

Tunable Diode Laser High-Resolution Spectroscopic Measurements of the Microbiota Gaseous Biomarkers Kinetics.

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Introduction

During several decades hydrogen/methane (H₂/CH₄)-breath test was used in gastroenterology for analysis of the fermentative activity of the gut microbiome, diagnosis of carbohydrates malabsorption, small intestine bacterial overgrowth (SIBO) depended on microbial composition, mouth-to-caecum transit time and the location of the fermentation along the gastrointestinal system. To overcome some limitations of the traditional H₂/CH₄ breath test we suggest combining the lactulose breath test with an analysis of the kinetics of the exhaled H₂ and CH₄ after taking H₂+CH₄-rich water. Tunable Diode Laser High-Resolution Spectrometer (TDLS) was used for measurements of O₂, 12CO₂, 13CO₂,CH₄, H₂S, H₂O and NH₃ levels in breath in real time (time resolution <0.5 s). The level of H₂ in the breath was measured in parallel by the metal-insulator-semiconductor sensor.

Aim of the study. was to obtain experimental data to analyze the process of absorption of H₂ and CH₄ in the gastrointestinal tract and the process of their release through the lungs.

Methods. Concentrations of CO₂ CH₄ were measured by the multichannel diode laser spectrometer, for O₂-electrochemical sensor, and for H₂-MIS sensor were used. Minute volume of the exhaled air was measured with spirometer. . 5 adult volunteers participated in the pilot study. They drank 150 ml portions of water that was saturated with hydrogen and methane at a pressure 6 atm above the surface of the water.

TDLS spectrometer



Multipath optical cell (35 m total optical path)

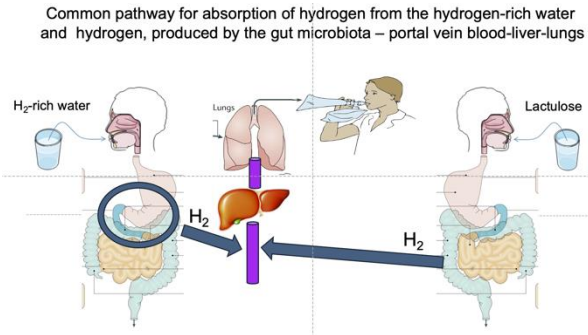


Sample preparation H₂+CH₄-rich water

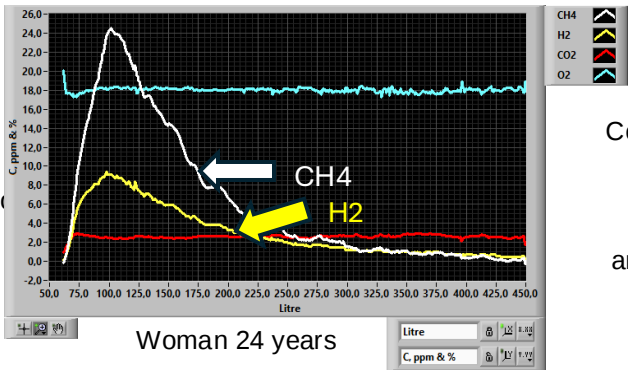


- 1. 160 ml of deionized water was poured into two sealed glass vessels with a capacity of 320 ml.
- 2. Pumping air from vessels to a residual pressure of 0.1 atm. with constant stirring of water using magnetic stirrers. The vessels were flushed three times and filled with methane or hydrogen at a pressure of 1 atm . Stirring the enriched water for one hour.
- 3. Drinking 100 ml of prepared portions of water enriched with H₂ and CH₄.
- 4. Additional chromatographic analysis of enriched water samples with a volume of 2 - 5 ml.

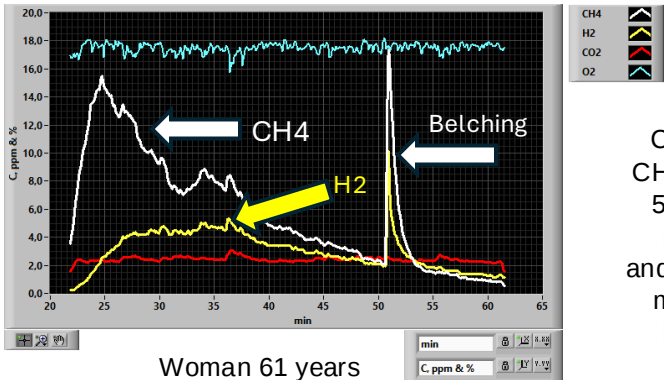
Conclusions. Diagnostic test with the H₂- and CH₄ – saturated water allows to assess the the amount of H₂ and CH₄ consumed by the liver and could be applied to the analysis of the kinetics of gaseous biomarkers generated by the gut microbiota due to the common pathway of their clearance. Addition of lactulose or carbamide to the test water load allows to perform regular breath test in one run.



Results



Content of H₂ and CH₄ in exhaled air is 64% of consumed molecules of H₂ and 57% of consumed molecules of CH₄ H₂/CH₄ = 1.123



Content of H₂ and CH₄ in exhaled air is 54% of consumed molecules of H₂ and 46% of consumed molecules of CH₄ H₂/CH₄ = 1.125