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Research Article

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Biosynthesis and Characterization of Silver Nano Particles against Food Borne Pathogens

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Abstract: In this communication, very simple, low-cost and facile method for the synthesis of silver nanoparticles using *Averrhoa bilimbi* leaf extract is reported. Conventional methods for the synthesis of AgNPs have many disadvantages. Biosynthesis provides a cost-effective, non-toxic, and environment friendly method for the synthesis of nano particles. The biosynthesized AgNPs were characterized by UV-VIS spectroscopy, Transmission Electron Microscopy (TEM), Scanning Electron Microscopy (SEM), X-Ray diffraction (XRD) and Fourier Transform Infrared Spectroscopy (FTIR). The synthesized AgNPs showed a distinct surface Plasmon peak at 410 nm and also the colour of the solution changed to reddish brown. The TEM and SEM images revealed that the morphology of AgNPs is almost spherical with an average size of 10 to 15 nm. Crystalline nature and purity of the AgNPs were evident from the characteristic XRD pattern. XRD-analysis showed intense peaks corresponding to (111), (200), (220), (311), (222) planes of face centered cubic structure of metallic silver. FTIR was used to find out the specific functional group responsible for the reduction of silver nitrate to AgNPs. The antibacterial effect of AgNPs was determined by well diffusion method. The AgNPs showed antibacterial activities against food borne pathogens *Escherichia coli* and *Listeria monocytogene*. The antibactericidal effect increases with increase in the concentration of AgNPs. The promising results of biosynthesised AgNPs suggest its usage as an effective

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RESEARCH PAPER

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Bioprospection of Kerala Flora for the Multipurpose Drug - Phytoecdysoids

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ABSTRACT

*Phytoecdysoids are analogues of the arthropod steroid hormone ecdysterone, found in plants which are apparently non-toxic to mammals with a wide range of pharmacological - adaptogenic, anabolic, anti-diabetic, hepatoprotective, immunoprotective, wound healing, and perhaps even anti-tumor- activities. Though they have been reported from more than 100 terrestrial plant families, till date, only less than 2 % of the world's flora has been investigated for their presence. Considering its pharmacological activities and extremely non toxic nature, it can very well be the darling of pharmaceutical companies in future. Kerala, being a part of the mighty Western Ghats range has a huge potential in exploiting its rich, unique and highly endemic biodiversity. A bio prospection study for ecdysteroids has been done with regard to the Angiosperm flora of the state for the first time. Fifty plant species were screened from the study area. A simple protocol for screening ecdysteroids using very less amount of the plant source was developed using ultra sonication and Thin Layer Chromatography. Ten species were found positive for phytoecdysoids. Ecdysterone was reported for the first time ever from *Coscinium fenestratum*.*

Key words: Kerala flora-ecdysterone-bioprospection-phytoecdysoids.

INTRODUCTION

The study of natural products not only provides novel bioactive compounds, but also helps in understanding the nature's way of tackling environmental problems. So far, only a small proportion of the known flora has been subjected to chemical or biological investigations; the vast unexplored biotechnical potential of flora awaits discovery and exploitation (Banerji, 1992). Ecdysteroid (EC)s are steroidal hormones, controlling the moulting and metamorphosis in insects. The first EC, ecdysone, was isolated by Burtenandt and Karlson (1954) from silkworm pupae. Phytoecdysteroid (PE)s are analogs of EC, occurring in 5–6 % of plant species (Dinan,

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EFFECT OF PHYTO ECDYSTEROIDS ISOLATED FROM DIPLOCLISIA GLAUDESCENS (BLUME) DIELS AND COSCINIUM FENESTRATUM (GAERTN.) COLEBR. AND JUVENILE HORMONE ANALOGUE ISOLATED FROM CULLEN CORYLIFOLIUM (L.) MEDIK. ON ECONOMIC PARAMETERS OF BOMBYX MORI L. UNDER FIELD CONDITION

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ABSTRACT

In insects, moults and metamorphosis are initiated and coordinated by the interplay of juvenile hormone (JH) and moulting hormone (MH). External application of plants extracts containing phytoecdysteroids (PE) is found to reduce the maturation process in silkworms and synchronise it. Field level experiments were conducted to test the effects of PE isolated from the indigenous plants *Diploclisia glaucescens* (Blume) Diels (DG) and *Coscinium fenestratum* (Gaertn.) Colebr. (CS) on bivoltine double hybrids FC₁×FC₂ – a popular variety of silkworms. Synchronisation and significant reduction in maturation time by 12 h of silkworms was obtained on application of PE. A convenient method of using both JH analogue and PE extracts together on a single crop was also developed. Silk worm (*Bombyx mori* L.) positively responds to exogenous JH analogues and mimics when applied in minute quantities at appropriate time and thereby enhances the commercial traits. On application of JH analogue- Backuchiol - rich extract from another indigenous plant *Cullen corylifolium* (L.) Medik. (CC) produced an increase of 15-20% with regard to cocoon weight and shell weight. This technology is simple, affordable and could be scaled to industrial level.

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INTRODUCTION

The process of metamorphosis is characteristic to larval growth and development in insects and is controlled by circulating hormones like Juvenile Hormone (JH) and Moulting Hormone (MH) (Wigglesworth, 1985). Ecdysteroids (MH) regulate the time and onset of moulting, while JH determines whether it is larval to larval or from larval to pupal (Sehnal, 1989; Riddiford, 1994). When the threshold JH level to retain the larval features diminishes in the haemolymph below the normal level, the larvae prepare to metamorphose into pupa (Nair et al., 2003). In China, various plant extracts rich in ecdysteroids are used in the last instar stage of *Bombyx mori* L. for fastening and synchronisation of the maturation process (Chow and Lu, 1980). Such studies were totally lacking in India till last decade, but since then some serious attempts have been made in this regard and some plants

containing ecdysteroids have been identified (Banerji et al., 1971). Considerable amount of ecdysteroids were isolated from DG and CS collected from Wayanad District, Kerala as a part of our bioprospection study. Phytoecdysteroid rich extracts from these plants were used in sericulture for the first time. Reduction in mounting time and decline in economic parameters due to phyto ecdysteroid use were recorded. Judicious use of plant extracts towards the end of last instar stage reduces the labour involved in mounting and also help sericulture farmers rescue the crop in case of acute leaf shortage.

