Detection of *Fusarium poae* Infestation in Wheat Grain by Measurement with Two Electronic Noses

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Introduction

- *Fusarium* species cause diseases of many crop species.
- The detection of fungi of the genus *Fusarium* in cereal ears or stored grains, e.g., wheat, is visually difficult.
- An easy way to detect *Fusarium* is to smell the bulbs. Infested bulbs have a distinct sour odor that can easily be detected by the human nose and is due to the fungi destroying the bulb's tissue.
- Application of an electronic nose for the purpose of detection of Fusarium spoilage would be very useful for practical applications.

Materials and Methods

Two electronic nose devices were used in the experiment:
- The commercially available PEN3 (Airsense Analytics GmbH, Schwerin, Germany),
- Self-made low-cost PW8 device applying Figaro TGS series MOX sensors.

Samples wheat grain mixed in various proportions of healty/infected material were used for the measurements:

(i)   0/15 = 15 g of healthy seeds,
(ii) 1/15 = 1 g of infected seeds + 14 g of healthy seeds,
(iii) 3/15 = 3 g of infected seeds + 12 g of healthy seeds,
(iv) 5/15 = 5 g of infected seeds + 10 g of healthy seeds.
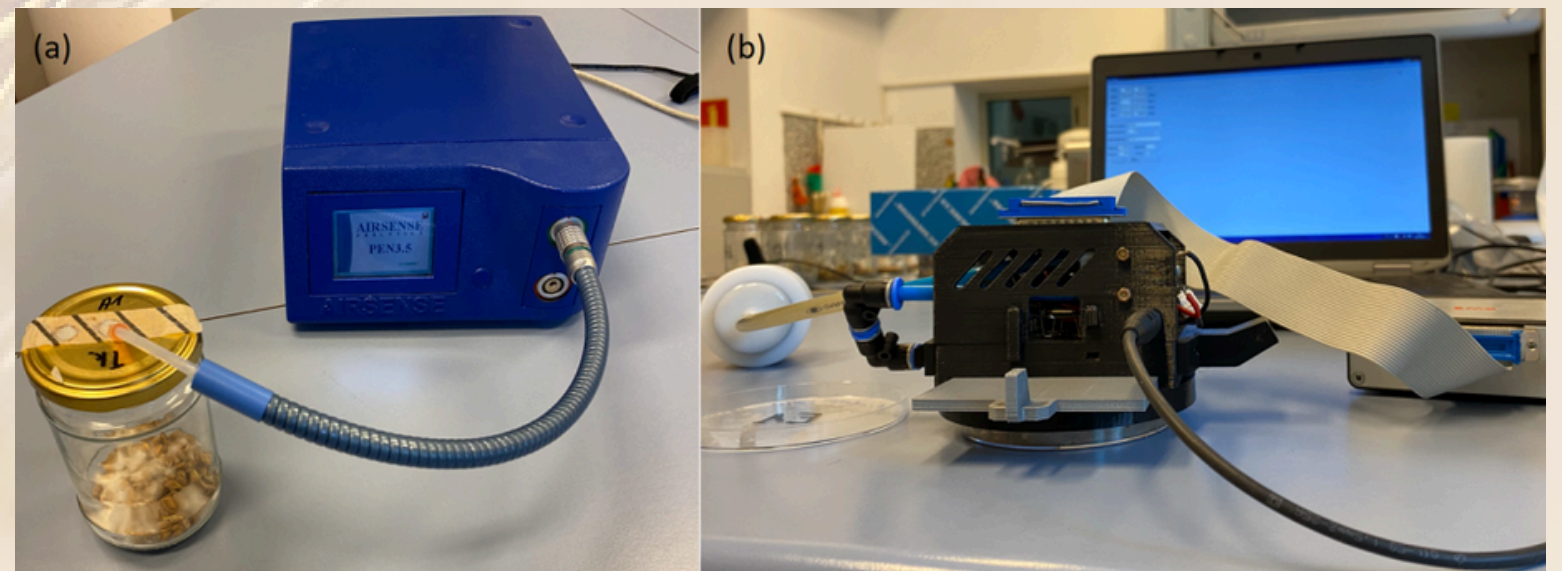
Measurement setup of the used electronic nose PEN3 (a) and PW8 (b) applied to a sample with *Fusarium poae* infected wheat grains. The sample measured by PEN3 device is noticeable in the photography, while in the case of PW8 device it is contained in the Petri dish applied under the devices.

