CHRIST
COLLEGE (AUTONOMOUS)
IRINJALAKUDA, KERALA

AQAR 2023-2024

CRITERION	**III**	**Research, Innovations and Extension**
KEY INDICATOR	**3.4**	**Research Publications and Awards**

3.4.3 - Number of research papers per teacher in CARE journals notified on UGC website during the year

Eco. Env. & Cons. 29 (2) : 2023; pp. (703-706)
Copyright@ EM International
ISSN 0971–765X

DOI No.: http://doi.org/10.53550/EEC.2023.v29i02.025

First report of *Eudocima cajeta* (Cramer) (Lepidoptera: Erebidae) from Kerala, India with notes on male and female genitalia

Adarsh P.K. and Abhilash Peter*

Entomo Taxonomy Lab, Department of Zoology, Christ College (Autonomous), Irinjalakuda, Thrissur 680 125, Kerala, India (Affiliated to University of Calicut)

(Received 7 October, 2022; Accepted 10 December, 2022)

ABSTRACT

A report on the fruit piercing moth *Eudocima cajeta* (Cramer) (Lepidoptera: Erebidae) is authenticated for the first time from Kerala, India. In addition to the morphology of the adults, detailed notes on the male and female genitalia structures are also provided in this paper.

Key words : *Eudocima cajeta, Erebidae, Genitalia, Kerala*

Introduction

The genus *Eudocima* Billberg includes approximately 50 species of fruit piercing moths which are distributed tropical, subtropical and neotropical regions (Zaspel and Branham (2008); Zilli *et al.* (2017). Many species of neotropical and oriental regions were earlier placed under other genera such as *Othreis* Hübner, *Ophideres* Boisduval and *Trissophaes* Hübner. Currently, all the fruit piercing moths were placed under the genus *Eudocima* (Sergio Vargas-Fonseca *et al.* (2020). Unlike other moth pests, many adult *Eudocima* species are reported as major pests of pomegranate, citrus, orange and papaya (Shendge and Chavan (2019). Adults pierce and suck juice using its strong sclerotized proboscis, which leave behind scars and color change on fruits gradually leading to rotting of fruits.

E. cajeta (Cramer), *E. srivijayana* (Banziger) and *E. talboti* (Prout A.E.) are the morphologically similar and sexually dimorphic species reported from the Indo- Australian regions. (Zilli *et al.* (2017). It is mandatory to do genitalia analysis for the species level authentication. 12 species of *Eudocima* have been reported so far from India (Singh *et al.* (2019); Shendge, and Chavan, 2019). The genitalia feature of *Eudocima* moths of India is not well recorded. Most of the species level identifications were done without genitalia study, even for species groups with similar morphology. Singh *et al.* 2019 conducted genitalia studies of *E. materna* and *E. phalonia* from India. This species has also been reported from other parts of India (Assam, Rose (2002); Tamil Nadu, Sivasankaran *et al.* (2017). In this manuscript, we authenticate *Eudocima cajeta* for the first time from the state of Kerala, India based on the study of both male and female genitalia.

Materials and Method

The adult male and female specimens of *E. cajeta* were collected from Kattungachira, Irinjalakuda, Thrissur, Kerala on 3rd of February 2022 (100 22’08’’N 76012’50’’E) and Panamaram, Wayanad

***Corresponding author’s email:** abhilashpeter@christcollegeijk.edu.in

Zootaxa 5339 (6): 547–561
https://www.mapress.com/zt/

Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

https://doi.org/10.11646/zootaxa.5339.6.4
http://zoobank.org/urn:lsid:zoobank.org:pub:693C621E-AAF1-4BDE-BC15-1181726E2E5D

Description of two new species of *Nemoleon* Navás, 1909 (Neuroptera, Myrmeleontidae) from India

THANGALAZHI BALAKRISHNAN SURYANARAYANAN[1*], LEVENTE ÁBRAHÁM[2] & CHENTHAMARAKSHAN BIJOY[1*]

[1]*Shadpada Entomology Research Lab, Department of Zoology, Christ College (Autonomous), Irinjalakuda, Thrissur, 680125, Kerala, India*
suryantb1995@gmail.com; *https://orcid.org/0000-0002-0679-6914*
bijoyc@christcollegeijk.edu.in; *https://orcid.org/0000-0002-5016-0454*
[2]*Rippl-Rónai Museum H-7400 Kaposvár, P.O. Box 70, Hungary*
https://orcid.org/0000-0002-8007-7117
**Corresponding Author*

Abstract

The Nemoleontid genus, *Nemoleon* Navás, 1909 from the Oriental realm, with two new species namely *Nemoleon ghoshi* **sp. nov.** and *Nemoleon madayiensis* **sp. nov.** are described from Kerala, India. Also, a species key of *Nemoleon* from India based on the adult characters is provided, and compered to African species.

Key words: New species, antlion, Nemoleontini, *Nemoleon*, India

Introduction

Nemoleon Navás, 1909 (Neuroptera, Myrmeleontidae, Nemoleontini) is an antlion genus with 22 species recorded in Afrotropical and Palaearctic realms (Oswald 2023). The genus was established by Navás (1909) based on the type species, *Nemoleon notatus* (Rambur, 1842) from Senegal. Most of the antlion species in this genus have narrow wings, elongate abdomens and simple tarsal claws (Stange, 2004) and the first tarsal segment and tibial spurs are mostly as long as tarsal segment 2–4 together (Hölzel 1972).

In the previous century, Navás (1912, 1914a, 1914b, 1914c, 1915, 1921, 1928, 1929, 1932, 1934, 1935) described 10 antlion genera, namely, *Gandulus* Navás, 1912; *Nicarinus* Navás, 1914a; *Griala* Navás, 1914b; *Nisteus* Navás, 1914c; *Landanus* Navás, 1914d; *Naldanus* Navás, 1921; *Vinga* Navás, 1928; *Ladrus* Navás, 1929; *Lybekius* Navás, 1934 and *Meconemurus* Navás, 1935 all of which were subsequently regarded by Banks (1911), Hölzel (1972), Markl (1954), Oswald & Penny (1991) and Stange (2004) to be the junior synonyms of *Nemoleon*.

Then Stange (2004) gave a hint about an undescribed *Nemoleon* species distributed from India. But none of other researchers discovered this undescribed species. Recently this genus was added to the Indian Neuroptera fauna by Suryanarayanan *et al.* (2022) with future remarks. Therefore, in this paper, based on latest collection from Kerala regions of India, we discovered two new *Nemoleon* species from India, and we described these two new species as well as presented the species key of *Nemoleon* from India.

Material and methods

The adult antlions were collected using a sweep net from semi-closed grassland (Figs. 1A–B & Figs. 5A–B). The collected specimens were transferred into a killing jar with 1–2 drops of ethyl acetate. After that, specimens were pinned, stretched, dried, labelled, and preserved. The specimens were examined through Labomed Luxeo 6Z stereomicroscope. The photos were prepared with Canon 7D Mark II digital camera with a 100 mm F/2.8L macro

Accepted by X.-Y. Liu: 16 Aug. 2023; published: 4 Sept. 2023

https://doi.org/10.33307/entomon/v48i3/942
ENTOMON 48(3): 411-420
Article No. ent. 48309

A checklist of robber flies (Diptera, Asilidae) of Kerala, India

Kavya G. Pillai[1], C. Bijoy[1*], Chris M. Cohen[2] and Gigi Poulose[3]

[1]Shadpada Entomology Research Lab, Department of Zoology, Christ College (Affiliated to Univesity of Calicut), Irinjalakuda, 680125, Kerala, India.
[2]North Carolina State University, Raleigh, North Carolina, U.S.A.
[3]Department of Zoology, St. Joseph's College (Affiliated to Univesity of Calicut), Irinjalakuda 680121, Kerala, India.
Email: bijoyc@christcollegeijk.edu.in

ABSTRACT: A checklist of robber fly species reported in Kerala, India based on literature survey is provided. In this list, 87 species of robber flies representing 25 genera and eight subfamilies are enumerated. The diversity of robber flies in Kerala was highlighted. Most of the species were reported from the protected forest areas of Kerala such as Ponmudi, Anamalai hills, Idamalayar, Thekkadi, Valparai, Chembra peak, Nilambur, Peermade, Walayar, Tenmalai and Silent Valley of the Western Ghats.

KEYWORDS: Assassin flies, biodiversity, taxonomy, Western Ghats

INTRODUCTION

The Western Ghats is regarded as one of the eight biodiversity hotspots in the world and as a vulnerable ecological region. With its tall, dense tropical rain forests, Kerala, at the southernmost tip of India, boasts the most diverse vegetation of the region (Reddy *et al.*, 2016). Asilidae is the third most diverse family in the order Diptera and is commonly known as robber flies or assassin flies (Pape *et al.*, 2011; Brown *et al.*, 2018). They are a significant group of predators in all zoogeographical zones and contain 7531 species in 556 genera scattered throughout the world (Pape *et al.*, 2011; Dikow, 2020). Currently a comprehensive information on the Asilidae of Kerala is not available. As a foundation on this fauna, a checklist of the asilid species previously recorded from Kerala was worked out.

MATERIALS AND METHODS

The checklist was prepared entirely based on a literature. Asilidae generic classification *sensu* Dikow (2009) is followed in this study. Reported details regarding the robber fly diversity of Kerala were collected from various sources in the literature. When the exact distribution of a taxon is unknown, it is recorded simply as Kerala.

RESULTS AND DISCUSSION

Subfamily Asilinae Latreille, 1802

Genus *Astochia* Becker, 1913

The genus *Astochia* Becker has a vast distribution in the Oriental region, which includes China, India, Indonesia (Java, Sumatra), Philippines, and Thailand (Scarbrough and Biglow, 2004).

* Author for correspondence

https://doi.org/10.33307/entomon/v48i3/936
ENTOMON 48(3): 331-356
Article No. ent. 48303

Grasshoppers, crickets and katydids of Kerala, an updated checklist for the order Orthoptera

E. S. Thasnim, C. Bijoy* and Dhaneesh Bhaskar[1]

Shadpada Entomology Research Lab, Department of Zoology, Christ College (Autonomous & affiliated to University of Calicut), Irinjalakuda 680121, Kerala, India.
[1]IUCN SSC Grasshopper Specialist Group: Care Earth Trust, Chennai, Tamil Nadu, 600061, India.
Email: bijoyc@christcollegeijk.edu.in; thasnimshafeek25@gmail.com; dhaneeshbhaskar24@gmail.com

ABSTRACT: An updated checklist of the order Orthoptera of Kerala is provided. Eighty-five species have been added to the existing checklist. A total of 215 species and 21 subspecies belonging to 154 genera under 18 families of two suborders are enumerated along with their distributional data across the state. Suborders Caelifera and Ensifera are represented by 127 and 88 species, respectively.

KEYWORDS: Species, Caelifera, Ensifera, distributional data

INTRODUCTION

Orthoptera is a familiar and significant insect group found in diverse ecosystems (Bhowmik and Rui, 1982), comprising grasshoppers, locusts, crickets, mole crickets and katydids. Besides being conspicuous pests, they are also significant as primary consumers, prey to predators and good indicators of changing environmental conditions (Bazelet and Samways, 2011; Gangwere and Muralirangan, 1997; Belovsky and Slade, 2017). The order consists of more than 29,410 valid species belonging to 43 families under two suborders, Caelifera and Ensifera (Cigliano *et al.* 2023). In India, no major taxonomic compilation is available on the Orthoptera fauna except for a review by Chandra *et al.* (2010) and an annotated checklist of Orthoptera from India by Shishodia *et al.* (2010) in which 1033 species were reported. Recently Gupta and Chandra (2020) compiled a checklist of Orthoptera of Western Ghats. The grasshoppers of India mostly recognised as agricultural pests, are least explored after the colonial researchers (Bhaskar *et al.*, 2019). Notable taxonomic works on Indian Orthoptera were done by Kirby (1914), Hancock (1915), Uvarov (1921, 1929), Hebard (1929), Henry (1940), Chopard (1969), Tandon (1976) and Bhowmik (1977, 1985). Many other significant works on Orthoptera were conducted in various states of India (Tandon and Shishodia, 1977; Vasanth, 1993; Tandon and Hazra, 1998; Shishodia, 1999, 2000; Chitra *et al.*, 2000; Shishodia and Kulkarni, 2002; Dey and Hazra, 2003; Thakur *et al.*, 2004; Kulkarni and Shishodia, 2005; Senthilkumar *et al.*, 2006; Senthilkumar, 2010; Usmani *et al.*, 2010; Nayeem and Usmani, 2012; Akhtar and Usmani, 2014; Kumar and Usmani, 2015; Bhaskar *et al.*, 2022). Significant studies on

* Author for correspondence

ORIENTAL INSECTS
https://doi.org/10.1080/00305316.2023.2173326

A new species of cuckoo bee genus *Thyreus* (Hymenoptera: Apoidea: Apidae) from India with a revised key to Indian species

Anju Sara Prakash[a], Thayyullathil Jobiraj[b] and Chenthamarakshan Bijoy[a]

[a]Shadpada Entomology Research Lab (SERL), Department of Zoology, Christ College (Autonomous), Irinjalakuda, University of Calicut, Kerala, India; [b]Department of Zoology, Government College, Kodenchery, University of Calicut, Kerala, India

ABSTRACT

A new species of cuckoo bee, *Thyreus narendrani* **sp. nov**. is described from Kerala, India. This species resembles *Thyreus massuri* and *Thyreus irena* and mainly differs by the presence of unequally divided hair band of tergite 3, which forms two isolated spots.

http://urn:lsid:zoobank.org:pub:DE52F4A4-078D-422A-AB76-8A594694A625

ARTICLE HISTORY
Received 7 June 2022
Accepted 23 January 2023

KEYWORDS
Apidae; Apinae; melectini; cleptoparasite; description

Introduction

Bees of genus *Thyreus* Panzer, 1806 are known as cuckoo bees or cleptoparasites. This genus consists of 106 described species in the world and 16 species in India (Ascher and Pickering 2022). This genus belongs to subfamily Apinae and tribe Melectini. This tribe comprises apiform to anthophoriform parasitic bees distributed in the Palearctic, Oriental, Australian, Nearctic and in the northern parts of Neotropics (Michener 2007). Several authors studied the cleptoparasitic behaviour of the genus *Thyreus* and their interaction with hosts. Rozen (1969) described the interaction of *Thyreus lieftincki* Rozen, 1969 with its host *Anthophora braunsiana* Friese, 1905. Rozen and Özbek (2005) studied the cleptoparasitic behaviour of *Thyreus ramosus* (Lepeletier, 1841) on a bee from genus *Anthophora (Dasymegilla)* Brooks, 1988. Despite this, *Thyreus* are believed to parasitise mainly the genus *Amegilla* Friese, 1897, which is sister to *Anthophora* Latreille, 1803 (Engel 2014). Generally, female bees of tribe Melectini, including genus *Thyreus,* parasitise their hosts by breaking and entering the closed cells of nests and resealing the cells after laying their eggs (Michener 2007).

International Journal of Entomology Research
www.entomologyjournals.com
ISSN: 2455-4758
Received: 22-03-2023, Accepted: 09-04-2023, Published: 25-04-2023
Volume 8, Issue 4, 2023, Page No. 32-36

A Study on the role of *Hermetia illucens* (Diptera: Stratiomyidae) as a bioconversion agent

Kavya G Pillai[1], Aswathi P G[2], Bijoy C[3*]
Shadpada Entomology Research Lab, Department of Zoology, Christ College, Irinjalakuda, Thrissur, Kerala, India

Abstract
The effectiveness of the Black soldier fly, *Hermetia illucens* larvae in the bioconversion of four types of organic wastes, including organic debris, vegetable waste, fish waste, and chicken waste was assessed. In addition, the effects of various organic wastes on *H. illucens'* life cycle, larval growth, and weight gain were evaluated.

Keywords: *Hermetia illucens,* bioconversion efficiency, waste reduction index, substrate reduction

Introduction

The rapid urbanisation, population growth, and economic advancement of nations that demand high-quality meals and the management of organic waste would require a lot of resources [1, 2]. Between 2013 and 2050, agricultural production has to expand by 49% to meet this need [1]. Worldwide, especially in developing nations, enormous amounts of organic waste are being produced and are improperly managed [3, 4]. Large-scale daily production of municipal solid trash results in significant environmental issues [5]. The recycling of different types of garbage and other accumulated nutrients in our environment is greatly aided by insects. Utilization of *Hermetia illucens* author name and year for the bioconversion of organic wastes is one such strategy [6]. *H. illucens* belongs to the Order Diptera and family Stratiomyidae and popularly known as the black soldier fly (BSF).

Another major global challenge is the growing demand for animal fodder which may not be produced satisfactorily from those resources that are naturally available. A solution that is feasible to overcome this challenge is the application of feed that is produced from insects [7]. About 37- 63% protein and up to 49% fat are present in BSF larvae along with some micro and macronutrients that are essential for animal growth, and development as well as for human nutrition [8]. The price for the feed can be minimized by promoting the use of good quality insect-based feed which may in turn boost productiveness. The frass that *Hermetia illucens* larvae produce has the capacity to recover Nitrogen and Phosphorus from the food chain and reuse it as fertilizer, thereby minimizing the demand for chemical fertilizers [9].

This study investigated the effectiveness of BSF larvae in the bioconversion of four distinct organic wastes, which include vegetable, fish, poultry wastes, and organic debris, as well as the impact of these organic substrates on the survival, weight gain, and growth rate of BSF larvae and their life cycle.

Materials and Methods

The present study followed the experimental methods described by Nguyen *et. al.*[10].Organic debris, vegetable waste, chicken waste, and fish waste were the different types of waste given to BSF as the diet in this study. In order to make a consistent homogeneous diet, large quantities of each organic waste were crushed with the help of a shredder [10].

About 50 four-day-old BSF larvae were kept in each 12 square-shaped containers made of glass without lids and added 6 grams of waste from each type of waste to these containers. The square containers measured about 30 x 30 x 6.5 cm and are sealed properly with the help of good quality muslin cloth and rubber bands so that larvae cannot escape outside and to prevent other flies or insects from causing any kind of infestation or decay. The glass containers should not be placed directly under the sunlight. 50 BSF larvae in three sets of control replicates were simultaneously fed and larvae were removed from the containers on the alternative days in order to weigh and record the remaining waste left in the containers. Out of three sets of replicates, the first and second were labeled as handled, and unhandled, and no larvae were placed in the third set. The third set of replicate was set up in order to determine the amount of waste diet being reduced due to evaporation and bacterial decomposition. The dehydration loss was taken into account while calculating the rate of reduction of waste by the activity of BSF larvae. 6 grams of waste were newly added to each container on a regular basis. On the alternative days of study, those larvae in the handled sets were taken out, the remaining waste diet was weighed and recorded. The amount of diet was increased by 5 grams when the wet weight of provided feed reached 25%. The experiment was stopped when 40% larvae of the handled set attained the wandering stage of their life cycle. Same quantity of waste diet was also added to the second and third sets, then the mortality rate, rate of survival, and weight gain of BSF larvae were noted when 40% of larvae in the first set reached their wandering stage. The larval weight of 5 samples consisting of ten larvae each was measured with the help of an electronic weighing balance.

The parameters measured include the rate of survival, Waste Reduction index, larval growth rate, and weight gain, percentage of substrate reduction, and Efficiency of Conversion of Ingested food. The mathematical formulas applied in the calculations were described in Jucker *et. al.* [11].

Natura Somogyiensis 40: 31-46. Kaposvár, 2023 DOI:10.24394/NatSom.2022.40.31

Submitted: 26.02, 2023; Accepted: 04.03, 2023; Published: 30.03, 2023 www.smmi.hu/termtud/ns/ns.htm

Revision on the genus *Bubopsis* MacLachlan, 1898 known in India (Neuroptera: Myrmeleontidae: Ascalaphinae)

Thangalazhi Balakrishnan Suryanarayanan[1], Levente Ábrahám[2]
Chenthamarakshan Bijoy[1*] & Rishikesh Tripathi[3]

[1]Shadpada Entomology Research Lab, Department of Zoology, Christ College (Autonomous), Irinjalakuda, Thrissur, 680125, Kerala, India
suryantb1995@gmail.com, https://orcid.org/0000-0002-0679-6914
*Corresponding Author: drbijoyc@gmail.com, https://orcid.org/0000-0002-5016-0454,
[2]Rippl-Rónai Museum, H-7400 Kaposvár, Hungary
labraham@smmi.hu, https://orcid.org/0000-0002-8007-7117
[3]Centre for Animal Taxonomy and Ecology, Department of Zoology, Christ College, Irinjalakuda, Thrissur, 680 125, Kerala, India
rishikesh.tripathi14@gmail.com, https://orcid.org/0000-0002-9192-4609

Suryanarayanan, T. B, Ábrahám, L., Bijoy, C. & Tripathi, R.: *Revision on the genus Bubopsis MacLachlan, 1898 known in India (Neuroptera: Myrmeleontidae: Ascalaphinae).*

Abstract: The ascalaphid, *Bubopsis zarudnyi* Martynova, 1926 is recorded for the first time from India. *Bubopsis rubrapunctata* Ghosh, 1981 was the only owlfly species previously described from India from the genera. The two species are revised from a taxonomic point of view and *Bubopsis zarudnyi* is redescribed. The habitat and flight activity of the species is documented. Based on the re-identified specimens preserved in different collections, the distribution of the species is outlined. After examining type specimens, *Bubopsis rubrapunctata* is removed from the genus *Bubopsis* MacLachlan, 1898 and *Pseudobubopsis* **gen. n.** is erected for *Pseudobubopsis rubrapunctata* (Ghosh, 1981) (**comb. n.**). Also, the new genus is compared with *Bubopsis*, and generic key is provided.

Keywords: owlfly, ascalaphid, Ascalaphinae, *Bubopsis*, taxonomy, redescription, new genus, India.

Introduction

According to Machado et al. (2019), Ascalaphini is the largest tribe with 286 species belonging to 70 genera. *Bubopsis* which belongs to Ascalaphini was described by MacLachlan (1898) and is distributed mainly in Southern Europe, North Africa, the Middle East, and Arabian Peninsula (McLachlan 1898, van der Weele 1909, Martynov 1926, Aspöck et al. 1978, Aspöck et al. 1980, Sziráki 1998, Sziráki 2000, Hölzel 2004). *Bubopsis* currently includes 7 species in the world, i.e., *B. agrionoides* (Rambur, 1838), *B. andromache* U. Aspöck et al. 1978, *B. eatoni* McLachlan, 1898, *B. hamata* (Klug in Ehrenberg, 1834), *B. rubrapunctata* Ghosh, 1981, *B. tancrei* van der Weele, 1909 and *B. zarudnyi* Martynova, 1926 (Oswald 2023). In India, only one *Bubopsis* species was reported so far, i.e., *B. rubrapunctata* which was distributed in the

ISSN 1587-1908 (Print); ISSN 2062-9990 (Online)

International Journal of Entomology Research
www.entomologyjournals.com
ISSN: 2455-4758
Received: 08-10-2023, Accepted: 25-10-2023, Published: 09-11-2023
Volume 8, Issue 11, 2023, Page No. 26-27

A preliminary study on the bee (Insecta: Hymenoptera: Apoidea) diversity in Christ college (Autonomous), Irinjalakuda, Thrissur, Kerala

Ann Miya Antony, Tessa Mathew, Rahul Babu, Anju Sara Prakash, Bijoy C
Department of Zoology, Shadpada Entomology Research Lab, Christ College, Irinjalakuda, Thrissur, Kerala, India

Abstract
Fourteen species of bees were collected from various sites of the Christ College campus, Irinjalakuda, Thrissur, Kerala during the study period from October 2022 to February 2023. Genus *Tetragonula* Moure is the most abundant and Genus *Lasioglossum* Curtis is least abundant.