The silkworm *Bombyx mori* L. positively responds to exogenous application of JH analogues, when applied in minute quantities, at appropriate time by enhancing commercial traits such as cocoon weight, shell weight and length of the silk filament (Akai et al., 1985). Effect of JH analogue along with PE produces synchronisation in maturation as well as increase in cocoon and silk parameters. JH analogue - Backuchiol- rich extract isolated from CC has been used along with PE on the commonly cultivated bivoltine double hybrids (FC₁ x FC₂) silkworm variety. The extraction

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Fimbristylis griffithii (Cyperaceae), a new record for Peninsular India

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Abstract

Fimbristylis griffithii Boeckeler (Cyperaceae) is reported for the first time from Peninsular India. In India, this species was earlier reported only from northeastern state of Assam and the Andaman and Nicobar Islands. A brief description and photo plate are provided for facilitating easy identification.

Keywords: *Fimbristylis griffithii*, Kerala, New record, Peninsular India.

Introduction

Fimbristylis Vahl is one of the largest genera of family Cyperaceae comprising c. 316 species (Govaerts *et al.*, 2018) distributed worldwide, especially in the tropics and subtropics. Karthikeyan *et al.* (1989) enumerated 91 species and Prasad and Singh (2002) reported 115 species from India. Nayar *et al.* (2006) reported 59 species from Kerala, while Sasidharan (2013) included only 52 species, and Nayar *et al.* (2014) listed 91 species from the Western Ghats.

During a floristic survey in the forests of Ernakulam district in Kerala, a few interesting specimens of *Fimbristylis* were collected from the marshy riverbanks in Koomul forest and Kalady plantation. A perusal of the literature and a critical study of the specimens at CAL revealed that they belong to *F. griffithii* Boeckeler, which is not yet reported from Peninsular India. Hence, its occurrence in Kerala forms a new distributional record for Peninsular India.

Taxonomy

Fimbristylis griffithii Boeckeler, Flora 43: 241. 1860; J. Kern, Blumea 8: 142. 1955 & in Steenis, Fl. Males., Ser.1. Spermat. 7: 584. 1974; A.S. Rao & D.M. Verma, Cyperaceae NE India 34. 1982; Karthik. *et al.*, Fl. Ind. Enum. Monocot. 53. 1989. *F. aestivalis* var. *glaberrima* Boeckeler, Linnaea 37: 11. 1871. *F. aestivalis sensu* C.B. Clarke in Hook.f., Fl. Brit. India 6: 637. 1893, *p.p. non* (Retz.) Vahl, 1805.

Fig. 1.

Annuals with fibrous roots, glabrous. Culms densely tufted, 8–36 cm long, 1–1.5 mm thick, compressed, 3–5-angled, smooth. Leaves slender, often falcate when young, flat or canaliculate, 7.5–32 × 0.2–0.45 cm, acute to acuminate at apex, sub-coriaceous, scabrid on involute margins; sheaths 2–3.5 cm long; ligule absent. Inflorescence a decompound corymb, loose, 4.5–10 × 6–13 cm, bearing 70–90 spikelets. Involucral bracts 4–7, shorter than inflorescence, scabrid at margins. Primary rays up to 7, 2–8 cm long. Spikelets solitary, angular, oblong-ovoid or ellipsoid, 2.5–4 × 1–1.3 mm, acute at apex, creamy-greenish, 6–19-flowered, glabrous. Glumes spiral, membranous, elliptic or ovate-lanceolate, 1.3–1.6 × 0.6–1 mm, keeled, with the prominent midvein excurrent into a mucro, with nerveless sides, hyaline towards margins. Stamen 1; filament 1–1.3 mm long, hyaline; anther oblong, 0.3–0.4 mm long. Ovary obovate; style 0.8–1 mm long, glabrous; stigmas 2, c. 0.5 mm long, ciliate. Achenes biconvex, obovate, 0.5–0.7 × 0.4–0.5 mm, shortly stipitate, smooth; epidermal cells elliptic to rectangular or of different shapes, in 12–15 vertical rows on either face.

Flowering & fruiting: February–May.

Habitat: Grows in marshy areas at about 130 m elevation post-monsoon season. It grows in association with *Cyperus haspan* L. and *Fimbristylis aestivalis* (Retz.) Vahl.

GC-MS ANALYSIS AND NUTRIENT EVALUATION OF RARE, ENDEMIC AND THREATENED SPECIES- *Aponogeton appendiculatus* V. BRUGGEN OF SOUTH INDIA

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ABSTRACT

Aponogeton appendiculatus V. Bruggen is an aquatic, endemic species of Southern Western Ghats and belongs to the family of Aponogetonaceae. The present study aims to determine the bioactive constituents from leaf parts by GC-MS and nutrient value assessment of its tuber by chemical analysis. The GCMS analysis of ethanol crude leaf extract revealed the presence of 36 bioactive compounds with significant biological activities. The major chemical constituent in the crude leaf extract is determined as phytol with peak area 14.812%. The other major observed chemical bioactive component are γ -Sitosterol (9.763%), n-Hexadecanoic acid (7.390%), Hexadecanoic acid, ethyl ester (6.270%). Nutrient analysis of the tuber of *Aponogeton appendiculatus* showed carbohydrate is the major nutrient (77 \pm 0.71%) and has rich crude protein (11.74 \pm 0.37%), low crude fat content (0.94 \pm 0.1%) and good crude fiber (2.45 \pm 0.08%). These nutrients and phyto components present in the plant indicated the beneficial aspects of the plant.

