toxic chemicals (Deepali *et al.*, 2019) [5]. One of the substances used in nanoformulation is silver (nanosilver). Due to its antimicrobial properties, silver has been used in filters to purify the drinking and clean swimming pool water. Silver nanoparticles are mostly smaller than 100nm and consist of about 20 - 15,000 silver atoms. Still, the remarkable strong antimicrobial activity is the major direction for development nano-silver product. Example are food packaging materials and food supplements, odour-resistant textiles, electronics,



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NOTE

New distribution record of two endemic plant species, *Euphorbia kadapensis* Sarojin. & R.R.V. Raju (Euphorbiaceae) and *Lepidagathis keralensis* Madhus. & N.P. Singh (Acanthaceae), for Karnataka, India

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Euphorbia L., *sensu lato* is a cosmopolitan genus distributed almost throughout the world. It comprises 1,836 species in the world, of which 84 species indigenous or naturalized and three species are cultivated in India (Binojkumar & Balakrishnan 2010, 2012). Recently *Euphorbia kadapensis* Sarojin. & R.R.V. Raju (2014), *Euphorbia gokakensis* S.R. Yadav, Malpure & Chandore (2016), and *Euphorbia seshachalamensis* Prasad & Prasanna (2016) were added to the Indian flora as new species.

Lepidagathis Willd. comprises about 100 species, mainly distributed in the tropical and warm regions of the world (Mabberley 2017). In India, the genus is represented by 23 species and eight varieties, among them 15 species are endemic to the Western Ghats and Eastern Ghats of southern India (Nayar et al. 2014; Singh et al. 2015).

During a recent botanical exploration in Karnataka State, we collected specimens of two interesting species of the genera *Euphorbia* and *Lepidagathis*. After thorough scrutiny in previously published Floras and research articles (Binojkumar & Balakrishnan 2010, 2012; Sarojinidevi & Reddivenkatraju 2014; Madhusoodanan & Singh 1992), they were identified as *E. kadapensis* Sarojin. & R.R.V. Raju (Euphorbiaceae), endemic to Andhra Pradesh and *L. keralensis* Madhus. & N.P. Singh (Acanthaceae), an endemic species of Kerala. *Euphorbia kadapensis* was described by Sarojinidevi & Raju in 2014 from the Kadappa District of Andhra Pradesh while *L. keralensis* was described by Madhusoodanan & Singh in 1992 from the west coast of Kerala and so far has not been reported from Karnataka. Hence the present collections form new distributional records of the species for Karnataka. A brief description, distribution and photographs are provided here for easy identification.

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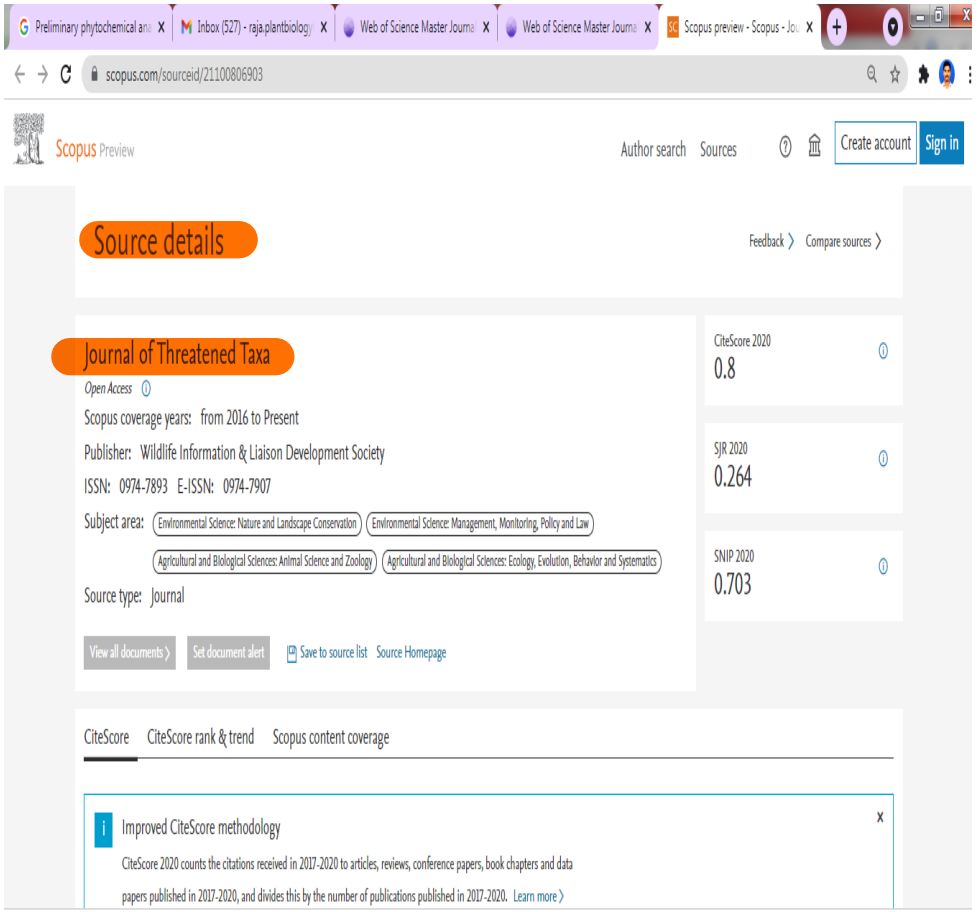

