State of the art stable isotope methods

Owing to the limitations of traditional methods to evaluate nutrient status and absorption from our foods, more sensitive methods are useful for surveillance and research using stable, non–radioactive isotopes.

- Stable isotopes of an element differ in the number of neutrons they contain.
- Stable isotopes occur naturally in our bodies.
- Stable isotopes are completely safe to use.

Vitamin A methods

Stable isotopes of hydrogen (deuterium (^{2}H)) and carbon (^{13}C) are used for work with vitamin A. Assessing vitamin A stores using isotopic techniques is important, for example, to determine the vitamin A values of fruits, vegetables and biofortified staples after dietary intake. Stable isotope methods are the only way to measure excess status, which may occur when vitamin A supplements and fortification programmes occur in the same communities.

Bioavailability studies using isotopes of iron and zinc

Assessing bioavailability (absorption and utilization) of nutrients from food is important for mixed diets that contain enhancers and inhibitors of absorption. Bioavailability studies of iron and zinc in foods using stable isotopes can reveal large differences among meals.

A study partially supported by IAEA in Rwanda determined components of beans that affect iron absorption in humans. The results will influence further agricultural breeding activities to sustainable improve the nutritional value of bean crops.

Good nutrition is a human right

Stable isotope methods are the most sensitive methods available and useful for evaluating the long term human health impact of foods rich in provitamin A carotenoids, iron and zinc. Foods biofortified with micronutrients do not cause excess amounts in the body. Evaluating the impact of interventions to improve human nutrition needs the best scientific evaluation tools available.

Zambian children eating biofortified orange maize, which has been released in Zambia. These children adapted quickly to eating their main meal with orange instead of white maize. Stable isotope methods were used to evaluate the change in vitamin A status. The IAEA is supporting further work in Zambia with orange maize.

Developed by the IAEA's Nutritional and Health-related Environmental Studies Section

IAEA
International Atomic Energy Agency

Wagramer Strasse 5, PO Box 100, A-1400 Vienna, Austria
For more information contact: nahres@iaea.org
http://nucleus.iaea.org/HHW/Nutrition/index.html
www.iaea.org

Micronutrients for Better Health

Good nutrition is the backbone for good health

Achieving universal food and nutrition security involves much more than ensuring a sufficient supply of food to feed the world's population. Food and nutrition security means that all people "have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (FAO).

IAEA
International Atomic Energy Agency

Micronutrients are necessary for optimal health

Many micronutrients are limited in human diets. This is largely due to high intakes of energy dense, nutrient poor staple foods. Micronutrients include vitamin A, folic acid, iodine, iron and zinc, which play key roles in the body.

- Vitamin A: Fat-soluble vitamin essential in vision, growth, immune function and reproduction.
- Folic acid: Water-soluble vitamin important for growth and formation of the spinal cord during development.
- Iodine: Necessary in thyroid hormone production and in prevention of goiter and mental retardation.
- Iron: More than 30% of the world suffers from iron deficiency anaemia, leading to low work capacity.
- Zinc: Essential for growth and used to reduce duration, severity and subsequent episodes of diarrhoea.

Senegalese mother and child participating in an IAEA supported trial to determine breast milk volume using stable isotopes to estimate vitamin A intake. The study confirmed that vitamin A status was better in the infants whose mothers received high dose vitamin A supplements after birth.

Strategies used to improve micronutrient malnutrition

Supplementation: One or more micronutrients given daily or periodically in liquid, tablet or capsule form.

- High dose vitamin A supplements every 6 months to children between 6 and 59 months, to prevent mortality.
- Daily folic acid and iron supplements during pregnancy and lactation or weekly for women of reproductive age.
- Iodine supplements for pregnant and lactating women where iodized salt coverage is <20%.
- Zinc for 10 or 14 days as dispersible tablets or syrups in the treatment and prevention of diarrhoea.

Fortification: Adding single or multiple micronutrients to foods. In order to reach large segments of the population, foods that are fortified need to be commonly consumed and processed in a centralized location.

- Sugar in some countries is fortified with vitamin A as retinyl palmitate in a water-soluble matrix.
- Synthetic folic acid is added to processed grain products.
- Iodine is commonly added to table salt.
- Wheat and maize flours are fortified with sodium iron EDTA, ferrous sulphate, or ferrous fumarate.
- Zinc oxide is added to processed wheat and maize.
- Fortification with multiple micronutrient powders.

Dietary diversification: Intensive nutrition education to diversify diet with healthy choices. “Scaling-up nutrition” by dietary diversification needs to be accompanied with scaled-up agriculture to improve food security.

- Promote consumption of orange and yellow fruits and vegetables to increase vitamin A and folate intakes.
- Promote eggs to improve vitamin A and protein intakes.
- Promote green leafy vegetables for increased folate, vitamin A and iron intakes.

Biofortification: Intrinsically improve foods by breeding for higher nutritional value. Nutritious food is key to improved community health. If food and nutrition security are to be achieved at the country level and hunger and undernutrition eradicated, countries must use local resources to produce nutritious foods.

- Maize has been biofortified with provitamin A carotenoids (precursors to vitamin A).
- Orange-fleshed sweet potato with high provitamin A is a success story in many African communities.
- Beans are being biofortified with iron.
- Wheat and rice are being biofortified with zinc.

Thai children enjoying lunch that includes rice fortified with vitamin A, iron and zinc. This IAEA study determined the improvement in vitamin A stores in children eating fortified rice using stable isotopes.

Traditional nutrition evaluation methods

Infection and inflammation impact vitamin A, iron, and zinc status. Respiratory infections, malaria, diarrhoea, intestinal parasites and HIV/AIDS depress serum retinol and zinc concentrations and increase serum ferritin (iron storage protein). Obesity increases inflammation and the carrier protein of vitamin A.

- Serum vitamin A (retinol) concentrations are used at the population level, but do not reflect total body stores.
- Haemoglobin concentrations are used for iron status, but do not become depressed until stores are depleted.
- Plasma zinc concentrations are used for population zinc status, but are not sensitive for individual status.

Ugandan children enjoying orange-fleshed sweet potato, a rich source of provitamin A. The IAEA has supported a trial on Vitamin A status in Bangladeshi women to assess the impact of adding sweet potato to the diet.