Journal de Mycologie Médicale (2017) xxx, xxx—xxx

Available online at
ScienceDirect
www.sciencedirect.com

Elsevier Masson France
EM|consulte
www.em-consulte.com

GENERAL REVIEW/REVUE GÉNÉRALE

Contamination of cockroaches (Insecta: Blattaria) to medically fungi: A systematic review and meta-analysis

H. Nasirian

Department of medical entomology and vector control, school of public health, Tehran university of medical sciences, POB 6446-14155 Tehran, Iran

Received 31 January 2017; received in revised form 8 April 2017; accepted 14 April 2017

KEYWORDS
Blattella germanica;
Cockroach fungal contamination;
Fungal infection;
Periplaneta americana;
Supella longipalpa

Summary
Introduction. — Fungal infections have emerged worldwide. Cockroaches have been proved vectors of medically fungi.
Methods. — A systematic meta-analysis review about cockroach fungal contamination was investigated. Relevant topics were collected between January 2016 and January 2017. After a preliminary review among 392 collected papers, 156 were selected to become part of the detailed systematic meta-analysis review.
Results. — Cockroaches contaminated to 38 fungi species belonging to 19 families and 12 orders. About 38, 25 and 13 fungal species were recovered from the American, German and brown-banded cockroaches, respectively with a variety of medical importance. Except the fungi isolated from German and brown-banded cockroaches, 15 species have been isolated only from the American cockroaches. The global world mean and trend of cockroach fungal contamination were 84.1 and 50.6—100%, respectively in the human dwelling environments. There is a significant difference between cockroach fungal contamination in the urban and rural environments ($P < 0.05$) without a significant difference between hospital and household environments ($P > 0.05$). The external and internal cockroach fungal contamination is more dangerous than entire surfaces, while the internal is more dangerous than the external surface. The German and brown-banded cockroach fungal contamination are more dangerous than the American cockroaches in the hospital environments.
Conclusion. — The study indicates that globally cockroach fungal contamination has been increased recognizing as agents of human infections and associating with high morbidity and mortality in immune-compromised patients. These facts, along with insecticide resistance

E-mail address: hanasirian@yahoo.com.

http://dx.doi.org/10.1016/j.mycmed.2017.04.012

Please cite this article in press as: Nasirian H. Contamination of cockroaches (Insecta: Blattaria) to medically fungi: A systematic review and meta-analysis. Journal De Mycologie Médicale (2017), http://dx.doi.org/10.1016/j.mycmed.2017.04.012

emergence and increasing globally cockroach infestation, reveal importance of cockroaches and need for their control more than ever.

Introduction

After growing immune-suppressed patients suffer from cancers, AIDS, transplant recipients, premature neonates, and recovering from major surgery, opportunistic fungal infections have emerged worldwide [1]. There has been also an overall increase in fungal healthcare-associated infections due to developing new medical treatment methods [2]. Cockroaches are the most human dwelling infesting insects such as homes, restaurants and hospitals [3—10], and have been proved that they are vectors of medically fungi. Researchers have isolated medically important fungi from cockroaches [11—15], which can cause a wide range of fungal human infections [11,16—18].

During the recent decades, the incidence of fungal infections has dramatically increased. Fungal infections are associated with increased mortality, morbidity and length of stay in hospitalized patients [19—21]. Some predominant fungal pathogens are mentioned as *Candida* spp., *Aspergillus* spp., *Mucorales*, *Fusarium* spp., and other molds, including *Scedosporium* spp. [22], which potentially contaminated by cockroaches.

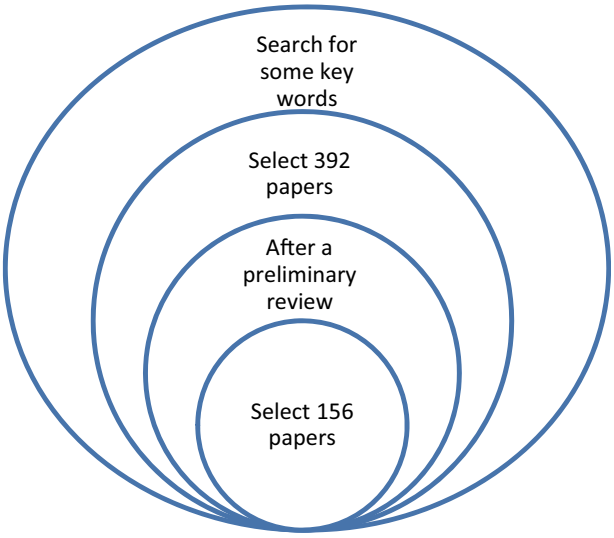
In the investigated studies the different groups of fungi isolated from the external or digestive tract of cockroaches. While in this regard there is no a comprehensive study or a detailed statistical work were done. There is also no a detailed information about the cockroach fungal contamination or a precise report. So a study designed to review a comprehensive and detailed study and to obtain also detailed information about the cockroach fungal contamination. The aim of the study was to a systematic review and meta-analysis about cockroach medically fungal contamination.

Materials and methods

Data collection and selection

At first some special key words such as cockroaches as spreader diseases, cockroach fungal contamination, *Blattella germanica* or German cockroach fungal contamination, *Periplaneta americana* or American cockroach fungal contamination, *Supella longipalpa* or brown-banded cockroach fungal contamination and human fungal infection were used to search the papers. Then after searching detail cockroach fungal species contaminated, 'any fungal species' plus 'human infection' were used as new key words to search the new papers about human fungal infection.

Relevant scientific papers about cockroach fungal contamination and human fungal infection were collected from various scientific websites such as Google Scholar, Scopus, PubMed, Web of Science, Elsevier and Springer, as well as ScienceDirect, between January 2016 and January 2017. As seen in the below flow chart, about 392 papers and scientific notes were collected from the mentioned addresses and after a preliminary review, 156 were selected to become part of the detailed synthesis review and meta-analysis.



Data meta-analysis

The scientific papers about cockroach fungal contamination were read carefully and the data were extracted and analyzed. Contamination of cockroaches mainly categorized in the two parts including hospitals and households environments. The results summarized in the Tables 1—3. Figs. 1 and 2 show the cockroach species fungal contamination. A briefly statement and fungal infections cause by fungi isolated from cockroaches, and their families and orders are summarized in the Table 4.

Statistical analysis

The global trend contamination of cockroaches were calculated and estimated by Microsoft Excel 2010. The global trend cockroach fungal contamination was drawn by clicking on graph line distribution and selecting ''add trendline'' option. The global cockroach fungal contamination was calculated by insertion function and selecting ''average'' option. Fig. 3 shows the global world fungal contamination trend of cockroaches, and *Periplaneta americana* and *Blattella germanica* cockroach species. Fig. 4 shows the global mean fungal contamination of cockroach species in the human dwelling environments. IBM SPSS Statistics Data Editor Version 23 was used to analyze any statistical analysis of the data. One-sample Kolmogorov-Smirnov test was used to check the normality of the data distribution. After checking to make sure that the distribution of data was normal, paired-samples *t*-test was used to compare contamination

Please cite this article in press as: Nasirian H. Contamination of cockroaches (Insecta: Blattaria) to medically fungi: A systematic review and meta-analysis. Journal De Mycologie Médicale (2017), http://dx.doi.org/10.1016/j.mycmed.2017.04.012