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PHYTODIVERSITY OF SOOLAKARAI KALIYAMMAN SACRED GROVE IN SIVAGANGAI DISTRICT, TAMIL NADU, INDIA

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Abstract

The plant wealth and diversity were documented for Soolakarai Kaliyamman sacred grove in Artipuram village, Thirupathur taluk, Sivagangai district, Tamil Nadu, southern India. The vegetation is of inland tropical dry evergreen type. The sacred grove holds 153 plant species belonging to 128 genera of 51 families of flowering plants and ferns. They represent 18 trees, 48 shrubs, 26 climbers and 61 herbs. Among these were several medicinal, endemic and rare species. The study indicates that the sacred grove, with its natural rural vegetation, is well protected and conserved by local people in a traditional way.

Keywords: Plant biodiversity; Sacred Grove; On-site conservation.

Introduction

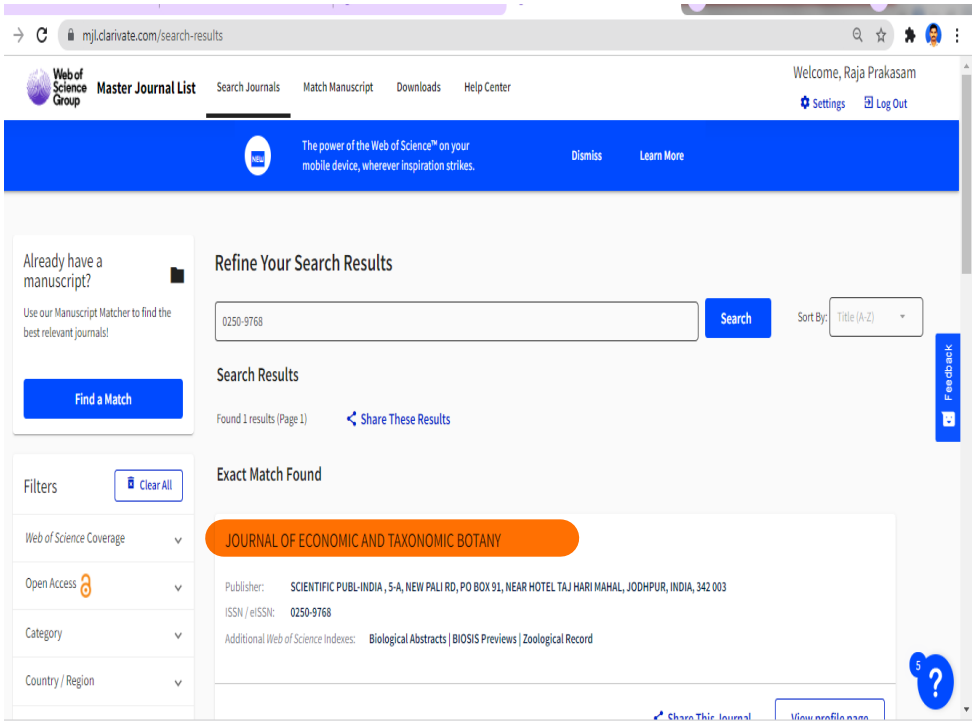
India is one of the leading countries in Asia in terms of the wealth of traditional knowledge systems related to the uses of plants; the concept of using plants for the medicinal purpose exists way back from 500 B.C.E. The Indian subcontinent is a vast repository of plants used in traditional medical treatments. As many as 20,000 medicinal plants have been recorded (Dev, 1997) though only 7,000–7,500 plants are being used by traditional communities for curing different diseases (Perumalsamy & Ignacimuthu,1998; Kamboj, 2000).

