Concept Note

TM 'Role of Nuclear Techniques to Tackle Nutritional Challenges in the 21st Century'

Background

Nearly every country in the world is affected by malnutrition and many experience several burdens of malnutrition and disease: undernutrition and infectious diseases, multiple micronutrient deficiencies, overweight, obesity and related non-communicable diseases (NCDs). These burdens of malnutrition and disease coexist in many countries, communities and households, across all levels of economic development and may occur in the same individual at different stages in the life course. Programmes that address the combined burden of malnutrition and NCDs should focus on evidence-based double duty actions with the potential to simultaneously address undernutrition, overweight, obesity and diet-related NCDs. There is a strong need for better tools for programme evaluation to understand the impact of programmes as well as for more accurate data on nutrient intake and nutritional status.

Stable isotope and other nuclear techniques have been used over the past 5 decades to assess various nutritional outcomes with enhanced accuracy and precision compared to routine methods. Over the past 15 years, the IAEA has been at the forefront in the development of new stable isotope and nuclear imaging techniques for nutrition assessments. The Agency has supported their adoption and application by its Member States (MS) to evaluate programmes designed to address malnutrition in all its forms. There are a suite of well-established nuclear techniques of relevance to the public health agenda that are currently being used to promote optimal infant and young child feeding practices and to prevent and control obesity across the life course. Data obtained using nuclear applications have contributed to changes in nutrition policies and practices in several MS.

Nuclear techniques can be used to assess diet quality via measurement of nutrient bioavailability (e.g. iron, zinc, provitamin A, protein) from foods, measure micronutrient status (e.g. vitamin A), corroborate food intake (e.g. of added sugar, fish and meat) from proxy measurements (e.g. FFQ, 24-hour recalls, food records), quantify and track the dynamics of metabolism ('metabolic flux') across multiple bodily systems and investigate the link between infection, health and nutritional status. The techniques are also applied clinically for the assessment of body composition, energy expenditure and bone health in the context of nutritional therapy of several patient groups, including those with cancer, diabetes, cardiovascular disease and osteoporosis. Emerging nuclear nutrition techniques include a breath test to assess nutrient absorption which is currently being optimized for use in low- and middle-income countries. This test will enable the assessment of the link between exposure to unsanitary environments and chronic undernutrition.

Recent developments in more robust and portable instrumentation as well as more affordable equipment available for use in the field at the point of care have enabled the

wider use of nuclear techniques globally. Examples include high-resolution mass spectrometers that allow for the separation of different isotope labels at low enrichment and the move from expensive mass spectrometry to spectroscopy techniques, using desktop or even portable Fourier Transform Infrared Spectrometers (FTIR). In addition, the scope of applications has increased. For example, there are new developments in the assessment of protein, lipid and energy metabolism and flux, as well as bioavailability, absorption, status and metabolism of nutrients (e.g. B_{12}, D, choline, iron, iodine). Another example are stable isotope breath tests as markers of certain types of cancer and gut damage. It is necessary to keep abreast with new developments in the global stable isotope and nuclear technology space in order to maximize support to MS.

As novel technologies and methods continue to advance the fields of food and medicine, there is an ever-growing demand to use these methods to develop targeted approaches for nutrition-related conditions. Such conditions (e.g. diabetes, heart disease, stroke, cancer) are often multifactorial in nature and are prone to interindividual variability, which makes it quite challenging to develop tailored approaches or recommendations to optimize health or reduce the risk for disease. One area which aims to understand the complex aetiology of these nutrition-related conditions by examining the interplay between genetics; biological sex and ethnic diversity; the microbiome; metabolism; environment and other economic, social and behavioural characteristics is the field of precision nutrition (PN). This field employs the use of various methodologies (e.g. genomics, metabolomics, machine learning, etc.) as tools to explain why there are variable responses to nutrition exposures within and across populations. Nuclear techniques have great potential to serve as promising tools within the larger precision nutrition framework.

The IAEA will host a Technical Meeting in 2023 with the aim to improve nutrition assessments through the use of nuclear techniques. The purpose of the TM will be to evaluate new developments on the global use of nuclear applications in nutrition to better tackle current nutritional challenges.

Objectives

- To review potential new areas of the application of nuclear nutrition techniques for public health and clinical settings in relation to body composition and bone health; protein, lipid, energy and other nutrient metabolism; metabolic flux; bioavailability, absorption and status; gut permeability and function; the microbiome; objective biomarkers of food intake; and precision nutrition;
- To make recommendations on how the information generated by applying nuclear techniques can be used to improve the design and impact evaluation of public health and clinical nutrition programmes and contribute to filling important nutritional data gaps;
- To define future research needs to enhance the use of nuclear techniques in nutrition assessments;

- To expand IAEA's network and collaboration in the use of nuclear techniques in nutrition.

Date and venue

October 2023, at IAEA HQ, Vienna