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Health risks associated with exposure to fungi

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Abstract

Occupational environment of farmers is full of biohazards. Especially frequent are molds found in grain, grain dust, and soil. People might be affected by diseases caused by these molds inducing: skin infections, bronchial asthma, allergic rhinitis and others.

The aim of the study was to detect and quantify colonization by molds in samples of grain and grain dust collected during combine threshing, as well as in soil samples from organic and conventional cultivation systems in south – east Poland. The following were used for the study: 20 samples of rye, wheat and barley grain, 20 samples of every grain dust collected during combine threshing and 20 samples of soil for every cereal were collected from an organic cultivation system. The same number of corresponding samples from a conventional system of farming was also obtained. The concentrations (CFU/g) of molds were determined applying the method of plate dilution on two media, and the species composition of molds was determined using taxonomic keys and atlases. The results show a potential risk for people engaged in agriculture. The presence of allergenic and toxigenic molds in the work environment of this working group creates serious occupational exposure. This subject is of high significance for the health of population engaged in agricultural production and calls for further studies.

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Keywords: fungy; health hazards; agriculture.

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1. Introduction

Fungi are one of the known biological factors that have a negative impact on human health. According to the current scientific literature, molds constitute particular threat to health. Airborne spores of these microorganisms are ubiquitous, and under favorable conditions begin development cycle. Molds have the ability to produce secondary metabolites that have toxic effects on human body and on animals. Additionally, they may cause different types of diseases. Prolonged exposure to these pathogens may lead to serious respiratory diseases. Molds belong to parasites if the source of the organic substances is living organism,, and to saprophytes if these compounds are derived from dead wet organic material or substrates such as, for example: wood, paper, paint, dirt, debris, food and skin. Their share in the total ground biomass is estimated to be approx. 25% (Wiszniewska et al, 2004; Zukiewicz-Sobczak et al 2012, 2013).

The spores are mostly present and reach high concentrations during summer due to the presence of nutrients in the medium, favorable temperature and humidity. Therefore, in Poland – country with temperate climate the peak concentration of molds spores in the air occurs mostly in late summer and early autumn when the rainy days are followed by sunny days, which are dry and windy. The spores are commonly found in very large quantities, not only in outdoor environment, but also indoors. Fungal spores present in the environment enter indoors with air movement or are transmitted by humans and animals (Miklaszewska B. et al 2005; Ejdys E 2009; Żukiewicz-Sobczak W. et al 2012, 2013).

Another way of penetration of fungi into human body is the oral route. Eating foods contaminated with fungi and its metabolites is extremely dangerous to human health. Raw materials and food products used in food production for humans should meet hygiene requirements and high quality standards. Contaminated raw cereal or animals grown on contaminated feed should be disqualified as a semi-finished product for further processing. Until now, food technology does not have effective thermal treatment, or another way that would remove from contaminated food toxic metabolites of fungi. Therefore, we can talk about a huge immunotoxic threat to human health. These types of issues are very important, because quality control in the agri-food establishments operates on an unsatisfactory level. Preliminary testing of raw materials in factories is carried out through organoleptic methods, which exclude evaluation of changes in enzymatic and microbial raw materials, especially in the early stages of growth (Larone DH 2011; Lipiec A. et al 2010; Nolard N. 2001; Pokrzywa P. et al 2007; Zukiewicz-Sobczak W.et al 2012, 2013).

Moulds produce a tremendous amount of spores that can be transported over thousands of kilometres. They are even in the stratosphere. Very small size (3-10μm) spores also allow them to deeply penetrate the bronchial tree, which, in turn, promotes lower respiratory sensitization (Bożek A. et al. 2010). The residential indoor air level of fungal spores sometimes even exceeds 1000/m^3 (Piotrowska M. et al 2001; Samoliński B. et al 2010). The species of fungi most commonly found at homes are: *Aspergillus, Penicillium, Mucor, Rhizopus, Aureobasidium and Cladosporium*. (Bożek A. et al 2010; Piotrowska M. et al 2001; Samoliński B.et al 2010; Zukiewicz-Sobczak W.et al 2012, 2013).

According to the research molds produce spores throughout the year, and their growth is dependent primarily on relative humidity, which, in turn, depends on ventilation, the presence of air and thermal insulation of the building. The process of release of spores depends not only on the type of fungus, but also on the weather and the concentration of spores at home environment and increases with increasing quantities of fungi in the environment. Certain spores are released when air is dry and their concentration in the air increases with the increased blast and reduced moisture during high solar radiation, for example. These are, among others, fungal spores from genera *Alternaria, Cladosporium, Helminthosporium.* On the other hand "wet" spores produced by fungi from class of *Ascomycetes* are released into atmosphere during rain, often overnight. The results of several studies show a significant correlation between increased concentration of spores and adverse health symptoms. Namely, higher levels of antigen fungi in the environment (residential, outdoor) generates the occurrence of various types of allergy symptoms (Etzel R. et al. 1999; Platts-Mills T.A. et al. 1987, Bush R. et al. 2001; Bousquet J. et al. 2001; Douwes J. et al. 2009; Cakmak S. et al 2002).

As shown spores are the most allergenic form of fungi; what is more substantial portion of secondary metabolites mycelium – mycotoxins accumulates in them. Even innocent-looking water droplets on the surface of the mycelium are the source of the highest concentrations of pathogenic metabolites. Some molds produce several toxins; some