The medicinal plants are listed in various indigenous medicinal systems such as *Siddha* (600 species), *Ayurveda* (700 species), *Amchi* (600 species) and *Unani* (700 species). Major pharmaceutical industries depend on plant products for the preparation of medicines (Anbarashan & Padmavathy, 2010). In the last century, about 121 pharmaceutical products have been discovered, based on the information obtained from the traditional healers. India's indigenous population can be given better access to efficacious drug treatment and improved health status (Manandhar, 1985). Currently, 80% of the world population depends on plant-derived medicine for primary healthcare because it has no side effects and safe (Azaizeh *et al*., 2003).

Sacred groves of Tamil Nadu

These are small conservation areas and spiritual retreats. These wooded areas are preserved as sacred places and remain undisturbed amidst development, as the last remnants of rural biodiversity. From ancient times to to-date, the village people believe that anyone damaging these groves would be punished by the Gods. Womenfolk, in particular, were afraid even to go near the groves. In Tamil Nadu, sacred groves are found in the districts of Dharmapuri, Erode, Perambalur, Pudukkottai, Salem, Sivaganga, Namakkal, Nilgiri, Tiruchirappalli and Tiruvannamalai. *Kovilkaadu* (temple forests) are found in every village in the state and regarded as the abode of the Mother Goddess. The guardian spirits of the village such as *Ayyanar, Muneeswarar, Karuppuswami* and *Veeran* are believed to be powerful and can fulfil wishes. The most favoured of these deities is *Ayyanar*. Fowl, goat and sheep are offered to the deities except *Ayyanar*.

The sacred grove conservation activities have been increased manifold due to current awareness and successful case studies (Gadgil & Vartak, 1976). Scared grove oriented studies are concentrated in some specific regions including four global hot spots, In 2006, *Conservation International* demarked 34 global 'Biodiversity Hotspots', four of which partly fall within Indian political boundaries: (i) Himalaya, (ii) Western Ghats, (iii) Indo-Burma, and (iv) Sunderland (Mittermeier *et al*., 2004), neglecting the smaller groves distributed in different ecosystems. Apart from documentation and inventory, a few studies exist on



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Grass flora of
Pudukkottai district, Tamil Nadu, India

The present study deals with an account of grasses (Poaceae) collected from Pudukkottai district of Tamil Nadu, India. The study records 91 species under 56 genera and the most dominant genus is Eragrostis (7 species), Brachiaria, Panicum (5 species each). Besides twenty one (21) species were first time reported from Pudukkottai district. Three species are endemic to India, among them Chrysopogon hackelli and Isellema anthephoroides are endemic to Peninsular India.

Key words: Checklist, Grasses, Poaceae, Pudukkottai.

Introduction

Grasses (Poaceae) are natural and unique group of plants with remarkable diversity (Kabeer and Nair, 2009). Poaceae are one of the largest families in flowering plants with 11,369 species under 720 genera (Clayton *et al*., 2016) and have significant role in sustaining the life of human beings and animals (Kabeer and Nair, 2009). Grasses are important food provider as major cereals like rice, wheat and maize. Besides, they provide variety of useful products such as oils, house-building and lawn making (Jain, 1986). In India Poaceae are the largest family represented by 1,334 species under about 261 genera (Karthikeyan, 2005).

Kabeer and Nair (2009) have reported 447 species (including 19 infraspecific taxa) in 136 genera in *Flora of Tamil Nadu Grasses*. No comprehensive account on the grass flora of Pudukkottai district is available except some collections at Madras Herbarium (MH) and Rapinat Herbarium Tiruchirappalli (RHT). Targeting to reduce the gap in the knowledge of biodiversity of Pudukkottai, the present study has been carried out to contribute the knowledge of grass flora occurring in Pudukkottai district.

Material and Methods

Study area

Pudukkottai district is rich in natural resources and situated at the eastern part of Tamil Nadu in Peninsular India. Administratively, the district is composed of 11 Taluks. They are Aavudaiyarkoil, Alangudi, Aranthangi, Gandarvakkottai, Illupur, Karambakudi, Kulathur, Manamelkudi, Ponnamaravathi, Pudukkottai and Tirumayam. The district lies between latitudes 9°50' - 10°40' N and longitudes 78°25' - 79°15' E. It covers an area of 4663.29 km^2, occupying 3.5% of the total area of Tamil Nadu. It has a coastline of 42 km which includes 32 coastal villages. The district is bordered, on the south by Sivaganga and Ramanathapuram, on the east by Bay of Bengal and on the north and west by Tiruchirappalli district in the north by Thanjavur district (Raja, 2017).

