

Zygomycetous Fungi in Wild Rats in Vembanadu Wetland Agroecosystem

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ABSTRACT

Fungal infections with zygomycetous fungi are exceptionally severe, with high mortality rate. Immunocompromised hosts, transplant recipients, and diabetic patients with uncontrolled ketoacidosis and high iron serum levels are at risk. Zygomycota are capable of infecting hosts immune to other filamentous fungi. However, zygomycetous fungi not get due consideration and the present study is an attempt to explore the range of zygomycetous fungal pathogens carried by wild rats in a wetland agroecosystem. A total of 16 fungi was isolated and identified from the 40 rats (*Rattus norvegicus*) collected. Among the isolates, *Syncephalastrum racemosum* was more common (75%) followed by *Rhizopus stolonifer* (67.5%), *Absidia corymbifera* (62.5%) and *Cunninghamella bertolletiae* (57.5%). The familywise analysis revealed a preponderance of family Mucoraceae (18.75%) followed by *Incertae sedis* and *Cunninghamellaceae* (12.5% each). Water rats of Vembanadu-Kol wetland agroecosystem are potent carriers of zygomycetous fungi and strong carrier paths are existing too. The ecology and transmission dynamics of these rodentborne zygomycetous fungi are complex. The factors that influence transmission are unique to each fungi and the fluctuations in rodent population or their habitat exerts profound influence too.

Keywords: Zygomycetous Fungi, Vembanadu Wetland, Agroecosystem, *Rattus Norvegicus*

INTRODUCTION

Zygomycetes are ubiquitous filamentous fungi involved in zygomycoses which is considered as an emerging infection with severe pathognomonic features, especially in immune compromised individuals (Kontoyiannis et al., 2005 and Geramizadeh et al., 2012). The close linkages of zygomycetes with cancer, prolonged antibiotic therapy, diabetes, transplantation and the allied forms of immunosuppressive therapies was well established with a steady expansion of organisms causing diseases.

An emergence of zygomycete infection from rhinocerebral, pulmonary, and disseminated diseases to gastrointestinal, Cutaneous/subcutaneous, allergic and asymptomatic colonization was observed.

The role of rodents in harboring and spreading various bacterial, fungal, viral and parasitic diseases are well studied. Vast majority of the emerging infectious diseases are considered as vector-borne and among these, greater part are rodent-borne. The role of rodents as host and vector of zoonoses in several regional and

worldwide epidemics are well documented. However, the rodent carrier status of zygomycetous fungi was least explored and the present study is in this outlook.

MATERIALS AND METHODS

The fringes of Vembanadu-Kol Wetland (Ramsar site) have the most extensive agricultural fields of the state of Kerala. Water rats (*Rattus norvegicus*) were trapped regularly by Oil Palm farmers in the wetland oil palm plantation of Kallara Grama Panchayath, Kottayam district, Kerala, so as to prevent crop damage. Rodents were trapped (during August 2014 – August 2015) by using box type wooden live traps baited with *Nymphae* flowers and roasted coconut which were set on the oil palm plantation at 18.00 hours and checked at 06.00 hours in the next morning.

Rats collected and killed by farmers were weighed, morph metrically measured, sexed and taxonomically identified. 15 samples were collected from each specimen such as ventral hair (4 samples), dorsal hair (4 samples), whisker (1 sample), Front nail (1 sample), hind

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nail (1 sample) and tail scrapings (4 samples). The collected samples were inoculated into Sabouraud Dextrose Agar, (SDA) (with antibiotics) and incubated at room temperature for fifteen days. Developed, suspected zygomycetous colonies were sub cultured into SDA plates and identified by observing macroscopic and microscopic characteristics (Howard, 2002).

RESULTS

A total of 16 fungi was isolated and identified from the 40 rats collected. Among the isolates,

Syncephalastrum racemosum was more common (75%) followed by *Rhizopus stolonifer* (67.5%), *Absidia corymbifera* (62.5%) and *Cunninghamella bertolletiae* (57.5%) (Table 1). Emerging pathogens like *Apophysomyces elegans*, *Conidiobolus coronatus* and *Basidiobolus ranarum* was also observed in the study. The familywise analysis revealed a preponderance of family Mucoraceae (18.75%), Incertae sedis and Cunninghamellaceae (12.5% each) was documented (Table 2).