KEYWORDS: *Aponogeton appendiculatus*, GCMS, Nutrient Analysis, Phytol

Aponogeton appendiculatus V. Bruggen (Aponogetonaceae) is a rare, endemic and threatened aquatic plant species of Southern Western Ghats and included in IUCN Red List (2011), occurs mostly in brackish water. It is a perennial and its edible root tuber was part of diet in certain parts of Kerala and two years old tubers are preferred by local farmers as subsistence of food. Biochemically, the tubers are composed of proteins, fats, carbohydrates and minerals and are good source of energy (Sridhar & Bhat, 2007).

Aponogeton appendiculatus is a folkloric valued medicinal plant. The folkloric medicinal plants are rich sources of secondary metabolites and are responsible for various therapeutic activities. In recent years, gas chromatography and mass spectrum (GC-MS) has been applied unambiguously to identify the structures of different phyto constituents from the plant extracts with great success. The genus *Aponogeton* is reported to have medicinal properties as anti-diabetic, anti-inflammatory, anti-microbial activities, used for treating stomach disorder, reviving the digestive system (Les *et al.*, 2005). Literature reports that leaf paste consumed along with the hot water used to treat cuts and wounds (Britto *et al.*, 2007). *Aponogeton appendiculatus* is still a major source of food for forest-based communities like Paniya in Wayanad and this plant serve as a 'life saving' plant group during periods of food scarcity (Ratheesh Narayanan *et al.*, 2011). However, no information is available on chemical profiling in ethanol extract of leaf part and limited information about the nutritional composition of the root tubers available in India. Therefore the present study has been planned to identify bioactive compounds

from crude leaf ethanol extracts and also estimate the concentration of minerals and essential life nutrients in tuber of *A. appendiculatus*. To the best of our knowledge, this is the prime report investigating the phyto components and nutrient value of *A. appendiculatus*.

MATERIALS AND METHODS

Collection of plant material: Fresh leaves and tubers of *A. appendiculatus* were collected from Karupadanna (Latitude -10°15'27.72" N and Longitude -76° 12' 8.23" E), Thrissur District, during August 2015 to November 2016.

Preparation of sample powder and leaf extract : The fresh leaves and tubers were washed with distilled water to remove mud. Materials are dried under shade and made fine powder by using mechanical grinder. 50 gm of leaf powder mixed with 500ml ethanol solvent for 18 hours, thus plant extracts were prepared by using soxhlet apparatus. All the extracts were collected, condensed and stored in a vial for further studies (Alade and Irobi, 1993). Gas chromatographically analysis was made by Joachim and Hubschmann, 2008. The chemical components from the ethanol extract of plant leaves were identified by comparing the retention times of chromatographic peaks using Quadra pole detector with NIST Library (2011) to relative retention indices. The following methods were applied for analyzing various nutrients in the tuber. The nitrogen content in sample tuber powder was estimated by the Kjeldahl's method (AOAC. 2000). The protein percentage was calculated by multiplying nitrogen percent with a factor 6.25. Soxhlet extraction technique using petroleum ether (40-50 C) was used to evaluate the crude

CHEMICAL PROFILING OF ENDEMIC PLANT *Osbeckia wynaadensis* CLARKE. BY GAS CHROMATOGRAPHY –MASS SPECTROMETRIC METHOD

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ABSTRACT

Plant kingdom is a treasure house of potential drugs. The medicinal value of these plants lie in some chemically active substances, which may help in the protection against incurable diseases. However only very few of these plant species have found to be used in medicine and little or no literature exit on their chemical and biological activities. *Osbeckia wynaadensis* is underutilized herbal medicinal plant, restricted in Southern Western Ghats. This study revealed the presence of 21 phytocomponents. Among these Methyl 3 β -hydroxyolean-18-en-28-oate is major bioactive compound. Isolation of individual components would however, help to find new drugs.

KEYWORDS: GC-MS, Methyl 3 β -hydroxyolean-18-en-28-oate, NIST, *Osbeckia wynaadensis*.

In recent years several new diseases has been arised due to our undisciplined life styles and activities. Scientific world are focusing about its remedies. The plants have valuable source of natural products for maintaining human health. The medicinal properties of plants are due to the accumulation of complex bioactive compounds in different plant parts. Screening of active compounds from the plants has leads to the invention of new medicinal drugs, which has efficient property for the treatment of various diseases. GC-MS is the best technique to identify the bioactive constituents present in the plants and it is the powerful tool for screening, identification, quantification of many phytocompounds present in plant extracts. It is the valuable method for non-polar and volatile components.

However only very few of these plant species have found to be used in medicine and little or no literature exit on their chemical and biological activities. Traditionally different species of *Osbeckia* used in different medicinal purpose while the species *Osbeckia wynaadensis* Clarke.(Melastomataceae) is an underutilized herbal medicinal plant, rare, endemic to Southern Western Ghats. It is a wild plant usually seen marshy area at about 4500ft above the sea level. The plant is used to cure vitiated pitta, inflammation, urinary tract infection, hemorrhage, menorrhagia, hemorrhoids and leucorrhea. Antioxidant, cytotoxicity and antimicrobial activity of plant extracts was reported by Mujeeb et al., 2014 and Sujina et al.,2012. Tribal peoples in Nilagiries Kurumbas and Paniyas are consuming its raw fruits (Ramanchandran et al., 2012). Flowers and fruits are used for the preparation of dye by Kani tribals of Ponmudi hills (Bosco et al., 2015).There is no previous report for the chemical characterization of bioactive components present in plant. To consider its medicinal importance, the ethanol extract

of *Osbeckia wynaadensis* were analyzed in this study by GC-MS analysis.