Keywords: Diversity, floral interactions, bees, Hymenoptera

Introduction
The order Hymenoptera contains Apoidea (bees), Vespoidea (wasp) and Formicidae (ants). All the bees belong to the superfamily Apoidea. There are 7 families of bees which include Apidae, Megachilidae, Andrenidae, Colletidae, Halictidae, Melittidae and Stenotritidae (Mason and Huber, 1993) [2]. Bees are the primary pollinators. Major work on the bee fauna of the world by Michener (2007) [3] titled, "The bees of the world" treated around 16,000 species under 1200 genera. There are four distinct social behaviours among bees. They are solitary bees, social bees, brood parasites, and social parasites. Almost 20,759 bees are known from the world and majority of them are solitary (Ascher and Pickering, 2023) [1]. In social colonies, numerous bees share a nest and each female has a specific job to do. Workers cannot breed but they gather pollen and nectar for the colony and protect it from invaders. The queen gives birth but doesn't leave the colony or go foraging. There are two kinds of social bees, highly social bees and primitively social bees. These highly social bees, both stingless bees and honey bees, always live in big colonies with a queen who lays the majority of will feed and tend to the growing larvae of the nest the eggs and large number of workers who produce honey. Kerala is rich in bee diversity. Sheeja and Jobiraj (2017) [6] conducted studies on the bee fauna of the Vanaparvam biodiversity park, Kozhikode, Kerala and identified 18 species belong to 9 genera. Prakash *et al.* (2020) [5], published checklist of bees of Kerala, which reported 86 species of bees under 19 genera.

Materials and methods
Study area and period
The study was conducted in the campus of Christ College (Autonomous), Irinjalakuda, Thrissur from October 2022 to February 2023.

Collection and preservation of bees
Two collections were taken per month between 9 am to 12 pm on each collection days. The specimens collected were killed using ethyl acetate vapour in the killing bottles, pinned and dried. The air tight insect wooden boxes were used to preserve the specimens. Identification keys, standard reference books and available literature were used for identifying various species of collected bees.

Statistical Analysis
PAST (Paleontological Statistics Software Package) version 4.03 was used to calculate diversity indices. The formula was also used to calculate the relative abundance of the species.

$$Relative\ abundance\ of\ species\ A = \frac{Number\ of\ individuals\ of\ species\ A}{Total\ number\ individulas\ collected} \times 100$$

Results and discussion
A total of 412 bees belonging to 14 species were collected during the study period. Collected specimens were identified up to species/morphospecies level which includes *Amegilla zonata, Megachile lerma, Tetragonula* sp., *Lasioglossum* sp.1, *Lasioglossum* sp.2, *Ceratina* sp., *Xylocopa fenestrata, Xylocopa ruficornis, Xylocopa* sp.3, *Lipotriches* sp., *Pseudapis oxybeloides, Thyreus* sp., *Apis cerana* and *Nomia (Hoplonomia) elliotii*. *Xylocopa* is the most speciose genus of the study area with 3 species. Species like *Amegilla zonata, Tetragonula* sp., *Lasioglossum* sp.1, *Nomia (Hoplonomia) elliotii* and *Xylocopa ruficornis* is found throughout the study period. Month wise data of bees collected from the site is provided in Table 1. Most number of bees were collected in January 2023, and the least number of bees were found in October 2022. The study outcome highlights that *Tetragonula* sp. has the highest relative abundance and *Lasioglossum* sp. 2 has the least relative abundance among the bees collected from college campus (Table 3). *Tetragonula* bees which has the highest relative abundance was found mostly in *Calotropis gigantea* flower. *Amegilla zonata* was found on *Stachytarpheta jamaicensis,* and *Lasioglossum* sp. 1 on *Turnera ulmifolia.* These observations show the floral relationship of bees. A study conducted on bee diversity on ash gourd from Kerala also indicated high relative abundance of *Tetragonula* bees (Prakash and Bijoy, 2021) [4]. From the collected data, species diversity indices were calculated (Table 3). Simpson (0.8642) and Shannon-weaver (2.124) diversity indices are high in the month of November 2022. Similarly, Simpson (0.6392) and Shannon-weaver (1.504) diversity indices are lowest in the month of January 2023.

Experimental Brain Research (2023) 241:571–583
https://doi.org/10.1007/s00221-023-06546-4

RESEARCH ARTICLE

Antibiotics modulate frequency and early generation of epileptic seizures in zebrafish

Dhanusha Sivarajan[1] · **Binu Ramachandran**[2]

Received: 25 October 2022 / Accepted: 2 January 2023 / Published online: 10 January 2023

Abstract

Antibiotics have been used for decades to treat various bacterial infections. Apart from bactericidal activities, their potential side effects have not been much studied or evaluated. Neurotoxicity is a major concern in the case of β-lactam and fluoroquinolone families, which can result in convulsions or seizures. Here, we proposed a hypothesis to check whether antibiotic treatment can conclusively enhance anxiety-like behaviours and how seizure behavioural profile gets modulated in pentylenetetrazole (PTZ)-treated zebrafish. Zebrafish were treated with selected antibiotics such as 25 mg/L Penicillin G (PG) and Ciprofloxacin (CPFX), for 7 days and thereafter exposed to PTZ (7.5 mM) for 20 min. The data indicate that PG and CPFX-treated groups exhibited anxiety-like or stressed behavioural phenotypes in the novel tank test (6 min), and also, they were found to promote hyperactivity. Early onset of PTZ-induced seizure-like behavioural scores, the heightened intensity of seizure and reduced latency in different scores were found in PG and CPFX-administered groups. This study substantiates that PG and CPFX as potential seizure modulators in zebrafish. The zebrafish is a well-established and still expanding model organism in many fields. Here, we again reinforce zebrafish as a prominent model to investigate seizure-like neuro-behavioural entities and confirm that chronic antibiotic use has negative consequences that can exacerbate the circumstances of vertebrate species exhibiting seizure-related reactions.

Keywords Zebrafish · Antibiotics · Anxiety · Novel tank test · Pentylenetetrazole · Seizure

Introduction

Antibiotics are widely used as chemotherapeutic means for controlling infectious diseases in human beings, plants, and animals. Besides their beneficial effects, possible consequences of them also should have taken into consideration. The inclusion of antibiotics in various non-therapeutic purposes as growth promoters in animal agriculture is massive scale (Chattopadhyay 2014) and they appear to elevate the development of antibiotic-resistant strains (Yap 2013). Antibiotics used in agriculture, livestock, and humans can escalate the antibiotic load in the environment, which is a major concern in the evolution of antibiotic-resistant bacteria and consequential health problems (Koch et al. 2021). Moreover, it was reported that antibiotics cause allergies, nephritis, gastrointestinal issues, haematological problems, electrolyte imbalance, and nervous system dysfunction in patients undergoing periodontal treatments (Heta and Robo 2018). The neurotoxic side effect is of major concern. Among the different classes of antibiotics, β-lactams and fluoroquinolones are frequently linked to the central nervous system (CNS) dysfunction (Wanleenuwat et al. 2020; Zhang et al. 2013), including pro-convulsive or epileptogenic effects (Grondahl and Langmoen 1993). The unopposed mechanisms underlying the situation are (Gamma-aminobutyric acid A) $GABA_A$ receptor antagonism and (N-methyl-D-aspartate) NMDA receptor agonism (Sugimoto et al. 2003; Wanleenuwat et al. 2020). Other side effects of β-lactam and fluoroquinolones are the production of reactive oxygen species (ROS) and mitochondrial dysfunction, which induce DNA, protein, and lipid damage in mammalian cells and

Communicated by Sreedharan Sajikumar.

✉ Binu Ramachandran
binuramachandran@uoc.ac.in

[1] Department of Zoology, Christ College (Autonomous), Irinjalakuda, Thrissur, Kerala 680125, India

[2] Neuronal Plasticity Group, Department of Zoology, University of Calicut, Thenhipalam, Malappuram, Kerala 673635, India

Behavioural Brain Research 450 (2023) 114470

Contents lists available at ScienceDirect

Behavioural Brain Research

journal homepage: www.elsevier.com/locate/bbr

Research report

Environmental stressors differentially modulate anxiety-like behaviour in male and female zebrafish

Atheena Amar [1], Binu Ramachandran [*]

Neuronal Plasticity Group, Department of Zoology, University of Calicut, Thenhipalam, Malappuram, Kerala 673635, India

ARTICLE INFO

Keywords:
Zebrafish
Anxiety
Caffeine
Conspecific alarm substance
Predator
Sex difference

ABSTRACT

How differently male and female responds in a stressful situation is a matter of curiosity. Apart from curiosity, this opens a new arena to the synthesis of personalized/individualized medications. Here, we used zebrafish, a suitable experimental animal model to study stress and anxiety. We evaluated the differential responses in adult male and female zebrafish on the acute exposure of three different stressors: Caffeine (100 mg/L), Conspecific alarm substance (3.5 ml/L), and sight of sympatric predators (Leaf fish and Snakehead) with the help of two different behavioural paradigms (Novel tank test & Predator exposure). Behavioural responses were captured over 6 minutes and quantified using Smart 3.0. Male zebrafish were found to be more responsive to caffeine treatment. Conspecific alarm substance-challenged males and females showed robust alarm reactions whereas females were found to be more prone to it. Female zebrafish showed statistically significant aversion to the visual representation of sympatric predators. Taken together, each stressor induced differential responses in male and female zebrafish.

1. Introduction

Zebrafish (*Danio rerio*) is a popular model organism studied across diverse research areas [2,28,41,69,97]. A multitude of biological traits like high genetic and physiological homology with humans, completely characterized genome, easiness in genetic and experimental manipulation, prolific nature, development outside the maternal organism, space and cost-effectiveness, optical transparency of eggs and larvae, etc. Kalueff et al., [50] upsurge its demand in biological sciences. Contributions of zebrafish to modeling debilitating neuropsychiatric disorders like anxiety [53,95] is invaluable as this fish share anatomical, endocrine, and genetic similarity with humans and rodents regarding anxiety [66,95]. Besides, the presence of a well-defined stress axis, ability to exhibit complex and robust anxiety-like behavioural patterns, sensitivity towards anxiolytic and anxiogenic substances, and presence of stress hormone - cortisol make this organism a suitable experimental tool to give additional insight into this ailment [51,95].

Anxiety is a serious neuropsychiatric illness that compromises the quality of life of victims [81]. In our society, anxiety still constitutes an unsolved medical urgency [44,9]. Unresponsiveness to medication, [77] burden on family and society [101,89], etc. necessitates a deeper understanding of this medical condition. Stress reaction serves as an adaptive mechanism as it helps the organism to regain its homeostatic state and become maladaptive when the severity of the stress is high [13,25]. Danger-evoked responses have been reported in insects, molluscs, fishes, and mammals [15]. Several stressors have been identified to cause fear responses in zebrafish viz, caffeine, Conspecific Alarm Substance (CAS) [33], and natural predators [14].

Caffeine is a potent neuroactive substance and has a high profile for its worldwide consumerism [23,73]. Coffee, tea, chocolates, soft drinks, energy drinks, and pharmaceutical drugs contain caffeine in different amounts [23,55,87]. Exposure to caffeine has been shown to have a diverse effect on different domains like memory [6], cognition [91], sleep [76], etc. The neuroprotective role of caffeine is remarkably evident in Alzheimer's disease [36,7] & Parkinson's disease [24]. Apart from its stimulating and ameliorative effect, caffeine is a powerful candidate for inducing anxiety-like behaviour in preclinical [31,34] and clinical studies [46]. Mounting pieces of evidence suggest the presence of caffeine in different environmental compartments including natural waters and was detected as a potential and emerging contaminant [55,90,99].

Aquatic animals are equipped with a chemosensitive ability [71,8].

* Corresponding author.
E-mail address: binuramachandran@uoc.ac.in (B. Ramachandran).
[1] Department of Zoology, Christ College (Autonomous), Irinjalakuda, Thrissur, Kerala-680125, India.

https://doi.org/10.1016/j.bbr.2023.114470
Received 28 December 2022; Received in revised form 5 March 2023; Accepted 16 March 2023
Available online 4 May 2023

CORONAVERTISING

Dr. Arun Balakrishnan M B, Assistant Professor, Dept. of Commerce, Christ College, Thrissur, Kerala.
Nurjahan E I, Ph.D. Scholar, Dept. of Commerce, Christ College, Thrissur, Kerala.

Abstract

Covid-19 brought harm to the world but it was a positive situation for most of the manufacturers and marketers. This is the period which saw a number of innovations and inventions. During the outbreak of pandemic consumers were targeted by new and hastily constructed forms of advertising. Some companies have induced consumers by exaggerating the severity of the pandemic in a favoring way. Advertisements addressing social concerns are common, not just related to Covid, but to a range of causes from poverty to climate change. However, such advertisements are found to be gaining more popularity during pandemic, especially for those relating to hygiene.

Keyword: Coronavertising, advertisement, consumer buying behavior.

INTRODUCTION

Commerce is trade between economic agents. Generally, commerce refers to the exchange of goods, services or anything of value between businesses or institutions. From a broader perspective, nations are concerned with managing commerce in a way that increases the welfare of citizens by providing jobs and producing useful goods and services. Marketing includes all activities undertaken by a company to promote the purchase or sale of a product or service (Twin, n.d.). Marketing involves advertising, selling, and distributing products to consumers or other businesses. In marketing, promotion refers to any form of marketing communication used to convey the relative merits of a product, service, brand, or issue to a target audience, most often persuasively in nature (National libraries Japan, n.d.). It helps the marketers to create a special place in the mind of the customers, which can be cognitive or emotional. Advertising is a marketing communication that uses a publicly sponsored, non-personal message to promote or sell a product, service, or idea. Sponsors of advertising are usually businesses that want to promote their products or services. Advertising differs from public relations in that an advertiser pays and has control over the message.

STATEMENT OF THE PROBLEM

The advantage of television advertising is that it can reach a larger audience than local newspapers and radio stations, and it does so in a shorter period of time. In most cases the consumers are influenced and they believe the advertisements and buy the products projected through the advertisements. But the reality is that TV ads are over promising, they are not as reliable as they are portrayed in the ads. During the Covid-19 era, many TV commercials till date focus on how to protect against this virus and the various control measures that people should take. Companies are launching new products every day to protect against the Coronavirus. But the purpose behind such products is to persuade people to buy their products rather than to protect them from the virus. These advertisements influence people a lot and they buy the products. Some of them may be satisfied with the products and some may be dissatisfied. Therefore, this study focuses on the effects of advertisements to fight against Covid-19.

Study of Influence of Inorganic CuI Hole Transport Layer on Bulk Heterojunction P3HT:IC60BA Polymer Solar Cells Using SCAPS 1-D

C D Ramabadran [1, 2 a)], K S Sudheer [1 b)]

[1]*Opto-electronic device simulation research lab, Department of Physics, Christ College (Autonomous), University of Calicut, Irinjalakuda, Kerala - 680125, India*
[2]*Govt. College, University of Calicut, Chittur, Palakkad, Kerala, India*

[a)] *Corresponding Author: ramabadrancd@christcollegeijk.edu.in*
[b)]*sudheersebastian@christcollegeijk.edu.in*

Abstract: Bulk heterojunction Polymer solar cells [BHJPSCs] are considered as a promising option in the field of organic solar cells due to their features like low cost, light weight, ease in fabrication and roll-to-roll compatibility. In this work we considered P3HT:IC60BA based BHJ PSC and studied the influence made by CuI Hole transport layer on the solar cell parameters. CuI is preferred over PEDOT:PSS hole transport layer which is commonly used due to its features like wider band gap, low cost and high stability. On optimization, the new structure gives Voc of 1.2170 V, Jsc of 6.9243 mA/cm^2, Fill factor of 73.95 %, Power conversion efficiency of 6.23 %. The results are really encouraging and promising.

INTRODUCTION

In Photovoltaics, the overall performance of Organic solar cells has progressed a lot in current years[1-4]. Bulk Heterojunction Polymer Solar Cells [BHJ PSCs] are one off the alternatives withinside the subject of nonconventional energy sources due to their features like low cost, ease of fabrication, light weight and easily availability [5-7]. Hole Transport Layer [HTL] performs an essential function in the performance of a BHJ PSCs. Usually PEDOT:PSS is considered as HTL due to its features like high conductivity, transparency and high work function [8-9], it's instability and influence of moisture and electron mobility are not consistent [10-13]. Hole transport Layer has an important role in taking holes to the respective electrodes while blocking electrons. CuI as a hole transport layer for BHJ solar cells is shown to have greater performance than the traditional structure with PEDOT:PSS as HTL [14].

The BHJ PSC with P3HT:IC60BA as Active Layer has shown a high Voc of 0.84 V and a higher PCE [15-17]. So far, no computational research were carried out to for the usage of CuI as HTL in BHJ PSC with P3HT:IC60BA as Active Layer and simulation research is a beneficial for developing a high-overall performing BHJ PSC in the future.

In this study, we looked at the SCAPS 1-D software [35] with an illumination of AM 1.5 G spectrum. SCAPS 1-D is used to simulate BHJ PSC with P3HT:IC60 BA blend as active layer, CuI serves as the hole transport layer, and ZnO Nanoparticles as the electron transport layer (ETL). Numerous forms of solar cells, including polymer solar cells, have been modelled using SCAPS. The software is calibrated by experimental paper on BHJ PSC [18] and device modelling is used to investigate how CuI affects the calibrated BHJ PSC performance.

Device Structure and Modelling

SCAPS 1D software is standardized by successfully simulating the polymer solar cell structure [18] given in Fig 1. The simulated output matches the experimental findings for BHJ PSC [18] as given in Table 1. This

Third International Conference on Advances in Physical Sciences and Materials: ICAPSM 2022
AIP Conf. Proc. 2901, 040001-1–040001-10; https://doi.org/10.1063/5.0178644
Published by AIP Publishing. 978-0-7354-4765-3/$30.00

Sustainable Food Technology

ROYAL SOCIETY OF CHEMISTRY

PAPER

View Article Online
View Journal

Cite this: DOI: 10.1039/d3fb00126a

A metamaterial based sensor for moisture and density of cereal flours

Aswathi P. V.,[a] Anju Sebastian,[a] Lulu Varghese,[b] Joseph V. P.[a] and Jolly Andrews *[a]

The dielectric properties of cereal grain flours are studied by varying the moisture content and density, using a novel metamaterial Wire Split Ring Resonator (WSRR) based sensor working in the microwave frequency range at room temperature. Four types of cereal grains ground into fine powders are used as the test samples. The WSRR sensor is kept in the electromagnetic field that exists between two monopole antennas connected to the receiving and transmitting ports of a Vector Network Analyzer (VNA) which serves as the measuring device. The *LC* resonance behavior of the WSRR on interacting with the electromagnetic field and the shift in its resonance frequency in response to any changes in the dielectric environment around it form the basis of sensing. The variation in the moisture content and density of cereal flour samples will cause corresponding changes in the capacitive environment of the sensor which is reflected as the resonance frequency shift. From the resonance–density calibration plot, the maximum packing density of cereal grain powders is found which is useful in determining the efficient use of the available packing space. The moisture content, an essential requirement in ensuring the shelf life of cereal grain powders, is analyzed from the resonance–moisture calibration plot. This simple and accurate metamaterial-inspired measuring technique may find wide applications in the food industry in optimizing the shelf life and packing space of cereal grain powder products.

Received 8th August 2023
Accepted 3rd November 2023

DOI: 10.1039/d3fb00126a

rsc.li/susfoodtech

Sustainability spotlight

Countries take various measures to ensure high quality for food products since nation building is possible only through healthy, energetic people. Quality of food products must be ensured from the harvesting to packing stage. Shelf life is determined by the moisture content present in the food product. A novel method is introduced to measure the moisture content of cereal food products using a metamaterial-based sensor in a reliable and easy way. The cost of transport is also a major concern in food trade which is connected with maximum utilization of available space. This proposed method can be employed for the compaction density packing in this regard. Hence this work is aligned with the goal 3 of UN SDG.

1 Introduction

Powdered cereal grains serve as important raw materials for a wide variety of food products. The taste and quality of these foods largely depend on the grade of the cereal grains and various treatments in the subsequent processing stages.[1] Top-grade cereal grains are characterized by good intrinsic qualities like composition, color, and aroma, and process-induced qualities like long shelf life and good storage properties.[2] The storage properties of cereal grains are determined by the parameters of moisture content, density, porosity, *etc.* In order to ensure the good storage properties of cereal grains, these parameters should be studied and optimized.[3] Since all these parameters depend upon the dielectric data, the dielectric study of cereal grains requires special attention.[4,5] The dielectric properties at different frequencies are determined for a material by analyzing its interaction with the electromagnetic (em) field. Different types of free space and resonant methods have been followed for the dielectric study of cereal grains over the past fifty years which include the cavity perturbation technique, free space transmission technique, two-point method using waveguides, *etc.*[6,7] According to the theoretical model of these methods, the material medium under study should be homogeneous. But the grain medium possesses inhomogeneities due to non-uniform kernel size distribution and porosity. This problem can be resolved by choosing the sample in powdered form. The dielectric study reports of many types of loose cereal grains are available in the literature, but those in powdered form are rarely found.[8,9]

A novel method in this regard is introduced here which involves the recently emerging metamaterial-based measurement techniques.[10] Metamaterials are artificially engineered composites with dimensions much less than the wavelength of the interacting em wave and possessing exotic properties that cannot be found in natural materials.[11–13] They are also

[a]*Department of Physics, Christ College (Autonomous) Irinjalakuda, University of Calicut, Kerala, 680125, India. E-mail: jollyandrews@christcollegeijk.edu.in*
[b]*Department of Food Processing Technology, Christ College (Autonomous) Irinjalakuda, University of Calicut, Kerala, 680125, India*

Indian Journal of Natural Products and Resources
Vol. 14(2), June 2023, pp 270-277
DOI: 10.56042/ijnpr.v14i2.4211

Evaluation of acute and subacute toxicity of *Vernonia cinerea* (L.) Less using mice model

Jimsy Johnson and Leyon Varghese*

Immunology and Toxicology Research Laboratory, Department of Zoology, Christ College (Autonomous), Irinjalakuda, Kerala 680125, India

Received 29 July 2022; revised received 24 January 2023; accepted 28 February 2023

Vernonia cinerea (L.) Less is a medicinal plant distributed throughout India and is used traditionally for treating several diseases. This study aimed to analyze the toxicological effects of ethyl acetate extract (VCEA) of this plant. Preliminary phytochemical screening of VCEA was conducted by conventional methods. For acute toxicity studies, female Swiss albino mice were treated with a single oral dose of 2000 mg/kg body weight of VCEA and observed for any changes in general characters. For the subacute toxicity study, mice were treated (50 or 100 mg/kg body weight) consecutively for 28 days and the haematological, biochemical, and histopathological changes were analysed. From the phytochemical analysis, it was inferred that terpenoid content was more in the VCEA extract. No mortality or toxic effects were observed in the acute study. Repeated dosage of VCEA at 50 mg/kg body weight did not impart any adverse effects in any of the parameters assessed. The higher dosage (100 mg/kg body weight) made the animals slightly anaemic. Therefore a dose of up to 50 mg/kg body weight is recommended as safe for testing the pharmacological properties of VCEA in mice models.

