

The food matrix: is it time to rethink how we evaluate the health effects of food?

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Foods consist of a large number of different nutrients contained in a complex matrix structure. Traditionally evaluation of a food's impact on human health has been based on the content of individual nutrients such as proteins, fats, carbohydrates, etc. However, recent research shows that the health effects of a food product cannot be determined simply on the basis of the individual nutrients it contains. The food must be evaluated as a whole, together with other foods eaten at the same time. The nature of the food structure and the nutrients therein (i.e. the food matrix) will determine nutrient digestion and absorption, thereby altering the overall nutritional properties of the food. As a result, the food matrix can lead to a different relationship with health indicators than would be interpreted from the single nutrients studied in isolation. An effect of the matrix is seen in a number of foods but the evidence for a dairy matrix effect is now convincing, notably for cheese, although common processing methods may also enhance interactions between nutrients in the dairy matrix and this may modify the metabolic effects of dairy consumption. In the future, diet assessment should consider the evidence on whole food effects alongside the evidence for individual nutrients.

In September 2016 a panel of 18 experts in epidemiology, food, nutrition and medical science were brought together for a workshop on dairy matrix issues, organised by the University of Copenhagen in collaboration with the University of Reading. The findings and conclusions of this workshop have been published in:

Thorning, T. K., Bertram, H. C., Bonjour, J-P., de Groot, L., Dupont, D., Feeney, E., Ipsen, R., Lecerf, J-M., Mackie, A., McKinley, M. C., Michalski, M-C., Rémond, D., Risérus, U., Soedamah-Muthu, S., Tholstrup, T., Weaver, C., Astrup, A. and Givens, D. I. (2017). Whole dairy matrix or single nutrients in assessment of health effects: current evidence and knowledge gaps. American Journal of Clinical Nutrition 105:1033–1045.



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The dairy matrix: a new approach to understanding the health effects of food

biography

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Professor Ian Givens has background training in biochemistry and nutrition and is currently Professor of Food Chain Nutrition and Director of the Institute for Food, Nutrition and Health at the University of Reading.

His research interests focus on food chain nutrition with emphasis on the relationship between consumption of animal-derived foods across the key life stages, nutrient supply and chronic disease risk with particular emphasis on vascular disease and dairy foods, saturated, trans and n-3 fatty acids. Current work includes meta-analysis of prospective studies on the association between dairy food consumption and cardiometabolic diseases (CMD) and research on lipids and proteins in milk and dairy products and their influence on risk factors for CMD.

Work also includes factors linked to primary production that for e.g. alter the fatty acid composition and concentrations of nutrients including iodine, selenium and vitamin D in foods. A study on the form of dietary vitamin D on vitamin D status is also ongoing.



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The dairy matrix and body composition

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Traditionally, nutrition research has examined the effect of individual nutrients on aspects of health. Although useful, this approach does not consider the interaction of the nutrients within a food, and with the overall food structure.

Evidence suggests that a 'matrix' effect exists for many foods, whereby the combination of nutrients within a food leads to differential effects on health than when considered in isolation. This statement is particularly true for dairy foods, which contain unique combination of beneficial nutrients and bioactives in different structures with may interact to confer a range of different, positive, health benefits when consumed within the matrix of dairy. This overview will focus on the effect of dairy food consumption on body composition, covering some recent research including associations between dairy intake and lean muscle tissue, bone health, waist circumference, and other markers of health.

Food for Health Ireland (FHI) is a dairy technology centre which brings together some of the main Public Research Organisations in Ireland, to unlock the potential health benefits of dairy. Recent FHI studies have examined dietary patterns of dairy food consumption from national dietary surveys, and their impact on health markers, as well as more specific controlled intervention trials to understand the true impact of nutrients consumed within and outside of the matrix. Preliminary results from University College Dublin's FHI Cheese Matrix suggest that the matrix is vital for some of these health benefits.



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Dr. Emma Feeney is a Lecturer / Assistant Professor at University College Dublin in Food Science and Human Nutrition.

She has previously held the position of Science Programme Manager in Food for Health Ireland (FHI), a dairy functional foods research centre. Emma co-ordinated the scientific research programme for FHI across 7 Irish public research institutions, and led the Technology workpackage. Her research interests cover various aspects of sensory evaluation, psychophysical measurements and nutrition intake assessment in children and adults. These include understanding individual differences in taste perception and preferences, and how these change over the lifespan and in response to diet.

She also has a a strong interest in dairy research, including food consumption patterns, different dairy food matrices and their effect on human health.



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Metabolic health: the impact of the dairy matrix

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Evidence from large observational studies and meta-analyses indicates an inverse association between dairy and body weight, body fat mass, type 2 diabetes and cardiovascular disease. The findings are supported by randomised controlled trails (RCT). However, although several of the reported RCT's show beneficial effects of dairy for cardio-metabolic effects, the mechanisms by which dairy influences metabolic health are not entirely clear.

There are several reasons for that:

The re-assessment of the role of saturated fat for cardio-metabolic diseases has clearly shown that overall total intake of saturated fat is not associated with type 2 diabetes or cardiovascular disease.

The effect of a saturated fatty acid is heavily dependent on its chain length, and the saturated fatty acids in dairy seem to exert a neutral to slight positive effect on type 2 diabetes and cardiovascular disease.

Dairy cannot be viewed as one entity, and particular positive health effects are exerted by the fermented dairy e.g. yoghurts and cheese.

Most importantly, the dairy matrix i.e. the total interaction by different fatty acids, minerals like calcium, proteins and bioactive peptides produce unpredictable biological effects, which have generally turned out to exert important health effects. Therefore, research needs to distinguish between different dairy products and the health effect.

Recent evidence shows that whether low-fat or high-fat dairy are preferred, the health effects entirely depends on the glycemic status of the individual e.g. normoglycemic individuals may achieve the best weight control by normal to low fat dairy whereas type 2 diabetics may benefit more from higher fat dairy.

In conclusion, a high intake dairy is a natural part of a nutrient dense diet that provides benefits for weight control, and the prevention of type 2 diabetes and cardiovascular disease. Future research and recommendations for the public need to observe differential health impacts of different dairy products due to the matrix effect, and personalized nutrition will be key to selecting low or high fat dairy.



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Arne Vernon Astrup heads the Department of Nutrition, Exercise and Sports at the University of Copenhagen, Denmark, and is senior Consultant at Clinical Nutrition Research, Herlev-Gentofte University Hospital.

He has over 30 years' clinical research experience, with his main areas of research focusing on physiology and pathophysiology of energy and substrate metabolism, with special emphasis on the aetiology and treatment of obesity. Dr Astrup is past President of World Obesity Federation, and founding editor-in-chief of Obesity Reviews. He is Associate Editor of American Journal of Clinical Nutrition, and a member of the editorial committee of Annual Review of Nutrition. He was the recipient of the International Association for the Study of Obesity Willendorf Award 2014.

He is author/co-author of over 600 original, review and editorial scientific papers (H-index: 77, Google Scholar H-Index: 99), and more than 1000 other academic publications such as abstracts, textbook chapters and scientific correspondence. He has supervised 32 PhD students to date. Astrup was created Knight of the Order of Dannebrog in 1999, and Knight of the First Order of Dannebrog in November 2012.



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