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FIRST RECORD OF THE PRESENCE OF PATHOGENIC AND TOXIGENIC FUNGI IN NORWAY RAT POPULATIONS FROM URBAN AND SUBURBAN HABITATS IN SERBIA.

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INTRODUCTION

Norway rat (*Rattus norvegicus* Berkenhout, 1769) is a common pest rodent species with wide distribution. In our country, it is encountered most frequently in urban and suburban habitats (K a t a r a n o v s k i, 1999). Norway rat is a synanthropic animal, living near humans, who provide it with food and shelter. The economic damage caused to humans by wild brown rats is brought about by their feeding habits (consuming human food and fooder of domestic animals) and infliction of mechanical damage (chewing on paper, fabrics, and various other goods) (H r g o v i ć et al., 1991; K a t a r a n o v s k i et al., 1998). Rats do not just represent an economic and social problem. Owing to their lifestyle (omnivorous, active throughout the whole day, and feeding everywhere), wild brown rat populations are constantly exposed to various microbes, for many of which they are reservoirs and vectors (W e b s t e r and M c D o n a l d, 1995; E a s t e r b r o o k et al., 2007). In this way, Norway rats are the cause of dangerous diseases of humans and animals, serving as an important indicator of the epizootic and epidemic situation of their environment (W i n c e w i c z, 2002). There is thus a need to determine the incidence of pathogen carriage by wild Norway rats in order to assess the associated public health hazards.

While we know a great deal about viral, bacterial, and helminthic burdens in natural populations of rats, there are virtually no data regarding the presence of fungi in their organisms. Spores of fungi float freely in the air and are found in different environmental substrates (F i s h e r and D o t t, 2003). They can colonize rodent tissues upon contact, establishing biological sources of these agents. In this way, rodents can act as reservoirs of fungi and contribute to their spreading. Numerous fungal species cause diseases known as mycoses and mycotoxicoses. The presence of fungi and their metabolic products, mycotoxins, in grains and other food contaminated by rat excrement presents a potential hazard to human and animal health (I A R C, 1994). With this in mind, research has been undertaken to examine the presence of pathogenic and toxigenic fungi in wild rat populations.

Wild Norway rats were captured during the summer-autumn season of 2006 using live-catching traps in urban habitats of Belgrade (Novi Beograd, Ada Huja) and Kovin, and in nearby suburban habitats (Leštane, Ovča, Jajinci). Swabs of skin from the snout were taken and lung tissue homogenates prepared under sterile conditions. Swabs and specimens of lung tissue homogenates were inoculated on Sabouraud maltose agar (SMA) medium with the addition of streptomycin to avoid bacterial infection, as described by T a r r a n d et al. (2005). After incubation, micromycetes were isolated, reisolated, and identified on the basis of micro- and macrocharacteristics of fungal isolates (R a p e r and F e n n e l, 1965; V o n A r x, 1974; P i t, 1979).

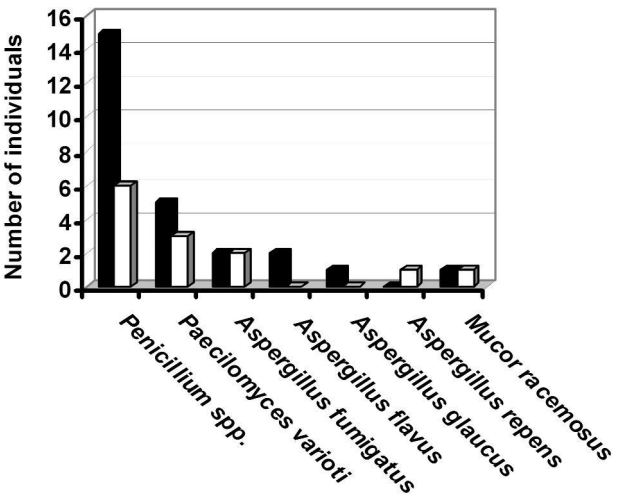
Of 45 rats examined, fungi were isolated from 26 individuals (57.8%). Seven fungal species were identified after isolation (Fig. 1), six belonging to the class Hyphomycetes (Deuteromycotina) and one, *Mucor racemosus*, to Zygomycotina. Some of the fungal isolates, particularly *Penicillium* species, were not identified at the species level because of atypical fungal elements (atypical characteristics of spores, with altered shape and size and branched conidiophores with elongated phialides).

In 15 animals (33.3%), fungi were detected in inoculations from swabs of the snout; in 20 animals (44.4%), fungal growth was detected in lung homogenate inoculations; and nine animals (20.0%), fungi were detected in inoculations of both snout swabs and lung homogenates. In seven cases (15.5%), the presence of fungi on nasal skin and in the lungs was coincident. In three animals, two or more fungal species were present in the lungs or on the snout. *Penicillium* species were the most abundantly represented fungi detected in inoculations of both lung homogenates (in 33.3% mof individuals) and swabs from the snout (in 13.3% of individuals). The presence of *Aspergillus* species was noted in lungs of 8.9% and on snouts of 8.9% of examined individuals, while *Paecilomyces varioti* was recorded in

lungs of 11.1% and on snouts of 6.7% of the examined individuals. The lowest rate of occurrence was noted for *Mucor racemosus* (2.2%).

The isolation of fungi from the examined rats is significant from the point of view of incidence of mycotic deseases in people and animals. Observation of fungi in the lungs and snouts of rats suggests a role played by the Norway rat as a vector and disseminator of mycotic infection. Some *Penicillium* species are the source of ochratoxins (P i t t, 1994), while others are common opportunistic fungal pathogens (U n g p a k o r n, 2000) or causal agents of invasive pulmonary and cerebral diseases (L y r a t z o p o u l o s et al., 2002). *Aspergillus* species are associated with a wide range of disorders in humans, ranging from allergies to pulmonary infections. *Aspergillus flavus* is a known toxigenic species, producing aflatoxin B1, the most carcinogenic human mycotoxin, which causes hepatocellular carcinoma (I A R C, 1994; C o o t y et al., 1994). An osmophilic species well adapted to dry substrates, *A. repens* commonly causes farmer's lung and other pulmonary infections (B u s h and P o r t n o y, 2001). Of special interest is *A. fumigatus,* the most common invasive mold, which is the cause of life-threatening opportunistic infections in individuals with a weakened immune system, such as patients on chemotherapy, AIDS patients, post-transplant patients on immunosuppressive therapy, individuals undergoing prolonged antibiotic treatment, children, and the elderly (L i n et al., 2001). *Paecilomyces varioti* can cause disseminated infections fatal in immunocompromised individuals (W a l s h et al., 2004; P f a l l e r and D i e k e m a, 2004). *Mucor* species cause infections in immunocompromised individuals, especially those with diabetic ketoacidosis or neutropenia, and in patients undergoing corticosteroid therapy (G o n z a l e s e t al., 2002). In addition to human health, the presence of these fungi can affect animal health as well, thus influencing the characteristics of natural populations of rodents (R o s e n g u r t and S a n c h e z, 1992; B y r d et al., 1992; P i t, 1994).

Fig. 1. Mycromycetes isolated from lung and snout of Norway rats.



In conclusion, the presented data demonstrate the presence of fungi in Norway rats from natural populations. In the light of the importance of emerging and rare opportunistic fungal pathogens, the fungal burden in wild brown rat populations and its characteristics in terms of seasonal and annual changes warrant further investigation.

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