

On distributive lattices of simple ordered semirings

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In this paper, we study principal ordered ideals of ordered semirings, and give their descriptions with some properties. The characterization of simple ordered semirings is studied, and a relation between a prime ordered ideal and filter has been developed. Finally, we characterize the ordered semirings which are distributive lattices of simple ordered semirings. Here, we find that the equivalence relations \mathcal{N} and \mathcal{J} induced, respectively, from principal filters and principal ordered ideals coincide as distributive lattice congruence in an ordered semiring S whenever S is a distributive lattice of simple ordered semirings.

Keywords: Ordered ideal; semiprime ordered ideal; prime ordered ideal; filter; distributive lattice congruence; simple ordered semiring.

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A TREND MODEL OF COVID-19 SCENARIO IN WEST BENGAL

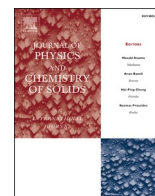
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Abstract. COVID-19 has become a nightmare to human civilization for the last two years around the world. It really has become a serious public health threat through rapid spreading. The entire world is trying to find some pattern to predict the nature and cause of fatal SARS COV-2. Frequent mutations make it more difficult to predict its behaviour. India, being a developing country is facing severe problems in this issue. In this investigation, we aim to construct a mathematical model to find some pattern in disease spread in different districts of West Bengal, India. This model will primarily be an algebraic equation constructed with least square fitting. A little bit of trial-and-error will determine the most appropriate model both in terms of goodness of fit and prediction accuracy. The goodness of fit has been checked with the corresponding R^2 values. We have used cumulative dataset between 26th April, 2020 to 31st October, 2021 obtained from github.com to find out a mathematical description of ups and downs of the representing curve. We have drawn trend curves (mostly straight lines) and shown how they may be helpful to forecast the future progress of infection, so that necessary precautions can be taken in advance.

Keywords: COVID-19, Least square method, Trend model, Goodness of fit

1. Introduction. People across the world are facing a hard time due to unexpected outspread of COVID-19. On 11th March, 2020, the World Health Organization (WHO) declared the situation as pandemic due to its devastating and widespread nature. Almost every country in the world have more or less been affected by this calamitous virus. According to worldometer, as on 31st October, 2021, more than 263 million people are infected with the death toll of more than 5.2 million. It is really miserable to experience that millions of people are compelled to die without any treatment, short supply of oxygen, lack of beds in hospitals, insufficiency of doctors, scarcity of medicines etc. Gradually all the affected countries were compelled to go for a complete lockdown. The second wave again pushed the whole world into a complete disaster including India.



FLA

π -Stacked $(C_n-C_6H_6-Fe-C_6H_6-C_{13-n})_{n=2}$: A spin operated thermoelectric nanodevice

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ABSTRACT

Harvesting waste heat back into electricity by exploiting the temperature difference across two ends of a nanodevice and its concomitant spin dependence has led to the emergence of a new field known as spin caloritronics. Herein, we report the spin polarized thermoelectric features in a π -stacked system comprised of $(C_n-C_6H_6-Fe-C_6H_6-C_{13-n})_{n=2}$. A decisive factor, the Seebeck coefficient, becomes fully spin dependent on temperature and switches from positive to negative values, which illustrates the switching of the thermoelectric behavior from a p-to n-type due to the change in the spin state from spin-down to spin-up. A relatively large thermoelectric figure of merit has been reported in the case of the spin figure of merit of the system. In this context, three major observations have been made: i) The Seebeck coefficient has a distinctive feature over two different spin channels, ii) the spin Seebeck coefficient (S_s) is nearly four times larger than the charge Seebeck coefficient (S_c), and (iii) the spin thermoelectric figure of merit (Z_s) rises by 80% with respect to charge thermoelectric figure of merit (Z_c) under thermal bias. Our results have been well explained through the analysis of temperature dependent transmission spectra of the system. The emergence of a relatively large spin Seebeck coefficient allows us to measure the pure spin current of the system as well as extending the devices application from simple memory (MRAM) devices to on-chip energy harvesting systems.

