Metabolomics of Ramadan fasting: an opportunity for the controlled study of physiological responses to food intake.

High-throughput screening techniques that analyze the metabolic endpoints of biological processes can identify the contributions of genetic predisposition and environmental factors to the development of common diseases. Studies applying controlled physiological challenges can reveal dysregulation in metabolic responses that may be predictive for or associated with these diseases. However, large-scale epidemiological studies with well controlled physiological challenge conditions, such as extended fasting periods and defined food intake, pose logistic challenges. Culturally and religiously motivated behavioral patterns of lifestyle changes provide a natural setting that can be used to enroll a large number of study volunteers. Here we report a proof of principle study conducted within a Muslim community, showing that a metabolomics study during the Holy Month of Ramadan can provide a unique opportunity to explore the pre-prandial and postprandial response of human metabolism to nutritional challenges. Up to five blood samples were obtained from eleven healthy male volunteers, taken directly before and two hours after consumption of a controlled meal in the evening on days 7 and 26 of Ramadan, and after an over-night fast several weeks after
Ramadan. The observed increases in glucose, insulin and lactate levels at the postprandial time point confirm the expected physiological response to food intake. Targeted metabolomics further revealed significant and physiologically plausible responses to food intake by an increase in bile acid and amino acid levels and a decrease in long-chain acyl-carnitine and polyamine levels. A decrease in the concentrations of a number of phospholipids between samples taken on days 7 and 26 of Ramadan shows that the long-term response to extended fasting may differ from the response to short-term fasting. The present study design is scalable to larger populations and may be extended to the study of the metabolic response in defined patient groups such as individuals with type 2 diabetes.