# Which grain dust composition in microorganisms impacts the respiratory health of grain workers and farmers?

H. Niculita-Hirzel[1], P. Wild[2], D. Savova-Bianchi[1], G. Hantier[1], V. Dorribo[3], J. Pralong[3], Brigitta Danuser[3], Peggy Krief[3]

[1]Service of Occupational Hygiene, Institute for Work and Health, University of Lausanne and Geneva, Epalinges-Lausanne, Switzerland
[2] INRS, Scientific Management, Nancy, France
[3]Service of Occupational Hygiene, Institute for Work and Health, University of Lausanne and Geneva, Epalinges-Lausanne, Switzerland

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Presenting author email: Helene.Hirzel@hospvd.ch

Occupational exposure to grain dust is associated with both acute and chronic effects on the airways. The main reported respiratory effects of exposure to grain dust are still asthma and acute asthma-like symptoms reduced lung volume and symptoms evoking chronic bronchitis. However, the aetiology of these effects is not completely understood, mainly due to the complexity and variety of potentially causative agents within grain dust. Indeed, grain dust is a generic name for the total dust generated by manipulating different varieties of cereal crops, and comprises variable microbial flora associated with multiple plants.

One way to clarify this issue is to focus on the populations exposed to one main type of crop dust. Working populations handling wheat grain or straw are one such population in western countries, where wheat is the most intensively cultured cereal. The quantities of wheat generated require working populations with specialised task sets in the process of wheat harvesting and transformation. Harvesting workers are specialised in grain or straw harvesting. Terminal elevator operators are specialised for grain unloading, cleaning, storage and loading. Finally, livestock and dairy farmers, by intensifying their activity, see an increase in their exposure to wheat straw as livestock litter. Thus, all of these populations are exposed to wheat dust.

However, differences in microbial composition of wheat dust are still expected between the dust delivered from freshly harvested grain or stored grain as well as between fresh grains depending on its growing place conditions. Indeed, fresh wheat might be infected by the genus Fusarium that produces metabolites that are toxic for humans and animals, such as deoxinevalenol (DON), nivalénol (NIV) and zearalenone (ZEN), although stored grain might be infected by the genus Penicillium or Aspergillus that are toxic and/or allergenic.

The aims of the present study were to include subjects from different wheat-dust exposed populations, to identify the dust-exposing tasks, assess semi-quantitatively the fungal composition of the wheat dust to which they are exposed in summer and in winter, and to document dose-response relationships with the respiratory outcomes.

Information on estimated personal exposure to wheat dust was collected from 87 workers exposed to wheat dust and from 62 controls. Lung function (FEV1, FVC, and PEF), exhaled nitrogen monoxide (FENO) and respiratory symptoms were assessed during two medical visits: one in summer and another in winter. Dust had been sampled from the working environment of each volunteer during six weeks before each medical visit with an electrostatic dust fall collector. The DNA has been extracted and the ITS1 amplified and sequenced in parallel by pyrosequencing in order to define the fungal community composition. Aerosols had also been collected on PTFE filters during different activities in order to detect and quantify the most frequent mycotoxins, DON, NIV and ZEN by LC-MS/MS. Sampling was performed at a flow rate of 2 l/min using pocket and clear styrene cassettes with three sections (25 mm diameter). Linear regression models were used to explore the associations between exposure indices, fungal community profile, level of mycotoxins and respiratory effects.

Acute symptoms - cough, sneezing, runny nose, scratchy throat - were significantly more frequent in exposed workers than in controls. FEV1 decreased significantly with the cumulative exposure and mean exposure levels. The estimated decrease was close to 200 mL per year of high exposure (>10 mg/m$^3$). Peak expiratory flow and several acute symptoms correlate with recent exposure level. The acute symptoms in particular were significantly correlated to the exposure to fresh wheat dust and not to stored wheat dust. Interestingly the fungal community composition differed between fresh and stored wheat dust which let us propose a specific microbial profile responsible of the acute symptoms. This exposure profile is completed by the frequent detection of mycotoxins in fresh wheat dust.

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