The Food Matrix:

More Than The Sum of its Nutrients

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Today's Presenter

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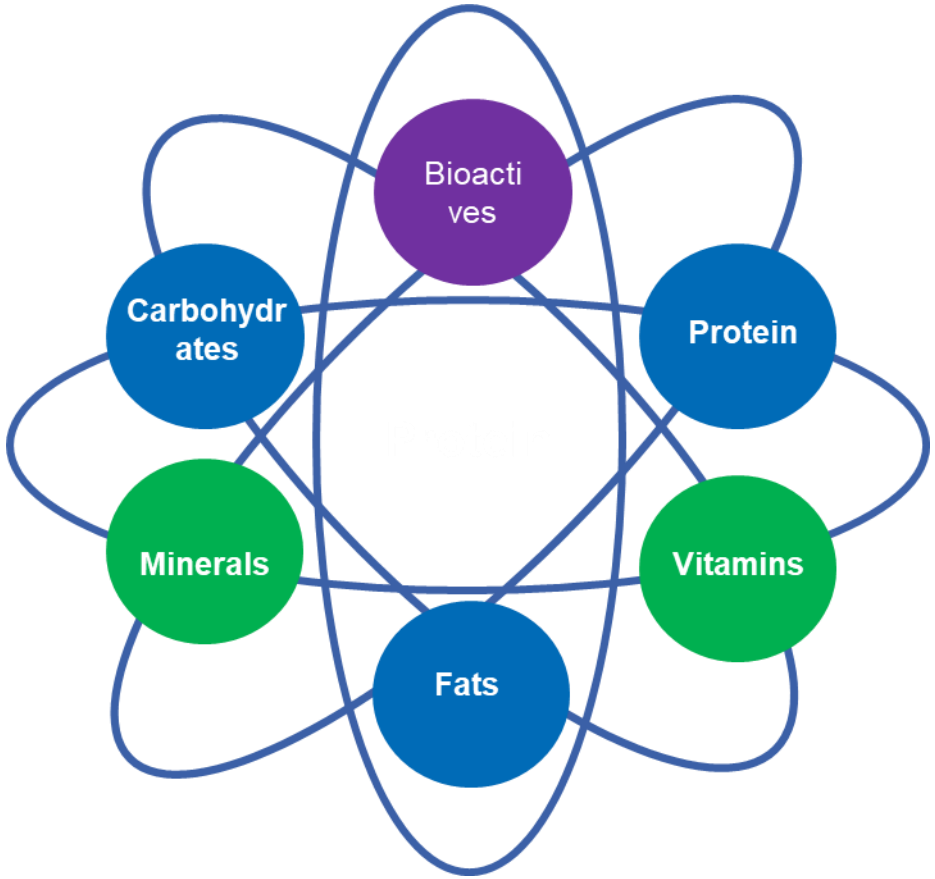
Objectives

1. Describe the emerging concept of the food matrix and how unique combinations of nutrients and bioactives work together in synergy to impact health
2. Discuss the unique components of the dairy matrix
3. Provide examples of scientific research that supports consuming dairy foods (e.g., milk, cheese, yogurt) is linked to lower risk of cardiovascular disease and type 2 diabetes, as well as improved bone health

Today's Discussion

- Review the history of nutrition science
- Explore the emerging concept of the food matrix
- Look at examples of how the matrix may be responsible for unexpected results
- Discuss what this means to the you



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Bringing to life the dairy community's shared vision of a healthy, happy, sustainable world, with science as our foundation

The U.S. Dairy Stewardship Commitment. http://commitment.usdairy.com/

The History of Nutrition Science

SCIENCE AND POLITICS OF NUTRITION

History of modern nutrition science—implications for current research, dietary guidelines, and food policy

Dariush Mozaffarian and colleagues describe how the history of modern nutrition science has shaped current thinking

Although food and nutrition have been studied for centuries, modern nutritional science is surprisingly young. The first vitamin was isolated and chemically defined in 1926, less than 100 years ago, ushering in a half century of discovery focused on single nutrient deficiency diseases. Research on the role of nutrition in complex non-communicable chronic diseases, such as cardiovascular disease, diabetes, obesity, and cancers, is even more recent, accelerating over the past two or three decades and especially after 2000.

