

Specific smells of substances derive from volatile organic compounds. These chemicals are inhaled through the nose into the olfactory bulb, where they react with receptors in the olfactory epithelium membrane. Already in ancient times, physicians often made diagnosis based on the scent of patients. Some smells are clearly attributed to certain diseases, and that specific volatile organic compounds can be measured by technique called a gas chromatography tandem mass spectrometry.

There is extensive research on smells emitted by people affected by cancer, or infected with certain bacteria, whereas there is little knowledge of the smells of virus infection.

The COVID-19 pandemic has prompted a search for rapid diagnostic methods. In some countries, specially trained dogs are used to identify people infected with SARS-CoV-2. Dogs have a 40 times more sensitive sense of smell than humans and are successfully used to detect trace amounts of drugs, explosives or cancer cells. In a project called "How does a viral infection smell like? Analysis of volatile organic compounds and the possibility of their detection on cell culture and mouse models" we will examine what smells - volatile organic compounds are generated as a result of viral infection.

Since viruses, as inanimate particles, do not have their own metabolism and do not possess volatile substances in their structure, the smell generated during infection probably comes from changes in the metabolism of infected cells or organism. Our study will be performed first in cell culture models and then in a mouse model.

Fragrance tests carried out on model systems have the advantage that we eliminate many variable factors that may affect the production and detection of smells: e.g. diet, smoking or used cosmetics.

Cell cultures will be infected with mammalian viruses belonging to different virus families, which have different types of replication. Using gas chromatography, we will check what volatile organic compounds are produced at different stages of viral infection. In the mouse model we will check what volatile organic compounds are formed in mice infected with various viruses causing respiratory and digestive symptoms, the controls will be the odours released during bacterial infections and in mice vaccinated with inactivated respiratory virus.

The goal of next stage of the research is to check the sensitivity and specificity of the detection of viral diseases by trained dogs. A group of ten beagles will undergo olfactory training, and the dogs will be trained to detect one of the viruses. During the tests, we will check the sensitivity and specificity of detection using dogs, whether they are able to distinguish two different viral strains of the same virus species, that however induce different disease symptoms in mice. Possibility to distinguish viruses causing the same symptoms, and samples from sick animals versus vaccinated animals will be tested.

This research will contribute to the creation of volatilome libraries for use in clinical gas chromatography and to the improvement of electronic nose devices. Studies with dogs will help understand the mechanisms of viral disease detection and the sensitivity and specificity of such methods in a controlled study with model systems.