



## GLOBAL DAIRY PLATFORM

### **The Food Matrix: Foods We Consume are Much More Than a Combination of Individual Nutrients**

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#### ***Foods in their natural state: a combination of compounds that are known, unknown, and still to be discovered***

While not the most appealing or attractive way to describe our diets, the nutritionist's perspective of the foods we eat is often that of a natural combination of chemicals, nutrients, and other compounds that work in synergy with one another to provide the nourishment we (the humans and animals who consume the food) need to survive and thrive. Foods in their natural state are viewed by many as nature's perfect gift whose sum, in most instances, is truly greater than its parts.

However, the study of food has generally been reductionist in nature, with researchers looking at the effects of individual nutrients in foods on various health indices. But nutrients are not consumed in isolation, and researching nutrients as individual entities neglects the subtle and sometimes not-so-subtle interplay between compounds in foods that allow them to act as they do in the body. As Dr. Paul Moughan said in [a recent article on the holistic properties of foods](#), "The complex food matrix itself influences nutritional outcomes, which often cannot be fully explained on the basis of the effects of the sum of the nutrients alone." The additive effects of nutrients, nutrient interactions, and the impact of food components that in many instances have yet to be discovered are all aspects of the understudied, and often underappreciated, matrix effect of foods.

#### ***Individual nutrients don't nearly tell the story of a food's impact on the body***

Looking at complex food matrices as just a bundle of nutrients or creating foods by combining several nutrients that exist in natural products (e.g., alternative beverages compared to dairy milk) is akin to dropping the parts of an automobile (steering wheel, tires, chassis, etc.) into a box and suggesting you've created a car. Both examples, of course, ignore the way the constituent parts fit together, interact, and ultimately create a product that works at peak effectiveness. A better understanding of the food matrix effect is integral to truly understanding the health impacts of the foods we eat.

However, in a world full of highly processed foods created largely by taking foods apart, removing constituent pieces, and then putting them back together, the matrix effect of foods is often lost, or unaccounted for. For example, it's hard to be sure if removing the bran layer from a whole grain product like oats, then adding back fiber to the germ and endosperm left behind actually creates a product that is more or less healthy than the original oat groat. But food processors have performed "food magic" like this for decades, often creating products whose ingredient list might not look too different than that of a natural product but may not have the same health effects.

#### ***Compounds in foods can potentiate or diminish the impact of other nutrients in that food***

Further, there are many instances of individual foods, or combinations of foods, creating matrix effects that can either potentiate or diminish the impact of nutrients that exist in those foods. A case in point is the

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calcium in spinach compared with the calcium in milk. One cup of cooked spinach has about 260 mg of calcium, which is comparable to a cup of milk, which has about 300 mg of calcium. However, due to the anti-nutrients in spinach (oxalates, phytates) which can inhibit calcium absorption, only about 5%, or 13 mg calcium, are absorbed from a cup of spinach. In contrast, over 30 % of the calcium in milk (~100 mg) is absorbed. In this instance, the natural matrix of nutrients in the spinach tends to inhibit calcium absorption far greater than the milk matrix. Due to this food matrix effect, milk is a much better source of bioavailable calcium than spinach, but you wouldn't know it if you homed in solely on the amount of calcium in each food source. The matrix makes a difference.

Mixtures of foods can exert a combined matrix effect on individual nutrients as well. Some years ago, [Kim et al.](#) attempted to assess the impact of adding an egg to a salad on the absorption of several micronutrients in the salad leaves. In short, the addition of the egg increased the bioavailability of vitamins (particularly fat-soluble vitamins) from the salad more so than the salad alone. This was likely due to the addition of fat from the egg, which enhanced the availability of the fat-soluble vitamins in the salad. This example demonstrates how the matrix of one food can (in this instance) potentiate the health potential of a second food.

### ***The Milk Matrix is Being Studied Extensively***

Milk and dairy products form complex food matrices and have undergone extensive study in recent years. While there is still much to be learned, particularly regarding the mechanisms by which dairy foods [exert positive health benefits](#) much is known as well. As is the case with all foods, dairy is much more than a concoction of proteins and other macronutrients, vitamins and minerals. Bioactive compounds including various peptides, oligosaccharides, and milkfat globules have also been identified in milk and dairy products and all are thought to exert health effects on the consumer, alone or in concert with one another. For example, the dairy matrix effect may help to explain why the [saturated fatty acids in milk](#) do not tend to promote adverse cardiovascular effects, while saturated fats from other food sources may be atherogenic.

### ***In Summary***

The more one studies the food matrix, the more he or she learns to appreciate the complexity and intricacies of the foods we consume. Food labels, and the constant admonitions we receive to “eat this nutrient but avoid that nutrient” tend to foster the idea that individual foods are inherently good and bad, and that eating a healthy diet is as simple as meeting the Recommended Daily Allowances (RDA) for the nutrients we consume. But truly understanding the health and disease implications of our food choices involves much more; we need to assess food forms, food combinations, and food matrices to have a real handle on how foods work in the body. Simply putting protein and a few vitamins and minerals into a white liquid and suggesting it is nutritionally equivalent to dairy milk neglects to acknowledge the literally thousands of compounds, some bioactive and some not, that exist in milk, and that surely exert effects in the body that alternative beverages cannot.

In future Perspectives articles we will further explore the science behind the dairy matrix, and the ongoing work to more fully understand the dairy matrix effect. For now, suffice it to say that foods like dairy are certainly much more than the sum of their parts.