Keywords: Acute toxicity, Ayurveda, Phytochemicals, Subacute toxicity, Swiss albino mice

IPC code; Int. cl. (2021.01)- A61K 36/00, A61K, 36/28, A61P

Introduction

Phytopharmaceuticals have an important role in the general medical practice due to their intrinsic biological properties. Developing new drugs from herbal sources is often safe and cost-effective[1]. Screening of active extracts from plants, by subjecting them to accurate bioassays followed by purification of phytochemicals are the initial steps to the effective, side-effect free nutraceutical-based therapeutic approaches. However, scientific validation on the safety level of herbal extracts is an inevitable step in developing modern drugs from traditional medicines. Plants produce a variety of secondary metabolites which could be beneficial or toxic to humans. Those drugs which are therapeutically effective at one dose might be toxic at increased doses or on prolonged exposure. Toxicity screening for plant extracts used in traditional medicines to cure diseases is essential for the purpose of determining safe doses[2].

Vernonia cinerea (L.) Less is an ayurvedic medicinal plant found throughout India. The Ayurvedic Pharmacopoeia of India describes its traditional uses such as treatment for intermittent fever, boils, lymphatic filariasis, blisters, vaginal discharges, and psychoneurosis[3]. This plant, in combination with other herbal ingredients, is used to cure breast tumours by the tribal community in the southern region of the Western Ghats of India[4]. It is known as poovamkurunnila in Malayalam and belongs to Family Asteraceae. Various extracts of this plant were widely studied for their anti-inflammatory, anti-diabetic, nephroprotective, antimicrobial and anticancer potentials[5–11].

Sesquiterpene lactones (germacranolides) and steroids are the major classes of chemical compounds found in the genus *Vernonia.* Ethyl acetate soluble fraction of *V. cinerea* was reported to have many sesquiterpenes including vernocinolide A, Vernolide A, Vernolide B, and 8 alpha tigloyl oxyhirsutinolide 13-O acetate(8αTGT)[12]. These sesquiterpenes contribute to the anti-cancer property of the plant *V. cinerea*[13]. Though this plant is known for these therapeutically effective terpenoids, especially sesquiterpenes soluble in ethyl acetate, its toxicity studies in suitable animal models are still lacking. Thus the present study was undertaken to evaluate the acute

*Correspondent author
Email: leyon@christcollegeijk.edu.in
Supplementary tables are available online only.

JOURNAL OF HERBS, SPICES & MEDICINAL PLANTS
2023, VOL. 29, NO. 4, 438–451
https://doi.org/10.1080/10496475.2023.2217491

Taylor & Francis
Taylor & Francis Group

Tumor Reduction Potentials of *Vernonia Cinerea* Sesquiterpenes by Induction of Ferroptosis

Jimsy Johnson and Leyon Varghese

Immunology and Toxicology Research Laboratory, Department of Zoology, Christ College (Autonomous), (University of Calicut), Irinjalakuda, India

ABSTRACT

The anti lymphoma potentials of Vernonia cinerea were evaluated. In a short-term in vitro study, ethyl acetate extract (VCEA) was found to be cytotoxic to DLA cells with an LC50 of 61.24 µg mL−1. GC-MS analysis of VCEA revealed presence of several volatile molecules including nerolidol. Molecular docking study using nerolidol with Ferroportin-1 predicted strong binding affinity, indicating ferroptosis induction which was later confirmed by in vitro assays. VCEA also demonstrated strong reduction in the proliferation of YAC-1, another lymphoma cell line with G2/M arrest leading to apoptosis. The tumor reduction potentials of VCEA was further confirmed using the DLA-induced solid tumor model in mice.

ARTICLE HISTORY
Received 29 November 2022

KEYWORDS
Antitumor; apoptosis; DLA; lymphoma; nerolidol

Introduction

Cell proliferation occurring inappropriately with the reduction of sensitivity to signals that normally tell a cell to adhere, differentiate or die, in an organism leads to the development of tumors. A number of chemical compounds having the ability to combat tumor or cancer cells have been identified of which 50% are natural in origin or structurally modified forms. The chemical diversity and the capability for selective inhibition of proliferation and induction of apoptosis are important qualities of phytochemicals in the search for new chemotherapeutic agents.[1] Paclitaxel, Docetaxel, Topotecan, Vincristine, Vinblastine, and Etoposide are examples of phytochemicals used in current cancer therapy.[2]

Vernonia cinerea (Asteraceae) also known as "Ash colored fleabane" in English and *Poovamkurunnila* in Malayalam, is an herbaceous medicinal plant distributed all over India. It is traditionally used for treating intermittent fever, blisters, boils, lymphatic filariasis, vaginal discharges and psychoneurosis.[3] This plant, in combination with other herbal ingredients is used to cure breast tumors by the tribal people in the

CONTACT Leyon Varghese leyon@christcollegeijk.edu.in Immunology and Toxicology Research Laboratory, Department of Zoology, Christ College (Autonomous), (University of Calicut), Irinjalakuda 680125, India

Author JJ is a recipient of UGC-JRF, MHRD, Government of India.
Supplemental data for this article can be accessed online at https://doi.org/10.1080/10496475.2023.2217491.

Revista Brasileira de Farmacognosia
https://doi.org/10.1007/s43450-023-00462-y

ORIGINAL ARTICLE

Evaluation of the Tumor Reduction Potentials of *Pleurolobus gangeticus* Using *In Vitro* and *In Vivo* Models

Madhuri Menon[1] · Soumya Raj[1] · Achuthan C. Raghavamenon[2] · Leyon Varghese[1]

Received: 30 March 2023 / Accepted: 7 September 2023

Abstract

The plant parts of *Pleurolobus gangeticus* (L.) J.St.-Hil. (synonym: *Desmodium gangeticum*), Fabaceae, were extracted and evaluated for its antitumor potential using *in vitro* and *in vivo* lymphoma models. Cytotoxic potentials and apoptosis induction was evaluated using *in vitro* systems. Ethanol extract, among others, had the lowest IC_{50} value of 17.5 µg/ml in cytotoxicity assay conducted in DLA (Dalton lymphoma ascites) cells. Cytotoxicity assays performed on YAC-1 cells showed reduction in the number of live cells from 10×10^4 to 2.2×10^4 after 48 h of treatment with ethanol extract (15 µg/ml) at which time point the untreated cells multiplied to reach 17.5×10^4 in number. The flow cytometric analysis revealed that at this concentration, 44.7% cells are already in the early apoptotic phase by 24 h of treatment. Considering its bioactivity, ethanol extract was further used for *in vivo* toxicology profiling and antitumor studies in mice models. Treatment with nontoxic doses of ethanol extract (200 and 400 mg/kg b.w.) significantly reduced the tumor burden in mice. The biopsy analysis of tumor tissue of ethanol extract treated animals also showed a considerable number of apoptotic and necrotic cells. Ethanol extract was also subjected to chromatographic analysis (GC–MS and LC–MS), which revealed presence of several pharmacologically important molecules, but the absence of salicin was also noticeable. This highlights the role of other compounds detected in giving the extract its tumor reduction property. Further investigation to identify the active components and to obtain a deeper knowledge on their mechanism of action is worthwhile to acquire novel safer and effective anticancer drugs.

Keywords Antitumor · Ayurveda · Dalton lymphoma ascites · Histopathology · Lymphoma

Introduction

According to the statistical update conducted by the International Agency for Research on Cancer, they estimated 19.3 million new cancer cases and 10 million cancer deaths in the year 2020 globally. There is also a high risk of increase in the global cancer burden by 47% by the year 2040 (Sung et al. 2021). Ranked the fifth most common type of cancer in the developed world, lymphomas are a heterogeneous group of lymphoid malignancies that are classified based on histological characteristics and stage of maturation of lymphocytes (Jiang et al. 2017; Shankland et al. 2012). Multi-step accumulations of genetic aberrations like mutations, deletions, or chromosomal translocations are the root cause of non-Hodgkin lymphoma which is the major form of malignant lymphoma (Nogai et al. 2011). All chemotherapeutic regimens come with a lot of systemic side effects and complications, requiring safer alternatives (Liu et al. 2016). The anticancer ability and potential to overcome resistance, along with zero side effects, highlight the importance of using natural compounds for management of cancer.

The presence of secondary metabolites makes plants a good source of natural therapeutic drugs. Several plants have been attributed to have a wide range of therapeutic potentials. The secondary metabolites of *Ganoderma applanatum* (Pers.) Pat., Ganotermataceae, are known to have overlapping effects like cell cycle arrest, inhibition cell proliferation, and thereby exerting prompt apoptosis (Elkhateeb et al. 2018). β-Aesin, a triterpene saponin from *Aesculus hippocastanum* L., Hippocastanaceae and diosin, an unsaturated flavonoid glycoside from citrus fruits previously known for

✉ Leyon Varghese
leyon@christcollegeijk.edu.in

[1] Immunology and Toxicology Research Laboratory, Department of Zoology, Christ College (Autonomous) (Affiliated to University of Calicut), Irinjalakuda, India 680125

[2] Amala Cancer Research Centre, Amalanagar PO, Thrissur, India 680555

Published online: 28 September 2023

Journal of Applied Biology & Biotechnology Vol. 11(4), pp. 84-91, Jul-Aug, 2023
Available online at http://www.jabonline.in
DOI: 10.7324/JABB.2023.87672

Evaluation of the phytochemical constituents and tumor reduction potentials of *Tragia involucrata* Linn.

Madhuri Menon, Leyon Varghese*

Immunology and Toxicology Research Laboratory, Department of Zoology, Christ College (Autonomous), Irinjalakuda (University of Calicut), Kerala, India.

ARTICLE INFO

Article history:
Received on: November 14, 2022
Accepted on: February 09, 2023
Available online: June 04, 2023

Key words:
Antitumor,
Ayurveda,
Histopathology,
Lymphoma,
Terminal deoxynucleotidyl transferase.

ABSTRACT

The ethanol extract of *Tragia involucrata* (TME) whole plant was evaluated for its antitumor potential using *in vitro* as well as *in vivo* lymphoma models. The antiproliferative potential of the extract was revealed in the *in vitro* assay performed using YAC-1 cells. The number of live cells reduced from 10.25×10^4 to 1.0×10^4 after 48 h of treatment with 15 µg/mL of TME, and the untreated control cells multiplied to reach 15.0×10^4 in number by this time. In the *in vivo* study, tumor burden in the mice was significantly reduced when nontoxic doses of TME (200 mg/kg b. wt and 400 mg/kg b. wt) were administered consecutively for 28 days. Considerable number of apoptotic cells was also observed in the biopsy analysis of tumor tissue of the TME-treated animals. The gas chromatography–mass spectrometry analysis of the extract revealed 14 different compounds and the LC–MS analysis revealed ten secondary metabolites. Promising antitumor potential of *T. involucrata* by inducing apoptosis in lymphoma cells may be attributed to these molecules, and further, investigation is necessary to identify the active molecule and their mechanism of action, to obtain safer and effective anticancer drugs.

1. INTRODUCTION

Lymphomas, the malignant transformation of the cells of the immune system, are broadly classified as Hodgkin's lymphoma (HL) and non-Hodgkin's lymphoma (NHL). Hodgkin's lymphoma in most of the cases is known to involve altered B-cells [1]. Globally, in males and females, NHL is ranked the 10th and 12th most frequently occurring type of cancers, respectively. It involves the B-lymphocytes and a smaller portion of T-lymphocytes and natural killer cells. However, its classification is not easy as it requires a deep insight into the clinical features and genetic abnormalities [2]. With advances in areas of science such as genomics and molecular biology, chemotherapy and immunotherapy are promising in combating cancer; however, multidrug resistance and drug induced toxicity remains a major cause of concern. Plant-derived drugs, an alternative treatment to fight cancer, are the need of the hour as it has the potential to deliver highly efficient and non-toxic treatment [3]. The efficacy of anticancer agents depends on its ability to increase apoptosis, decrease cell proliferation, induce cell differentiation, modulate intracellular pathways, and inhibit activity of DNA topoisomerase and angiogenesis. Several plants such as *Luffa aegyptiaca*, *Beta vulgaris*, *Capsicum frutescens*, *Solenostemma argel,* and *Colocasia antiquorum* are known to have anticancer potentials against acute myeloid leukemia and lymphocyte leukemia [4]. *Tragia involucrata* Linn. belongs to the Family *Euphorbiaceae* and is widely distributed in South Asian countries. The various parts of this plant have tremendous ethnopharmacological importance, as it has been known to be used against inflammation, allergy, epilepsy, renal stones, asthma, bronchitis, vomiting, diarrhea, and numerous other ailments [5]. The present study aims to evaluate the apoptotic and tumor reduction potentials of *T. involucrata* ethanolic extract using lymphoma (DLA solid tumor) models.

2. MATERIALS AND METHODS

2.1. Plant Authentication and Extraction

The whole plant of *T. involucrata* Linn. was procured from Thrissur district, India (10.3469°N, 76.2074°E) and a voucher specimen (Accession number 17682) was submitted at Kerala Forest Research Institute, Kerala, India. The plant, after being cleaned thoroughly, was dried at 50°C in a hot air oven and powdered for extraction. The fine plant material was weighed (15 g) and extracted in accelerated solvent extractor (Thermo Scientific, Dionex 150) using (200 ml) *Tragia* ethanol extract (TME). A vacuum evaporator was used to dry the crude extracts and it was stored in a refrigerator at 4°C until further use.

2.2. Cell Lines and Animals

YAC-1 and DLA cell lines used for the study were procured from National Center for Cell Sciences, Pune and Amala Cancer Research Center, Thrissur, respectively. YAC-1 cell line was cultured in RPMI medium supplemented with FBS (10% v/v), streptomycin

*Corresponding Author:
Leyon Varghese, Immunology and Toxicology Research Laboratory, Department of Zoology, Christ College (Autonomous), Irinjalakuda, University of Calicut, Calicut - 680 125, Kerala, India.
E-mail: leyon @ christcollegeijk.edu.in

2023 Annual International Conference on Emerging Research Areas: International Conference on Intelligent Systems (AICERA/ICIS) | 979-8-3503-0345-2/23/$31.00 ©2023 IEEE | DOI: 10.1109/AICERA/ICIS59538.2023.10419941

Dynamic Learning: A System for Learning Offensive Content

Jeslin Rani Jijo
Department Of Computer Science
Christ College (Autonoumous), Irinjalakuda, Kerala-680125

Priyanga K.K
Department Of Computer Science
Christ College (Autonoumous), Irinjalakuda, Kerala-680125

***Abstract*: In the digital era, online social networks have become an integral part of global communication. However, managing offensive language and content poses a significant challenge for these platforms. To address this issue, extensive research has focused on developing systems that can effectively detect and mitigate offensive language. This paper emphasizes two crucial aspects of offensive language detection: data preprocessing and feature selection. Data preprocessing involves removing noise, filtering out irrelevant information, and segmenting the text for analysis. Feature selection employs a fuzzy-based convolutional neural network (FCNN) to identify relevant features. Fuzzy logic handles uncertainty and ambiguity, while convolutional neural networks capture patterns and representations. By leveraging these techniques, offensive language detection systems can achieve accuracy and effectiveness, promoting a safer online environment. Continuous refinement of data preprocessing and feature selection methods contributes to the ongoing efforts to create inclusive and respectful digitalspaces.**

Index Terms: GAN, NLP, FCNN,CNN.

I. Introduction

In today's digital age, online social networks have become an integral part of our lives, connecting people and facilitating communication on a global scale. However, these platforms also face the challenge of managing offensive language and content that can harm individuals and communities. To address this issue, extensive research has been conducted to develop systems that can effectively detect and mitigate offensive language in online social networks [1]. This paper focuses on two crucial aspects of offensive language detection: data preprocessing and feature selection. Data Preprocessing: The first step in the offensive language detection process is data preprocessing, which plays a crucial role in ensuring the quality and consistency of the collected data. This step involves removing noise, filtering out irrelevant information, and segmenting the text into smaller units for analysis. Noise removal is essential to eliminate unwanted elements such as special characters, punctuation marks, and emoticons that can interfere with the subsequent analysis [2]. By removing noise, the system can focus on the essential aspects of offensive language and improve the accuracy of the detection process. Filtering out irrelevant information involves identifying and removing non-relevant content that does not contribute to the offensive language detection task. This could include advertisements, URLs, or non-textual data. By filtering out irrelevant information, the system reduces the noise further and improves the efficiency of subsequent analyses. Segmentation, the final component of data preprocessing, entails dividing the text into smaller units for more granular analysis [2]. Proper segmentation enables the system to examine individual words or phrases, which is essential for identifying offensive language accurately. Segmenting the text effectively prepares it for subsequent feature extraction and analysis. In summary, this paper recognizes the growing importance of addressing offensive language in online social networks and emphasizes the critical role of data preprocessing in this context [4]. By comprehensively preprocessing the data, offensive language detection systems can better equip themselves to identify and mitigate harmful content, ultimately fostering a safer and more inclusive online environment [3]. The subsequent sections of this paper will delve into the intricacies of feature selection and its significance in the offensive language detection process..

II. Proposed Methodology

By segmenting the text, the system gains a more granular understanding of the language patterns and can capture the nuances of offensive content more effectively. Feature Selection: Once the data has been pre-processed, the next step is feature selection [5]. Fuzzy logic is particularly useful in handling uncertainty and ambiguity often present in offensive language [7]. By leveraging fuzzy logic, the FCNN can effectively handle the complexities of offensive language and extract the relevant features required for accurate detection [6]. In conjunction with fuzzy logic, convolutional neural networks (CNNs) are employed to extract patterns and representations from the segmented data [8]. The combination of fuzzy logic and CNNs in the FCNN model provides a comprehensive approach to feature selection [10]. Data preprocessing and feature selection are critical steps in offensive language detection systems [9]. These processes contribute to the accuracy and effectiveness of offensive language detection, enabling the development of systems that promote a safer and more respectful online environment [10]. By continually refining data preprocessing techniques and improving feature selection methods, researchers can enhance the robustness and adaptability of offensive language detection systems, contributing to the ongoing efforts to create inclusive and secure online platforms [11],[13].

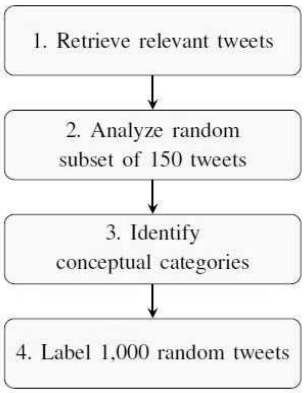


Fig. 1. Data Analysis

AN EFFECTIVE IMAGE COMPRESSION AND DENOISING OF IMAGE USING DEEP LEARNING TECHNIQUE

Ms. Priyanga k.k
Department of Computer Science
SRMIST, Kattankulathur, Tamil Nadu- 603203
Christ college (Autonomous), Irinjalakuda, Kerala-680125
priyasumesh111@gmail.com

Dr.S.Sabeen
Department of Computer Science
SRMIST, Kattankulathur
Tamil Nadu- 603203
sabeens@srmist.edu.in

***Abstract*: Deep Learning neural networks might be employed to handle a vast range of inverse issues that arise in computer generated imaging, according to recent machine learning exploration. The most popular approximations for resolving picture inverse issues right now are DL models. The great maturity of these algorithms learn the function from a dataset in an point- to- point manner in order to break the inverse issue. We examine the key recurring themes in this developing field and provide a taxonomy that will be used to group various issues and reconstruction approaches. By using the denoising and compression concepts, this study proposes an image solution to the picture inversion issue. A modified convolution neural network is used for denoising and compression.**

***Keywords: Pruning, neural network, optimization, genetic algorithm, bio-inspired technique, and generalization*.**

I. INTRODUCTION

The inverse problem has been addressed in recent times using a numerous approaches grounded on repetitive reconstruction, including interpolation, de-convolution, and de-noising (1). Due to compressed sensing and related algorithmic regularizations, the picture quality has significantly improved while the computing cost has decreased. The discipline of biomedical imaging, includingX-ray reckoned tomography and glamorous resonance imaging(MRI), has demonstrated the significance of this advancement (2). As a result, there's a swap between noise and acquisition time.

In approximate, protracted acquisitions affect patient injury (radiation-grounded ways), discomfort for the case, and stir vestiges, whereas short acquisitions will affect worse picture quality. Deep literacy has been successfully applied in recent times to produce a framework that provides a strong foundation for picture segmentation and classification (3),(4). Also, while treating the inverse problem, regression-grounded neural networks have produced good results by addressing problems including signal recovery, deconvolution, interpolation, artifact reduction and signal denoising (5) ,(6).

Without the utilisation of photographs and movies, which are increasingly being produced in digital format, modern life is difficult to fathom. One hundred times ago , humans communicated a great deal of information through audio and its type signals(speeches, telephone, telegraphs, radio), but currently, we use picture and videotape-grounded means more and more(TV, computers, internet).This holds true for a variety of different aspects of daily living as well as engineering, health, and science. Think of how stethoscopes changed into contemporary medical imaging technology or how meteorological stations on the ground changed into satellite-based weather surveillance as examples.

Inverse issues, or recreating an image from observations, are the focus of this work. A forward procedure, which is often non-invertible, is used to extract the observations from the unknown data. Without some prior understanding of the data, recreating a singular solution that fits the observations for these forward processes is challenging or impossible. The data-fit term, that evaluates how effective the repaired picture fits compliances and regularizer, which considers once information and favors images with worthwhile characteristics like smoothness, are the factors of the cost function that are frequently minimised. Deep learning approaches are presently revolutionising image reconstruction ways, which has an influence on various imaging operations. Here, we give a summary on this snappily changing script.

Reducing image noise may significantly improve the final picture or print because it can impair the degree of detail in your digital or film photographs. The issue is that most noise reduction or removal procedures invariably result in softening the image as well. The effectiveness of image processing and prunning is attained using denoising as well as compression, which motivated the experimenters to develop different exploration efforts. The major donation this research provides is to develop deep literacy fashion for image compression and denoising.

II. RELATED WORK

Deep neural networks can directly calculate regularized reconstructions covering an assortment of computational imaging operations using enormous volumes of training data, as lately proved by machine literacy exploration(7). By taking the rebuilt picture x being on trained manifold, and have shown how these deep generative models may regularise (8). We examine the key recurring themes in this developing field and offer a taxonomy that can be applied to group various issues and reconstruction approaches. We also go through the trade-offs related to various reconstruction strategies and outline potential directions for further research.

Deep learning has proven to have significant potential in the last five years for resolving a variety of imaging inverse issues (9). The fundamental applications of deep learning techniques and also limitations, however, is still

2023 International Conference on Circuit Power and Computing Technologies (ICCPCT) | 979-8-3503-3324-4/23/$31.00 ©2023 IEEE | DOI: 10.1109/ICCPCT58313.2023.10245492

International Journal of Communication Networks and Information Security
ISSN: 2073-607X, 2076-0930
Volume 15 Issue 01 Year 2023

Optimisation of Deep Convolutional Neural Network with the Integrated Batch Normalization and Global pooling

Ms. Priyanga k. k
Department of Computer Science, SRMIST, Kattankulathur, Tamil Nadu
pk9856@srmist.edu.in
Dr. S Sabeen
Department of Computer Science, Christ College (Autonomous), Irinjalakuda, Kerala
pk9856@srmist.edu.in

Article History

Received: 01 March 2023
Revised: 18 April 2023
Accepted: 17 May 2023

Abstract

Deep convolutional neural networks (DCNN) have made significant progress in a wide range of applications in recent years, which include image identification, audio recognition, and translation of machine information. These tasks assist machine intelligence in a variety of ways. However, because of the large number of parameters, float manipulations and conversion of the machine terminal remains difficult. An optimisation process is initiated to address this issue by adjusting the neural network's convolution characteristics, which minimises information loss and enhances its overall performance. Minimisation of the convolution function addresses the optimisation issues. Initially, batch normalisation is completed, and instead of lowering neighbourhood values, a full feature map is minimised to a single value using the global pooling approach. Traditional convolution is split into depth and pointwise to decrease the model size and calculations. The optimised convolution-based DCNN's performance is evaluated with the assistance of accuracy and occurrence of error. The optimised DCNN is compared with the existing state-of-the-art techniques, and the optimised DCNN outperforms the existing technique.

