



August 20, 2021

Stable Isotope study "Changes in daily energy expenditure with aging in humans" was published in the American scientific journal "Science"

Taiyo Nippon Sanso Corporation ("TNSC", President: Kenji Nagata) hereby announces that the results of an international project (IAEA Doubly Labeled Water Database), which TNSC has been cooperating with for many years, which was published in the journal "Science" by the American Association for the Advancement of Science (August 13, 2021 edition).

1. Background

Human life activities, such as growth and development, reproduction, digestion and absorption of food, and physical activity, require energy.

Therefore, knowing your total energy expenditure (*1) in your free-living environment plays an important role in understanding both the energy you need to consume in your daily diet and how you use the energy you consume.

In 2014, the National Institute of Biomedical Innovation, Health and Nutrition and TNSC jointly organized an international workshop in Tokyo and a tour of the Water-¹⁸O (*2) production plant.

This was an opportunity for researchers from around the world to work together to develop a single measurement of total energy expenditure using the doubly labeled water method (*3), the gold standard for measuring total energy expenditure. The outcome of this workshop led to establishment of the doubly labeled water database hosted by the International Atomic energy agency (Chair of management group: Dr. John Speakman, University of Aberdeen/ Chinese Academy of Sciences).

The study, (first Author, Dr. Herman Pontzer at Duke University) included four Japanese researchers (Drs. Yosuke Yamada and Tsukasa Yoshida at National Institute of Biomedical Innovation and Health and Nutrition, Dr. Hiroyuki Sagayama at the University of Tsukuba, and Dr. Misaka Kimura at Kyoto University of Science and Technology) involved data from more than 6,600 people aged 8 days to 95 years from 29 countries around the world, and analyze their total energy expenditure over the lifetime.

Please refer to the link below for details of the results of this research.

<https://www.dlwdatabase.org/>

2. Our role

In this project, we have provided the stable isotope of oxygen-18 (Water-¹⁸O) to many of the study participants, which is required for the doubly labeled water method and stable isotope analysis in biological samples such as blood, urine and saliva. In addition, we have provided support for the promotion of this project, including lectures and workshops on stable isotope analysis using this technique, both in Japan and abroad.

3. Our future development

TNSC has supported research activities all over the world by providing oxygen-18 stable isotope labeled water (Water-¹⁸O) and stable isotope ratio analysis technology, which is necessary for

doubly labeled water method.

In the future, we will continue to provide solutions to a wide range of problems in healthcare and other fields through our stable isotope production and analysis technology.

【Terms】

***1 Total energy expenditure**

The amount of energy (in kcal or MJ) consumed in a day, comprising basal metabolism (BMR), diet-induced thermogenesis (DIT) and energy expenditure from physical activity (AEE).

***2 TNSC's Oxygen-18 Stable Isotope Labeled Water (Water-18O)**

A water molecule is composed of two hydrogen atoms and one oxygen atom. Water-¹⁸O is an isotope of oxygen with a mass of 18 instead of the more common mass of 16.

There are three isotopes of oxygen in air, with mass numbers 16, 17 and 18. Their ratios are 99.76%, 0.04% and 0.2% for each. The isotopes have almost identical physico-chemical properties and are therefore extremely difficult to enrich and separate.

We have developed an oxygen-18 enrichment method using oxygen (O₂) cryogenic separation technology, and have achieved the world's highest enrichment of over 98atom% and started its production from 2004. At present, we have an annual production capacity of 600kg of Water-¹⁸O (total of three oxygen-18 production plants) and have produced under GMP production facilities and quality control. Water-¹⁸O is mainly used in PET (Positron Emission Tomography) and Alzheimer's tests as a raw material.

***3 Doubly labeled water method**

Doubly labeled water method is used to determine the rate of rise and subsequent decay of stable isotope in biological samples such as blood, urine and saliva by orally taking doubly labeled water, labeled with stable isotopes of hydrogen and oxygen (non-radioactive molecules).

From the difference in decay rates of stable isotopes of hydrogen and oxygen, the CO₂ emission rate in exhaled air can be calculated. And also from the CO₂ emission rate, the total daily energy consumption can be estimated.

【Title】 Daily energy expenditure through the human life course.

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