1. Introduction

A clean and green energy solution to the loss of heat generated in our electronic and electrical appliances is to obtain electricity back from this thermal energy waste [1–4]. Over the years, physicists have been addressing this issue using simple and easily attainable devices known as thermoelectric materials, wherein the difference in temperature can produce electricity. Some of the notable, but powerful thermoelectric materials include $Mg_3(Sb,Bi)_2$, Cu_2Se , $CuInSe_2$, Bi_2Te_3 , $PbTe$, $SiGe$, and Cu_2S [5–12]. However, most of these devices are bulk materials and not sufficient to address the waste heat developed in modern nanoelectronic devices. This issue has been highlighted in a number of recent studies along with demonstration of novel features, such as thermoelectric switching from p-type to n-type [13], in which the tunneling of electrons purely depends on the change in the thermal bias of the electrodes. In this efficient energy conversion technology, 2D nanostructures such as

graphene have been proven to be highly effective. Modification in the thermoelectric features against the spin polarization of tunneling electrons has developed the new, but unexplored, domain of spin caloritronics. In this work we have focused on spin polarized thermoelectric features of a π -stacked system and its concomitant spin polarized thermoelectric switching behavior.

As reported in the literature, thermoelectric features are estimated using parameters such as the thermoelectric figure of merit (ZT), which is defined as follows: $ZT = G_0 S_0^2 T / k$, where G_0 , S_0 , k , T are the spin polarized electrical conductivity, spin polarized Seebeck coefficient, thermal conductivity, and absolute temperature, respectively. The thermal conductivity contains contributions from both electrons and phonons. In spin caloritronics, one will have separate figure of merits for the charged and spin parts. The charge Seebeck coefficient is defined as follows: $S_c = \frac{G_1 S_1 + G_2 S_2}{G_1 + G_2}$ and the spin Seebeck coefficient is defined as

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Immature stages of *Culicoides innoxius* Sen & Das Gupta and pupa of *C. huffi* Causey (Diptera: Ceratopogonidae) from India

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Abstract

Both larval and pupal stages of *Culicoides innoxius* Sen & Das Gupta and pupal stages of *C. huffi* Causey are described and illustrated. All specimens were collected from the Lower Gangetic plains of West Bengal. Larvae of *C. innoxius* were obtained from rotten banana stem, while a single pupa of *C. huffi* was collected from an irrigation channel associated with the rice agroecosystem. A pictorial pupal key of the species of the genus reported from India is provided.

Key words: Taxonomy, Clavipalpis group, *Hoffmania*, immature, key, India

Introduction

Culicoides Latreille is one of the most species rich genera of the family Ceratopogonidae with approximately 1368 valid species, 32 subgenera, 38 species group, and 176 unplaced species described worldwide (Borkent & Dominiak 2020), and so far 76 species were reported from India (Chatterjee *et al.* 2020). Most female members of this genus are haematophagous and many species act as important vectors of pathogenic viruses, protozoans and filarial nematodes (Mellor *et al.* 2000; Borkent 2005). These midges are of great concern because they transmit bluetongue (BT), Akabane and other viruses that cause disease in sheep, cattle and wild ruminants (Kettle 1977; Linley *et al.* 1987). Immatures of this genus can be found in a variety of aquatic or semi aquatic habitats, including tree holes, ponds, marshes, streams, various muddy and saturated organic materials, damp or rotting vegetation, and manure (Kettle & Lawson 1952; Jamnback 1965; Borkent 2014; Saha *et al.* 2017; Shults & Borkent 2018). Immature stages of ceratopogonid midges including *Culicoides* are least studied. Only 3% of the larvae and 7% of the pupae are so far described worldwide from the total identified species of the genus (Borkent 2014). Immature stages of only nine species have been described from India. Seven species of *Culicoides* were reported from India which have putative role as a vector of BT virus (Prasad *et al.* 2009). *Culicoides* is a very complex group with many cryptic species, so that the species level identification became sometimes tough. In order to provide additional characters to identify cryptic species, the description of immature characteristics and their habitats may prove to be useful.

This paper aims to redescribe the pupal stage of two species, *Culicoides innoxius* Sen & Das Gupta, 1959 and *C. huffi* Causey, 1938 in light of modern terminologies with a pupal key to the species reported from India of the genus *Culicoides*.