Keywords: Neural Network, Weight Optimisation, Pooling, Deep Learning, Convolution, Normalisation

1. Introduction

Deep Neural Networks (DNN) is a mathematical function that exploits the functioning of the human brain to think and interpret a suitable mapping. DNN has a wide range of applications in real-life problems [1]. The classification success of DNN is solely based on empirical results, and its theoretical explanation is unknown. Hence the classification accuracy needs to be examined to characterise the ability of DNN. Some studies question the generalisation ability of DNN and experimentally show its tendency to misclassify untrained data. This needs further investigation with a reliable performance measure [2]. The standard measures to evaluate the error in the classification results of DNN are accuracy, mean squared error, mean absolute error and the sum of squared error [3]. But these measures could be more reliable in computing the generalisation error [4].

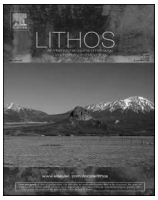
Deep Neural Networks (DNNs) have shown effectiveness in various challenging applications, including semantic segmentation, object recognition, voice synthesis, and image classification [5], [7]. At a high computational cost, recent neural network models with hundreds of parameters

LITHOS 460–461 (2023) 107357

Contents lists available at ScienceDirect

LITHOS

journal homepage: www.elsevier.com/locate/lithos



Neoarchean crustal reworking inferred from granitoids in the western Dharwar Craton: Constraints from Nd isotopic composition, trace elements, and phase equilibrium modelling

Sibin Sebastian [a], Rajneesh Bhutani [a,*], S. Balakrishnan [a], J.K. Tomson [b]

[a] Department of Earth Sciences, Pondicherry University, Puducherry 605014, India
[b] National Centre for Earth Science Studies, Thiruvananthapuram, Kerala, India

ARTICLE INFO

Keywords:
Western Dharwar Craton
Neoarchean crustal reworking
High-K granite
Low-K trondhjemite
Phase equilibrium modelling

ABSTRACT

The granitoid magmatism in the Chitradurga greenstone belt implies crustal reworking in the western Dharwar Craton during the Neoarchean. High-K granites and low-K trondhjemites are studied for their petrogenesis using the whole-rock elemental and Nd isotopic composition and compared with the earlier works. These granitoids were formed by partial reworking of older crust, which includes TTG gneisses and metabasites. Low Sr/Y ratios (0.1–7.6) and zircon saturation temperatures (< 850 °C) suggest that crustal anatexis occurred at the shallower crustal levels by low-T fluid-present melting. Phase equilibrium and trace element modelling show that the potassic granites were formed by partial melting of TTG gneisses at shallower depths corresponding to 4–6 kb pressures and melt extraction in batches leaving a final residue comprising ~66% plagioclase, ~ 30% quartz, ~ 3% orthopyroxene, and ~ 1% ilmenite. Monzogranite was formed from the melt extracted at a higher temperature with some entrained minerals, whereas the early batches of water saturated melt modified by fractional crystallization during the ascent formed syenogranites. The low-K trondhjemites were formed by 10–12% partial melting of metabasites at 4–5 kb pressures, leaving residual assemblages with plagioclase (42–46%), amphibole (24–26%), orthopyroxene (20–21%), ilmenite (4–5%), and garnet (2–9%). The partial melting of various crustal source rocks at different crustal levels indicates a reworking event in the terrane, which was likely triggered by mafic underplating and H_2O dominated fluid flux.

1. Introduction

Granitoids constitute a major part of the Earth's continental crust, representing 70–80% of the exposed Archean crust (Windley, 1995), and provide vital clues on evolution and differentiation of the continental crust. The source characteristics and formation mechanisms have a strong influence on the geochemical characteristics of granitoids, which therefore, reveal the changes in geodynamics during the late Archean (Halla, 2018). The transition from a sodic TTG (Tonalite-Trondhjemite-Granodiorite) dominated magmatism in a stagnant-lid/plume/arc tectonic setting (Bédard, 2018; Johnson et al., 2017; Martin et al., 2014; Moyen, 2011) to the multi-sourced potassic magmatism during this period is believed to mark the onset of modern-style plate tectonics and stabilization of cratons (Cawood et al., 2018; Dhuime et al., 2012; Laurent et al., 2014). The widespread late Archean magmatism recorded in almost all Archean cratons, including the Indian shield (Dey and Moyen, 2020 and references therein), therefore, provides insights into the reworking of Archean crust and the final consolidation of cratonic nuclei.

The formation of granitoids from a wide range of potential sources by diverse processes makes their petrogenetic studies demanding. They can be formed either by partial melting of pre-existing crustal rocks or by extreme fractionation of mafic magmas (Moyen et al., 2017). These end-member models may not always explain their formation as granitoids often show characteristics of both crustal and mantle sources (Moyen et al., 2021). Even if purely crustal-derived, they can be formed in a broad range of pressure-temperature conditions from a variety of source rocks. The magma composition can be modified further by one or more processes near magma source and/or at emplacement levels, including peritectic assemblage entrainment (e.g., Stevens et al., 2007), magma mixing, fractional crystallization, etc. Qualitative as well as quantitative studies considering the nature of source, mechanism of melting, and

* Corresponding author.
E-mail address: rbhutani@gmail.com (R. Bhutani).

https://doi.org/10.1016/j.lithos.2023.107357
Received 25 February 2023; Received in revised form 3 September 2023; Accepted 9 September 2023
Available online 17 September 2023

Women in the Agrarian Struggles of North Malabar: Narratives of Resilience and Fortitude

Sreevidhya V.

This study focuses on the role of women in the agrarian struggles of North Malabar, in the present state of Kerala.[1] Though women played an important part in these, little attention has been paid to their crucial role and struggles in the written histories of tenant struggles against landlords in the 1930s and 1940s. It needs to be recognised that in the traditional agrarian system, women's labour comprised a substantial part of agricultural labour input, especially in the North Malabar region, which was the centre of sustained struggles of the *verumpattakar* or tenants. The extensive participation of women labourers in these agrarian struggles throws up several questions. North Malabar is a region where women's activism stayed alive even after the 1940s, and where women's organisations have had a mass following from then to the present day. In this region, where radical and national politics took deep roots and wields considerable influence even to this day, these linkages need further exploration.

Land Relations in Kerala: The Case of North Malabar

While land relations show regional variations and are influenced by several factors like geography, socio-political culture and so on, in the case of Kerala, the added specificity was that the landlords and chiefs sought ownership and control of land along with diverse religious institutions. Some of the common terms related to land relations in Kerala were *janmam, kanam, pattam* and *maryadai. Janmam*[2] is the full proprietary right to the soil. In connection with landed properties, *kanam* is a tenure partaking of the nature of both a mortgage and a lease: the tenant pays a lump-sum *kanam*[3] to the *janmi*. An annual *pattam* or rent is fixed according to the capacity of the land, and from it the tenant is entitled to deduct the interest due to him on the amount of *kanam*. Most of the ancient systems of landholding in Malabar were however materially affected by the Malabar Tenancy Act of 1929.

In the case of land relations in North Malabar,[4] different systems evolved, with a marked feature being a three-tier division of land rights, known as *janmam, kanam* and *verumpattam*. Here caste rank was closely correlated with relationship to the land. Nambudiris and chieftain castes tended to be land owners; the higher Nayar sub-castes were either land owners or non-cultivating tenants; and the inferior Nayars and some Thiyyas were cultivating sub-tenants, either on permanent or annual leases.

Description of the male *Macrogomphus wynaadicus* Fraser, 1924, from the Western Ghats, India (Odonata: Gomphidae)

Ayikkara Vivek Chandran[1,4,5], Subin Kaniyamattathil Jose[1], Parag Rangnekar[2] & Bijoy Chenthamarakshan[3]

[1] Aqua Research Lab, Department of Geology and Environmental Science, Christ College (Autonomous), Irinjalakuda, Thrissur, Kerala, India-680125

[2] Foundation for Environment Research & Conservation. #407, III-A, Susheela Seawinds, Alto-Vaddem, Vasco-da-Gama, Goa, India-403802

[3] Shadpada Entomology Research Lab, Department of Zoology, Christ College (Autonomous), Irinjalakuda, Thrissur, Kerala, India-680125

[4] Society for Odonate Studies, Velloorparampil, Kuzhimattom PO, Kottayam, Kerala, India-686533

[5] Corresponding author: avivekchandran2@gmail.com

Received 18th July 2023; revised and accepted 18th October 2023

Abstract. Description of the male *Macrogomphus wynaadicus* Fraser, 1924, is given based on specimens collected from different localities of the Western Ghats, India. Photographs and illustrations detailing the taxonomic characters are provided.

Further key words. Dragonfly, Anisoptera, South Asia

Introduction

The genus *Macrogomphus* Selys, 1858, is widely distributed in Asia and currently has 15 described species (Paulson *et al.* 2023). Five species are known to occur in India (Subramanian & Babu 2017), of which *Macrogomphus wynaadicus* Fraser, 1924, is restricted to the Western Ghats (Babu *et al.* 2013; Kalkman *et al.* 2020). It was described based on a single female collected by Fraser (1924) from Masinagudi in the southern Western Ghats. Fraser (1931: 459) later came across some males and noted that they do not differ in any respect from the female but stopped short of formally describing the male. Later, he simply referred to the male as unknown (Fraser 1934). The

Journal of Asia-Pacific Biodiversity 16 (2023) 597–604

Contents lists available at ScienceDirect

Journal of Asia-Pacific Biodiversity

journal homepage: http://www.elsevier.com/locate/japb

Original Article

A new species of *Epithemis* Laidlaw, 1955 (Odonata: Libellulidae), from the Western Ghats, India

Ayikkara Vivek Chandran [a,b,*], David Valiyaparambil Raju [b,c], Subin Kaniyamattathil Jose [a], Zeeshan Ayaz Mirza [d]

[a] *Aqua Research Lab, Department of Geology and Environmental Science, Christ College (Autonomous), Irinjalakuda, Thrissur, Kerala 680125, India*
[b] *Society for Odonate Studies, Velloorparampil, Kuzhimattom PO, Kottayam, Kerala 686533, India*
[c] *Valiyaparambil House, Kuzhimattom PO, Kottayam, Kerala 686533, India*
[d] *Max Planck Institute for Biology, Max-Planck-Ring 5, 72076 Tübingen, Germany*

ARTICLE INFO

Article history:
Received 19 April 2023
Received in revised form
23 July 2023
Accepted 6 August 2023
Available online 9 September 2023

Keywords:
Anisoptera
barcode
biodiversity
dragonfly
endemic

ABSTRACT

The monotypic genus *Epithemis* Laidlaw, 1955, is endemic to the Western Ghats and is represented by the nominate species *Epithemis mariae* (Laidlaw, 1915). *Epithemis mariae* is distributed across the Western Ghats, and as part of an ongoing study, we identified a distinct population from Wayanad. Morphological and molecular data for *E. mariae* and the population from the Wayanad plateau affirm that the two are distinct taxa and allow us to describe a new species. *Epithemis wayanadensis* sp. nov. is described based on male specimens collected from Wayanad, a part of the Western Ghats in Kerala state, southern India.

Introduction

The genus *Epithemis* Laidlaw, 1955 was hitherto considered to be monotypic. The sole described species was *Epithemis mariae* (Laidlaw, 1915), which is endemic to the Western Ghats in India (Paulson et al. 2022). This is a dragonfly of small size and slight build that inhabits marshes and pools at the foot of forested hills (Fraser 1936). The male is colored blackish-brown and red, whereas the female is colored golden-yellow and black. It occurs in small colonies and is highly seasonal; the adults are seen only during the southwest monsoon period (Subramanian 2009). It is a weak flier and generally does not stray far from the marshes in which it breeds. It has been recorded from the states of Kerala, Tamil Nadu, Karnataka, and Maharashtra in India (Sawant and Ogale 2022; Subramanian et al. 2018).

In the course of an ongoing study of the odonates of Kerala state, we collected specimens of a population that resembles *E. mariae* but differs in having darker pigmentation, restricted red coloration on the abdomen, and lacking the yellow antehumeral stripes (Figure 1). Further investigation of morphological and molecular data of the two populations in question revealed that the population from the Wayanad plateau are distinct. Based on this database of evidence, we describe the population from the Wayanad plateau as a new species with notes on its distribution and natural history.

Material and methods

Morphological data

Two males of *Epithemis wayanadensis* sp. nov. were caught using a butterfly net and were stored in molecular-grade alcohol. Later, one of these specimens was preserved dry, and the other was retained in alcohol. Legs of one side of the specimen in alcohol were used for molecular study. A male *E. mariae* was collected from a home yard at Kuttampuzha, a village near the forested Anamalai hills of the Western Ghats, for morphological and molecular comparison (Figure 2). Morphological data for the specimens were made using a stereomicroscope (SkiHi TDLED-1005, India), and they were photographed using a mirror-less digital camera (Sony a7III body, Sony 90 mm macro lens and Raynox DCR-250 super macro lens). Descriptive terminology follows Garrison et al. (2006). All measurements were taken using a digital Vernier caliper (ZHART CT-ZT-VERNIER).

* Corresponding author. ORCID.: 0000-0003-2149-2502
E-mail address: avivekchandran2@gmail.com (A Vivek Chandran)
Peer review under responsibility of National Science Museum of Korea (NSMK) and Korea National Arboretum (KNA).

https://doi.org/10.1016/j.japb.2023.08.006
pISSN2287-884X eISSN2287-9544/

Zootaxa 5389 (4): 483–490
https://www.mapress.com/zt/

Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

https://doi.org/10.11646/zootaxa.5389.4.6
http://zoobank.org/urn:lsid:zoobank.org:pub:238A54F0-8539-4E8B-9CF2-EB7792137F5D

A new species of *Oecobius* Lucas, 1846 from the Thar Desert, India (Araneae: Oecobiidae)

RISHIKESH TRIPATHI[1,4*], AMBALAPARAMBIL V. SUDHIKUMAR[1,5] & DANNIELLA SHERWOOD[2,3,6*]
[1]*Centre for Animal Taxonomy and Ecology (CATE), Department of Zoology, Christ college (Affiliated to University of Calicut), Irinjalakuda, Thrissur, Kerala 680 125, India*
[2]*Arachnology Research Association, 124 City Road, London, EC1V 2NX, United Kingdom*
[3]*Fundación Ariguanabo, 4111, Calle 58, e/ ave. 41 y ave.43, San Antonio de los Baños, Provincia Artemisa c.p. 18100, Cuba*
[4] *rishikesh.tripathi14@gmail.com; https://orcid.org/0000-0003-0884-5625*
[5] *spidersudhi@gmail.com; https://orcid.org/0000-0002-4479-4995*
[6] *danni.sherwood@hotmail.com; https://orcid.org/0000-0001-8170-9529*
[*]*Corresponding authors*

Abstract

We describe a new species of *Oecobius* Lucas, 1846 from the Thar Desert ecoregion in India, based on both sexes: *Oecobius* thar **sp. nov.**. We also provide photographs of the new species in vivo and the general habitat of its type locality.

Key words: distribution, morphology, SEM, spider, taxonomy

Introduction

The genus *Oecobius* Lucas, 1846 presently contains 95 valid species (World Spider Catalog 2023). Hitherto, the genus was known from three species in India: *O. chiasma* Barman, 1978, *O. marathaus* Tikader, 1962 and *O. putus* O. Pickard-Cambridge, 1876 (World Spider Catalog 2023). Of these, all are known from both sexes, and *O. marathaus* and *O. putus* are species with a wide range and have spread to non-indigenous areas (World Spider Catalog 2023; Nentwig *et al*. 2023; pers. obs.).

The Thar Desert covers over 200,000 km² of land and its inhospitable habitat constitutes its own ecoregion, the Thar Desert ecoregion (Dinerstein *et al*. 2017). The vegetation, particularly intermittent grasslands, in this area are host to a relatively high diversity of spiders (Sivaperuman & Rathore 2009) presently comprising 14 families and at least 35 species, although these numbers continue to rise (*e.g.* Tripathi *et al*. 2021, 2023; Jäger *et al*. 2022). Recently, the first author collected specimens of a species of *Oecobius* from this unique ecoregion, which appeared not to match any species hitherto known from India. Our subsequent comparison of this material against other described species of *Oecobius* across the rest of the world demonstrated that the morphology of both sexes was unique. In this work, we describe this new species based on both sexes.

Material and methods

Specimens were examined under binocular microscopes. Photographs of habitus and genitalia (except SEM images) were made using a Leica DMC4500 digital camera attached to a Leica M205C stereoscopic microscope, with images stacked using Leica Application Suite software. The male palp was removed from the left-hand side. For SEM, the palp was dehydrated using air drying, then mounted on a metal stub using sticky carbon tape. Finally, it was gold-coated to increase conductivity and imaged with a Carl Zeiss supra-40VP field emission scanning electron microscope (FESEM) at Cochin University of Science and Technology (CUSAT), Kochi, Kerala (India).

Accepted by A. Santos: 28 Nov. 2023; published: 21 Dec. 2023

Zootaxa 5352 (3): 447–450
https://www.mapress.com/zt/

Correspondence

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

https://doi.org/10.11646/zootaxa.5352.3.10
http://zoobank.org/urn:lsid:zoobank.org:pub:CFD62B07-6BC9-4C35-A3AB-8CCAC8CE6CC6

First record of *Sparbambus* Zhang, Woon & Li, 2006 from India, with description of a new species (Araneae: Salticidae)

RISHIKESH TRIPATHI[1,3*], GAUTAM KADAM[2,4*] & THERESA JOY ASHA[1,5]
& AMBALAPARAMBIL VASU SUDHIKUMAR[1,6]

[1]*Centre for Animal Taxonomy and Ecology, Department of Zoology, Christ College, Irinjalakuda, Thrissur, Kerala 680 125, India.*
[2]*87a Kapil Nagar, Vetal bambarde, Kudal, Sindhudurg, Maharashtra 416 520, India.*
[3] *rishikeshtripathi14@gmail.com; https://orcid.org/0000-0002-9192-4609*
[4] *gautamkadam7wild@gmail.com; https://orcid.org/0000-0002-8254-1323*
[5] *ashatheresajoy@gmail.com; https://orcid.org/0009-0007-9715-0548*
[6] *avsudhi@rediffmail.com; https://orcid.org/0000-0002-4479-4995*
[*]*Corresponding authors*

Sparbambus was erected by Zhang, Woon & Li in 2006, and its generic name 'Spar-bambus' reflects that it belongs to the subfamily Spartaeinae and the specimens were collected from a bamboo habitat. The monotypic genus originally reported from Malaysia was recently described from China (Wang *et al.* 2022). In this paper, we record *Sparbambus* for the first time and describe a new species from India.

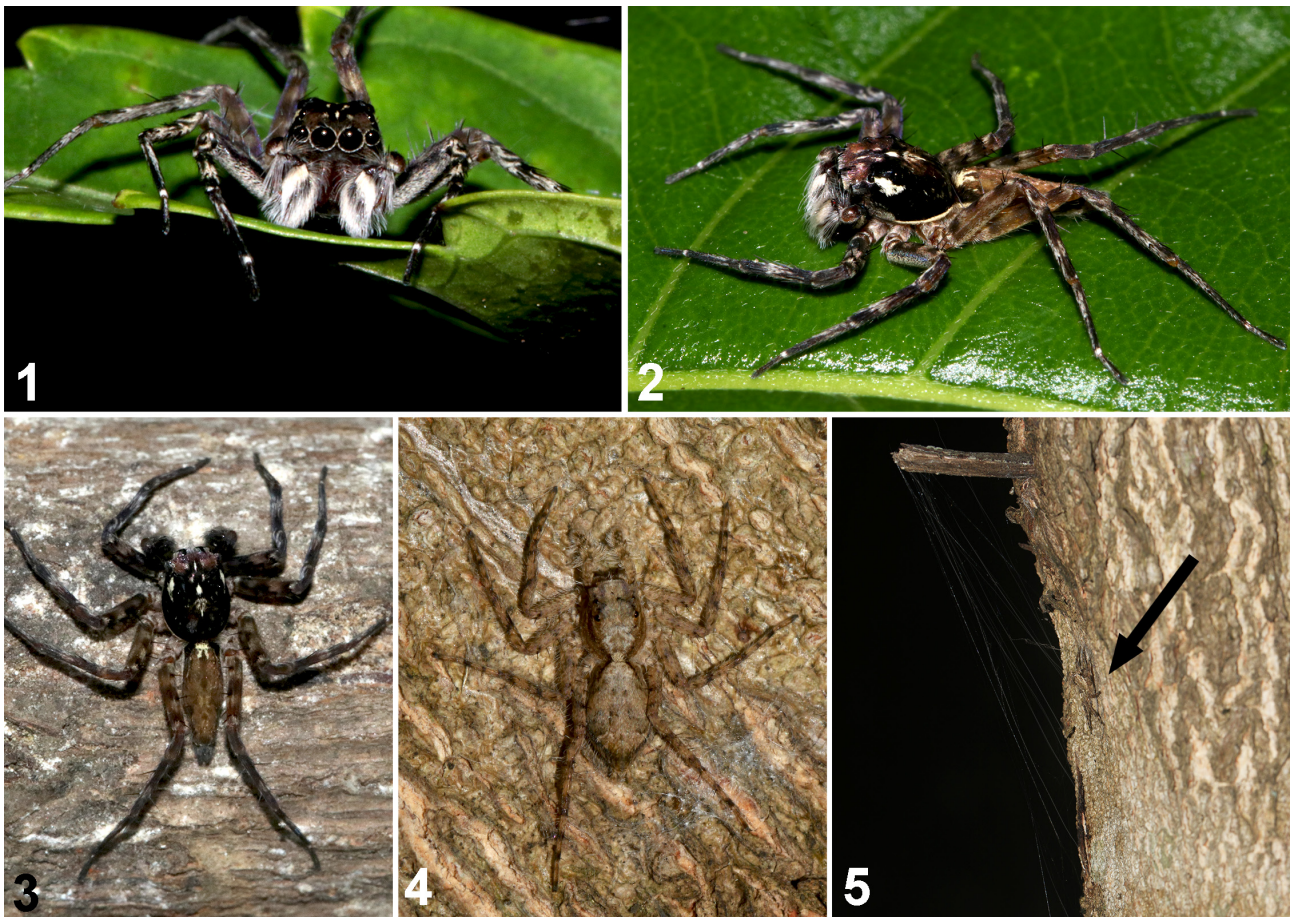


FIGURE 1–5. Living photos of *Sparbambus sindhudurg* Kadam & Tripathi, **sp. nov.** 1–3 holotype male (NRC-AA-4151); 4–5 paratype female (NRC-AA-4152). Photos by G. Kadam.

Accepted by J.-X. Zhang: 22 Sept. 2023; published: 4 Oct. 2023

European Journal of Taxonomy 891: 26–50
https://doi.org/10.5852/ejt.2023.891.2265
ISSN 2118-9773
www.europeanjournaloftaxonomy.eu
2023 · Tripathi R. *et al.*

Research article

urn:lsid:zoobank.org:pub:C0AD31F0-5059-4E24-9CAE-C7EC6827228A

New species of *Palpimanus* Dufour, 1820 from India (Araneae: Palpimanidae, Palpimaninae), with a catalogue of the Indian palpimanid fauna

Rishikesh TRIPATHI [1,*], Pradeep M. SANKARAN [2,*], Nikhil KUNI [3] & Ambalaparambil V. SUDHIKUMAR [4]

[1,4] Centre for Animal Taxonomy and Ecology, Department of Zoology, Christ College, Irinjalakuda, Thrissur, Kerala 680 125, India.
[2] Division of Arachnology, Department of Zoology, Sacred Heart College, Thevara, Cochin, Kerala 682 013, India.
[3] Department of Zoology, Walchand College of Arts and Science, Solapur, Maharashtra 413 003, India.