MATERIALS AND METHODS

Collection of Plant Material

The plant material *Osbeckia wynaadensis* was collected from Mayiladumpara Malakkapara (N-10°15.700.E-076°52.958) in the month of March 2015. Plant was Taxonomically identified and authenticated.

Preparation of Plant Extract

The whole plant was cleaned, shade dried and powered in a mechanical grinder.100gm of powered sample were extracted with ethanol (500ml,24 h) at temperature between 60°C by using Soxhlet apparatus. The extracts were collected and the solvent was evaporated by using rotary evaporator and stored in refrigerator for further study. The required quantity of final residues was then subjected to GC-MS analysis.

GC-MS Analysis

The experiment was carried out in the sophisticated instrumentation facility, CARE KERALAM, Koratty Thrissur. GC-MS analysis was carried out on a GC clarus 500 Perkin Elmer system comprising a AOC-20i autosampler and gas chromatograph interfaced to a mass spectrometer (GC-MS) instrument employing the following conditions: The column (HP5) was fused silica 50 m×0.25mm I.D. Analysis conditions were 20 minutes at 100°C, 3 minutes at 235°C for injector temperature, helium was the carrier gas and split ratio was 5:4. The sample (1 μ l) was evaporated in a split less injector at 300°C.Run time was 22 minutes. Interpretation on mass spectrum GC-MS was done by using the data base of National Institute of Standard and Technology (NIST).

Eriocaulon tuberiferum (Eriocaulaceae) a new record for south India

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इरियोकोलोन ट्यूबेरिफेरम (इरियोकोलेसी) दक्षिण भारत के लिये एक नया पादप अभिलेख

सी. एन. सुनील, के. एम. प्रभुकुमार, वी. वी. नवीन कुमार,
वी. पी. थॉमस, आर. जगदीशन एवं इंदिरा बालाचंद्रन

सारांश

इ. ट्यूबेरिफेरम को दक्षिण भारत से प्रथम बार अभिलेखित किया गया है जिसका विस्तृत वर्णन, वितरण, चित्रण रंगीन छायाचित्रों के साथ प्रस्तुत किया गया है।

ABSTRACT

E. tuberiferum is reported here for the first time from south India with a detailed description, distribution, illustration and colour photographs.

Keywords: New record, South India.

INTRODUCTION

The genus *Eriocaulon* L. (Eriocaulaceae) is distributed mainly in the tropical and warm temperate regions of the world with about 485 species (Govaerts, 2014). In India, the genus is represented by 97 species with a high percentage of endemism in Peninsular India (Ansari & Balakrishnan, 2009; Sunil & Naveen, 2015; Manudev & al., 2015).

During a floristic exploration in the Western Ghats of India, the present authors collected specimens of

a tuberiferous *Eriocaulon* from the Elivalmala hills of Muthikulam forest in Palakkad district and Shoolamudi hills of Ernakulam district of Kerala. A critical study with herbarium specimens, available literature and comments from experts helped us to conclude that the identity of the collected specimens was *E. tuberiferum* Kulkarni & Desai, which is being considered as endemic species of Maharashtra (Ansari & Balakrishnan, 2009). Hence the present collection of this species from Kerala is an addition to the flora of south India.

On the identity and distribution of *Vasconcellea pubescens* (Caricaceae) in Asia

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वैस्कोन्सेल्लिया प्यूबेसेन्स (कैरिकेसी) का एशिया में वितरण एवं पहचान

कोनिककल माम्बेटा प्रभुकुमार, चंद्रासेरिल नारायण सुनील, वानारत्ता वेट्टिल नवीन कुमार, तरुण छाबरा, एन मोहनराज एवं इंदिरा बालाचंद्रन

सारांश

प्रस्तुत शोध पत्र में वैस्कोन्सेल्लिया प्यूबेसेन्स (कैरिकेसी) का एशियाई देशों में वितरण एवं सही पहचान को रंगीन छायाचित्रों से वर्णित किया गया है। इसी के साथ हमारे द्वारा वैस्कोन्सेल्लिया सेस्ट्रीपलोरा एवं कैरिका कंदमारकेन्सिस नामों का लेक्टोटाइपिफिकेशन भी प्रतिपादित किया गया है।

ABSTRACT

The present paper discusses the identity and distribution of *Vasconcellea pubescens* (Caricaceae) in Asian countries with detailed description and colour photographs. Here we also designate the lectotypes for the names *Vasconcellea cestriflora* and *Carica candamarcensis*.

Keywords: *Carica papaya*, India, Mountain Papaya, Nilgiri

INTRODUCTION

The family Caricaceae Dumort. is a small family of flowering plants, best known for the fruit crop *Carica papaya* L., comprising 34 taxa under six genera (Mabberley, 2017) distributed in tropical & warm America and tropical Africa. *Vasconcellea* A. St.-Hil. is the largest genus of the family comprising 20 taxa (Mabberley, 2017). The genus is distributed throughout South America, with a concentration of diversity in the Andean valleys of Ecuador (Carvalho & al., 2014).