Material and methods

The substrates with both larvae and pupae of *C. innoxius* Sen and Das Gupta, 1959 and only one pupa of *C. huffi* Causey, 1938 were obtained from their habitats. The immature stages were sorted under a stereozoom trinocular microscope



Descriptions of two new species of *Culicoides* Latreille from Sundarbans, India with an adult key to the *ornatus* species group of the Oriental region (Diptera, Ceratopogonidae)

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Abstract

Two new species of biting midges, *Culicoides cornatus* **sp. nov.** and *Culicoides pileus* **sp. nov.** are described based on adults. The new species are compared to their congeners with close similarity. All specimens were collected from the Indian Sundarban Mangrove Forests, few specimens were mounted in glass slides and few were prepared for SEM study. Total 78 species under the genus *Culicoides* Latreille including the two new ones (6 species from *ornatus* species group) are described from India. An adult key of the *ornatus* species group from the Oriental Region is provided.

Key Words

Adult Key, India, New species, *ornatus* group, Sundarbans, Taxonomy

Introduction

Culicoides Latreille, 1809 is one of the most species rich genera of the family Ceratopogonidae with approximately 1368 valid species, 32 subgenera, 38 species groups, and 176 unplaced species described worldwide (Borkent and Dominiak 2020); so far 76 species have been reported from India (Chatterjee et al. 2020). Most female members of this genus are haematophagous and many species act as important vectors of pathogenic viruses, protozoans and filarial nematodes (Mellor et al. 2000; Borkent 2005). These midges are of great concern because they transmit blue-tongue (BT), Akabane and other viruses that cause disease in sheep, cattle and wild ruminants (Kettle 1977; Linley et al. 1983). The outbreak of the BT disease in Tamil Nadu (India) and its occurrence in many parts of India over the last few decades has affected millions of sheep and goats and other livestock (Ilango 2006). Immature stages of this genus can be found in a variety of aquatic or semi aquatic habitats, including tree holes, ponds, marshes, streams, various muddy and saturated organic materials, damp or

rotting vegetation, and manure (Kettle and Lawson 1952; Jamnback 1965; Borkent 2014; Shults and Borkent 2018).

The *ornatus* species group of this genus comprises of 33 species worldwide (Nandi et al. 2013; Borkent and Dominiak 2020) including 27 reported from the Oriental region (Table 1). Before this study, four species of the *ornatus* group have been reported from India: *C. peliliouensis* Tokunaga in Tokunaga and Esaki 1936, *C. aequalispinus* Nandi, Mazumdar & Das Gupta, 2013, *C. fuscitibialis* Nandi, Mazumdar & Das Gupta, 2013, and *C. pateli* Nandi, Mazumdar & Das Gupta, 2013. Members of the *ornatus* group can be recognised by the following characteristics: Eyes usually bare, seldom hairy; contiguous to moderately separated; hind tibial comb with 4 (rarely 5) tibial spines, the one nearest the spur longest; wing with second radial cell usually dark to tip but pale distally in some species; presence of two large sclerotised spermathecae with a vestigial one, sclerotised ring present or absent; male genitalia with well developed apicolateral processes, aedeagus usually with low basal arch and long, tapering, rather blunt distal process; parameres usually fused at bases, the



Larval Food Analysis and Qualitative Determination of Exoenzyme-Producing Gut Bacteria in Adult Ceratopogonid Midges (Diptera)

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ABSTRACT

Biting midges are small nematoceros Diptera. *Culicoides* and *Dasyhelea* are two important genera of the family Ceratopogonidae. Larvae of *Culicoides innoxius* and *Dasyhelea aprojecta* are found in the semiaquatic moist habitat. The larvae feed on the small debris and habitat substrata. The materials consumed by these larvae aid in their development to become adult. The nutritional evaluation of the food material of larvae of *C. innoxius* and *D. aprojecta* was carried out to know the essential elements for their development. In the case of adult *Culicoides*, many species are hematophagous. However, the adult midges of the genus *Dasyhelea* are dependent on nectar and honeydew. Along with their digestive enzymes, exoenzyme-producing gut associated bacteria have also an important role in the digestion of these food materials. Digestion and metabolism of these food materials aid in insect maturation, immunity, reproduction, maintaining diapause, etc. Qualitative determination of the gut associated bacteria of adult *C. innoxius* and *D. flava* was accomplished to infer the role of bacteria supplementing the digestive enzymes.

Keywords: *Culicoides*, *Dasyhelea*, Larval food material, Proximate composition, Exoenzyme-producing gut bacteria, Qualitative determination.