[*] Corresponding authors: pradeepmspala@rediffmail.com; rishikeshtripathi14@gmail.com
[3] Email: nikhilkuni33@gmail.com
[4] Email: avsudhi@rediffmail.com

[1] urn:lsid:zoobank.org:author:755C1120-025C-4F96-9FFF-ECD878A8DC3C
[2] urn:lsid:zoobank.org:author:0AEC69AA-7E17-401F-B83B-280C2F04AC6E
[3] urn:lsid:zoobank.org:author:C2DB57B0-6270-40D3-8672-5C86362944E6
[4] urn:lsid:zoobank.org:author:97DD9CE0-7619-4ED7-85AA-09CE70210965

Abstract. Two new species of *Palpimanus* Dufour, 1820 are described from India: *P. godawan* Tripathi & Sankaran sp. nov. (♂♀), collected from the Thar Desert in Rajasthan, and *P. maldhok* Kuni, Tripathi & Sankaran sp. nov. (♂♀), collected from Maharashtra. Images of the endogyne and male palp of the holotype and paratype of *P. narsinhmehtai* Parajapati, Hun & Raval, 2021 are presented to facilitate its identification. A key to Indian species of *Palpimanus* and a catalogue of Indian palpimanid spiders are provided. The current distribution of all the known Indian palpimanid spiders is mapped.

Keywords. Distribution, grassland ecosystem, Great Indian Bustard, taxonomy, Thar Desert.

Tripathi R., Sankaran P.M., Kuni N. & Sudhikumar A.V. 2023. New species of *Palpimanus* Dufour, 1820 from India (Araneae: Palpimanidae, Palpimaninae), with a catalogue of the Indian palpimanid fauna. *European Journal of Taxonomy* 891: 26–50. https://doi.org/10.5852/ejt.2023.891.2265

Introduction

Palpimanus Dufour, 1820, the second largest species-rich genus after *Otiothops* MacLeay, 1839 of the family Palpimanidae Thorell, 1869, currently comprises 40 nominal species distributed in Africa, Mediterranean, and central and southwest Asia (World Spider Catalog 2023). Platnick (1981) redefined *Palpimanus*, and proposed three species groups: *gibbulus*, *maroccanus*, and *vultuosus*,

TAPROBANICA, ISSN 1800–427X. November, 2023. Vol. 12, No. 02: pp. 94–95, pl. 25.

http://www.taprobanica.org
https://doi.org/10.47605/tapro.v12i2.310

On the report of a new world millipede (*Rhinotus purpureus*) from India

The Indian millipede fauna is diverse with many families and genera but remains seriously underexplored (Golovatch & Wesener 2016). Among the families of the order polyzoniida, Siphonotidae is the only family to have reports from the southern hemisphere (Enghoff *et al*. 2015, Anilkumar *et al*. 2022). The tropical tramp species of this family, *Rhinotus purpureus* (Pocock, 1894) shows a cosmopolitan distribution. It has been repeatedly described as a new species leading to more than a dozen synonyms (Hoffman 1980). It is designated as a common tramp species as it is frequently found in green houses and other synanthropic habitats from many different parts of the world including Kew Gardens in England (Read 2008), green houses in Germany (Decker *et al*. 2014), Central America and Southern USA (Mauriès 1980), Comoro Islands, Madagascar and Indian Ocean Islands (Vandenspiegel & Golovatch 2007). The present study provides the first record of *R. purpureus*, from the Indian subcontinent.

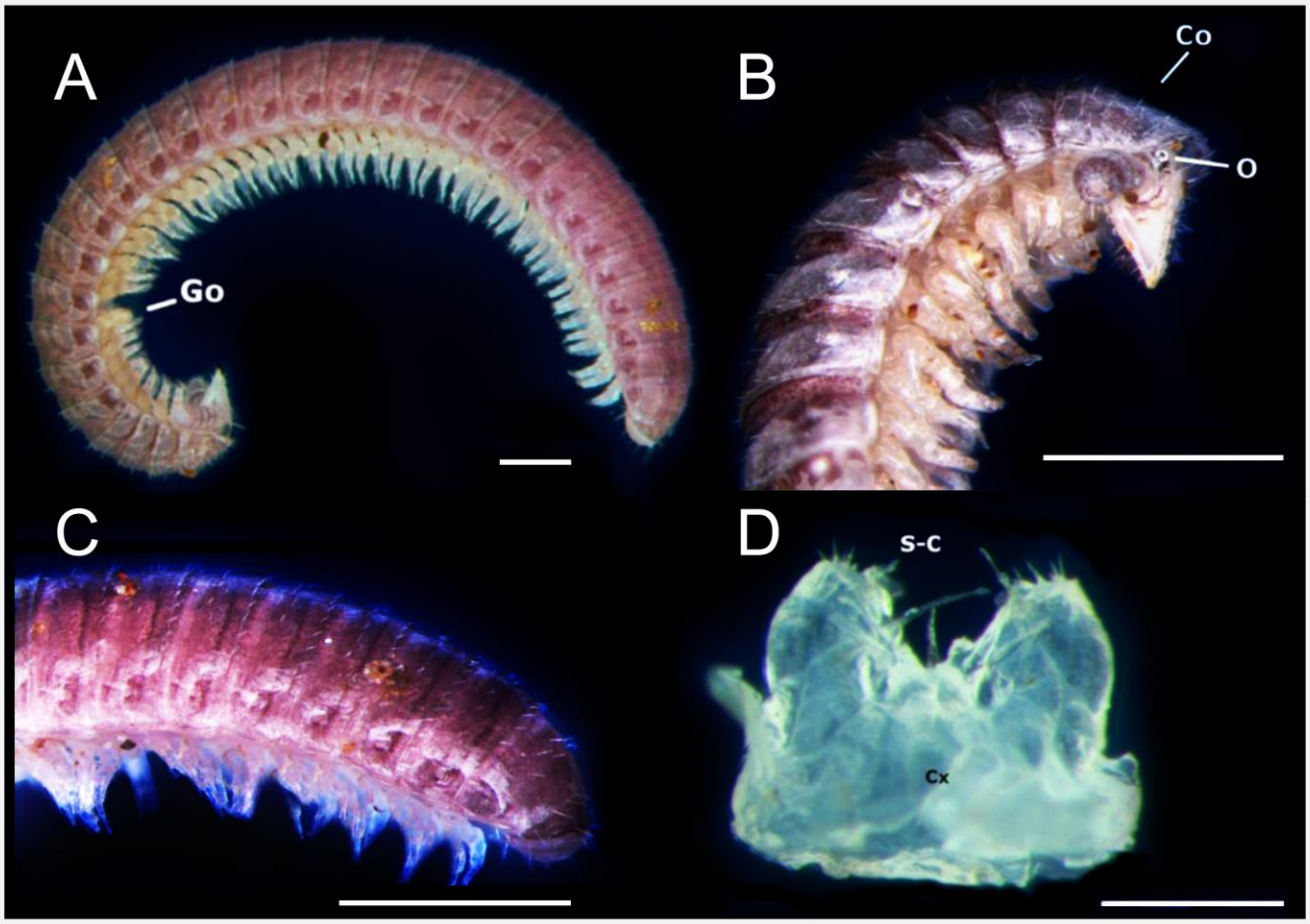
Specimens were hand collected from a sacred grove in the Kannur district of Kerala, India. The local name of the grove is Thekkumbadu Koolom—Thazhekkavu, which is located on an inland island bordered by thick mangroves. The samples were collected in October 2021 (post monsoon season) and are preserved in 96% ethanol. The specimens are deposited in the Diplopoda collection of the Centre for Animal Taxonomy and Ecology (CATE), Christ College, Irinjalakuda, Kerala, India, with ID numbers: CATE 12031A (male) CATE 12031B (female). Multifocal photographs of specimens were taken in the laboratory with a Leica DMC4500 digital camera mounted on a Leica M205C stereo microscope. Photographs were fixed, and the measurements taken, using Leica Application Suite (LAS) version 4.3.0 software. The final images were processed with GNU Image Manipulation Program (GIMP 2.8.22) software.

The male millipedes were 1.6 cm in length and 0.66 mm wide, females were 1.5–2.3 cm in length and 0.57–0.84 mm wide. Male with 31 body rings + 1 telson, females up to 35 + 1 telson. Body pinkish purple color with pale pink legs, after preserving for 6 months in 96% ethanol (Fig. 1A). The millipede has a triangular head with a single large ocellus on each side. A macrosetae located along the bottom of each ocellus. Antennae stout, slightly broader at the end (Fig 1B). Collum large, faintly convex and partially extending forward to head covering initial half of ocelli. Collum is sparsley setaceous with short setae. Body slightly convex and flat. Circular ozopores, located at mesozonite. Tergites smooth with two lateral rows of short setae. Legs short without any tarsal brushes, tarsi of legs arranged as thick tufts of hair (Fig. 1C). Slight extension of tarsi commonly referred as an accessory claw present on walking legs. Preanal ring slightly pointed downwards and hardly extending the telson (Fig. 1C). Telson is much shorter than preanal ring. Three pairs of setae on anal valves and a single pair of anal setae present on telson. Gonopods clearly resemble the previous descriptions and illustrations (e.g., Golovatch & Korsos 1992, Wesener 2014) (Figs. 1E, 1F).

Anterior gonopod has a huge coxa (cx) and the sternite (st) of the anterior gonopod has bilobulated extensions with each lobe carrying a long seta on the telopodite (post femoral segments) region of the anterior gonopod. Telopodite massive, bulbous and stout with around 4 setae at the terminal (Fig. 1D, 1E). Posterior gonopod also with a huge coxa (cx) and indistinguishable (slightly fused) podomeres with a long and slender tarsus. The sternite is separate with rectangular lobes carrying 4 or 5 setae (Figs. 1D, 1F).

This species was originally described from the high-altitude mountain forests of St. Vincent in the West Indies (Pocock 1894) but it shows an abnormal distribution by being present all across the world. This makes it thought to be an introduced species in the non-tropical parts of the

Plate 25



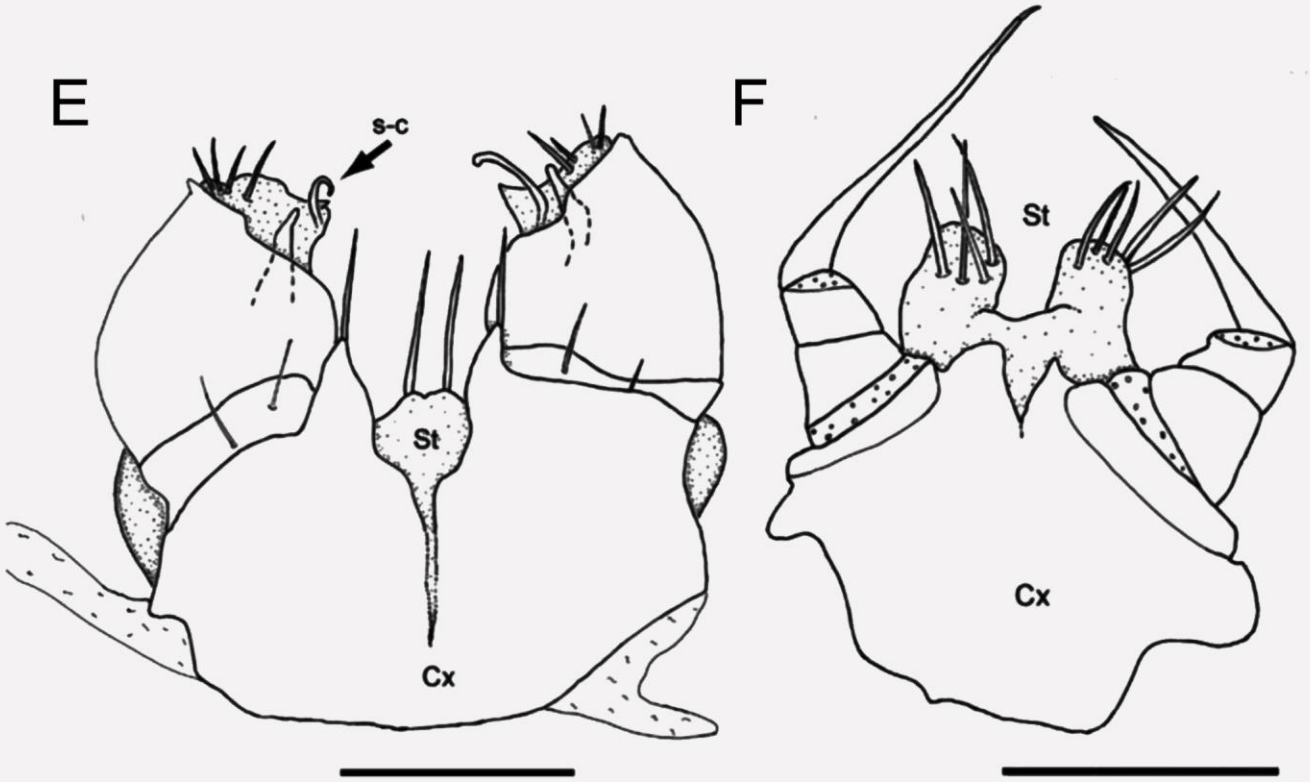


Figure 1. *Rhinotus purpureus* **(A)** male full body, lateral view (scale: 0.2 mm); **(B)** female anterior body, lateral view (scale: 0.5 mm); **(C)** anal segments (scale: 0.5 mm), lateral view; **(D)** anterior and posterior gonopods (scale: 0.1 mm); **(E, F)** line drawings of gonopods, after Wesener (2014); **Co**, collum; **cx**, coxa; **Go**, gonopod; **O**, ocellus; **st**, sternum; **s-c**, apical end canal of posterior gonopod

world. However, Enghoff *et al*. (2015) notes that there could be perhaps five species within this genus. The distribution and origin of this species can only properly be understood by extensive molecular phylogenetic studies.

Acknowledgements

We thank the principal (Christ College, Kerala, India) for providing the facilities for this study; UGC-JRF (F. No. 16-6(Dec.2018)/2019(NET/ CSIR) for financial support; Chandran, care taker of the sacred grove for their hospitality and field support; P.A. Anilkumar (Bonn, Germany) and reviewers, for their valuable comments to improve the paper.

Literature cited

Anilkumar, P.A., T. Wesener, and L. Moritz (2022). First record of the order Polyzoniida from the Indian subcontinent with an integrative description of a new genus (Diplopoda, Colobognatha, Siphonotidae). *Zootaxa*, 5182(5): 401–428.

Decker, M.P., H. S. Reip, and K. Voigtländer (2014). Millipedes and centipedes in German greenhouses (Myriapoda: Diplopoda, Chilopoda). *Biodiversity Data Journal*, 2(2): e1066.

Enghoff, H., S. Golovatch, M. Short *et al*. (2015). Diplopoda—taxonomic overview. Pp. 363–453. *In*: Minelli, A. (ed.). *Treatise on Zoology-Anatomy, Taxonomy, Biology. The Myriapoda*. Volume 2. Koninklijke Brill nv Leiden.

Golovatch, S.I. and Z. Korsos (1992). Diplopoda collected by the Soviet Zoological Expedition to the Seychelles Islands in 1984. *Acta Zoologica Hungarica*, 38 (1–2): 1–31.

Golovatch, S.I. and T. Wesener (2016). A species checklist of the millipedes (Myriapoda, Diplopoda) of India. *Zootaxa*, 4129(1): 1–75.

Hoffman, R.L. (1980). *Classification of the Diplopoda*. Muséum d'histoire naturelle Genève: 237pp.

Mauriès, J.-P. (1980). Diplopodes Chilognathes de la Guadeloupe et ses dépendances. *Bulletin du Muséum national d'histoire naturelle*, 4e Série (A), 2: 1059–1111.

Pocock, R. I. (1894). Contributions to our Knowledge of the Arthropod Fauna of the West Indies. Part III. Diplopoda and Malacopoda, with a Supplement on the Arachnida of the Class Pedipalpi. *Zoological Journal of the Linnean Society*, 24(157): 473–544.

Read, H.J. (2008). Records of millipedes from Kew Gardens and the Eden Project, including descriptions of three species. *Bulletin of the British Myriapod & Isopod Group*, 23: 27–35.

Shelley, R.M. and S.I. Golovatch (2011). Atlas of myriapod biogeography. I. Indigenous ordinal and supra-ordinal distributions in the Diplopoda: perspectives on taxon origins and ages, and a hypothesis on the origin and early evolution of the class. *Insecta Mundi*, 158: 1–134.

VandenSpiegel, D. and S.I. Golovatch (2007). The millipedes of the Comoro Islands (Myriapoda: Diplopoda). *Journal of Afrotropical Zoology*, 3: 41–57.

Wesener, T. (2014). Redescription of '*Polyzonium' malagassum*, a new synonym of *Rhinotus purpureus* (Pocock, 1894), with notes about the occurrence of the order Polyzoniida on Madagascar (Diplopoda). *Zootaxa*, 3790(4): 587–594.

Submitted: 28 Sep 2022, *Accepted*: 9 Nov 2023

M.D. Aswathy[1] & A.V. Sudhikumar[1,2]

[1] Centre for Animal Taxonomy & Ecology (CATE), Department of Zoology, Christ College Irinjalakuda, Kerala, India
[2]E-mail: spidersudhi@gmail.com

Natura Somogyiensis 41: 79-84. Kaposvár, 2023 DOI:10.24394/NatSom.2023.41.79

Submitted: 11.10, 2022; Accepted: 06.11, 2023; Published: 21.11, 2023 www.smmi.hu/termtud/ns/ns.htm

First report of the jumping spider *Epeus daiqini* (Patoleta, Gardzińska & Żabka, 2020) (Araneae: Salticidae) from India

Konnoth Kuttappan Sibi[1], Poulose Gigi[2] & Ambalaparambil Vasu Sudhikumar[1]*

[1]Centre for Animal Taxonomy and Ecology, Department of Zoology, Christ College (Autonomous), Irinjalakuda, Kerala-680125, India

[2]Department of Zoology, St. Joseph's College, (Autonomous), (Affiliated to University of Calicut), Irinjalakuda, Kerala-680121, India

email: kksibi61@gmail.com; gigijmj@gmail.com; *Corresponding author: spidersudhi@gmail.com

Sibi, K. K., Gigi, P. & Sudhikumar, A. V.: *First report of the jumping spider Epeus daiqini (Patoleta, Gardzińska & Żabka, 2020) (Araneae: Salticidae) from India.*

Abstract: *Epeus* Peckham & Peckham, 1886 is a genus from family Salticidae. So far, the species *Epeus daiqini* (Patoleta, Gardzińska & Żabka, 2020) only reported from Thailand. This paper reports and describe both sexes of *E. daiqini* for the first time from India.

Keywords: Taxonomy, Faunistic, India, Kerala

Introduction

Epeus Peckham & Peckham, 1886 is a little-known genus from family Salticidae and currently comprises 19 valid species, of which the majority have been reported from south and southeast Asia. Of the 19 described species, four have been recorded from India (World Spider Catalog 2023): *Epeus albus* Prószyński, 1992, *E. chilapataensis* (Biswas & Biswas, 1992), *E. indicus* Prószyński, 1992, *E. triangulopalpis* Malamel, Nafin, Sudhikumar & Sebastian, 2019. The genus *Epeus* described based on the characters like, male carapace usually with protruding and upward bristles; length of ocular is shorter than half of carapace. Legs covered with dense hair and numerous spines (Peng, & Li 2002). The cymbium of male palp flattened and elongated, with a basal apophysis retrolaterally, pointing postero-ventrally; tegulum with a tongue-like process; filiform embolus; and epigyne with several loops and long copulatory ducts (Meng et al. 2015).

Epeus daiqini described by Patoleta et al. (2020) from Thailand. The species *E. daiqini* closely related to *E. tener* and mainly distinguished by the absence of embolic serration, the presence of a small outgrowth on the retrolateral cymbial apophysis, orientation of copulatory openings and copulatory ducts do not reach epigastric fold (Patoleta et al. 2020). This paper documents the first report of the jumping spider *E. daiqini* from India based on specimens collected from Pathanamthitta, Kerala.

ISSN 1587-1908 (Print); ISSN 2062-9990 (Online)

Arthropoda Selecta 32(4): 459–465

Two new species of *Afraflacilla* Berland et Millot, 1941 (Araneae: Salticidae: Chrysillini) from India

Два новых вида *Afraflacilla* Berland et Millot, 1941 (Araneae: Salticidae: Chrysillini) из Индии

Nishi Babu[1], Rishikesh Tripathi[2]*, M. Sampathkumar[3], John T.D. Caleb[4], G. Prasad[1]*, A. Mohanasundaram[5], G. Mahendiran[3], Ambalaparambil Vasu Sudhikumar[2]

Н. Бабу[1], Р. Трипати[2]*, М. Сампаткумар[3], Дж.Т.Д. Калеб[4], Г. Прасад[1]*, А. Моханасундарам[5], Г. Махендиран[3], А.В. Судхикумар[2]

[1] Department of Zoology, Kariavattom Campus, University of Kerala 695582, Kerala, India.

[2] Centre for Animal Taxonomy and Ecology, Department of Zoology, Christ College (Autonomous), Irinjalakuda 680125, Kerala, India.

[3] ICAR-National Bureau of Agricultural Insect Resources, Bengaluru 560024, Karnataka, India.

[4] Department of Anatomy, Saveetha Medical College & Hospital, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai 602105, Tamil Nadu, India.

[5] ICAR-National Research Centre for Banana, Tiruchirapalli 620102, Tamil Nadu, India.

*Correspondence: rishikesh.tripathi14@gmail.com; probios1@gmail.com

KEY WORDS: Aranei, Jumping spider, Kerala, species discovery, Tamil Nadu, taxonomy.

КЛЮЧЕВЫЕ СЛОВА: Aranei, паук-скакунчик, Керала, видове разнообразие, Тамилнад, таксономия.

ABSTRACT. Two new species of *Afraflacilla* Berland et Millot, 1941 are described from the states of Kerala and Tamil Nadu, India: *A. adavathurensis* sp.n. (♂) and *A. kerala* sp.n. (♂). Detailed descriptions, diagnostic features, and illustrations are given. A map showing the distribution of all the known Indian *Afraflacilla* species is also provided.

How to cite this paper: Babu N., Tripathi R., Sampathkumar M., Caleb J.T.D., Prasad G., Mohanasundaram A., Mahendiran G., Sudhikumar A.V. 2023. Two new species of *Afraflacilla* Berland et Millot, 1941 (Araneae: Salticidae: Chrysillini) from India // Arthropoda Selecta. Vol.32. No.4. P.459–465. doi: 10.15298/arthsel. 32.4.10

РЕЗЮМЕ. Два новых вида *Afraflacilla* Berland et Millot, 1941 описаны из штатов Керала и Тамилнад, Индия: *A. adavathurensis* sp.n. (♂) и *A. kerala* sp.n. (♂). Приводятся детальные описания, диагностические признаки и иллютрации. Также дана карта распространения всех отмеченных в Индии видов *Afraflacilla.*

Introduction

The Chrysilline genus *Afraflacilla* Berland et Millot, 1941 was established by Berland & Millot [1941], with *Afraflacilla bamakoi* Berland et Millot, 1941 as the type species. Denis [1955] considered this genus a senior synonym of *Flacilloides* Denis, 1954, but later Clark [1974] synonymised it with *Pseudicius* Simon, 1885. Since then, Żabka [1993] has revalidated the genus, which currently contains 45 valid species: 19 from Africa, 16 from Asia, six from Australia, one from Oceania, and three are widespread across the African and Asian continents [WSC, 2023]. The genus was recently recorded from India, being represented by three species: *Afraflacilla banni* Prajapati, Tatu et Kamboj, 2021, *A. miajlarensis* Tripathi, Jangid, Prajapati et Siliwal, 2022 and *A. kurichiadensis* Sudhin, Nafin et Sudhikumar, 2022 [Prajapati *et al.*, 2021; Sudhin *et al.*, 2022; Caleb, Sankaran, 2023]. In the present paper, two more new *Afraflacilla* species from Kerala and Tamil Nadu States in southern India are described.

