

Painless, quick and reliable method for diagnosing Helicobacter from exhaled air

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VTT releases a painless, quick and reliable method for diagnosing Helicobacter from exhaled air . Credit: Technical Research Centre of Finland (VTT)

In the future, several illnesses can be quickly and painlessly diagnosed by the optical analysis of isotopes contained in exhaled air. VTT developed its first prototype for this purpose. With the device, it is possible to

determine painlessly and with absolute certainty during the appointment whether the patient's stomach troubles are caused by Helicobacter. The certainty of the device is based on its ability to measure not only carbon13(^{13}C) but also oxygen18(^{18}O) in exhaled air.

The invention is based on a technology developed by VTT's MIKES Metrology, optical absorption spectroscopy in a multipass chamber with the sample volume reduced to just 40 microlitres, which is less than ten millionths of an adult's lung capacity. Due to the extremely small sample volume, the gas inside the chamber can rapidly be exchanged. This, in turn, enables the entire breathing cycle of the patient to be analysed rapidly by the same device.

Diagnosis methods based on respiratory [air](#) are a growing trend. In addition to the Helicobacter, respiratory air can be used to analyse a person's energy consumption and weight loss, early-stage Type 2 diabetes and blood poisoning or sepsis that causes considerable expenses to hospitals and is one of the main causes of mortality after the surgical operations.

VTT is planning follow-up projects intended to develop the device for diagnosing also other illnesses. The device can be used to analyse proteins and various chemicals. Oxygen17 can be measured as well. Because the device measures completely safe, stable isotopes, it can also be utilised by the food industry.

The analyser also has possible applications in the monitoring of surgery patients and unconscious patients, because it can operate next to the patient around the clock. Accurate and specific data can be obtained from each breathing cycle.

"Researchwise, it is a significant step that we can now measure the ratios of both isotopes in real time", states Albert Manninen from VTT.

VTT's prototype includes a computer, a pump and optics, and it is operated with a single button. It communicates wirelessly with tablets and smartphones. The result of the measurement is displayed immediately.



Credit: Technical Research Centre of Finland (VTT)

Current commercial devices based on exhaled air analysis give a result with a 95 to 98 per cent reliability, which means that the results must often be confirmed with gastroscopy, a procedure that is rather

unpleasant for the patient. The device developed by VTT has the benefit of eliminating false positives from the analyses. According to a study published in 2014 (Abhijit Maity et. al. J. Anal. At. Spectrom. 29, 2014), a 100 per cent analysis accuracy can be achieved, when oxygen18 is analysed from exhaled air in addition to carbon13. The current commercial exhaled air analysers only perform the analysis on carbon13.

Easy method for both the patient and staff

Carbon dioxide is formed of [carbon](#) atoms with different masses. The origin of the gas can be determined by measuring these carbon isotopes. Helicobacter can be detected in exhaled air, when the carbon12 of a urea molecule is artificially replaced by carbon13. This replacement is done by means of a harmless pill containing the urea chemical and swallowed by the patient. If there are Helicobacteria in the stomach, they will break down the urea molecules into [carbon dioxide](#) molecules that will then enter the patient's system, finally travelling via the lungs into the exhaled air.

The device developed by VTT analyses the ratio between carbon13 and carbon12 in exhaled air. When the carbon13 ratio in exhaled air increases after taking the pill, it has been shown that with a 97 per cent certainty that the patient is suffering from Helicobacter that can be treated with drugs. The difference in VTT's device is that it also analyses the ratio of oxygen18 in the exhaled air, which guarantees a 100 per cent certainty for the diagnosis.

Spectrometry based on the analysis of isotopes has thus far been widely applied in medical analysis, because carbon13 is relatively easy to measure with a nondispersive optical [device](#). Detecting oxygen18 is more difficult due to its significantly weaker absorption, and spectrally, it is located between the main isotope and carbon13. Its detection requires mid-infrared lasers that did not enter the market until recent

years.

Helicobacter is one of the most common infections

The Helicobacter pylori or Helicobacter is connected to several problems in the upper gastrointestinal tract, such as ulcers and gastritis. According to estimates, 30-40% of the population in the developed countries has the infection.

Diagnosis of the bacteria is unpleasant for the patient, as it requires a biopsy using gastroscopy, which currently means that the patient has to swallow a tube that is then used to take a sample from the stomach. The accuracy of the procedure depends on the skills of the person performing the procedure, and getting a diagnosis may take several days.

Provided by VTT Technical Research Centre of Finland

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