National Research Programme NRP 69
Healthy Nutrition and Sustainable Food Prodution

Measuring the effects of nutrition with biomarkers

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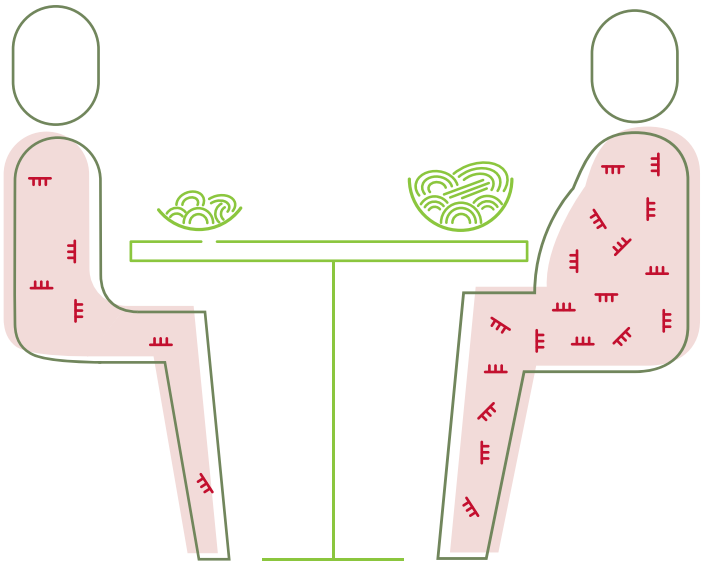
microRNAs are still promising biomarkers for dietary intake

Biomarkers are indicators that can show whether normal or pathological processes are at work in the human body. Looking specifically at nutrition, biomarkers could provide an accurate way of measuring the effects of dietary intake on health. As part of NRP 69, scientists have investigated the ribonucleic acid molecules – known as microRNAs – that adipose tissue releases into the blood. To determine whether microRNAs are suitable as biomarkers for dietary intake, they observed how the molecules respond to different types of diet. The project highlights the technical challenges involved in measuring microRNAs.



microRNA circulating in blood

The scientists investigated for instance whether the quantity of microRNAs released into the blood by adipose tissue varies as a function of the calorific intake associated with a particular diet.

Specialists cannot issue recommendations for healthy eating, unless they are able to measure food intake and identify its effects on health. Dietary intake is currently evaluated using questionnaires. However, the information provided by these questionnaires is approximate because many of them do not take full account of everything respondents have eaten. Biomarkers would provide a more precise way of measuring food intake and its effects on the human body. These molecules are present in the blood and tissues, and act as quantifiable indicators for certain processes in organisms, such as food conversion or the onset of diseases. As part of NRP 69, scientists from the University of Lausanne and Nestlé Institute of Health Science investigated whether microRNAs – molecules of ribonucleic acid released by adipose tissue – could act as biomarkers for dietary intake.

The scientists focused on adipose tissue because this endocrine organ is implicated in the complications associated with obesity. It accumulates in the abdominal cavity and releases substances known as adipokines into the blood. These interfere with a substantial number of metabolic processes, causing diabetes, cholesterol problems and inflammation of the arteries. Adipose tissue also secretes other substances such as microRNAs, small molecules that circulate in the bloodstream and which regulate gene expression. Theoretical evidence suggests that the microRNAs found in blood could be good biomarkers for nutritional research.

As a first step, the scientists therefore examined the profile of the microRNAs in the adipose tissue in different situations, namely after consuming very high or low calorie food, polyphenols or proteins, and when blood sugar levels change. They then looked for these microRNAs in the blood, to establish whether a relationship exists between the quantity of calories, polyphenols, proteins and sugar consumed and the quantity of microRNAs that adipose tissue releases into the bloodstream. Tissue biopsies and blood samples were taken from healthy, non-obese volunteers who had followed a controlled diet for the purposes of the study.

The results show that none of the microRNAs identified in the adipose tissue or blood gave any indication of the nutritional composition or calorie load of the different diets. Polyphenol-enriched food (polyphenols are known for their antioxidant properties) tends to reduce concentrations of two types of microRNAs circulating in the bloodstream. One of the microRNAs in adipose tissue proved to be a biomarker for reduced calorific intake. If diet involves a calorie deficit of 10,000 kJ or approximately 2,390 kcal, the concentration of this molecule in adipose tissue is 23% lower. Furthermore, reduced calorie consumption lowered the concentrations of two other microRNAs in the bloodstream.

Further information: *www.nrp69.ch*

European collaboration

The MIRDIET project is part of the European Joint Programming Initiative "A Healthy Diet for a Healthy Life". Six research groups from Switzerland, France and the Netherlands collaborated on this project.

Technical obstacles

Overall, the technical difficulties associated with measuring microRNAs in the bloodstream had a limiting effect on the results obtained. On the one hand, the experiments have shown that the quantity of microRNAs released by adipose tissue in the dietary situations observed by the researchers is very small. Very few, if indeed any, of the microRNAs measured in adipose tissue were detected in blood. In view of these low levels, it was difficult to obtain suitable primers and probes for the tests. Moreover, most of the microRNAs identified are not solely linked to food intake. Their concentrations may also change in response to other factors, for example inflammation or physical effort. These technical obstacles could not be overcome with the method used to extract the microRNAs. Despite these stumbling blocks, the researchers recommend continuing to search for biomarkers associated with food intake (see box).

Recommendation

Pursue search for biomarkers

The scientists recommend continuing to search for biomarkers for food intake, despite the complexity of the methods used to quantify them. Technical progress could help overcome these obstacles by making it easier to measure the microRNAs circulating in the bloodstream, since these still have plenty of potential in nutritional research and the promotion of a healthy diet.