Materials and methods

Specimens were hand-collected, preserved in 70% alcohol and then examined in detail. They were photographed by means of a Leica DFC295 camera attached to the Leica S8APO (for *A. adavathurensis* sp.n.) and a Leica DMC4500 digital camera attached to a Leica M205C stereomicroscope (for *A. kerala* sp.n.) with the software package Leica Application Suite (LAS, version 4.3.0). All images were then processed with the aid of LAS version 4.2 software. Zeiss EVO 18 Scanning Electron Microscope was used to image the palp of *A. kerala* sp.n. A distributional map was generated using the online mapping software QGIS (version 3.16.3). Description format follows Sudhin *et al.* [2022]. Leg and

TAPROBANICA, ISSN 1800–427X. May, 2023. Vol. 12, No. 01: pp. 1–4, pl. 1–3.
© Research Center for Climate Change and Department of Biology, Faculty of Mathematics & Natural Sciences, University of Indonesia, Depok 16424, INDONESIA.
http://www.taprobanica.org
https://doi.org/10.47605/tapro.v12i1.294

urn:lsid:zoobank.org:pub:734A2536-6401-45F5-ADD8-5BA628B0E74C

DESCRIPTION OF A NEW WOLF SPIDER SPECIES (ARACHNIDA: ARANEAE: LYCOSIDAE: *Draposa*) FROM WESTERN GHATS, INDIA

Section Editor: Francesco Ballarin *Submitted*: 10 June 2022, *Accepted*: 01 December 2022

Raveendran Sudha Abhijith[1,2] & Ambalaparambil Vasu Sudhikumar[1,3]

[1] *Centre for Animal Taxonomy and Ecology (CATE), Department of Zoology, Christ College (Autonomous), Irinjalakuda, Kerala 680125, India*
Corresponding authors. E-mail: [2]abhijithrvabhiraman@gmail.com, [3]spidervudhi@gmail.com

Abstract
Draposa is a relatively newly described wolf spider genus numbering 11 species, out of which eight have been reported from India. A new *Draposa* species from Kerala, Western Ghats, India, is described, photographed and illustrated. The male palp of the new species is similar to that of *D. lyrivulva* distributed in Pakistan, India and Sri Lanka, but it differs by having the following combination of characters: shorter tegular apophysis with a narrow and linear tip, prominent sub-apical protrusion, and embolus parallel to tegular apophysis.

Keywords: Arachnida, distribution, Kerala, *Pardosa*, South Asia, taxonomy

Introduction

The taxonomy of Indian lycosid spider needs a thorough revision since several species lack a clear description, photographs or illustrations of genitalia and there is inadequate information of the type materials. *Draposa* Kronestedt, 2010 is a small recently described wolf spider genus with only 11 species distributed in India, China, Pakistan, Sri Lanka, Bhutan, Maldives, Indonesia, East Malaysia, Myanmar, Iran, Bhutan, Bangladesh and United Arab Emirates, out of which eight have been reported from India (WSC 2022). Indian *Draposa* species already described were initially attributed to *Pardosa* Koch, 1847 and later transferred to *Draposa* by Kronestedt (2010) and Dhali *et al.* (2012). Subfamily level revisions of lycosids were suggested by Kronestedt (2010) and Murphy *et al.* (2006). Therefore, Piacentini and Ramirez (2019) placed the genus *Draposa* along with the genera *Pardosa* and *Wadicosa* Zyuzin, 1985 in the sub-family Pardosinae.

Material and Methods

All specimens were collected by hand and preserved in 70% ethanol. The holotype and other voucher specimens of the new species are deposited at the Centre for Animal Taxonomy & Ecology (CATE), Department of Zoology, Christ College, Irinjalakuda, Kerala, India. Specimens were studied, photographed and measured using a Leica M205C stereo-microscope, a Leica DFC450 Camera, and LAS software (Ver.4.13). Epigynes were dissected

TAPROBANICA, ISSN 1800–427X. May, 2023. Vol. 12, No. 01: pp. 26–27, pl. 15–17.

http://www.taprobanica.org
https://doi.org/10.47605/tapro.v12i1.299

First record of the cobweb spider (*Steatoda erigoniformis*) from India

There are three species of the Genus *Steatoda* Sundevall, 1833 (Family Theridiidae Sundevall, 1833) distributed on the Indian subcontinent (Caleb & Sankaran 2022, WSC 2022). Here, we report the first record of *S. erigoniformis* (O. Pickard-Cambridge, 1872) from India, specifically from Maharashtra and Rajasthan states. Previously, this species was known from Central Asia and China (Levy & Amitai 1982, Song *et al*. 1999, Bosmans & Hervé 2021), but now its range extends south to Central India.

The specimens were studied and photographed with a Leica DMC4500 digital camera mounted on a Leica M205 C stereomicroscope. Photographs were stacked with the image stacking software Leica Application Suite (LAS) version 4.3.0. Measurements were taken using the Leica Application Suite (LAS) version 4.3.0 software.

All measurements are reported in mm. Lengths of the palp/pedipalp and leg segments are given as follows: total length (length of femur, patella, tibia, metatarsus [except for palp/pedipalp], tarsus) and are listed from the proximal to the distal position. Morphological characters and abbreviations used in the text follow Levy & Amitai (1982).

Abbreviations: ALE, anterior lateral eye; AME, anterior median eye; PLE, posterior lateral eye; PME, posterior median eye. Material is deposited in the following museum (curator): MNHN, National Museum of Natural History, Paris (C. Rollard); NRC, National Centre for Biological Sciences, Bangalore (T. Karmakar).

Steatoda erigoniformis (P.-Cambridge, 1872)
Theridion erigoniforme P.-Cambridge, 1872
Steatoda signata P.-Cambridge, 1876

Holotype. A female (MNHN, not examined), collected from south Faqus (30.07°N, 1.83°E), Sawaleh, Egypt, by M. B. Condé on 7 Sep 1949.

Material examined (*n*=3). India: Maharashtra: 1 male (NRC-AA-7698; Fig. 1A–D) and 1 female (NRC-AA-7699) collected from Uruli-Kanchan Village (18°28'33.2" N, 74°08'03.2" E; alt: 569 m), by R. Tripathi on 20 Aug 2018; Rajasthan State: 1 female (NRC-AA-7700) collected from Thar Desert National Park Wildlife Sanctuary Jaisalmer (26°45'09.6"N, 71°25'40.5"E; alt: 269 m), by R. Tripathi on 15 Sep 2021.

Diagnosis. See Levy & Amitai (1982: page 11 and figures 63–71) to refer a previously published diagnosis.

Redescription. Male. Colour of carapace, eye region, fangs, clypeus, chelicerae, sternum, endites and legs dark brown; opisthosoma and spinnerets purplish- black. Carapace granulated, broad-oval, lateral margin serrated and clothed with scattered fine black hairs. Fovea narrow, horizontal, straight and reddish-brown. Cephalic region slightly elevated in lateral view. Cheliceral promargin lack tooth and retromargin with single tiny tooth. Opisthosoma widely oval; medially with four large sigillae; four white pigmented spots on anterior upper sides of dorsum and two or three smaller ones in a row, above spinnerets. Body length 1.90. Carapace length 0.97, width 0.65. Abdomen length 0.88, width 0.68. Ocular area length 0.11, width 0.25. Eye diameters and interdistances: AME 0.04, ALE 0.05, PME 0.05, PLE 0.05; AME–AME 0.03, AME–ALE 0.02, PME–PME 0.03, ALE–ALE 0.15, PME–PLE 0.03, PLE–PLE 0.19. Chelicera length 0.27. Clypeus height 0.15. Measurements of pedipalp & legs: Pedipalp 0.63 [0.28, 0.05, 0.10, 0.20], I 2.47 [0.75, 0.28, 0.59, 0.52, 0.33], II 2.09 [0.65, 0.24, 0.49, 0.42, 0.29], III 1.85 [0.57, 0.23, 0.38, 0.42, 0.25], IV 2.77 [0.85, 0.33, 0.65, 0.58, 0.36]. Leg formula: 4123. *Pedipalp* (Fig. 2A–C); pale brown; embolus long, twisted helix-like, mediolaterally orienting, with broad transverse embolic base; conductor with large distal projection, membranous, surrounding embolic tip.

Female (Fig. 1E–H). General aspects essentially as in male except for the followings:

Carapace lateral serration absent. Cephalic elevation indistinct. Abdomen wide, hirsute; spots off-white with two additional on sides, usually not visible from above, placed obliquely, in front of spinnerets. Body length 2.16. Carapace length 0.64, width 0.58. Abdomen length 1.46, width 1.17. Ocular area length 0.16, width 0.30. Eye diameters and interdistances: AME 0.04, ALE 0.05, PME 0.05, PLE 0.05; AME–AME 0.02, AME–ALE 0.01, PME–PME 0.03, ALE–ALE 0.14, PME–PLE 0.02, PLE–PLE 0.16. Chelicera length 0.25. Clypeus height 0.10. Measurements of palp & legs: Palp 0.58 [0.19, 0.08, 0.11, 0.20], I 1.99 [0.60, 0.23, 0.46, 0.41, 0.29], II 1.76 [0.59, 0.22, 0.37, 0.35, 0.23], III 1.52 [0.48, 0.21, 0.29, 0.33, 0.21], IV 2.16 [0.67, 0.27, 0.48, 0.45, 0.29]. *Genitalia* (Fig. 2D, E); epigynum hirsute, translucent, disc-shaped; with central depression and small inverted triangular-shaped epigynal hood. Copulatory ducts short, medially placed, parallely oriented, connected distally to spermathecae; spermathecae discoid-shaped, contiguous. Fertilization ducts narrow and converging.

***Distribution*.** Widespread from the East Mediterranean to the Middle East, Caucasus, China, Korea, Japan, India (Maharashtra and Rajasthan; Fig. 3). Introduced to the Caribbean, USA and Venezuela (WSC 2022; current record).

Habitat. *Steatoda erigoniformis* was found on the ground under stones and cattle dung. In Rajasthan, this species was encountered in arid grasslands, largely surrounded by sand dunes (Fig. 3A). In Maharashtra, individuals were observed in an agricultural landscape surrounded by mountains (Fig. 3B).

Acknowledgments

We thank Rev. Fr. J. Andrews (Principal, Christ College, Irinjalakuda, Thrissur) for providing facilities; the Rajasthan State Forest Department for providing the research permit; the Director and curator (National Center for Biological Sciences, Bangalore, India) for the deposition of voucher specimens; Manju Siliwal and Sutirtha Dutta (Wildlife Institute of India, Dehradun) for their support and CAMPA-GIB team members for their assistance in the field. The research was funded by the joint CSIR (Council for Scientific and Industrial Research), UGC (University Grants Commission) for the Junior Research Fellowship to RT. This study was also a part of the Bustard Recovery Programme of Wildlife Institute of India, funded by the National Compensatory Afforestation Fund Management and Planning Authority, Goverment of India, with an additional grant from Rajasthan State Pollution Control Board.

Literature Cited

Bosmans, R. and C. Hervé (2021). Less is more: eight new synonyms in Mediterranean spiders (Araneae), with a new *Pelecopsis* species from Tunisia (Linyphiidae). *Arachnologische Mitteilungen*, 61 (1): 58–64.

Caleb, J.T.D. and P.M. Sankaran (2022). Araneae of India. Version 2022. Available at <www.indianspiders.in> Aaccessed on 10 May 2022.

Levy, G. and P. Amitai (1982). The cobweb spider genus *Steatoda* (Araneae, Theridiidae) of Israel and Sinai. *Zoologica Scripta*, 11 (1): 13–30.

Pickard-Cambridge, O. (1872). General list of the spiders of Palestine and Syria, with descriptions of numerous new species, and characters of two new genera. *Proceedings of the Zoological Society of London*, 40 (1): 212–354.

Pickard-Cambridge, O. (1876). Catalogue of a collection of spiders made in Egypt, with descriptions of new species and characters of a new genus. *Proceedings of the Zoological Society of London*, 44 (3): 541–630.

Song, D.X., M.S. Zhu, and J. Chen (1999). *The spiders of China*. Hebei Science and Technology Publishing House, Shijiazhuang: 640pp.

WSC (2022). World Spider Catalog. Version 23.0. Natural History Museum Bern. Available at <www.wsc.nmbe.ch> Accessed on 21 May 2022.

Submitted: 23 May 2022, *Accepted*: 29 Oct 2022
Section Editor: Francesco Ballarin

R. Tripathi[1], A.K. Jangid[2], U. Bhagirathan[3] & A.V. Sudhikumar[1]

[1] *Centre for Animal Taxonomy & Ecology, Department of Zoology, Christ College, Irinjalakuda, Thrissur, Kerala 680125, India*
E-mail: rishikeshtripathi14@gmail.com
[2] *Wildlife Institute of India, Dehradun, Uttarakhand 248001, India*
[3]*Sree Kerala Varma College, Thrissur, Kerala 680011, India*

Natura Somogyiensis 40: 47-54. Kaposvár, 2023 DOI:10.24394/NatSom.2023.40.47
Submitted: 28. 03, 2023; Accepted: 05.04, 2023; Published: 20.04, 2023 www.smmi.hu/termtud/ns/ns.htm

First record of the genus *Bassaniodes* Pocock, 1903 (Araneae, Thomisidae) from India

Rishikesh Tripathi[1], Ashish Kumar Jangid[2], Usha Bhagirathan[3] & Ambalaparambil Vasu Sudhikumar[1]

[1]Centre for Animal Taxonomy and Ecology, Department of Zoology, Christ College, Irinjalakuda 680 125, Kerala, India. email: rishikesh.tripathi14@gmail.com*; avsudhi@rediffmail.com
[2]Wildlife Institute of India, Dehradun 248 001, Uttarakhand, India, email: ashishjangid22@gmail.com
[3]Sree Kerala Varma College, Thrissur, Kerala 680011, India
*correspondig author

Tripathi, R., Jangid, A. K., Bhagirathan, U. & Sudhikumar A. V.: *First record of the genus Bassaniodes Pocock, 1903 (Araneae, Thomisidae) from India.*
Abstract: The thomisid genus *Bassaniodes* Pocock, 1903 is recorded for the first time from India. The species *Bassaniodes tristrami* (O. Pickard-Cambridge, 1872) is redescribed based on specimens collected from the Thar desert, India and information on the species' natural history is presented.

Keywords: crab spider, Desert National Park, distribution, Rajasthan

Introduction

The genus *Bassaniodes* Pocock, 1903 was first described from Socotra island, Yemen with a new species, *Bassaniodes socotrensis* Pocock, 1903 under the family Thomisidae Sundevall, 1833. To date, the genus includes 40 nominal species globally (World Spider Catalog, 2023).

The species *Bassaniodes tristrami* (O. Pickard-Cambridge, 1872) was originally described under genus *Thomisus* Walckenaer, 1805. It was later transferred to *Xysticus* C. L. Koch, 1835 (Simon 1889), *Psammitis* Menge, 1876 (Wunderlich 1987) and finally to *Bassaniodes* (Breitling, 2019). It is found to be distributed in Greece, Turkey, Caucasus, Russia to Central Asia and the Middle East (World Spider Catalog, 2023).

Here, we report the occurrence of the species *B. tristrami* in the Indian subcontinent, thereby recording the genus for the first time from the country.

Material and methods

All measurements are in millimeters (mm). Lengths of palp/pedipalp and leg segments are given as: total (femur, patella, tibia, metatarsus (except for palp/pedipalp), tarsus). The micrographic images were taken with a Leica DMC4500 digital camera attached to a Leica M205A stereomicroscope with the software package Leica Application Suite

ISSN 1587-1908 (Print); ISSN 2062-9990 (Online)

PECKHAMIA 295.1, 2 April 2023, 1—10 ISSN 2161—8526 (print)
LSID urn:lsid:zoobank.org:pub:1EAC34CD-7EFE-431B-A6C4-32CF68C959C3 (registered 1 APR 2023) ISSN 1944—8120 (online)

Three new jumping spiders from northeastern India (Araneae: Salticidae: Hasariini: *Habrocestum*)

Gautam Kadam [1], Rishikesh Tripathi [2,3] and Ambalaparambil Vasu Sudhikumar [2,4]

[1] 87a, Kapil Nagar, Vetal Bambarde, Kudal, Sindhudurg, Maharashtra 416520, India, *email* gautamkadam7wild@gmail.com, *ORCID* https://orcid.org/0000-0002-8254-1323
[2] Centre for Animal Taxonomy and Ecology, Department of Zoology, Christ College, Irinjalakuda, Thrissur, Kerala 680 125, India
[3] Corresponding author: *email* rishikeshtripathi14@gmail.com, *ORCID* https://orcid.org/0000-0002-9192-4609
[4] Corresponding author: *email* avsudhi@rediffmail.com, *ORCID* https://orcid.org/0000-0002-4479-4995

Abstract. Three new species of jumping spider from northeastern India are described, all in the genus *Habrocestum* Simon 1876: *H. emanasakgrensis* Kadam & Tripathi 2023 (♂ only), *H. imilchang* Kadam & Tripathi 2023 (♂ only), and H. *togansangmai* Kadam & Tripathi 2023 (♂ only). Current distribution records for all three species are mapped.

Keywords. Indo-Burma, Meghalaya, Pa Togan Sangma, taxonomy

Introduction

As noted by Richman (1981), the genus *Habrocestum* Simon 1876 is poorly defined. Richman revised the North American members of this genus, but these were later transferred to the euophryine genera *Naphrys* or *Chinattus* (Edwards 2003). Only the female of the type species, *H. pullatum* Simon 1876, is known, and that primarily from later drawings by Prószyński (1987). Thus our placement of three new species into this genus, based only on the males, is based solely on the similarity of these spiders to other salticids that have been associated with *Habrocestum*.

Presently *Habrocestum* includes 52 species with a largely Afroeurasian distribution (WSC 2023). The occurrence of this genus in India was first reported by Sankaran et al. (2019) and a total of four nominal species have been reported so far from the Western Ghats of India (Sankaran et al. 2019; Asima et al. 2022; Sudhin et al. 2022; Caleb & Sankaran 2023). In this paper, we describe three new *Habrocestum* species that were recently collected in the Meghalaya State of India.

Materials and methods

All measurements are in millimeters (mm). Length of palp and leg segments are given as: total (femur, patella, tibia, metatarsus (except for palp), tarsus). Length of the chelicerae was measured dorsally from its point of attachment to the clypeus to base of the fangs. Photos of live spiders were taken using Canon 750D DSLR, Canon EFS 18-55mm Macro 0.25m/0.8ft lens and micrographic images were taken with a Leica DMC4500 digital camera attached to a Leica M205A stereomicroscope with the software package Leica Application Suite (LAS, version 3.8) for stacking images taken at different focal planes. Terminology of male genitalia mostly

PECKHAMIA 289.1, 15 January 2023, 1—10 ISSN 2161—8526 (print)
LSID urn:lsid:zoobank.org:pub:55680E36-48B3-4D10-AB15-03A5536D17A1 (registered 13 JAN 2023) ISSN 1944—8120 (online)

The first description of the female of *Myrmarachne uniseriata* Narayan, 1915 and the first report of *Myrmarachne spissa* (G. W. Peckham & E. G. Peckham, 1892) from India

Rishikesh Tripathi [1,3], Athira Jose [1,5], Karunnappilli Shamsudheen Nafin [1,6], Nishi Babu [2,7] and Ambalaparambil Vasu Sudhikumar [1,4]

[1] Centre for Animal Taxonomy and Ecology, Department of Zoology, Christ College, Irinjalakuda, Thrissur, Kerala 680 125, India
[2] Department of Zoology, University of Kerala, Kariavattom, Kerala 695 581, India
[3] **corresponding author**, *email* rishikeshtripathi14@gmail.com, *ORCID* https://orcid.org/0000-0002-9192-4609
[4] **corresponding author**, *email* spidersudhi@gmail.com, *ORCID* https://orcid.org/0000-0002-4479-4995
[5] *email* athirajose112@gmail.com, *ORCID* https://orcid.org/0000-0001-9884-0718
[6] *email* nafinks5@gmail.com, *ORCID* https://orcid.org/0000-0002-0114-4474
[7] *email* nishibabu510@gmail.com, *ORCID* https://orcid.org/0000-0002-8362-9079

Abstract. The salticid species *Myrmarachne spissa* (G. W. Peckham & E. G. Peckham, 1892) is reported for the first time from India, and the unknown female of *Myrmarachne uniseriata* Narayan, 1915 is described and illustrated. Both species are redescribed using fresh specimens.

Keywords. Araneae, Astioida, ant-mimicking spider, distribution, first record, jumping spider, Kerala, Maharashtra, Salticidae, unknown sexes

Introduction

Myrmarachne MacLeay, 1839 is one of the richest salticid groups (Benjamin, 2015) with a cosmopolitan distribution and including 190 valid species, of which 24 species have been recorded from India (Caleb & Sankaran, 2023; WSC, 2023). The taxonomic position of the genus remained unresolved for a long time. Edwards and Benjamin (2009) placed it in the subfamily Myrmarachninae. Later Maddison (2015) placed it in the subfamily Salticinae: clade Salticoida: clade Astioida: tribe Myrmarachnini.

The present paper provides the first description of the female *Myrmarachne uniseriata* Narayan, 1915 and a detailed redescription of its male based on material collected during our routine survey in Pune, Maharashtra, India. Very little is known about *M. uniseriata*, as the species is known only by its male and remained unknown for a century after its original description. Later, Caleb & Benjamin (2017) synonymized *M. aurantiaca* Benjamin, 2015 with *M. uniseriata*, and redescribed the male. In addition, this paper contains the first report of *Myrmarachne spissa* (G. W. Peckham & E. G. Peckham, 1892) from India, previously known only from Sri Lanka (Benjamin, 2015), as well as a detailed description of the male and female based on specimens collected from the Western Ghats, India.

Materials and methods

The micrographic images were taken with a Leica DMC 4500 digital camera attached to a Leica M205A stereomicroscope with the software package Leica Application Suite (LAS, version 3.8) for stacking images taken at different focal planes. In addition, an extra male of *M. spissa* (KUDZEN2022.IV.18a) was imaged using a Zeiss EVO 18 Scanning Electron Microscope. All measurements are in millimeters (mm).

TAPROBANICA, ISSN 1800–427X. May, 2023. Vol. 12, No. 01: pp. 24–25, pl. 13–14.

http://www.taprobanica.org
https://doi.org/10.47605/tapro.v12i1.298

First description of male long-jawed orb-weaver spider (*Tylorida flava*)

The long-jawed orb-weavers of the family Tetragnathidae are a cosmopolitan spider clade, particularly diverse in humid tropical and subtropical areas of the world (Dimitrov & Hormiga 2011). The subfamily Leucauginae comprises six genera and the genus *Tylorida* Simon, 1894 includes eight species (Caleb & Sankaran 2022). Four of them are reported from India and a comprehensive revision of Indian species was published by Sankaran *et al*. (2017) with a description of *T. flava* as a new species but based only on a female specimen. Here, the male *T. flava* is described for the first time along with illustrations of the genitalia. Specimens were collected during visual encounters by hand, and were stored in 70% ethanol. The body characters were examined under a Leica M205C stereomicroscope and the digital images were taken by means of Leica DMC4500 digital camera attached to the microscope, with the software package Leica Application Suite (LAS), version 4.3.0 LAS montage facility. Measurements for palps and legs are as follows: total length [femur, patella, tibia, metatarsus (except palp), and tarsus]. Spine positions are as follows: prolateral, dorsal, retrolateral and ventral. Specimens are deposited in the reference collection at the Centre for Animal Taxonomy & Ecology (CATE), Department of Zoology, Christ College, Irinjalakuda, Kerala. Abbreviations: C, conductor; CDBP, cymbial dorso-basal process; dmtT, disto-median triangular process of tegulum; E, embolus; EB, embolic base; P, paracymbium; ST, subtegulum; T, tegulum; ALE, anterior lateral eye; AME, anterior median eye; PLE, posterior lateral eye; PME, posterior median eye.