During the course of a botanical exploration in Nilgiris district of Tamil Nadu during 2011, one of us (KMP) observed the occurrence of one wild papaya in vegetative condition in the Long Wood Shola forests at an elevation of 2400m asl. The plant was quiet distinct from the normal *Carica papaya* by means of its pubescent nature on the leaves. Subsequent observation of two years revealed that, the plant was on fruiting stage during 2013 and flowering stage during 2016 and 2017 respectively. The 5-locular nature of the ovary helped us to confirm the generic identity as *Vasconcellea*. After a critical



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Phytochemical profiling and antibacterial activity of selected *Sida* species against common human pathogenic bacteria: An in vitro study

Asha A, Shameema Farsana and EC Baiju

Abstract

In the present study the acetone, methanol and aqueous extracts of *Sida acuta* Burm. F, *Sida alnifolia* L., *Sida fryxelli* Sivarajan & Pradeep (I.C.) and *Sida rhombifolia* L., whole plant were screened for the presence of phytochemical components and tested for antibacterial activity against *Escherichia coli*, *Staphylococcus aureus* and *Klebsiella pneumonia*. Result revealed the presence of phenolics, saponins, flavonoids, alkaloids, tannins, steroids, carbohydrates and proteins. The study indicates that phytochemical constituents of the four species of *Sida* are different. Acetone extract of *Sida* didn't show significant activity compared to the standard amoxicillin. Aqueous and methanolic extracts showed significant antibacterial property at higher dose. The different species of *Sida* studied didn't show significant antibacterial competence against *E. coli*. Prominent anti-bacterial activity was shown by *Sida acuta* against *Staphylococcus aureus* (20.5 mm) at 200 µg concentration in methanolic extract. In UV-VIS studies of the extracts in the range of 190nm to 400nm showed large number of peaks indicated the presence of active components in the extract.

Keywords: plant extract, phytochemical screening, antibacterial activity

Introduction

Nature has provided a complete store house of remedies to treat all ailments of mankind (Kokate *et al.*, 2007) [1]. Within the wide range of living organisms available on the earth including higher plants, animals, fungi, and marine organisms, the databases of natural products have recorded more than 200,000 compounds from almost all part of the world (Fullbeck *et al.*, 2006) [2]. Plants have been by far the most extensively studied source of medicinal compounds. Medicinal plants are the centre stone of traditional medicine. The W.H.O. has reported that 80% of the world populations primarily rely on traditional medicines and major part of traditional therapies involve the use of crude extracts of plants and herbs or their active constituents (WHO, 1993) [3]. In the present scenario, there is an urgent and continuous need of looking at and development of cheaper, effective new plant based drugs with enhanced bioactive potential and without any side effects.

The genus *Sida* L., includes a significant group of plants belonging to Malvaceae. The plants are large herbs or small shrubs profusely growing in the tropics and sometimes even assuming weed status. Many species of *Sida* are widely used as the ayurvedic raw drug 'Bala' in different regions for treating rheumatism (Remashree *et al.*, 2008) [4]. The present study deals with the comparative phytochemistry, antibacterial properties and UV-Vis studies of four species of *Sida*, which are *Sida acuta* Burm.f, *Sida alnifolia* (syn. *Sida rhombifolia ssp.retusa*), *Sida fryxelli* Sivarajan & Pradeep (I.C.) and *Sida rhombifolia* L. Phytochemical studies give an insight into the chemical constituent present in a plant.

Materials and Methods**Sample collection**

Four species of *Sida* plants were collected from Maliankara, Ernakulam District, Kerala during the month of November 2016. Whole plants were uprooted and soil and other debris adhered on the plants were removed. The collected plants were packed separately in polythene bags and brought to lab for identification. Identification of the plants was confirmed with the help of Dr. C.N. Sunil, Associate Professor from Sree Narayana Mangalam College, Maliankara.

Preparation of the extract

The whole plant of four species were washed thoroughly in water and dried in an oven at 45°C. Acetone, methanolic and aqueous extracts were prepared by mixing 20 g of each of the powder samples with 200 ml of each solvent.

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Ethnomedicinal flowering plants used by Kurumas, Kurichiyas and Paniyas tribes of Wayanad District of Kerala, India

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Abstract

Documentation of indigenous knowledge through botanical studies is very important for the conservation and utilization of biological resources. The present study aims to document the traditional knowledge of medicinal plants used by the indigenous tribes-Kurichiyas, Kurumas, and Paniyas residing in the pockets of Wayanad district of Kerala. Ethnobotanical information was collected using primary as well as secondary sources of data. The study noticed that the above-mentioned tribes use 114 medicinal flowering plant species belonging to 47 families., among them, 39 are herbs, 28 are shrubs, 26 are trees and remaining 21 are climbers. The difference in usage of plants by same tribes occupying different localities and different tribes of the same or nearby localities was observed. The study also revealed that the Kurichiya community possesses high ethnobotanical knowledge when compared to the other two communities. Ethnomedicinal studies supplemented with global information have great significance in the collection of traditional knowledge, preparation of recorded data and in the conservation of endangered medicinal plant species.