Historical summaries of nutrition science have been published, focusing on dietary guidelines, general scientific advances, or particular nutritional therapies.[1-4] Carl Sagan said, "You have to know the past to understand the present;" and Martin Luther King, Jr, "We are not makers of history. We are made by history." This article describes key historical events in modern nutrition science that form the basis of our current understanding of diet and health and clarify contemporary priorities, new trends, and controversies in nutrition science and policy.

KEY MESSAGES

- Modern nutrition science is young: it is less than one century since the first vitamin was isolated in 1926
- The first half of the 20th century focused on the discovery, isolation, and synthesis of essential micronutrients and their role in deficiency diseases
- This created strong precedent for reductionist, nutrient focused approaches for dietary research, guidelines, and policy to address malnutrition
- This reductionist approach was extended to address the rise in diet related non-communicable diseases—eg, focusing on total fat, saturated fat, or sugar rather than overall diet quality
- Recent advances in nutrition science have shown that foods and diet patterns, rather than nutrient focused metrics, explain many effects of diet on non-communicable disease
- Lower income countries are recognising a growing "double burden" (combined undernutrition and non-communicable disease)
- Nutrition policy should prioritise food based dietary targets, public communication of trusted science, and integrated policy, investment, and cultural strategies to create system level change across multiple organisations and environments

1910s to 1950s: era of vitamin discovery

The first half of the 20th century witnessed the identification and synthesis of many of the known essential vitamins and minerals and their use to prevent and treat nutritional deficiency related diseases including scurvy, beriberi, pellagra, rickets, xerophthalmia, and nutritional anaemias. Casimir Funk in 1911 came up with idea of a "vital amine" in food, originating from the observation that the bulk of unprocessed rice protected chickens against a beriberi-like condition.[1] This "vital amine" or vitamin was first isolated in 1926 and named thiamine, and subsequently synthesised in 1936 as vitamin B1. In 1932, vitamin C was isolated and definitively documented, for the first time, to protect against scurvy,[5] some 200 years after ship's surgeon James Lind tested lemons for treating scurvy in sailors.[1]

By the mid-20th century all major vitamins had been isolated and synthesised (fig 1). Their identification in animal and human studies proved the nutritional basis of serious deficiency diseases and initially led to dietary strategies to tackle beriberi (vitamin B1), pellagra (vitamin B3), scurvy (vitamin C), pernicious anaemia (vitamin B12), rickets (vitamin D), and other deficiency conditions. However, the chemical synthesis of vitamins quickly led to food based strategies being supplanted by treatment with individual vitamin supplements. This presaged modern day use and marketing of individual and bundled multivitamins to guard against deficiency, launching an entire vitamin supplement industry.

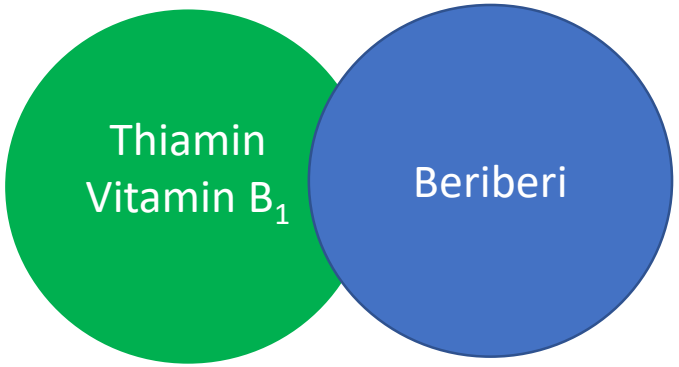
This new science of single nutrient deficiency diseases also led to fortification of selected staple foods with micronutrients, such as iodine in salt and niacin (vitamin B3) and iron in wheat flour

