

Invited Commentary

Wanted: specific nutritional biomarkers for food consumption for the study of its protective role in health

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Nutritional epidemiology focuses on an understanding of the relationship between diet and disease risk. The assessment of dietary and nutritional exposure is a complex methodological challenge. Traditionally, diet evaluations have been made by means of dietary data, such as 24-h recalls and food frequency or diet history questionnaires. However, all of these methods have some inherent weaknesses or limitations due to the limited accuracy in measuring the intake of food, nutrients or phytochemicals. Nowadays, nutritional biomarkers have become an attractive alternative approach.

According to conventional definition⁽¹⁾, a nutritional biomarker can be any biological specimen that is an indicator of nutritional status with respect to the intake or metabolism of dietary constituents. It can be a biochemical, functional or clinical index of status of an essential nutrient or other dietary constituents. Nutritional biomarkers are usually external components, such as food components or other external substances metabolised by the organism (metabolites), analysed in the participants' biological samples and used to determine their exposure to the intake of a food (specific food or food group) or component (nutrient or non-nutrient).

Nutritional biomarkers have three main advantages over dietary data^(1,2). The first and greatest strength is that samples are measured in a more objective, accurate and reliable way than the dietary data. The second is that dietary data, for some components, are inadequate because of the limitations of food composition data. The third advantage is that biomarkers provide a measure closer to the nutritional state, because these integrate component bioavailability and metabolism.

However, the development of nutritional biomarkers is a demanding process because, as with any analytical measure, it needs to be accurate, reproducible, reliable and validated⁽³⁾. Specifically, for any nutritional biomarker to be considered useful, it has to fulfil specific criteria⁽⁴⁾: (1) there must be a robust methodology to identify and quantify the biomarker correctly; (2) the concentration of the biomarker in the biological sample needs to be sensitive enough to reflect changes in dietary exposure; (3) biomarkers should be specific to the intake of the component in question. For this reason, any variation in their concentration has to be the result of a change in the consumption of this component. The interpretation of biomarkers is more complex than of dietary data because food biomarkers take into account the bioavailability of components. However, they have two limitations: the half-lifetime of the components in a biological sample; the large inter-individual variability that exists in most metabolic responses, when given the same dose of components.

To date, there are few validated nutritional biomarkers^(5,6), one of them is plasma alkylresorcinol metabolites as a

biomarker of cereal fibre intake, published in the present issue of the *British Journal of Nutrition*⁽⁷⁾. This shows that plasma alkylresorcinol metabolites are significantly correlated with whole-grain rye and wheat cereal fibre consumption in Finnish women. Previously, the same research group demonstrated that intact plasma alkylresorcinol and urinary alkylresorcinol metabolites can also be used as biomarkers of whole-grain intake in free-living women or after dietary intervention^(8–10). These biomarkers would contribute to increasing the evidence of the effects of both cereal fibre and whole-grain intake on several chronic diseases.

Recent advances in analytical techniques, such as MS, have increased the sensitivity and selectivity of measurement of the metabolites of some components. Furthermore, increased knowledge about the food composition of minor constituents, such as polyphenols, makes the development of new specific biomarkers possible^(4,11,12). Obviously, bioavailability research is also decisive in better understanding the metabolism, half-lives and inter- and intra-variability of these compounds. These three factors have improved the effectiveness and expanded the possibilities of biomarker analyses.

As indicated earlier, biomarkers can provide a substitute for traditional dietary estimations⁽¹³⁾, although in some situations the latter are still indispensable, either because of the lack of suitable nutritional biomarkers or due to economic limitations⁽²⁾. On the other hand, as Beaton *et al.*⁽¹⁴⁾ stated, 'There will always be error in dietary assessments. The challenge is to understand, estimate and make use of the error structure during statistical analysis'. Being aware of this is necessary in order to recognise the biomarkers that identify real consumption. These biomarkers would provide an additional and more accurate tool to evaluate the relationship between diet and health effects.

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