Keywords: western ghats, ethnic groups, ethnomedicine, traditional knowledge

Introduction

The mystic nature has hidden resources of Biodiversity and use of flowering plants to manage diseases dates back to the beginning of mankind. In ancient periods, man has been on the earth totally depending on green plants for his day to day life needs, especially for healthcare. India is rich in ethnic diversity and traditional knowledge (TK) that has resulted in a considerable body of ethnobotanical research, of which one study has revealed a deep understanding of medicinal plants supported by high consensus. In Kerala, the diversified system of traditional practices prevails among the rural communities since time immemorial. Even though modern medical systems are available, the majority of the people are still depending on the ethnic tradition for curing various diseases. But this valuable oral health information is not yet documented systematically. Wayanad district is with a hilly terrain on the southern Western Ghats and located in the northeast part of Kerala state in India. The district is unique for its rich wealth of flora and diverse ethnic cultures. The district has the highest concentration of tribals in Kerala. They form 17.1% of the total population of the district. The ethnic diversity of the district is very impressive as evidenced by ten different tribal groups/communities. Some of them are Paniyas, Adiyas, Kattunayakans, Kurichiyans, Kurumas, Uralis, and Uraali Kurumas *etc.* Among them, the three dominant tribal groups are Mullukuruma or Kuruma, Paniya, and Kurichiyans. These are the communities which still hold knowledge on biodiversity. Though Wayanad district is blessed with lots of natural beauty and vegetation, the studies related to ethical knowledge on medical plants occurred here are very less ^[1-5]. In this context, the present study was undertaken with an objective to understand the ethnic knowledge about flowering

medicinal plants used by different tribal groups of Wayanad district.

Materials and Methods

Study area

Wayanad district is situated in the Western Ghats region of Kerala with an altitude varying from 700 to 2100 m sea level. Nilgiri and Mysore district of Tamil Nadu and Karnataka respectively bound it on the East, Coorg district of Karnataka on the North, Malappuram district of Kerala on the South and Kozhikode and Kannur district of Kerala on the West. Wayanad lies between 11°27'N and 15°58'N latitude and 75°47'E and 70°27'E longitude. Extensive field visits were conducted to selected panchayaths and tribal colonies of the district which include Noolpuzha panchayath Kumulpura Kurumas colony, Mundupara Paniyas colony and Huruchiya Kurichiya colony of Thirunelli and Idiyamvayal panchayaths.

Ethnobotanical survey

Ethnobotanical data were collected according to the methodology suggested by Jain and Goel ^[6]. The ethnobotanical data were collected using a standard questionnaire through interviews and discussions with the help of Vaidyas and elder citizen. Plant species were identified with the help of Flora of the Presidency of Madras ^[7] and Flowering plants of Kerala ^[8]. Medicinal flowering plants were used by Kurichiya, Kuruma and Paniya tribes to treat various diseases are listed in Table 1. The plant species are arranged in alphabetical order of their botanical names, followed by their family, vernacular name, habit, parts used and a brief note on their Ethnomedicinal uses.

Composition and distribution of meiobenthos in Arctic Kongsfjord (Svalbard) with reference to carbon potential of selected fauna

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The meiobenthic samples collected as a part of Summer Phase III group 2 – Indian Arctic Expedition 2011, forms the basis of this study. There were some vital observations regarding the sediment characteristics that, inner and outer fjords were similar in terms of granulomertic composition and also the silt dominated in the entire Kongsfjord. Total carbon (TC) and total organic carbon (TOC) were higher in the outer fjord, but the inorganic carbon (IC) was slightly lower in the inner fjord. The meiofauna comprised of Nematoda, Foraminifera, Bivalvia, Polychaeta, Harpacticoid copepoda, Gastrotricha, and Kinorhyncha. Nematodes (54%) formed the dominant phylum among the fauna followed by foraminifera (37%). Forty five nematodes belonging to nineteen families were identified, in which *Anticoma eberthi* (14.06 µg) contributed the highest carbon, followed by *Maryllynia complexa* (12.94 µg) in the Arctic Kongsfjord. Fifty six species of foraminiferans belonging to five sub orders were identified of which, *Cribratomoides jeffreysii* (0.074 µg) and *Globobulimina auriculata* (0.071 µg) structured the maximum carbon content. Total carbon sequestered in the Kongsfjord accounted to an average of nematodes and foraminiferans respectively. The net carbon sequestered by the nematodes and foraminiferans were higher in the outer fjord as compared to inner fjord of Kongsfjord region.

[**Keywords:** Kongsfjord, nematodes, foraminiferans, mineralisation, carbon sequestration.]

Introduction

Meiobenthos is a highly dynamic part of the ecosystem and their abundance and diversity exceed that of macrofauna and megafauna¹. Meiobenthic communities of the arctic Kongsfjord-Spitsbergen are dominated by nematodes followed by foraminiferans. Mineralisation and remineralisation of carbon; sequestering and redistributing minerals and energy are the main functions of nematodes in the soil food web. Although oceans store most of the earth's carbon, soils contain approximately 75% of the carbon pool on land – three times more than the amount stored in living plants and animals². Soils therefore play a major role in maintaining a balanced global carbon cycle. The primary way that carbon is stored in the soil is as soil organic

matter (SOM). SOM is a complex mixture of carbon compounds, consisting of decomposing plant and animal tissue, microbes (protozoa, nematodes, fungi, and bacteria) and humus – carbon associated with soil minerals². Over the past 150 years, the amount of carbon in the atmosphere has increased by 30%. Most scientists believe that there is a direct relationship between increased levels of carbon dioxide in the atmosphere and rising global temperatures.

Nematodes and foraminiferans probably play a significant role in regulating the direction and magnitude of detrital carbon flow. The works done on nematode carbon sequestration is limited^{3,4,5,6,7&8}. Limited works are reported regarding the carbon sequestration

Marketing Strategy of Telcom Retail Sector – A Comparative Study between BSNL and Private Operators

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ABSTRACT:

Telecommunication has become the vital ingredient for human life these days. The modern telecommunication systems has evolved since the invention of telephone during the yester years of late 1800 by Graham Bell. This rampant development in the telcom sector has thrown the market open. It become an open competition for the players and a fight for survival of the fittest. Nevertheless, India's sole governmental telcom player BSNL thrives its best to keep up the pace in this race. A sample of 225 respondents of Coimbatore are selected for the study to analyze the marketing strategy of Telcom players like BSNL and Private operators. Semi-structured questionnaire is used and the results envisaged that private operators are more preferred than BSNL for the various attributes of the marketing strategy adopted by them. Although, a right mix of marketing mix would prove to support the customers and retain them and sustain the marketability.