Grass vegetation of Pudukkottai district comprising 91 species under 56 genera is needed to conserve for sustainable utilization.

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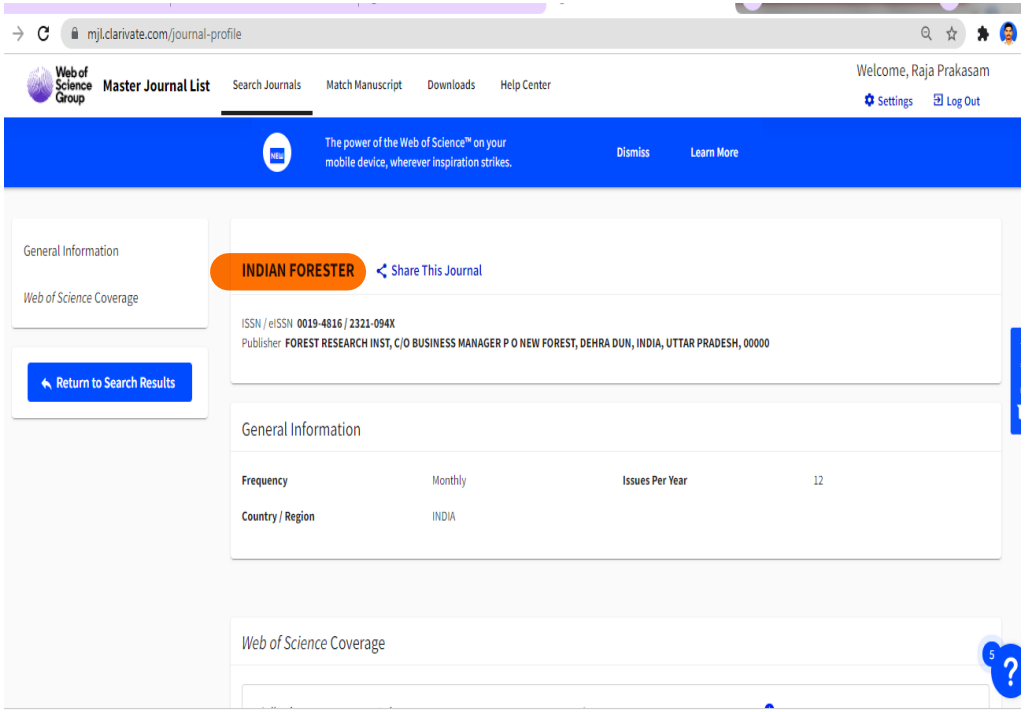

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Documentation of Vascular Plants of Mudumalai Tiger Reserve, Western Ghats, India

The wide range of climatic factors and their interaction reflect the diversity of the vegetation communities. The major vegetation types of Mudumalai Tiger Reserve (MTR) includes Southern Tropical dry thorn forest, Southern Tropical dry deciduous forest, Southern Tropical moist deciduous forest, Southern Tropical semi-evergreen, moist bamboo brakes and Riparian fringing forest. A total of 426 plant species under 311 genera belong to 100 families, including infraspecific taxa were recorded from the study area. Fabaceae is the dominant family with represents 42 species; similarly Ficus is the dominant genera with 9 species have been recorded. The MTR is a home for many rare and threatened plants. The present study we recorded 81 plants are under threatened condition. Using vegetation data collected from the larger Nilgiri Biosphere Reserve, in and around the five tribal settlements in Mudumalai Tiger Reserve. The current study concluded that the MTR poses a severe and persistent conservation threat to both within and outside protected reserve forests.

Key words: Biodiversity, Reserve forests, Mudumalai tiger reserve, Sanctuary, Western ghats.

Documentation, inventorying and conservation of vascular plants of the Mudumalai Tiger Reserve.

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Introduction

International Union for Conservation of Nature (IUCN) has developed a system of protected area management categories that helps classify protected areas based on their primary management objectives and recognizes the importance of all categories for biodiversity conservation (Dudley, 2018). The IUCN substantiates that a goal of conservation is the maintenance of existing genetic diversity and viable populations of all taxa in the wild to maintain biological interactions, ecological processes and function (IUCN, 2002). Forest Survey of India reported forest cover faced criticism. Recently, vegetation type-map of India could be used to generate vegetation cover statistics of the vegetation types in the hotspots using satellite datasets. Geospatial tools and techniques have a great potential to create vegetation type-maps with consistent spatio-temporal scale and vegetation classification. As species geographic ranges and ecosystem functions are altered in response to climate change, there is a need to integrate biodiversity conservation approaches that promote natural adaptation into land-use planning.