Results of Measurements
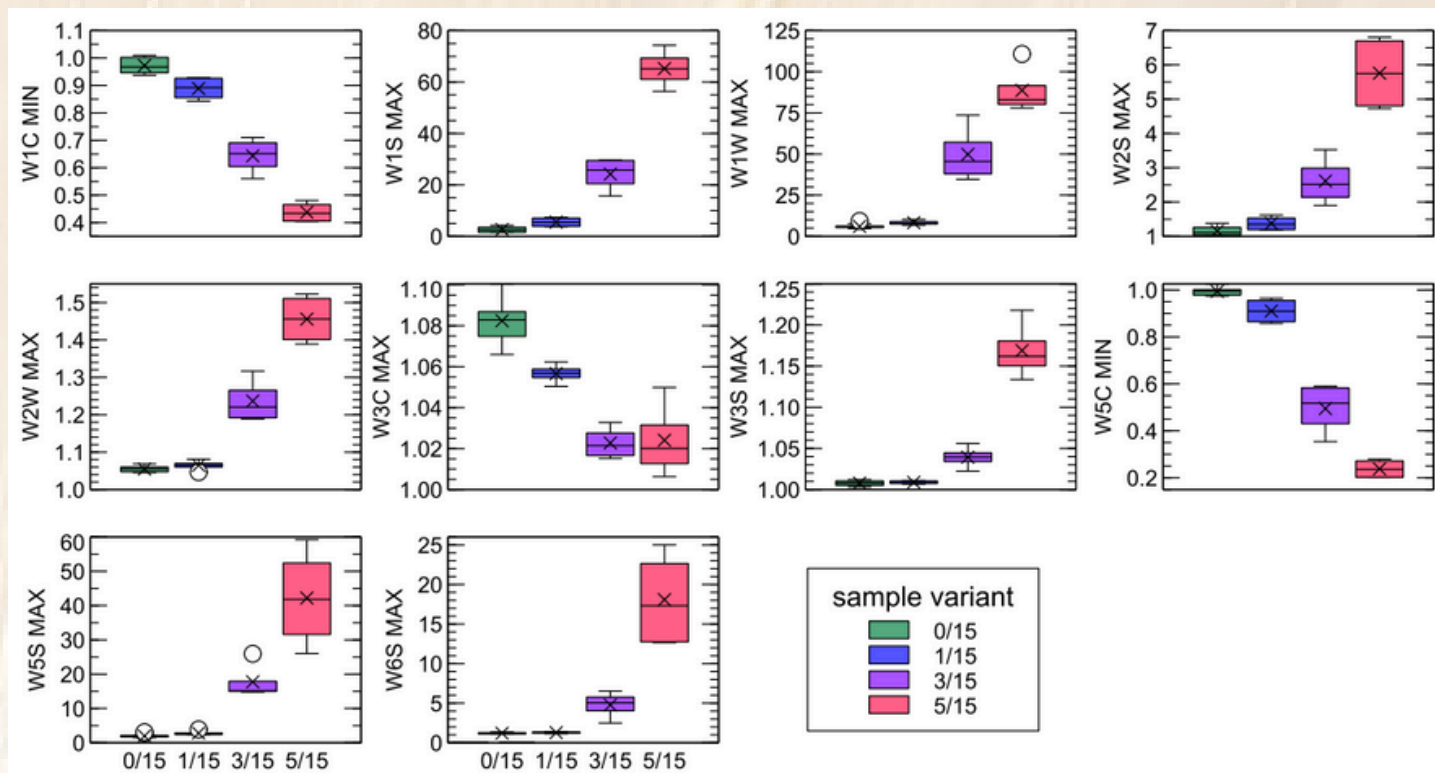
Comparison of the distribution of PEN3 electronic nose sensors response versus studied sample variant. The response was measured at the characteristic moment when the extreme magnitude (minimum or maximum) is reached. The sensor type is indicated at the y-axis caption.
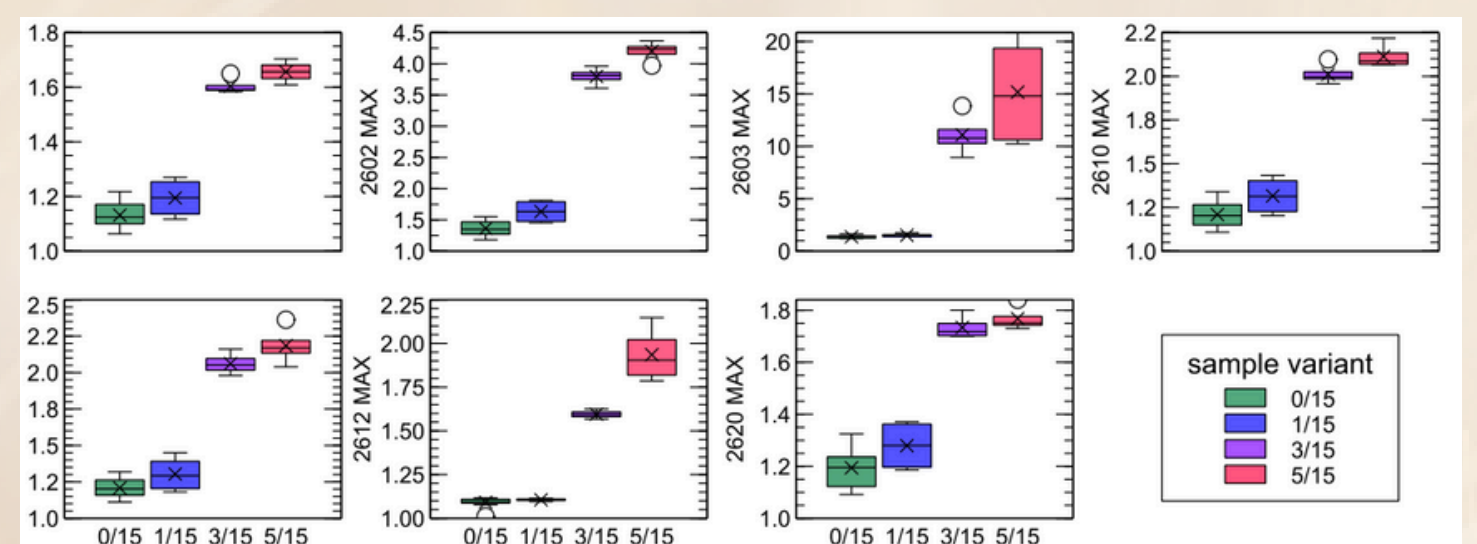
Comparison of the distribution of PW8 electronic nose sensors response versus studied sample variant. The response was measured at the characteristic moment when the maximum magnitude is reached. The sensor type is indicated at the y-axis caption.

Summary and Conclusions

- Both e-noses allowed for the differentiation of the tested samples of *Fusarium poae* infected wheat seeds from healthy samples in various proportions.
- The PEN3 proved to be more effective in detecting low concentrations of infected seeds compared to the PW8.
- The patterns of the response strongly depend on the concentration of the infected material in the sample. That can be viewed as various odor concentrations. Such a nonlinear response may be a problem for differentiation between the studied samples by the methods of machine learning algorithms of pattern recognition as the required size of the training sample may grow. For stronger concentrations of the odor, the patterns of response registered by the PW8 device are more similar, so the recognition may be more effective.