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Matrix Matters: A New Paradigm in Food Evaluation



KEY TAKEAWAYS:

- A reductionist approach to nutrition, one that emphasizes individual nutrients rather than the broader effects of whole foods and dietary patterns, can lead to oversimplified and potentially misleading conclusions about food quality and overall diet.
- Nutrition science focused on the food matrix emphasizes that foods be evaluated based on their overall composition and how components within foods interact with each other and the body to promote health.
- Dairy foods, including milk, cheese, and yogurt, have unique food matrices, which may help explain why the health benefits associated with dairy consumption extend beyond basic nutrient profiles.

As discussed in previous Perspective Papers, nutrition science over the last century has largely been framed through a reductionist lens, where food is analyzed based on individual macro and micronutrients - protein, carbohydrate, fat, vitamins and minerals - rather than its overall composition. In reality, nutrients are consumed as part of a whole complex food structure, or matrix, that interacts in unique ways and impacts how nutrients are digested and absorbed in the body. As research has evolved, so too has the thinking as to how food is evaluated, shifting from individual nutrients to a whole-food, matrix-based approach that better reflects nutrition behaviors and outcomes. There is still a long way to go. This Perspective Paper highlights some pitfalls and promises that public health initiatives face concerning a matrix-based approach to the science-policy interface.

The Limitations of Reductionist Nutrition

While the traditional approach of nutritional analysis based on nutrient components has been useful largely for identifying nutrient deficiencies, it often creates misleading conclusions about food and diet quality.

Take dairy fat as an example. Dietary guidelines¹ in many countries around the world have recommended replacing full-fat dairy with semi-skimmed varieties in an effort to drive a reduction in saturated fat consumption with the goal of reducing risk for cardiovascular disease. However, research indicates that full-fat dairy foods, such as cheese, are linked to reduced all-cause and cardiovascular mortality risk, and lower rates of heart disease and stroke.² This evidence, contrary to previous guidance around saturated fat, could be better understood when taking into account the full matrix of cheese, beyond saturated fat: not only its nutrient

contributions of high-quality protein and calcium, for example, but also the live and active microbes and bioactive fatty acids present in cheese that interact with one another as well as the microbes residing in the human gastrointestinal tract, which promote beneficial health outcomes by reducing inflammation and oxidative stress that are associated with cardiovascular and other disease risk.³

The reductionist nutrition approach has been applied to front-of-pack nutrition labeling systems with the goal of encouraging healthy dietary choices. For example, Nutri-Score, a front-of-pack labeling system based on the UK Food Standard Agency's nutrient profiling model, uses letter and color coding to score products based on their individual nutritional components.⁴ It was first developed and championed in France in 2017 and has since been voluntarily implemented across several European countries to help consumers better understand the nutritional value of food and encourage healthier choices.⁵

In March 2025, the European Commission opted against enforcing mandatory labeling requirements due to the complexities within this proposed system. Since its inception, Nutri-Score has been denounced in certain EU countries such as Italy for misleading information, cultural damage, and discrimination against traditional foods, such as cheese.⁶ It also has been criticized by scientists for its limitations and oversimplification of complex nutrient profiles, and reliance on outdated scientific literature to inform the profile's parameters.⁷ Because Nutri-Score does not account for the full suite of bioactive components present in foods, an artificially sweetened, zero-calorie cola beverage scores higher than apple juice simply because the juice contains sugar, while ignoring the positive vitamin contributions that are in juice but absent in cola. This type of misclassification has fueled growing skepticism about the validity of Nutri-Score and other reductionist nutrition labeling schemes, underscoring the need for a more holistic approach to evaluating food.

A More Comprehensive View of Nutrition

Enter the food matrix. This concept recognizes that food is more than the sum of its parts. Instead of focusing on isolated nutrients, the food matrix considers how food components and molecules interact with each other and the body, as well as the physical structure of food. Foods with the same chemical composition may digest or deliver nutrients differently in the body based on the food matrix, which affects the bioavailability and accessibility of certain nutrients.⁸

Using dairy as an example, dairy foods have distinct food matrices that might influence digestion, absorption and health biomarkers. This may help explain why dairy foods' health benefits extend beyond their nutrient profiles. Each contain different amounts and proportions of nutrients, bioactive compounds, complex microstructures, and microorganisms, all of which affect their functional and health properties.⁹ It's the entire food that helps mediate digestion, absorption, and metabolism to predict health outcomes and support functional wellness. Therefore, nutrition guidance and public health efforts may be most effective when focused on whole foods, and their ability to provide adequate nutrition and promote health, rather than avoidance of single nutrients.

A Path Forward

As nutrition science evolves, it is becoming clearer that a whole-foods approach offers a more comprehensive and realistic way to guide dietary recommendations and behavior. An example of this approach is the New Mediterranean Lifestyle Pyramid for Children and Youth that was published in March 2025. The pyramid encourages consumption of a variety of foods, such as fruits, vegetables, whole grains, extra-virgin olive oil, fish, dairy, and meat to encourage improved dietary habits and health outcomes in early life.¹⁰ Further, there is an emphasis on overall diet and lifestyle, a truly holistic way to approach guidance for health.

Food is more than the sum of its parts, and its effects on the body are dependent on the unique interplay between structure, molecules, nutrients and digestion – a complex balance that is yet to be fully understood. By embracing the whole food, matrix approach, we can create more meaningful dietary recommendations that promote health and well-being based on how foods interact within the body.

DAIRY LEADERSHIP: A CALL TO ACTION

- Support research to better understand the dairy matrix and the effects individual dairy foods have on human health.
- Socialize the food matrix concept to communicate the health implications of dietary choices, including the benefits of consuming a variety of dairy foods.
- Advocate for Food Systems Based Dietary Guidelines that promote a food matrix approach rather than focusing on individual nutrients.

For more information on the Global Dairy Platform's Perspective Papers or our Quarterly Webinar Series, please reach out to Dr. Beth Bradley at <u>beth.bradley@globaldairyplatform.com</u>.

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