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INTRODUCTION

Family Ceratopogonidae is an enormously diverse group of small nematoceros midges, usually known as biting midges. In this family along with some other genera *Culicoides* Latreille [1], and *Dasyhelea* Kieffer [2], are important in having medico-veterinary and economic significance respectively. Many species of *Culicoides* are vectors of pathogenic protozoans, viruses, and filarial nematodes [3-5] causing Akabane, Blue Tongue disease, etc. [6, 7]. Some members of the genus *Dasyhelea* are pollinators of cocoa and rubber trees [8, 9]. In the case of female *Culicoides*, the adult stage is hematophagous, feeding on vertebrate blood, though there is report of natural sugar feeding habit also [10]. The larvae of some species of

Culicoides are trophic generalists [11]. Adult stages of both the sexes belonging to the genus *Dasyhelea* rely on nutrition from the honeydew and nectar [12], larval stages of this genus are primarily herbivorous actively feeding upon the plant and animal debris [13-15]. However, there is also evidence of carnivorous feeding habit of *D. pseudoincisurata* Waugh and Wirth, [16, 17]. Insects harbor a broad variety of microorganisms in their gut which help in numerous physiological functions [18]. There is also role of autochthonous bacteria in production of digestive enzymes for plant-derived polymers [19]. Digestion of lipid and protein may also be contributed by these microorganisms [20].

This article aims to evaluate the composition of food materials ingested by the larvae during



Evaluation of mosquito larvicidal activity of *Azolla pinnata* leaf extracts against the filarial vector *Culex quinquefasciatus*

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Vector control is a major challenge now-a-days when they became resistance against commonly available insecticides. As an alternative, preliminary laboratory evaluation of *Azolla pinnata* crude and chloroform: methanol solvent extract was carried out under laboratory trials for control of *Culex quinquefasciatus*. Crude and solvent extract (chloroform: methanol) extracts of *A. pinnata* leaves were examined for the larvicidal activity against all the larval instars (1st to 4th) of *C. quinquefasciatus*. Dose-dependent mortality assays were performed using the extracts. Further, determinations of LC₅₀ and LC₉₅ values were accomplished through log-probit analyses and regression analyses. The larvicidal activity was statistically justified through ANOVA analyses. Effects of the extracts were examined on non-target water fauna. Exposure to *A. pinnata* crude and chloroform: methanol extract increased the mortality of first to fourth-instar *C. quinquefasciatus*. All the graded concentrations showed significant ($P < 0.05$) larval mortality and the results of the regression equation revealed that the mortality rates were positively correlated with the concentrations of the extracts (R^2 close to 1). LC₅₀ values of all instars after 24 h of exposure were between 86.99-294.06 ppm for crude and 48.87-111.44 ppm for chloroform: methanol extract. Chloroform: methanol extract is better than crude because the nature of biological components can be enhanced in presence of solvent and secondly the stronger extraction capacity could have produced a greater number of active constituents. The residual effect is noted even at the end of 72 h. A negligible toxicity to the larvae of *Chironomus circumdatus* was noticed as non-target organisms.

Keywords: *Azolla pinnata*, *Culex quinquefasciatus*, Larvicide, Leaf extract, Non-target organisms.

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Introduction

Mosquitoes are environmentally and economically significant insects because they transmit a variety of diseases that can be fatal. Filariasis is a disease transmitted by the vector *Culex quinquefasciatus* in tropical regions. The vectors of these diseases have long been a focus of disease eradication efforts¹. Mosquito embryonic and larval stages have been a key target for researchers looking for medications to decrease mosquito populations due to their prevalence in confined spaces (small pools and puddles)²⁻⁴. For mosquito control, pyrethroids, carbamates, and organophosphates are among the synthetic insecticides available.

Random use of organophosphates such as temephos and fenthion and insect growth regulators

such as diflubenzuron and methoprene leads to mosquito resistance against these chemicals⁵. The use of random synthetic pesticides leads to various types of cancer and birth defects in human beings⁶. Some 344 species have been reported to have a variety of activities against mosquitoes⁷⁻¹⁴.

However, majority of them are contaminants that impair the ecosystem and non-target creatures^{2,15,16}. When *Cx. quinquefasciatus* larvae were treated to the mosquito-control chemicals permethrin and temephos, respectively, they developed resistance^{17,18}. As a result, novel medications or drug combinations must be tested in order to manage mosquito populations.

Other biological pest management strategies, such as the use of fungal pathogens, predators, traps, and plant-based medications, are used in addition to synthetic pesticides^{2,16}. Plant-based pesticides are popular among biological mosquito control strategies because of their low cost, ease of availability, and environmental friendliness.

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