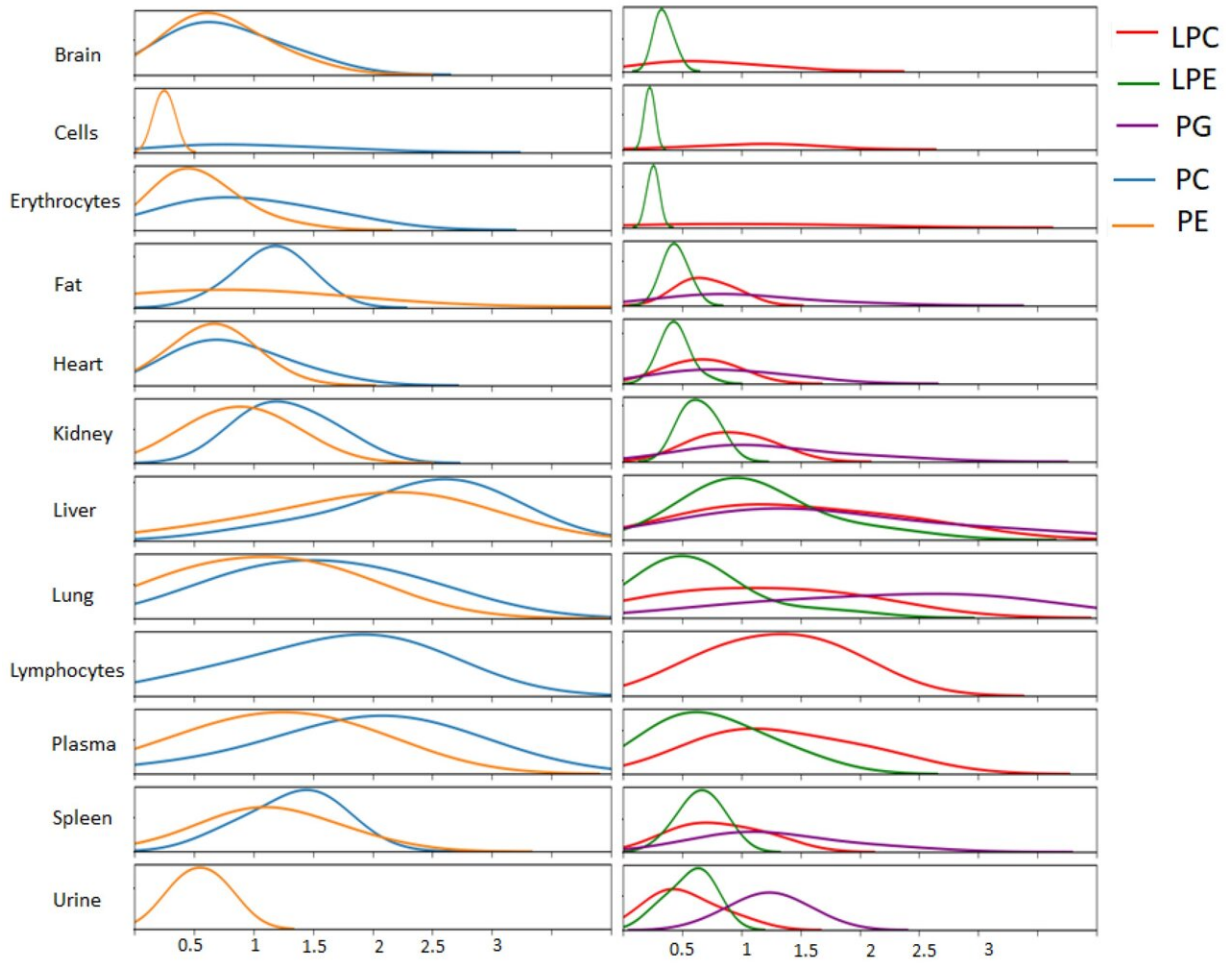
Medical Xpress

New research offers prospects to measure metabolic rate

August 1 2023



Deuterium uptake in different organs of mice for various classes of lipids. Credit: International Journal of Molecular Sciences

Scientists from Skoltech Institute of Science and Technology have proven that along with the level of biochemical substances in the living organism, we can also measure the substances' turnover rate. This analysis will improve the diagnostic and treatment procedures for many diseases associated with metabolic disorders—diabetes, obesity, cardiovascular diseases, non-alcoholic fatty liver disease, and others. The results are presented in the *International Journal of Molecular Sciences*.

"As of today, a blood test determines how much substance—hemoglobin, cholesterol, etc.—we have in our blood. If the level exceeds a certain indicator, it is a bad sign. But these are statistical characteristics, which do not show why the level is high or low and at which rate these substances are produced and consumed," says the leading author, Associate Professor Yury Kostyukevich from the Bio Center.

"For example, many people struggle with their weight, exhausting themselves with intensive training sessions, but one small burger after a workout destroys all efforts. This is an example of when the substance is regained as fast as it has been consumed. In our study, we aimed to measure dynamic indicators—how fast metabolism is."

The authors chose lipids as the object of the study. The metabolic disorder of lipids causes many diseases, while their excessive amount can result in obesity, heart dysfunction or failure, and kidney disorders. According to research, 20–30% of adults worldwide suffer from non-alcoholic fatty liver disease, a chronic condition and a risk factor for the development of type 2 diabetes.

For the experiment, researchers used mice that drank heavy water for 7 days. Unlike simple water, it contains heavy hydrogen—deuterium.

"Previously, such experiments involved substances with radioactive

marks. A person took medicine with that mark, and then researchers analyzed where they appeared—in blood, urine, organs, etc. Instead of that, we used stable isotopes. The isotope of hydrogen has a larger mass, which helps identify it through mass-spectrometry," adds Kostyukevich.

At the next stage, scientists examined where deuterium appeared in the organism of a mouse and in what proportion. The largest level of deuterium uptake in lipids was recorded for plasma, lungs, and liver. For the first time, it was demonstrated for each lipid molecule in particular at which rate and in which organ they synthesize.

"The fastest rate of lipid synthesis is in the liver, which is an expected outcome. For some lipids, we recorded a fast rate in lungs, plasma, and kidneys. In the heart and brain, it is much lower. The key result is that we learnt how to measure individually the metabolic rate in the living organisms," concludes Kostyukevich, and adds that in the future their research team is planning to conduct similar experiments on humans.

More information: Yury Kostyukevich et al, Untargeted Lipidomics after D2O Administration Reveals the Turnover Rate of Individual Lipids in Various Organs of Living Organisms, *International Journal of Molecular Sciences* (2023). DOI: 10.3390/ijms241411725

Provided by Skolkovo Institute of Science and Technology