Keywords: *Marketing strategy, Retail market, Public sector company, Private sector companies, Marketing mix*

I INTRODUCTION:

Telecommunication has become the vital ingredient for human life these days. The modern telecommunication systems has evolved since the invention of telephone during the yester years of late 1800 by Graham Bell. Now, the words like landline, trunk call, telegraph, pager etc have become extinct with the new generation technology. New words like 4G, spectrum, hotspot, wifi, mofi are being used day in and day out. Now that telcom has become the 4th elixir of life adding to food, clothing and shelter. Post liberalization period turned out to be the favourable period for the telcom sector inviting both domestic and foreign players. Indian telecommunication sector is the second largest in the world with 1.053 billion subscribers as on 31st August 2016. It is now grown to 1.21 billion subscribers as of July 2017.

It is greatly supported by the INSAT system that links all parts of the country by telephone, Internet, radio, television and satellite. This rampant development in the telcom sector has thrown the market open. It become an open competition for the players and a fight for survival of the fittest. Nevertheless, India's sole governmental telcom player BSNL thrives its best to keep up the pace in this race. It is the continuous innovations in the technology and marketing in pace with the speed of growth in liberalized period alone make a conducive environment for this rapid developments. This has facilitated the people to get access to the highest technology with the competitive price. The mobile telcom companies have actually redefined their marketing strategies from 'Premium Pricing' to 'Penetration Pricing'. The

Post-deposition thermal treatment of sprayed ZnO:Al thin films for enhancing the conductivity

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Abstract

Here, we report the enhanced conductivity of Aluminium doped (2at.%) zinc oxide thin films prepared by simple spray pyrolysis technique. The structural, optical, electrical, morphological and compositional investigations confirm the better quality of films that can be a potential candidate for application in transparent electronics. Most importantly, the film demonstrates an average transmittance of 90 percent with a low resistivity value which was dropped from 1.39×10^{-2} to $5.10 \times 10^{-3} \Omega.cm$, after annealing, and a very high carrier concentration in the order of $10 \times 20cm^{-3}$. Further, we have used the Swanepoel envelop method to calculate thickness, refractive index and extinction coefficient from the interference patterns observed in the transmission spectra. The calculated figure of merit of the as-deposited sample was $1.4 \times 10^{-3} \Omega^{-1}$ which was improved to $2.5 \times 10^{-3} \Omega^{-1}$ after annealing.

Keywords: Spray pyrolysis, ZnO, Al doping, TCO, Refractive index, Swanepoel method

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PAPER

Strain induced optical properties of perovskite LaFeO₃RECEIVED
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E-mail: LKA@uoc.ac.in**Keywords:** reduced graphene oxide, perovskite, fluorescence, lifetime measurements, strain, photocatalysisSupplementary material for this article is available [online](#)**Abstract**

Tuning the properties of perovskite metal oxide by varying the crystal structure leads to many functional applications. Here strain induced by an external matrix like reduced graphene oxide (RGO) in the crystal structure of LaFeO₃ (LFO) and its related optical properties are investigated. X-ray diffraction technique is used to find the strain in the crystal structure of graphene-LFO (GL) composite. The band gap and band tailing energy of the composites are determined by applying modified Kubelka–Munk function on UV–Vis DRS data. The steady-state fluorescence emission spectra of the samples show a monotonic decrease with increase in concentration of RGO. GL composites show enhanced photocatalytic degradation of RhodamineB (RhB) dye under solar spectrum irradiation. Variations in lifetime, fluorescence intensity and photocatalytic activity of GL composites are explained in terms of intermediate bands produced by RGO and associated radiationless transitions of photoexcited electrons. RGO induced strain and tuning the optical properties of perovskites can provide a pathway to engineer new multifunctional materials in optoelectronic applications.

Introduction

Perovskite nanomaterials are one of the promising materials in the 21st century. They are recently demonstrated as an emerging material in optoelectronics [1]. Their superior properties enable them to find application in photovoltaic and light emission applications. Moreover, among optical properties, the presence of a broad absorption spectrum and tuneable intense emissions (quantum yield ~10%–90%), make them useful in multicolor biological imaging [2].

Ferrite materials exhibit various intriguing properties and among them, rare-earth orthoferrites with ABO₃ crystal structures are well known for their shape related material properties [3–5]. The size of the rare earth metal oxide in the perovskite has an important role. The size determines the octahedral tilting which leads to strain in the crystal structure. As the ionic radius of rare-earth metal increase, the octahedral tilting angle also increases resulting in a less distorted structure. In comparison to cubic structure perovskites, the rare earth perovskites which adopt orthorhombic perovskite geometry, allows highly substitutable cation sites, widening its scope to be tuned for specific applications [6].

One of the members viz, Lanthanum orthoferrite, LaFeO₃(LFO) has peculiar physico-chemical properties making it suitable for advanced technologies like solid oxide fuel cell, catalyst, chemical sensors, and biosensors. They exhibit mixed conductivity i.e., a combination of electronic and ionic conductivity significant for its performance in technological applications [7]. Various properties of the perovskite LFO are also related to the crystal defects. La is the smallest element with ionic radius- 1.87 Å in rare earth family. The size effect of La is also one of the reasons for the observed distortion in the synthesised LFO. Mainly the defects generate fluctuations between the oxidation states of the iron which leads to insertion of O₂ from the environment or creation of oxygen vacancies [8]. Their surface area along with the interfacial state makes it useful in catalytic applications [9]. LFO and its composites are explored widely for its visible-light photocatalytic properties.