Material and Methods

Study area

Mudumalai Tiger Reserve lies between 11°32'-11°43' N and 76°22'-76°45'E in the North-western side of Nilgiri hills about 80 km northwest of Coimbatore in the western part of Tamil Nadu, on the interstate

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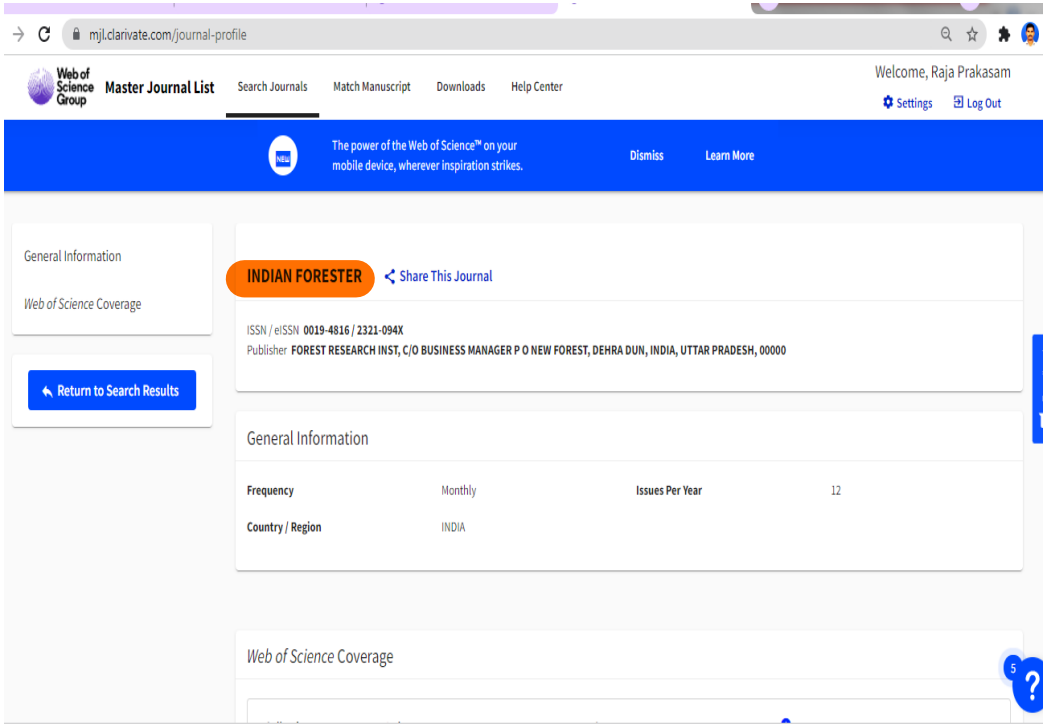

Solanum pulneyensis Soosairaj, sp. nov. (Solanaceae) from Palani Hills National Park of Tamil Nadu, India

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ABSTRACT

A new species, *Solanum pulneyensis* Soosairaj, sp. nov. (Solanaceae) is described from the woody savanna forest of Palani Hills National Park, Tamil Nadu, India. This species is unusual and special as it has subcapsular fruits unlike other Indian *Solanum* L. species that have berry fruits besides being entirely enclosed within persistent calyx as that of *S. wightii* Nees. A detailed morphological description with line drawings is provided here.