Tylorida flava Sankaran, Malamel, Joseph & Sebastian, 2017 (Figs. 1, 2)

Tylorida flava Sankaran *et al*., 2017: 296, figs. 1A, 3A–F, 4A–H.

***Material examined* (*n*=7).** India: Kerala: a male (CATE115421) and a female (CATE115422; mating pair from foliage), collected at Makkiyad Hills (11°45'18'N, 75°54'25'E; alt. 820 m a.s.l.), Wayanad, Kerala, India by A.V. Sudhikumar & Anju K. Baby on 18 April 2022; two males (CATE115423, 115424) and three females (CATE115425, 115426, 115427; from foliage), collected from Chirappullu Hill (11°42'37'N, 75°54'12'E; alt. 1,517 m a.s.l.), Wayanad, Kerala, India by Anju K. Baby on 25 May 2022.

***Diagnosis*.** Males of *T. flava* are most similar to the males of *T. marmorea* (Pocock, 1901), but can be separated by the following combination of characters: Cheliceral promargin with large rounded tubercle near the distal tooth and a rounded tiny tubercle set apart from the distal tooth on the retromargin (vs. cheliceral promargin lacks tubercle on the base, but with slightly bifid tubercle near the distal tooth of retromargin); cymbial dorso-basal process long, protruding and projected towards the dorsal side (vs. with short cymbial dorso-basal process and slightly folded retrolaterally); strong paracymbium with broad apex in contact with subtegulum (vs. paracymbium with apical warp touching the tegulum).

***Description* of the male.** CATE115421. Measurements are in mm. Total length: 4.76. Carapace 1.86 long, 1.41 wide. Abdomen: 2.87 long, 1.27 wide. Ocular area length 0.36, width 0.34. Eye diameters: AME 0.14, ALE 0.12, PME 0.11, PLE 0.09. Clypeus height 0.06. Chelicerae 1.31 long, 0.53 wide. Palp and leg measurements: palp 2.81 [1.38, 0.15, 0.33, 0.95], leg I 26.84 [7.29, 0.94, 7.72, 9.77, 1.12], II 14.61 [4.32, 0.56, 3.88, 4.81, 1.04], III 5.90 [2.01, 0.35, 1.23, 1.67, 0.64], IV 13.73 [3.36, 0.45, 3.92, 4.95, 1.05]. Leg formula: 1243. Spination. Palp. 0000, 0000, 0000, 0000; legs: femur I 3-1-1-0, II 0-1-0-0, III 1-1-1-0, IV 1-3-1-0; patellae I 0-0-0-0, II - III 0-2-0-0, IV 0-1-0-0; tibia I 1-0-1-0, II 0-1-0-0, III 0-0-0-0, IV 1-0-0-0; metatarsus I - II 0-0-0-0, III 0-2-0-0, IV 0-0-0-0; tarsi I - IV 0-0-0-0. Carapace olive green, cephalic region much darker towards the fovea.

Two rows of eyes strongly recurved; ocular area dark, lateral eyes contiguous and located on the tubercles. Fovea distinct. Clypeus black. Sternum heart shaped, yellowish black with long black hairs and a conspicuous bifid posterior extension. Labium yellowish brown and rectangular; maxillae elongated with distinct scopulae. Chelicerae yellowish brown, small; promargin with three teeth with distal one located on the upper end of the large rounded tubercle sharing the same basis; retromargin with four teeth, a tiny tubercle set apart from distal tooth and opposite to the large rounded tubercle. Abdomen elongated, greyish; dorsum with median longitudinal black patches and a pair of black spots on the posterior side; laterally with silvery spots; venter with a pair of black spots located on the sides of lateral spinnerets. Legs yellowish without annulations. Prolaterally femur III with single row of trichobothria and femur IV with two rows of trichobothria. Spinnerets greyish. Palpal segments yellow. Tegulam dark brown and nearly globular. Disto-median triangular process small, prominent and facing towards the embolic base. Subtegulum light brown. Embolus short, blackish, protruding with apical twist and slightly slanted distally. Embolic base short, flat and lying-in close contact with conductor base. Conductor, thick, nearly transparent and enclosing the embolus distally. Cymbium with broad base, bent towards the ventral side; prolaterally with a small flat cone like process on the posterior end. Cymbial dorso-basal process long, thickened at the base, distal end protruding and slightly projected towards the dorsal side. Paracymbium long with broad apex and the distal end in contact with subtegulum.

Note: Left chelicera of subadult male was depicted by Sankaran *et al.* (2017), which is somewhat different from that of the adult cheliceral morphology. Adult male chelicera with conspicuous round shaped tubercle on the distal end of the promargin, which is not prominent in the drawings of subadult (figure 4c in Sankaran *et al*. 2017). A blunt tiny tubercle located on the distal end of the retromargin of adult, which is unnoticeable in the drawings of subadult. The original description lacks lower view of chelicera.

***Natural history*.** Members of this species have mostly been collected from foliage. One male was found under tree leaves near a riparian habitat and the remainder were from the forest. Mating pairs were captured from foliage at high altitudes. During the day they shelter under leaves and show quick responses to danger. As do other tetragnathids, they usually build horizontal orb webs between tree trunks, shrubs and tree leaves.

Acknowledgements

We thank Rev. Fr. Jolly Andrews CMI, Principal, Christ College (Autonomous), Irinjalakuda, Kerala, India for providing research facilities; Asha T. Joy and other research scholars at CATE for support; DST-SERB Major Research Project (Grant No. EMR/2016/006401) and UGC Junior Research Fellowship (No. 16-9(June2019)/2019(NET/ CSIR) to KBA for financial support.

Literature Cited:

Caleb, J.T.D. and P.M. Sankaran (2022). Araneae of India. Version 2022. <www.indianspiders. in> Accessed on 1 June 2022.

Dimitrov D. and G. Hormiga (2011). An extraordinary new genus of spiders from Western Australia with an expanded hypothesis on the phylogeny of Tetragnathidae (Araneae). *Zoological Journal of the Linnean Society*, 161 (4): 735–768.

Sankaran, P.M., J.J. Malamel, M.M. Joseph, and P.A. Sebastian (2017). On the genus *Tylorida* Simon, 1894 with the first record of the genus *Atelidea* Simon, 1895 from India (Araneae: Tetragnathidae, Leucauginae). *Zootaxa*, 4353 (2): 294–326.

Submitted: 24 Jun 2022, *Accepted*: 23 Apr 2023
Section Editor: Akio Tanikawa

K.B. Anju[1] & A.V. Sudhikumar[1]

[1] *Centre for Animal Taxonomy & Ecology, Department of Zoology, Christ College (Autonomous), Irinjalakuda, Kerala, India*
E-mail: anjukbaby07@gmail.com

Serket (2023) vol. 19(4): 359-364.

Uloborus danolius Tikader, 1969 is a junior synonym of *Zosis geniculata* (Olivier, 1789) (Araneae: Uloboridae)

Theresa Joy Asha & Ambalaparambil Vasu Sudhikumar *
Centre for Animal Taxonomy and Ecology (CATE), Department of Zoology, Christ College (Autonomous), Irinjalakuda, Kerala-680125, India
* Corresponding author e-mail address: spidersudhi@gmail.com

Abstract

Many species described in the past have lacked a complete description a thing that led to misidentification and to describe the already described species as new species. A detailed analysis of the Indian spider species *Uloborus danolius* resulted in the synonymization with *Zosis geniculata* because of its misidentification.

Keywords: Synonymy, Uloboridae, *Zosis*, morphology, taxonomy, synanthropic spider. India.

Introduction

Uloboridae is a cosmopolitan family which contains 19 genera and 287 species across the globe (World Spider Catalog, 2023). Though this family is represented throughout the world, it only achieves its greatest diversity of species and genera in tropical and sub-tropical zones. The first uloborid was described by Olivier (1789), placing it into Linnaeus' genus *Aranea*. The genus *Uloborus* was erected by Latreille (1806) and was allied with Araneidae. In 1870, O. Pickard-Cambridge established the family Uloborides for the genera *Hyptiotes* and *Uloborus* and described the new genus *Miagrammopes*. Simon (1874) combined them to form Uloboridae and later he extended this family to include other subfamilies (Simon, 1892). A historical review of higher-level spider classification of Uloboridae was presented by Bristowe (1938), Bonnet (1959), and Lehtinen (1967). The uloborid species are small to medium sized (3-10 mm), cribellate, entelegyne spiders with variable carapace. They typically lack poison glands unlike most other spider species. Members of the family Uloboridae possess six

PECKHAMIA 299.1, 4 June 2023, 1—7 ISSN 2161—8526 (print)
LSID urn:lsid:zoobank.org:pub:7E00710B-E2A2-42CD-BC31-11D8D5C4C2EC (registered 3 JUN 2023) ISSN 1944—8120 (online)

First records of the genera *Anarrhotus* Simon, 1902 and *Gelotia* Thorell, 1890 from India (Araneae: Salticidae)

Athira Jose [1,2], Rishikesh Tripathi [1,3,5] and Ambalaparambil Vasu Sudhikumar [1,4,5]

[1] Centre for Animal Taxonomy and Ecology, Department of Zoology, Christ College, Irinjalakuda, Thrissur, Kerala 680 125, India
[2] *email* athirajose112@gmail.com, *ORCID* https://orcid.org/0000-0001-9884-0718
[3] *email* rishikeshtripathi14@gmail.com, *ORCID* https://orcid.org/0000-0002-9192-4609
[4] *email* avsudhi@rediffmail.com, *ORCID* https://orcid.org/0000-0002-4479-4995
[5] *corresponding authors*

Abstract. *Anarrhotus* Simon, 1902 (*A. fossulatus* Simon, 1902) and *Gelotia* Thorell, 1890 (*G. lanka* Wijesinghe, 1991), two fairly uncommon jumping spider genera and species, are reported for the first time from India. For both species, general appearance of male copulatory organs and a genus distribution map are provided.

Introduction

The salticid genus *Anarrhotus*, established by Simon in 1902, is known only by two nominal species from Malaysia and Vietnam (WSC, 2023). Both are chiefly distinguished by their males (WSC, 2023); the females of the genus remain unknown. Despite the absence of synapomorphic traits, strong molecular and phylogenetic data led Maddison (2015) to place this genus in the subtribe Plexippoida. Males of this genus in form resemble males of the genera *Panchorius* and *Orientatus*, however they may be differentiated by a triangular bulb (tegulum) with a significant prolateral extension (Hoang et al., 2022). Molecular analysis revealed 4.8% intraspecific variation among species from Vietnam and Malaysia (Hoang et al., 2022); however, further morphological and molecular data are required to elucidate the placement of this genus.

There are ten described species of *Gelotia* Thorell, 1890, all of which are only found in Australia and the Oriental region (WSC, 2023). The synapomorphic characteristic, a cap-like RTA, connected to the tibia by an "amorphous process" defines this genus (Wanless, 1984). *Cocalus* C. L. Koch, 1846 have a triangular projection on the RTA, comparable to the amorphous process of *Gelotia*; combined with geographic distribution this suggests that the two genera are sister groups (Wanless, 1984; Wijesinghe, 1991). Out of the 10 described species of *Gelotia*, 6 are only known from type localities, and 4 are only known by a single sex (WSC, 2023). The sole species currently recognized from the Indian subcontinent is *Gelotia lanka* Wijesinghe, 1991 (WSC, 2023).

Of the 672 salticid genera that have been named, 104 can be found in India (Caleb & Sankaran, 2023). This study adds the genera *Anarrhotus* and *Gelotia* to that count.

Arthropoda Selecta 32(2): 213–219

A new species of *Hasarius* Simon, 1871 (Araneae: Salticidae) from Mumbai, India

Новый вид *Hasarius* Simon, 1871 (Araneae: Salticidae) из Мумбая, Индия

Rishikesh Tripathi[1*], Pranav Joshi[2,3*], Raju Kasambe[3], Ambalaparambil Vasu Sudhikumar[1]
Ришикеш Трипати[1*], Пранав Джоши[2,3*], Раджу Касамбе[3], Амбалапарамбил Вазу Судхикумар[1]

[1] Centre for Animal Taxonomy and Ecology, Department of Zoology, Christ College, Irinjalakuda, Thrissur, Kerala 680 125, India.
E-mail: rishikeshtripathi14@gmail.com; ORCID: https://orcid.org/0000-0002-9192-4609
[2] Ecological Neuroscience Group, School of Natural Sciences, Macquarie University, Sydney, NSW 2109, Australia.
E-mail: joshipranav59@gmail.com; ORCID: https://orcid.org/0000-0002-2213-0303
[3] Bombay Natural History Society, Hornbill House, Dr. Salim Ali Chowk, Shaheed Bhagat Singh Road, Fort, Mumbai-400001, Maharashtra India. E-mail: r.kasambe@bnhs.org; ORCID: https://orcid.org/0000-0002-3909-3676
*Corresponding authors.

KEY WORDS: Aranei, Hasariini, jumping spider, Maharashtra, taxonomy.
КЛЮЧЕВЫЕ СЛОВА: Aranei, Hasariini, паук-скакунчийк, Махараштра, таксономия.

ABSTRACT. A new species of the jumping spider genus *Hasarius* Simon, 1871 — *H. mumbai* Joshi et Tripathi, 2023 sp.n. (♂♀) — is described from few remaining green plots in Mumbai, India. A detailed morphological description, diagnosis and illustrations of the copulatory organs of both sexes are provided.

How to cite this paper: Tripathi R., Joshi P., Kasambe R., Sudhikumar A.V. 2023. A new species of *Hasarius* Simon, 1871 (Araneae: Salticidae) from Mumbai, India // Arthropoda Selecta. Vol.32. No.2. P.213–219. doi: 10.15298/arthsel. 32.2.06

РЕЗЮМЕ. Новый вид пауков-скакунчиков из рода *Hasarius* Simon, 1871 — *H. mumbai* Joshi et Tripathi, 2023 sp.n. (♂♀) — описан из немногих оставшихся зеленых мест Мумбая, Индия. Даны детальное описание, диагноз и иллюстрации копулативных органов обоих полов.

Introduction

Simon [1871] erected the jumping spider genus *Hasarius* Simon, 1871, with the type species: *Attus adansoni* Audouin, 1826. The genus currently consists of 30 valid species [WSC, 2023], of which *Hasarius adansoni* and *H. kjellerupi* Thorell, 1891 are known from India [Caleb, Sankaran, 2023; WSC, 2023]. The former species was originally distributed in Africa and the Middle East but has been introduced to all continents; the latter species is restricted to the Nicobar Islands [Thorell, 1891; Prószyński, 2018; WSC, 2023]. Due to incomplete description and the lack of illustrations of the copulatory organs, Roewer [1955] doubted the identity of *H. kjellerupi* and considered it *nomen dubium*; later as *species inquirenda* [Roewer, 1955; Prószyński, 2018; WSC, 2023].

In the present paper, a new *Hasarius* species is diagnosed and described based on the specimens collected along seasonal streams of the Conservation Education Centre (CEC), also known as the Nature Reserve of the Bombay Natural History Society (hereinafter BNHS), Mumbai, India.

Material and methods

Specimens were collected from the rocks situated along seasonal streams, preserved in 70% ethanol and studied under a Leica EZ4 stereo microscope. All measurements are in millimeters (mm) and were made with LAS software. Length of palp and leg segments are given as follows: total [femur, patella, tibia, metatarsus (except palp), tarsus]. The taxonomic terminology follows Kadam *et al*. [2021]. Live photos were taken with a Nikon D3400 camera and a Tamron 90mm f/2.8 Macro prime lens. The microphotographs were made with a Leica DMC4500 digital camera attached to a Leica M205A stereomicroscope with the software package Leica Application Suite (LAS, version 3.8) for stacking images taken at different focal planes. All the specimens are deposited in the NCBS, Bangalore, India.

Abbreviations used in the text: ALE — anterior lateral eye; AME — anterior median eye; do — dorsal; NCBS — National Centre for Biological Sciences Research Collections; pl — prolateral; pld — prolateral dorsal; PLE — posterior lateral eye; plv — prolateral ventral; PME — posterior median eye; rl — retrolateral; rld — retrolateral dorsal; rlv — retrolateral ventral; RTA — retrotibial apophysis; I–IV — 1st to 4th leg.

Serket (2023) vol. 19(2): 132-139.

First record of *Araneus viridiventris* Yaginuma, 1969 (Araneae: Araneidae) from India with redescription of the female

Kongarampilly Rajendran Shilpa [1], Kuzhuppilly Varghese Anis [2] & Ambalaparambil Vasu Sudhikumar [1]*

[1] Centre for Animal Taxonomy and Ecology, Department of Zoology, Christ College, Irinjalakuda, Kerala-680125, India

[2] Department of Zoology, St. Joseph's College, Irinjalakuda, Kerala-680661, India

* Corresponding author e-mail address: spidersudhi@gmail.com

Abstract

Revisions and detailed studies on the cosmopolitan genus *Araneus* Clerck, 1757 are carrying out in different parts of the world. Light green garden spider, *Araneus viridiventris* Yaginuma, 1969 are known from China, Japan, and Taiwan. It is recorded from India for the first time. Redescription of female genitalia with detailed photographs are presented in this study. Known distribution of this species is also mapped.

Keywords: Araneidae, light green garden spider, orb-weaver, distribution, Kerala, India.

Introduction

The angulate orb-weavers are coming under genus *Araneus* Clerck, 1757 that is one among the genera that have been firstly described during the initial period of araneofaunal studies. Genus *Araneus* has been marked its presence over the whole world except Antarctica. Currently 541 species (+15 subspecies) are included in this genus worldwide (World Spider Catalog, 2023). Of these, 18 species have been recorded from India (Caleb & Sankaran, 2023). Since the genus is one among the initially described genera, many confusions have been raised in species level classification as new techniques and methods in taxonomy have evolved. Detailed revisions and molecular studies are carrying out in different parts of the world.

Araneus viridiventris Yaginuma, 1969, commonly called as light green garden spider, was first reported from Japan (Ohno & Yaginuma, 1969). Later the species

Indian Hydrobiology, 22(1): 145–152, 2023 Date of receipt: 31.03.2023; Date of acceptance: 20.05.2023

Application of phycoremediation technology in the treatment of ETP water – An assessment with *Spirulina platensis* (Nordst.) Gomont

T.M. Shaheedha[1,*], A.S. Adheena[1], M.S. Salma[1], K.M. Mohamed Nasser[1] and P. Tessy Paul[2]

[1]Research & PG Department of Botany, MES Asmabi College,
(Affiliated to the University of Calicut), P. Vemballur, Thrissur – 680 671, Kerala, India
[2]Department of Botany, Christ College (Autonomous), (Affiliated to the University of Calicut),
Irinjalakuda, Thrissur – 680 125, Kerala, India
*Corresponding Author – shaheedashahir@gmail.com

Abstract

Nature suffers from various types of pollution, most of them in water bodies. This adversely affects organisms throughout the food chain and negatively affects the sustainability of the ecosystem. There exist natural resolutions to defeat these issues. Algae are aquatic organisms that can be used for wastewater treatment because of their capacity of absorbing nutrients. *Spirulina platensis* (Nordst.) Gomont. is a microscopic, filamentous cyanobacterium widely used for its biosorbent property and high nutritional value. This study aimed at the cultivation of *Spirulina platensis* in different levels of effluent treatment plant (ETP) water and suggested ETP water as a medium for *Spirulina platensis* culture over a chemically defined medium. The study also aimed to assess the biotransformation of pollutants from sewage water by analyzing the parameters such as pH, COD, BOD, suspended solids, oil and grease, chlorides, sulphates, fluorides, nitrates, ammoniacal nitrogen, and phosphate. The growth pattern of *Spirulina platensis* was studied in different concentrations of ETP water and Zarrouk's medium. The growth was estimated through the measurement of cell concentration using a hemocytometer, determination of turbidity using a spectrophotometer, and specific growth rate evaluation. The results obtained reveal that *Spirulina platensis* has appreciable nutrient scavenging properties and lower concentrations of PT-ETP water and higher concentration of FT-ETP water can be utilized for culturing *Spirulina platensis*. ETP water can be utilized as a nutrient medium for *Spirulina platensis* in controlled concentrations.

Key words: *Spirulina platensis* (Nordst.) Gomont.; phycoremediation; ETP water; nutrient medium; growth estimation.

Introduction

The modern-day world is struggling with numerous ecological and environmental problems among which water pollution is of greater concern that can cause an imbalance in the environment. Water pollution depletes the aquatic ecosystem and causes unfettered phytoplankton expansion in lakes, food chain contamination and other serious issues thus adversely affecting sustainability.

Microalgae or microphytes are a diverse group of prokaryotic and eukaryotic photosynthetic organisms that are inconspicuous to the naked eye. Those are phytoplankton that exists singly or in chains or groups. Microalgae which are capable of photosynthesis, produce about half of the oxygen in the atmosphere, and at the same time, they grow phototrophically by using the greenhouse gas carbon dioxide. Microalgae are particularly attractive for biotreatment because of their ability to photosynthesize, transforming solar energy into useful biomass, and absorbing nutrients like nitrogen and phosphorus, which causes eutrophication in aquatic systems.

Microalgae have commercial uses because they produce a variety of bioproducts that are

Study on Freshwater Algal Biodiversity in Peechi Dam of Thrissur District, Kerala, India

Devikrishna C.S.[1]*, P. Tessy Paul[2], & K.M. Mohamed Nasser[1]

[1]*Research & PG Department of Botany, M.E.S. Asmabi College, P. Vemballur, Kerala-680671, India*
[2]*Department of Botany, Christ College (Autonomous), Irinjalakuda, Kerala-680 125, India*
[1, 2]*Affiliated to University of Calicut, India*
*Corresponding author: csdevi777@gmail.com

Received 05 May 2023/Received and accepted 18 May 2023/Published on line 20 December 2023

ABSTRACT: Microalgae have a key role in maintaining life on Earth. They comprise both the base of the food chain and act as major oxygen producers. Microalgae are also beneficial to aquatic ecosystems and make an excellent indicator of water pollution. The present study is an attempt to explore and take taxanomic account of the algal diversity found at the Peechi Dam, which lies across Manali River, a tributary of the Karuvannur River, Thrissur District, Kerala, that lies at $76^0$22'E longitude and $10^0$31'N latitude. Karuvannur River is one of the major freshwater sources of the Thrissur district, which flows through the famous Kole lands of Thrissur. The study was carried out over a period of one year, from June 2017 to May 2018. During the period of study, 48 species of phytoplankton were identified which come under 31 genera belonging to ten taxonomic classes. Out of these 10 species each belong to *Chlorophyceae* and *Zygnematophyceae* followed by *Bacillariophyceae* (9 species), *Euglenophyceae* (8), *Cyanophyceae* (5), *Xanthophyceae* (2), *Trebouxiophyceae* (1), *Coscinodiscophyceae* (1), *Mediophyceae* (1) and *Dinophyceae* (1). Two of the species *Xanthidium octocorne* Ehr. ex Ralfs and *Tetraplektron torsum* (Turner) Dedusenko-Scegoleva are new to Kerala.

