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The importance of the dairy matrix in the evaluation of the nutritional quality and health effects

Scientific excellence
Industry applicability
Strategic networking
Global influence

Introduction

Nutrition research has traditionally focused on identifying the specific associations through which single nutrients impact health outcomes - for example, calcium and bone health, protein and skeletal muscle and, saturated fat and heart disease. The approach to studying individual nutrients in relation to health has been described as a 'reductionist' perspective (Messina et al., 2001). However, the focus of nutrition research has shifted to examine the association of whole foods and dietary patterns with health (Mozaffarian et al., 2018). This includes recognizing not only that foods have numerous nutritional attributes but also that the effect of one attribute is likely dependent on the combination of nutritional components contained in the whole food and the resulting structure. This focus shift is also based on the fact that people consume nutrients as part of a food, and not in isolation. Moreover, foods are usually also eaten as part of a meal. Based on this emerging insight, the following definitions of dairy matrix and dairy matrix health effects are proposed:

- **Dairy matrix describes the unique structure of a dairy food, its components (e.g. nutrients and non-nutrients) and how they interact.**

- **Dairy matrix health effects refer to the impact of the whole dairy food on health that extends beyond its individual components (e.g. nutrients and non-nutrients).**

The dairy matrix

Dairy foods are unique with regard to their nutrient content and structures, both of which differ across the dairy food category. Dairy foods are excellent sources of calcium, vitamins B2 and B12, high-quality protein, iodine, and also rich in magnesium, potassium, and various fatty acids (FAO, 2013). Milk is an emulsion, which consists of droplets of fat suspended in an aqueous phase containing proteins and numerous vitamins and minerals. The composition and structure of cheese and yogurt can vary depending on the type of milk used and the method of production. The physical structure of dairy products varies from the solid matrix of cheese, to the gel-like structure of yogurt, and liquid milk. The unique structure of a dairy food, its components (e.g. nutrients and non-nutrients) and how they interact, is defined as dairy matrix.

The dairy matrix health effects

In 2017, an eminent group of researchers acknowledged that health effects of a food are much more complex than that of a single nutrient it contains or even a few nutrients owing to the food matrix. The health effects are a function of both the food's structure and its composition, and how the components interact with each other (Thorning et al., 2017). The food matrix affects directly the processes of digestion and absorption of food compounds in the gastrointestinal tract, affecting the overall nutritional and health effects of foods (Aguilera, 2019).

Milk and dairy products are broadly recommended as part of healthy eating patterns (Geurts, 2022). Their key role in human nutrition, health and development throughout life is generally only attributed to their nutrient richness. They are also sources of saturated fatty acids and sodium, which are nutrients associated with negative health effects (Griffin, 2017). However, dairy products have not shown to induce the expected negative effects of the individual nutrients. In fact, quite the opposite appears to hold which relates to the impact of the whole dairy food on health that extends beyond its individual components. These are the so-called dairy matrix health effects.

Drouin-Chartier et al. (2016) conducted a systematic review of meta-analyses of prospective population studies on the association between dairy consumption and cardiovascular disease, coronary artery disease, stroke, hypertension, metabolic syndrome, and type 2 diabetes. Results showed that the consumption of various forms of dairy products has either favourable or neutral associations with cardiovascular-related clinical outcomes. This has recently been supported by other meta-analyses of cohort studies (Feng et al., 2022; Giosuè et al., 2022). Giosuè et al. (2022) showed that dairy consumption (up to 200 g/day, globally) has no detrimental effect on cardiovascular health and indicated that the effect on cardiovascular health appears to depend more on the food type (cheese, yogurt, milk) than on the fat content. A neutral association was found for milk, while fermented products—cheese and yogurt—were associated with a lower risk of total mortality and cardiovascular events (Giosuè et al., 2022).

Additionally, it is well-accepted the importance of dietary calcium for its significant contribution to bone health. However, all calcium sources are not the same nor is the matrix in which it is contained. In this regard, it is widely acknowledged the positive dairy's role on bone health due to their calcium content. Some vegetables, nuts and legumes are also considered good sources of calcium, yet the absorbed calcium fraction is often much lower than that from dairy products due to antinutritional factors such as oxalate and phytate (Heaney et al., 1988). For instance, providing the same level of calcium intake, milk showed significant effects in preventing loss of bone mineral density in postmenopausal women compared with a calcium enriched soy beverage (Gui et al., 2012). This shows how the effect of the food matrix on bone health goes beyond the calcium content.

Conclusions

Further research is likely to reveal more in-depth insights about the beneficial health effects of considering dairy foods as a matrix, including the mechanisms and pathways through which the different components work together and their impact on health. The food matrix concept embraces the importance of considering whole foods, together with their individual components. Moving towards a more holistic approach by considering the health effects of whole foods and whole diets on health is crucial to better update dietary guidelines, and policies. This is critical, as most food-based dietary guidelines still express the health value of foods such as dairy products solely in terms of their nutrient content (Comerford et al., 2021).

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