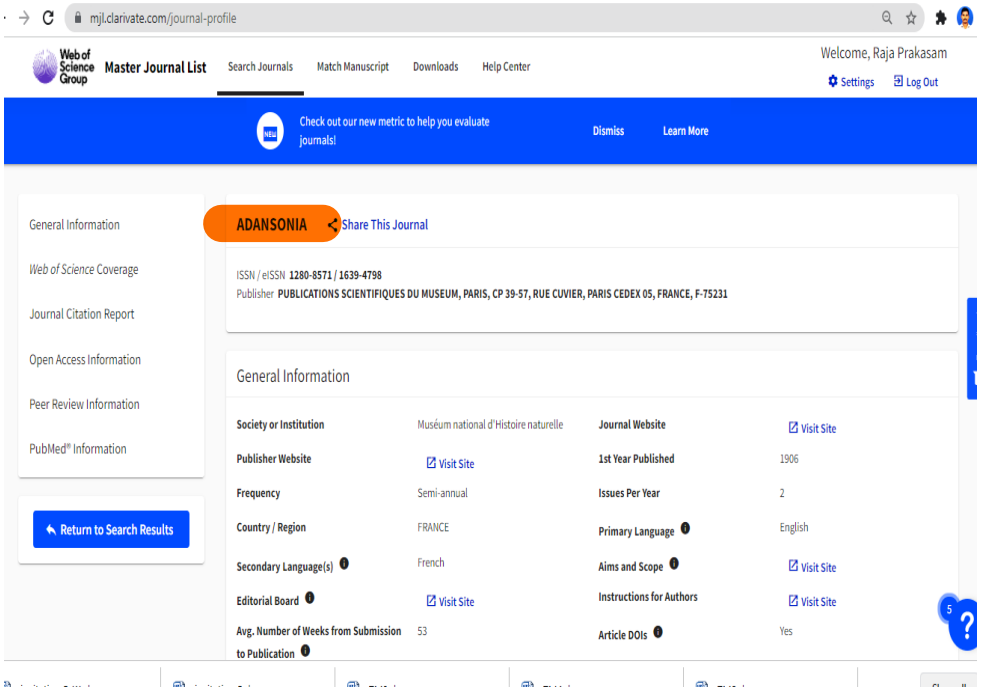
KEY WORDS
Solanaceae, *Solanum*, India, subcapsular fruit, new species.

RÉSUMÉ

Solanum pulneyensis Soosairaj, sp. nov. (Solanaceae), du Parc national de Palani Hills, Tamil Nadu, Inde.

Une espèce nouvelle, *Solanum pulneyensis* Soosairaj, sp. nov. (Solanaceae), est décrite de la savane arborée du Parc national de Palani Hills, Tamil Nadu, Inde. Cette espèce est très inhabituelle par ses fruits subcapsulaires, contrairement aux autres espèces indiennes du genre, qui présentent des fruits bacciformes complètement enfermés dans un calice accrescent, comme chez *S. wightii* Nees. Une description morphologique détaillée, accompagnée de dessins au trait, est fournie ici.

MOTS CLÉS
Solanaceae, *Solanum*, Inde, fruit subcapsulaire, espèce nouvelle.



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Studies on effect of salt stress on growth and biochemical compounds of *Arachis hypogea* l

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Abstract
The effect of varying levels of salinity on germination, seedling growth, and some metabolic parameters *viz.*, total soluble proteins, free amino acids and nitrate reductase activity in *Arachis hypogea* L. was studied. Seeds of *Arachis hypogea* tolerated salinity up to 100mM during germination. Root elongation remains unaffected and tolerated all the concentrations of NaCl tested while the shoot elongation was reduced by salinity. Chlorophyll and carotenoid content declined with increasing concentration of NaCl tested. Total soluble proteins accumulated due to salinity whereas total free amino acid content decreased. Nitrate reductase activity although declined, in general, about 60% activity was left at the highest concentration (100mM) of NaCl used.

Keywords: *Arachis hypogea* L, biochemical compounds

Introduction
A plant faces two problems due to salt stress, one of obtaining water from a soil of negative osmotic potential and another of dealing with the high concentrations of potentially toxic sodium, carbonate and chloride ions (Salisbury and Ross, 1992). The effect of high concentrations of total salt in the soil is referred to as salinity.
Salinity is known to reduce the growth of glycophytes (salt-sensitive species). This reduction in growth may result from salt effects on dry matter allocation, ion relations, water status, physiological processes, biochemical reactions or a combination of such factors (Seemann and Critchley, 1985) Salinity and sodicity are the major factors restricting the economic and efficient utilization of available and resources and adversely affect the crop productivity. Under natural conditions, terrestrial higher plants encounter high concentrations of salts. An extensive problem in agriculture is the accumulation of salts from irrigation water. Millions of acres have gone out of production as salt from irrigation water accumulates in the soil. Evaporation and transpiration remove pure water from the soil, and this water loss concentrates solute in the soil. The poor quality of irrigation water (that is water containing more of salts) and no opportunity to flush out accumulated salts to a drainage system results in salt injuries to sensitive species (Taiz and Zaiger, 1991).Pea nut (Arachis hypogea L.) is an important leguminous crop, cultivated extensively in Tamil Nadu. The aim of the present investigation is to study the changes in growth, protein, amino acid and nitrate reductase activity under NaCl salinity.