KEY WORDS: Peechi Dam, Karuvannur River, Manali River, *Chlorophyceae*, *Zygnematophyceae*

INTRODUCTION

Freshwater algae constitute a very diverse group of organisms. The variety and beauty of their forms when viewed through a microscope has delighted biologists for more than a hundred years (Bellinger, Sigee, 2010). Algal taxonomy is a key discipline in phycology and is critical for algal genetics, physiology, ecology, applied phycology, and particularly bioassessment (Manoylov, 2014). The role of microbial diversity in ecosystem functioning is becoming increasingly recognized. Hence, for any scientific utilization of water resources, plankton research is of primary interest. Algae, mostly autotrophic organisms , receive most of their nutrition from dissolved chemicals in the water. Thus, many author believe that they should be good indicators of the conditions prevailing in the aquatic

ISSN 1521-9429

Indian Hydrobiology, 22(2): 247–258, 2023 Date of receipt: 20.09.2023; Date of acceptance: 03.11.2023

Algal flora of Naranipuzha, Malappuram district, Kerala, India

Vinu Thomas[1,*], P. Tessy Paul[2] and K.M. Mohammed Nasser[1]

[1]Research and PG Department of Botany, M.E.S. Asmabi College, (Affiliated to the University of Calicut), P. Vemballur, Thrissur District, Kerala, India

[2]Department of Botany, Christ College (Autonomous), (Affiliated to the University of Calicut), Irinjalakuda, Thrissur District, Kerala, India

*Corresponding Author – vinuthms@gmail.com

Abstract

The present paper is a report on the algal diversity of Naranipuzha, Malappuram District, Kerala, India, which passes through the Ponnani Kole fields and drains into the Arabian Sea. The water samples were collected from Naranipuzha for a period of one year from January 2019 to December 2020. During the period of study, 48 species of phytoplankton were identified which comes under 37 genera belonging to 11 taxonomic classes. Of these 19 species belongs to Zygnematophyceae (40%), 11 species to Chlorophyceae (23%), 8 species to Bacillariophyceae (17%), 2 species each to Euglenophyceae (4%) and Dinophyceae (4%). 1 species each to Trebouxiophyceae (2%), Xanthophyceae (2%), Chrysophyceae (2%), Coscinodiscophyceae (2%), Mediophyceae (2%), Cyanophyceae (2%).

Key words: Algae; Vembanad Kol wetlands; Ramsar site; Naranipuzha; Ponnani Kole lands.

Introduction

Algae are almost ubiquitous in water capable of supporting photosynthetic life and can be found in a variety of habitats, including water, land, and extremely arid environments (John *et al.*, 2022). The algal community is regarded as the most immediate indicator of all the biological quality components of nutrient content in water.

Naranipuzha is a water channel which passes through the Ponnani Kole lands. Ponnani Kole lands are the southern end of Vembanad–Kol wetlands. It is one of the richest wetland habitats and the largest in the south western coast of India. It has been identified as a Ramsar site as per the guidelines of the Ramsar Convention of 1971 (https://www.ramsar.org). Naranipuzha originates from the northern part of Thrissur district – Pazhanji and Kattakambal regions and extends through Alancode, Nannamukku, Perumpadappa, Marancheri, Biyyam, Ponnani and Veliyankode regions. It drains independently into the Arabian Sea at Veliyankode coast. Marancheri kayal, Biyyam kayal and Veliyankode kayal are the parts of this water channel. The presence of huge sand deposits at Veliyankode and the regulator cum bridge at Biyyam prevents the entry of brackish water into the Kole land (Johnkutty and Venugopal, 1993).

The present study aims to document the algal flora of Naranipuzha. There is lack of information about the phytoplankton diversity in Naranipuzha and also the inland water bodies of coastal areas in Malappuram district, Kerala.

Materials and methods

The study was conducted in Naranipuzha, Malappuram district, Kerala, India (Map 1). Naranipuzha drains into the Arabian Sea after passing through the Ponnani Kole fields. The water samples were collected from five sites of Naranipuzha (Table 1) with the help of a plankton net (mesh size 20 µm) from January 2019 to December 2020. The samples are fixed with 4% formalin for permanent preservation

International Journal of Biological Macromolecules 253 (2023) 126989

Contents lists available at ScienceDirect

International Journal of Biological Macromolecules

journal homepage: www.elsevier.com/locate/ijbiomac

BRCA1/TP53 tumor proteins inhibited by novel analogues of curcumin — Insight from computational modelling, dynamic simulation and experimental validation

Lovely Jacob Aloor [a,g], Sinosh Skariyachan [b,*,1], Achuthan Chathrattil Raghavamenon [c], Kalavathi Murugan Kumar [d], Rajeswari Narayanappa [e], Akshay Uttarkar [f], Vidya Niranjan [f], Tom Cherian [g,*]

[a] Department of Chemistry, Little Flower College, Guruvayoor, Kerala, India
[b] Department of Microbiology, St. Pius X College, Rajapuram, Kerala, India
[c] Department of Biochemistry, Amala Cancer Research Centre, Kerala, India
[d] Department of Bioinformatics, Pondicherry University, Chinna Kalapet, Kalapet, Puducherry, Tamil Nadu, India
[e] Department of Biotechnology, Dayananda Sagar College of Engineering, Bengaluru, Karnataka, India
[f] Department of Biotechnology, RV College of Engineering, Bengaluru, Karnataka, India
[g] Post Graduate & Research Department of Chemistry, Christ College (Autonomous), Irinjalakuda, Kerala, India

ARTICLE INFO

Keywords:
Breast cancer
Curcumin analogue
Molecular dynamic simulation
Cyclophosphamide
BRCA1-BRCT-c domain
In vitro cytotoxicity
In vivo antitumor

ABSTRACT

The current study aimed to design novel curcumin analogue inhibitors with antiproliferative and antitumor activity towards BRCA1 and TP53 tumor proteins and to study their therapeutic potential by computer-aided molecular designing and experimental investigations. Four curcumin analogues were computationally designed and their drug-likeness and pharmacokinetic properties were predicted. The binding of these analogues against six protein targets belonging to BRCA1 and TP53 tumor proteins were modelled by molecular docking and their binding energies were compared with that of curcumin and the standard drug cyclophosphamide and its validated target. The stabilities of selected docked complexes were confirmed by molecular dynamic simulation (MDS) and MMGBSA calculations. The best-docked analogue was chemically synthesized, characterized, and used for *in vitro* cytotoxic screening using DLA, EAC, and C127I cell lines. *In vivo* antitumor studies were carried out in Swiss Albino Mice. The study revealed that the designed analogues satisfied drug-likeness and pharmacokinetic properties and demonstrated better binding affinity to the selected targets than curcumin. Among the analogues, NLH demonstrated significant interaction with the BRCA1-BRCT-c domain (TG3; binding energy −8.3 kcal/mol) when compared to the interaction of curcumin (binding energy −6.19 kcal) and cyclophosphamide (binding energy −3.8 kcal/mol) and its usual substrate (TG7). The MDS and MM/GBSA studies revealed that the binding free energy of the NLH-TG3 complex (−61.24 kcal/mol) was better when compared to that of the cyclophosphamide-TG7 complex (−21.67 kcal/mol). *In vitro,* cytotoxic studies showed that NLH demonstrated significant antiproliferative activities against tumor cell lines. The *in vivo* study depicted NLH possesses the potential for tumor inhibition. Thus, the newly synthesized curcumin analogue is probably used to develop novel therapeutic agents against breast cancer.

1. Introduction

Cancer has piqued the interest of researchers, leading them to do extensive studies on drugs that target the different receptors in all proliferative pathways. Breast cancer, which had been discovered in 7.8 million women over the previous five years, was the most prevalent in the world. In 2022, India will have a national average of 100.4 cancer cases per 100,000 people, with a high percentage of women (105.4 per 100,000) being diagnosed with breast cancer, a treatable disease [1]. About 15 % of all deaths among women are attributed to breast cancer,

* Corresponding authors.
E-mail addresses: sinoshmicro@stpius.ac.in (S. Skariyachan), tomcherian@christcollege.ijk.edu.in (T. Cherian).
[1] Joint first author, equally contributed.

https://doi.org/10.1016/j.ijbiomac.2023.126989
Received 10 July 2023; Received in revised form 6 September 2023; Accepted 16 September 2023
Available online 21 September 2023

Original Article

Identification of heterochromatic variations in nonsyndromic cleft lip and palate

Abstract

Introduction: Orofacial cleft (OFC) has been one of the major common congenital anomalies exhibiting prominent ramifications allied with the medical, social, psychological, and economic strands. Most OFC occurrences do not have additional features, so they are categorized as nonsyndromic. The classification of the aforesaid complication has been directed toward the following categories: cleft lip (CL) with cleft palate, isolated CL, and finally the isolated cleft palate. The recent research concerning the aforementioned anomalies always searches for advanced novel inferences linked with the chromosomal perspectives since some of the specific genes are probably known to produce significant effects over the anomalies. **Materials and Methods:** Karyotyping was performed for all 130 cases of nonsyndromic cleft lip and palate (NSCLP). Aseptic collection of peripheral blood lymphocyte culture (PBLC) was performed from the patients using heparin vacutainers, and C-banding was done to confirm heterochromatic variations. **Results:** A total of 130 patients known to have the NSCLP were recruited for this study of which 88 cases (68%) had CL along with cleft palate, 18 cases (14%) had isolated CL and 24 cases (18%) had isolated cleft palate. Cytogenetic analysis by G-banding by Trypsin and Giemsa (GTG) banding in these patients revealed five cases (3.84%) with abnormal karyotype where a higher frequency of pericentric inversion in the analyzed region, specifically the chromosome 9, inv(9)(p11p13) was observed. **Conclusion:** The heteromorphisms or structural rearrangements involving the centromere were confirmed by centromere banding in two cases. Understanding the etiology with special inference on the above-said perspectives is significant to develop an effective strategy for the prevention and treatment of the individuals affected with the anomalies.

Keywords: *Centromeric banding, Heterochromatin variation, Inversion, Karyotyping, Orofacial cleft*

Soumya Raj[1,2], Leyon Varghese[2], Puthucode Viswanathan Narayanan[3], Suresh Kumar Raveendran[1], Pulikkottil Raphael Varghese[1], Alex George[1]

[1]Jubilee Centre for Medical Research, JMMC & RI, Thrissur 680005, Kerala, India, [2]Department of Zoology, Christ College, Irinjalakuda, Thrissur 680125, Kerala, India, [3]The Charles Pinto Centre for Cleft Lip, Palate and Craniofacial Anomalies, Jubilee Mission Medical College & Research Institute, Thrissur 680005, India

Introduction

The cleft lip (CL) and palate have been principally recognized as a common congenital defect documented at the birth stage, generally resulting from failure of fusion of palatal shelves or maxillary processes together with prominent psychological, medical, economic, and social complications. The various factors including the cleft type, race, and gender may determine the intensity and incidence of the complication.

The statistics concerning the incidence of CL and palate over the globe in the recent years was reported to be in the following pattern: 1 in 700 live births and the major fact is that from an Indian perspective, it is reported to be 1 in 500 live births.[1],[2] Development of the face starts in the fourth week of gestation with the migration of neural crest cells and the sixth to seventh weeks of gestation have witnessed a condition in which the MxP (paired maxillary processes) merges with the LNP (lateral nasal processes) and fuses with MNP (medial nasal processes) to develop the primary palate as well as the upper lip. Any failure in any of these could result in the development of an OFC in the upper lip, alveolus, and the primary palate.[3],[4] The influence of various genetic and environmental factors toward the complex molecular signaling pathways that are known to be essential for cellular processes regulation and palate morphogenesis has been reported by previous investigations.[5]

OFCs are recognized as either syndromic or nonsyndromic depending upon the presence

Received: 25 April 2023 **Revised:** 26 May 2023
Accepted: 1 June 2023 **Published:** 8-August-2023

How to cite this article: Raj S, Varghese L, Narayanan PV, Raveendran SK, Varghese PR, George A. Identification of heterochromatic variations in nonsyndromic cleft lip and palate. J Orofac Sci 2023;15:55-60.

Address for correspondence:
Alex George, Jubilee Centre for Medical Research, JMMC & RI, Thrissur 680005, Kerala, India.
E-mail: alexgeorge@jmmc.ac.in

Access this article online

Website: www.jofs.in

DOI: 10.4103/jofs.jofs_136_23

Quick Response Code:

Journal of Applied Pharmaceutical Science Vol. 13(01), pp 232-240, January, 2023
Available online at http://www.japsonline.com
DOI: 10.7324/JAPS.2023.130112
ISSN 2231-3354

An *in silico* study on reproposing eravacycline as an MMP inhibitor

Deepthy Varghese[1], Dhilna Sunny[2], Anna Kurian[2], Tom Cherian[1], Leyon Varghese[2*]

[1]Department of Chemistry, Christ College (Autonomous), Irinjalakuda, University of Calicut, Kerala, India.
[2]Immunology and Toxicology Research Laboratory, Department of Zoology, Christ College (Autonomous), Irinjalakuda, University of Calicut, Kerala, India.

ARTICLE INFO

Received on: 17/07/2022
Accepted on: 20/11/2022
Available Online: 04/01/2023

Key words:
Collagenases, eravacycline, gelatinases, MMPs, reproposing, tetracyclines.

ABSTRACT

Considering the role of matrix metalloproteinases (MMPs) in various pathological conditions, including cancer, they are investigated as good targets in present-day drug discovery. Tetracycline antibiotics are already being repurposed for their anticancer activities. Here, we made an investigation on some tetracycline compounds, such as demeclocycline, eravacycline, lymecycline, and omadacycline by analyzing their binding affinity with two groups of MMPs, viz, collagenases and gelatinases using *in silico* approach. The ΔG values of the interaction of eravacycline with different MMPs range from −8.6 Kcal/mol for MMP1 to −9.7 Kcal/mol for MMP9 indicating strong binding affinity. Further molecular dynamic simulation studies revealed that the MMP9-eravacycline interactions are highly stable and durable in virtual physiological conditions. Out of the four tetracyclines analyzed, eravacycline showed a strong broad-spectrum inhibitory potential against all the collagenase and gelatinase enzymes. This antibiotic is, therefore, recommended for further *in vitro* and pre-clinical validation studies to promote its repurposing in clinics.

INTRODUCTION

With the considerable developments made in the field of bioinformatics, *in silico* approaches of drug repurposing have become a more attractive approach recently (DeOliveira and Lang, 2018). Various antibiotics including N-thiolated β lactams and derivatives (Frezza *et al*., 2008; Kuhn *et al*., 2004), erythromycin (Chlebda-Sieragowska et al., 2007, 2013), clarithromycin (Van Nuffel *et al*., 2015), fluoroquinolones (Yadav and Talwar, 2019), etc. have already been proven to be anticancer agents. The potential of tetracyclines in cancer therapy was first proposed in the 1980's (Kroon *et al*., 1984), and molecules such as doxycycline, minocycline, and COL-3 (Rudek *et al*., 2001) have proven their role in cancer treatment, exerting the effects through different mechanisms. Matrix metalloproteinases (MMPs) are a reliable drug target in pathological conditions such as autoimmune disorders, central nervous system-related disorders, and cancer. But the development of specific MMPs inhibitors is laborious due to the shared structural similarity and overlapping substrate specificity between members of MMPs family which results in broad-spectrum actions on multiple MMPs causing undesirable side effects (Gooljarsingh *et al*., 2008; Vandenbroucke and Libert, 2014; Verma, 2012).

Recent development of high throughput screening has paved the way to develop specific MMPs with high affinity (Arkadash *et al*., 2017). Several natural products are also known to be inhibitors of collagenases and gelatinases (Leyon *et al*., 2005) and most MMPs inhibitors are chelating agents and target the zinc ion located in the catalytic site thereby blocking its activity (Jacobsen *et al*., 2010). Another class of small molecule-based inhibitors are designed in a way that they could fit to the S' pocket of MMPs located close to the catalytic site; this site is crucial for substrate recognition (Cathcart *et al*., 2015; Overall and Kleifeld, 2006). Novel MMP-13 pyrimidine derivative inhibitors utilize this mechanism of inhibition (Nara *et al*., 2017). Small molecules that make use of exosites for inhibition are also developed with the help of computational studies. This allosteric mechanism usually targets PEX domains of MMPs (Remacle *et al*., 2012; Udi *et al*., 2013).

The current study investigated the repurposing potentials of four tetracycline molecules, viz, demeclocycline (C21H-

*Corresponding Author
Leyon Varghese, Immunology and Toxicology Research Laboratory, Department of Zoology, Christ College (Autonomous), Irinjalakuda, University of Calicut, Kerala, India.
E-mail: leyon @ christcollegeijk.edu.in

Zootaxa 5380 (6): 587–594
https://www.mapress.com/zt/

Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

https://doi.org/10.11646/zootaxa.5380.6.6
http://zoobank.org/urn:lsid:zoobank.org:pub:AE1CE5D5-DBE4-4906-968B-88CA1A035173

Description of the Last Instar Larva of *Platylestes platystylus* (Rambur, 1842) from Kerala, India (Odonata: Lestidae)

AYIKKARA VIVEK CHANDRAN[1,2], SUBIN KANIYAMATTATHIL JOSE[1] & PROSENJIT DAWN[3]
[1]*Aqua Research Lab, Department of Geology and Environmental Science, Christ College (Autonomous), Irinjalakuda, Thrissur, Kerala 680125, India*
[2]*Society for Odonate Studies, Vellooparampil, Kuzhimattom PO, Kottayam, Kerala 686533, India*
[3]*Department of Zoology, Shyampur Siddheswari Mahavidyalaya, Ajodhya, Howrah – 711312*
[3]*Corresponding author.* *prosenjit.dawn@gmail.com*
https://orcid.org/0000-0003-2149-2502
https://orcid.org/0000-0003-4784-2312
https://orcid.org/0000-0001-9473-6702

Abstract

The description of the final instar larva and the subsequent exuvia of *Platylestes platystylus* (Rambur, 1842) is given based on a single male larva collected from Kerala and reared in the laboratory. A brief account of the habitat of the damselfly and an updated key to the larvae of genera of Family Lestidae Calvert, 1901 are also provided.

Key words: Damselfly, Exuvia, Larvae, Lestidae, Life History

Introduction

In India, Family Lestidae Calvert, 1901 is represented by only five genera, viz. *Indolestes* Fraser, 1922, *Lestes* Leach, 1815, *Orolestes* McLachlan, 1895, *Playlestes* Selys, 1862 and *Sympecma* Burmeister, 1839 (Subramanian & Babu 2017). Larval descriptions are available for some species of the genera *Indolestes* (Theischinger 2009), *Lestes* (Kumar 1972; Theischinger 2009), *Orolestes* (Lien & Matsuki 1985) and *Sympecma* (Dumont & Borisov 1993) either from Indian species or from other congeneric species. *Platylestes* is a small genus with only four species worldwide, and only two species from India, *Platylestes platystylus* (Rambur, 1842) and *Platylestes kirani* Emiliyamma, Palot & Charesh, 2020 (Emiliyamma *et al.* 2020) listed in Paulson *et al.* (2023). The larvae of this genus remained undescribed so far, though a set of images of the exuviae is claimed to be of *P. platystylus* by Thumboor (2023). This current paper deals with the description of the final instar larva and exuvia of *P. platystylus* from Kole wetlands, Kerala.

Material and methods

The Kole wetlands are spread over Thrissur and Malappuram districts in Kerala, covering an area of 13,632 ha. The wetlands are bound by Chalakkudy River in the south and Bharathapuzha River in the north. The flood waters in the Kole are mainly brought by the two rivers, Kechery and Karuvannur which finally drain into the Arabian sea. These wetlands remain submerged for about six months in a year during southwest monsoon when water level rises up to 5.5 metres. Paddy is cultivated from September to April and these wetlands together contribute about 40% of the paddy production of Kerala. The term ‘kole’ in Malayalam refers to the bumper harvest that is usually obtained from here. People living around the wetlands also engage in fishery for subsistence as well as for commercial purpose (Johnkutty & Venugopal 1993). These wetlands are rich in biodiversity and have been declared as a Ramsar site since 2002 (Islam & Rahmani 2008), an important bird area since 2004 (Islam & Rahmani 2004),

Accepted by M. Marinov: 21 Nov. 2023; published: 5 Dec. 2023

Theoretical and Applied Economics
Volume XXIX (2022), No. 4(633), Winter, pp. 133-146

Cointegration and stock market interdependence: Evidence from India and selected Asian and African stock markets

Tom JACOB
Christ College Autonomous, Irinjalakuda, India
tomjacob9753@gmail.com
LITTLEFLOWER P. J
Christ College Autonomous, Irinjalakuda, India
littleflower680620@gmail.com

Abstract. *This research aims to investigate the kind of link and potential long-term and short-term relationships between the stock market indexes of India and certain Asian and African nations. The stock market indexes of India, Indonesia, South Africa, Japan, Singapore, and China are studied using annual data from 2000 to 2021. There is a strong correlation between the stock markets. With a correlation coefficient ranging from 0.68 to 0.82, all nations have substantial correlations with the Indian stock market, with the exception of the Chinese stock market. Augmented Dickey-Fuller Test is used to determine whether the time series data is stationary or not, it is discovered that all values of the series are stationary at their level form. The Johansen Co-integration Approach is used to analyse the long-term linkages between the stock market indexes. The result demonstrated that the NSE Nifty and other key stock exchange indexes in Asian and African markets have a long-term relationship.*

Keywords: Asian stock markets, long-term relationship, stock market integration, augmented Dickey-Fuller test, Johansen cointegration.

JEL Classification: B26, C58, D53, F15.

Theoretical and Applied Economics
Volume XXX (2023), No. 2(635), Summer, pp. 239-250

Effect of inflation on the growth and development of the Pakistan economy: An empirical analysis

Tom JACOB
Christ College, Irinjalakuda, Kerala, India
tomjacob9753@gmail.com
Raphael RINCY
Sri Ramakrishna Engineering College, Coimbatore, Tamil Nadu, India
rincyraphael2019@srec.ac.in
V.S. AJINA
Christ College, Irinjalakuda, Kerala, India
ajinavsannju@gmail.com

Abstract. *High and sustained economic growth with low inflation is the central objective of the macroeconomic policy makers. Therefore, inflation has been one of the most researched topics in macroeconomics for the last many years because it has serious implications for GDP growth and performance. The main aim of this empirical study to examined the relationship between inflation and Gross Domestic Product performance in Pakistan by using time series data from 2000 to 2022. The major purpose of this study is to examine the existence of inflation- growth relationship in the economy of Pakistan and to analyse the impact of inflation on GDP growth of the economy. Augmented Dickey Fuller Unit Root Test is employed to check the unit root of the time series and Auto Regressive Distributive Lag (ARDL) technique is used to estimate the long run and short run impact of inflation in the economic growth of Pakistan. The present study uses Inflation as an independent variable and Gross Domestic Product is the dependent variable. The ultimate purpose of the study is find out long-term and short term relationships between these variables and investigate the effect of Inflation over Pakistan economic growth.*
A negative and significant inflation growth relationship has been found to be existed in the economy of Pakistan. The results of the study show that prevailing inflation is harmful to the GDP growth of the economy after a certain threshold level. On the basis of the descriptive and econometric analysis, this research study suggest to the policy makers and the State Bank of Pakistan to restrict the inflation in minimum level and to keep it stable. So that it may exert its positive effects on economic growth of the economy. Pakistan must need inflation but in single digit of inflation stimulate the economic growth.

Keywords: CPI, GDP, AIC, ARDL.

JEL Classification: B22, C22, C58, D53, E31, O11.