Measurement of stable carbon isotopic composition of breath and urinary acetone

K. YAMADA[1]*, A. GILBERT[2], K. OHISHI[1], M. AKASAKA[1], Y. MINETA[1], H. TAJIMA[1], N. KAWAKAMI[1], R. YOSHIMURA[3] AND N. YOSHIDA[1,2]

[1]Tokyo Institute of Technology, Yokohama 226-8503, Japan (*correspondence: yamada.k.ag@m.titech.ac.jp)
[2]ELSI, Tokyo Institute of Technology, Tokyo 152-8550, Japan
[3]NTT Device Innovation Center, NTT Corporation, Kanagawa 243-0198, Japan

Recently we developed a measurement method for the natural carbon isotopic composition of acetone in human urine using gas chromatography-combustion-isotope ratio mass spectrometry combined with headspace solid-phase microextraction (HSSPME-GC-C-IRMS) [1]. The method enabled us to determine the carbon isotopic compositions within ±0.2‰ of precision and ±0.3‰ of error using 0.05 or 0.2 mL of urine with acetone concentrations of 0.3-121 mg/L. Results for the monitoring of carbon isotopic compositions of urinary acetone from healthy subjects for several days suggested that changes in the availability of glucose in the liver are reflected in changes in the carbon isotopic compositions of acetone. In this study, we extended the method to exhaled breath acetone to investigate isotopic data at a high time resolution, which can not be obtained by urine measurement. Using 100 mL of exhaled breath with acetone concentrations of 200-5000 ppb, the carbon isotopic compositions of exhaled breath acetone could be determined within ±0.2‰ of precision and ±0.3‰ of error. Parallel observation of acetone in exhaled breath and urine showed good agreement, which indicates that the variations in carbon isotopic compositions of human biological acetone can be observed at a high time resolution using exhaled breath. Results for the monitoring of healthy subjects demonstrate that carbon isotopic measurement of acetone in human biological samples at natural abundance levels has great potential as a tool for detecting metabolic changes.

[1] Yamada et al. (2016) Anal. Bioanal. Chem. 408, 1597-1607.