Materials and Methods
Plant Material
Seeds of Ground nut (Arachis hypogea L.) obtained from local seed store,Tiruchirappalli-20 for the present investigation were surface sterilized with 0.1% HgCl2 solution(w/v) for one minute and then thoroughly washed with tap water and rinsed with distilled water.

Acid washing of sand
Carefully mixed enough volume of concentrated sulfuric acid with dried sand in a plastic container using a glass rod and retained as such overnight. Washed the sand thoroughly with sample volume of tap water, rinsed with distilled water, air dried and stored in a clean container next day for further use.

Seed germination
Soaked the surface sterilized seeds for three hours in distilled water and of equal number transferred over washed sand in polythene bags.

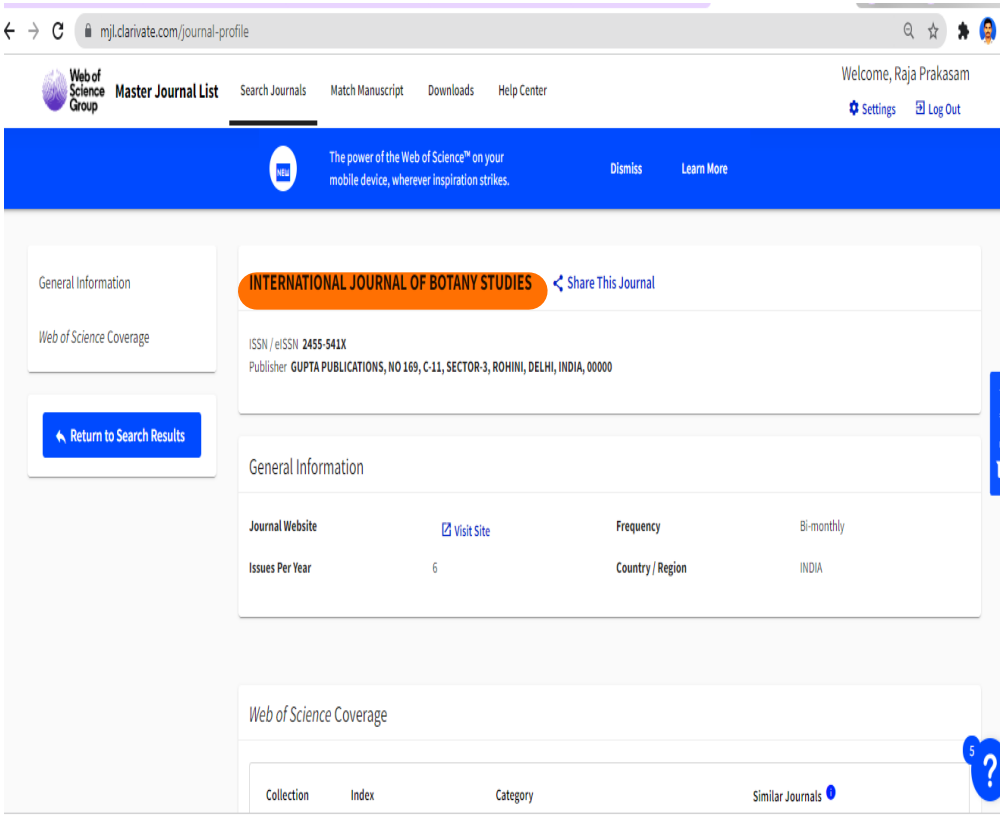
Seedling development
Raised the seedlings under cool, white fluorescent light of 1500Lux in Jamal Mohamed College, Botany Department Laboratory for seven days.

Seedling treatment
Exposed the seedlings to NaCl of various milliMolar concentrations *viz.* 5, 10, 25,50 and 100 which also contained the Hoagland nutrient solution, the controls received only Hoagland solution. On 8th day seedling were analyzed for germination, shoot and root elongation, total soluble proteins, and free amino acids, and Nitrate reductase activity.

Seedling Analysis
The seedlings were analyzed for the following parameters on the 8th of treatment.
Percentage of Seed Germination. The shoot emergence was considered as seed germination.

Shoot and Root Elongation
The seedlings were uprooted carefully without any damage and the shoot and root length was measured using a scale.

Seedling fresh weight and dry weight
Fresh weight of the seedlings was measured in an electronic balance immediately after uprooting the seedlings.