Table1. List of zygomycetous fungi isolated from collected *Rattus norvegicus* rats (n=40)

Sl. No.	Zygomycetous fungi isolated	Frequency of occurrence (%)
1.	<i>Absidia corymbifera</i>	62.5
2.	<i>Apophysomyces elegans</i>	12.5
3.	<i>Basidiobolus ranarum</i>	12.5
4.	<i>Cokeromyces recurvatus</i>	2.5
5.	<i>Conidiobolus coronatus</i>	25
6.	<i>Cunninghamella bertolletiae</i>	57.5
7.	<i>Mucor ramosissimus</i>	50
8.	<i>M. rouxianus</i>	17.5
9.	<i>Mucor</i> sp.	42.5
10.	<i>Rhizopus arrhizus</i>	10
11.	<i>Rhizopus oryzae</i>	5
12.	<i>Rhizopus stolonifer</i>	67.5
13.	<i>Rhizopus</i> sp.	25
14.	<i>Syncephalastrum racemosum</i>	75
15.	<i>Mycelia sterilia</i> (white)	12.5
16.	<i>Mycelia sterilia</i> (pale yellow)	10

Table2. List of zygomycetous fungal families identified from collected *Rattus norvegicus* rats (n=40)

Sl. No.	Family	Frequency of occurrence (%)
1.	Ancylistaceae	6.25
2.	Basidiobolaceae	6.25
3.	Cunninghamellaceae	12.5
4.	Incertae sedis	12.5
5.	Mucoraceae	18.75
6.	Mycotyphaceae	6.25
7.	Rhizopodaceae	25
8.	Saksenaeeae	6.25
9.	Syncephalastraceae	6.25

DISCUSSION

The term Zygomycota is broadly used for fungi belonging to Mucoromycotina, Entomophthoromycotina, Mortierellomycotina, Zoopagomycotina, and Kickxellomycotina. It should be noted that zygomycoses have a very complicated clinical manifestations depending on the causal agent and patient's health status.

As the knowledge on pathogenic Zygomycota ecology is very limited, understanding of the same is pivotal for understanding the epidemiology and to explicate recommendations.

The present study fetched 16 zygomycetous fungi coming under 9 families from the 40 water (*Rattus norvegicus*) rats collected from a wetland agroecosystem. Among the isolates, *Syncephalastrum racemosum* was more common (75%) followed by *Rhizopus stolonifer* (67.5%), *Absidia corymbifera* (62.5%) and *Cunninghamella bertolletiae* (57.5%). *S. racemosum* produces a variety of mycotoxins *in vitro* (Abdou *et al.*, 1989).

It has been studied extensively as a plant pathogen and cases of human disease with *Syncephalastrum* are well reported (Schlebusch

and Looke, 2005; Mangaraj *et al.*, 2014). Thus the presence of *Syncephalastrum* among rats in a wetland agroecosystem is significant as it has public health impacts.

It should be noted that the three genera of the Mucorales, *i.e.*, *Rhizopus* sp., *Mucor* sp. and *Absidia* sp., are the most frequent causes of invasive zygomycosis and any one of these moulds can cause pulmonary, rhinocerebral, cutaneous, gastrointestinal, bone and renal infections with possible dissemination (Ribes *et al.*, 2000).

Absidia corymbifera is involved generally in rhinocerebral mycosis, but gastrointestinal, pulmonary, cutaneous, and disseminated infections have also been reported. (Chandler and Watts, 1987; Sugar, 1995; Cloughley *et al.*, 2002). Lopes *et al.*, (1996) reviewed cases of *Cunninghamella bertholletiae* infections in Brazil and the diseases due to the fungi are increasing especially in HIV patients (Bharathi and Rani, 2011).

Basidiobolus ranarum and *Conidiobolus coronatus* affects individuals with apparently intact immunological status and occurs primarily in tropical areas. *C. coronatus* has already been isolated from soil samples, rotting plant matter, insects, and the gastrointestinal contents of lizards and frogs, especially in tropical and subtropical regions (Porto *et al.*, 1987). *Apophysomyces elegans* was also enlisted as an emerging pathogen by several researchers (Chakrabarti *et al.*, 2003).

Rodents are the most pernicious vertebrate pests to man and his crops from time immemorial. Besides, rodents serve as the potential source of several infections to humans and his livestock. Rodentborne diseases are considered as a 'human health time bomb'. The typical socio-economic conditions prevailing in the agroecosystems in VembanaduKol wetland make the rat-man contacts inevitable. The present investigation shows that *Rattus norvegicus* the principal rodent species of Vembanadu-Kol wetland agroecosystem is potentially carrying a number of zygomycetous fungal pathogens. The close contact between man-water-rat nexus in wetland agroecosystem paves an easy track for transmission of such infections.

CONCLUSION

The present investigation is a pioneer attempt in this part of the world and the carrier status of zygomycetous fungi by rodents in wetland agroecosystem is evident. The zoonotic risks

associated with *R. norvegicus* in wetland agroecosystems can't be ignored in the wake of emerging zygomycetous zoonotic fungal diseases.

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