A Statistical Approach to Optimize Cold Active β -Galactosidase Production by an Arctic Sediment Psychrotrophic Bacteria, *Enterobacter ludwigii* (MCC 3423) in Cheese Whey

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Abstract

Cold active β -galactosidases which catalyze lactose hydrolysis and transglycosylation reactions at low temperature make them highly potential biocatalyst in biotechnology, pharmaceutical and food processing industries. Moreover, an interest towards the utilization of dairy industrial waste, whey and its constituents, for manufacturing a wide range of valuable products at reliable cost is increasing among researchers in order to facilitate its wider commercial use. In the present study, the fermentation parameters for the maximum production of cold active β -galactosidase from a psychrotrophic bacterium, *Enterobacter ludwigii* in cheese whey was optimized by exploring statistical methods, Plackett-Burman design (PBD) and central composite design (CCD). Three most significant factors viz, pH, whey and tryptone out of 11 were selected by PBD and were further optimized by response surface methodology using CCD. The optimal levels of pH, whey and tryptone were indicated as 7.3, 82 (v/v) % and 3.84 g% respectively. An overall 3.6-fold increase in cold active β -galactosidase production (34.37 U/mL) was achieved in optimized medium compared to the yield from unoptimized medium. The quadratic regression model was proven to be adequate ($p=0.0001$, $R^2=0.9880$, $CV=7.96\%$) and the response (cold active β -galactosidase production) obtained on validation coincident with the predicted value.

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Functional Characterization of a New Cold-Adapted β -Galactosidase from an Arctic Fjord Sediment Bacteria *Enterobacter ludwigii* MCC 3423

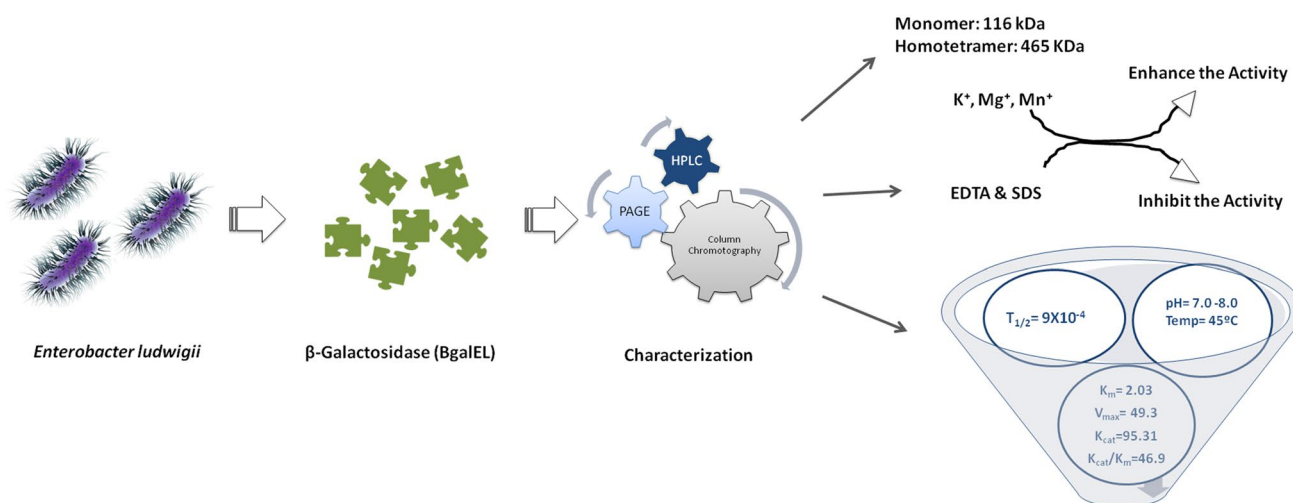
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Abstract

In the present study, a new cold-adapted β -galactosidase, BgalEL isolated from the fjord sediment bacteria, *Enterobacter ludwigii* MCC 3423, was purified and characterized. The phylogenetic analysis of partial sequence of *bgalEL* gene revealed 99% relatedness of the enzyme to *Enterobacter cloacae* β -galactosidase. BgalEL is a homotetramer with molecular weight 465 kDa composed of ~ 116.42 kDa subunits. The optimal pH range and temperature for maximum hydrolytic activity on ONPG were 7.0–8.0 and 45 °C respectively. BgalEL was stable at pH ranges 6.0–8.0. The K_m and V_{max} for BgalEL were recorded as 2.03 mM and 49.3 U mg^{-1} respectively. The product formation by BgalEL was modelled with various degradation kinetic models and zeroth was found as model was best-fitted model. The kinetic half-life period of ONPG was noted as 9.0×10^{-4} . The presence of K^+ , Mg^{2+} and Mn^{2+} at 10 mM concentrations stimulated BgalEL activity by 31 ± 3.9 , 34 ± 1.2 and $42 \pm 1.9\%$ respectively. It was interesting to see that BgalEL was least affected by the hydrolytic products, glucose and galactose. Noteworthy, effect of Ca^{2+} ions on BgalEL activity was negligible at concentrations of 10 mM. BgalEL hydrolyzed lactose in milk at refrigerated temperature and also displayed transglycosylation potential in the presence of substantial concentrations of lactose at 40 °C. Finally, this is the first report with such a detailed characterization of β -galactosidase enzyme from a gram-negative bacterium isolated from the Arctic region. In light of the above mentioned properties, we thus recommend the enzyme BgalEL for the large scale production lactose free milk for the safe consumption in lactose-intolerance and the prebiotic galactooligosaccharides as supplement for infant food formulas.

Graphical Abstract



Extended author information available on the last page of the article