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Evaluation of Phytochemical and Biochemical Profiling of Marine Red Algae *Gracilariacrassa*

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Abstract

The aim of the present study sought to evaluated that biochemical constituents like protein, carbohydrate, total lipids, total phenols and phytochemical were analyzed from the marine red algae *Gracilariacrassa*. The present observation *G.crassa* showed the flavonoids, alkaloid, phenol, chlorogenic acid and carbohydrates were presented all the extracts. The biochemical content, fatty acid profile and mineral compositions were also recorded from the *Gracilariacrassa* extract. In this study, the biochemical constituents such as total carbohydrate (19.34±0.10%), total protein (23.13±0.005%), total phenols (7.81±0.23 mg/g) and total lipids (0.27±0.5%) were observed from the extract of *G.crassa*. The fatty acid profile showed that the higher concentration of saturated fatty acid and poly unsaturated linoleic acids were recorded. In mineral composition, the Ca (135.4±0.20 mg/100^{-1}) level was high when compared with other elements. In view of the results, the present study suggests that *G.crassa* contains important nutrients for human health and is possible natural functional foods.

Key words: phytochemical, fatty acid, *Gracilariacrassa*, protein, mineral and total lipids.

INTRODUCTION

Seaweeds are primitive non-flowering plants without true roots, stem and leaves. They grow in the intertidal, shallow and deep sea areas up to 180 meter depth and also in estuaries, backwaters and lagoons on solid substrates such as rocks, dead corals, pebbles, shells, mangroves, and other plants (Anantharaman*et al.*,2007). Seaweeds are classified as Rhodophyta (red algae), Phaeophyta (brown algae) and Chlorophyta (green algae) depending on their nutrient and chemical composition. It was estimated that about 90% of the species of marine plant are algae and about 50% of the global photosynthesis is contributed from algae

Enzymatic Studies of Gut flora in the Earthworm

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Abstract

The present study is on the analysis of gut flora in earthworm *Eisenia fetida*. It indicates an enriched bacterial population, especially in the foregut and midgut regions (8.4 × 106 and 8.7 × 106 respectively). About 150 strains were isolatedand classified into 6 bacterial genera namely *Bacillus* sp. (24%), *Pseudomonas* sp., *Micrococcus* sp. (12.66%), *Staphylococcus aureus* (10.66%), *Streptococcus* sp. (12%), *Pseudomonas* sp. (12%) and *E. coli* (4%). Their hydrolytic potentiality was observed against starch, cellulose, casein, and liquid substrates. Most strains exhibited the production of amylase and cellulase followed by protease, while lipophilic conditions were the least. The findings reflect and prove that composting of solid wastes including litter can be enhanced through scaling up such potential microbes and making use of them as soil conditioners.

Keywords: Vermitechnology, *Eisenia fetida*, Gut flora, Hydrolytic enzymes.

Introduction

Vermitechnolgy, although an old concept, is currently gaining global significance. The earthworm's versatile role as a natural ploughman and a bioreactor has encompassed its transformative role in organic conversions through hydrolytic potentialities. Earthworms play a key role in soil biology as versatile natural bioreactors. Fiesher *et al.*, (1995) opined that the gut of earthworms is an effective tubular bioreactor processing the raw materials (feed) entering them. The gut flora of earthworms, contain bacteria and fungi, which can produce various hydrolytic enzymes like amylase, cellulose, phosphatase, protease, and lipase (Manuel, 2005). These enzymes have been found to increase the pace of degradation of organic and inorganic substances swallowed by the earthworms (Mahalingam and Daniel, 2008). The present study pertains to the isolation of bacteria from different gut regions of *E. fetida* and the nature of their hydrolytic enzymes and aims to delineate their potential influence on composting trends.

Materials and Methods

Collection and Culturing of Earthworms

E. fetida worms were collected from the N.K.
Natural farm, Appakuddal, Erode District (Tamil Na
The collected earthworm species were cultured at r
temperature in clean large-mouthed earthen pots ha
soil and leaf litter in the ratio of 3:1 under moist condit
and were acclimatized to the laboratory conditions for
weeks before they were used.

Preparation of Earthworms for the Total Bact Population (TBP) Assay

The earthworms were washed thoroughly
sterile distilled water and anesthetized with ethanol (2
They were dissected to split open the foregut, midgut,
hindgut regions under aseptic conditions. The respe
gut contents were collected in aseptic containers. Onc
of the gut contents was added individually to 9 ml dil
tubes and homogenized using a spinner. The prep
samples were decimally diluted to required levels
poured into plates containing nutrient agar medium.
plated samples were incubated at 37°C for 24-36 h
The bacterial colonies were developed, obse