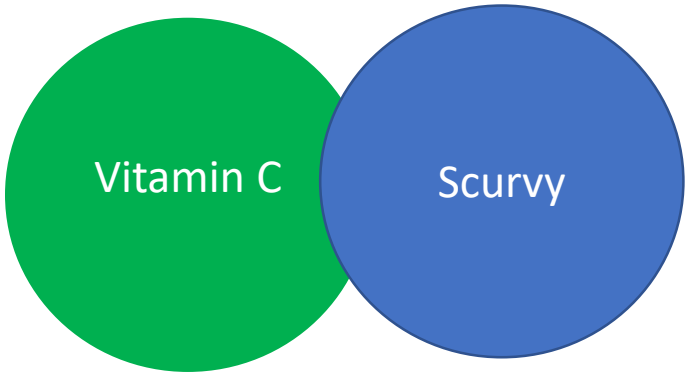
Dariush Mozaffarian, DrPh, MD, MPH

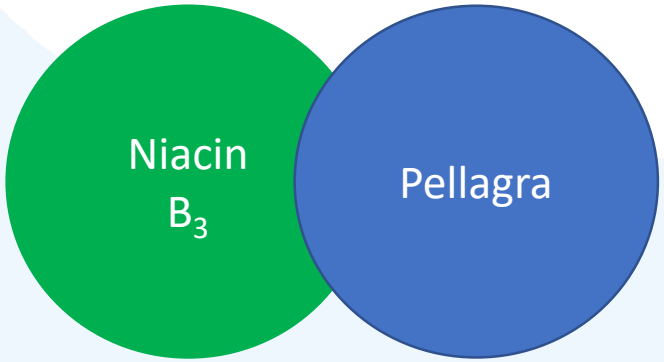
Source:
- Mozaffarian D, et al. History of modern nutrition science—implications for current research, dietary guidelines, and food policy *BMJ* 2018; 361 :k239

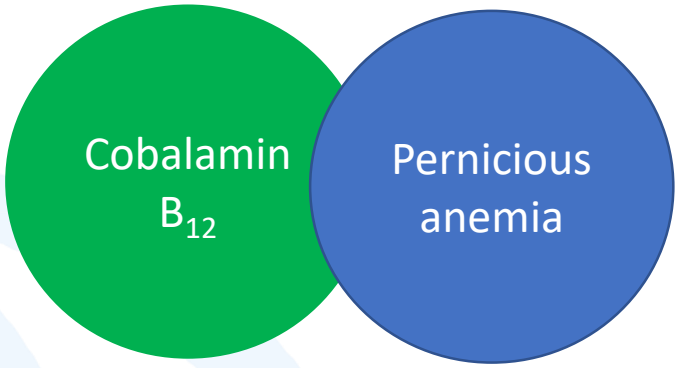
Nutrition is a Young & Vibrant Science

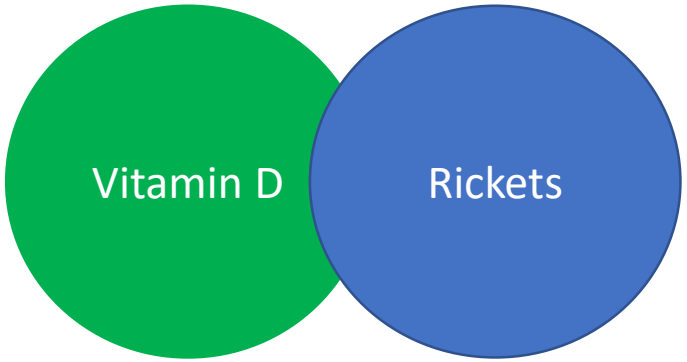
The first vitamin was discovered less than a century ago











Source:
- Mozaffarian D, et al. History of modern nutrition science—implications for current research, dietary guidelines, and food policy *BMJ* 2018; 361 :k239

Focus on Prevention of Deficiencies through Fortification

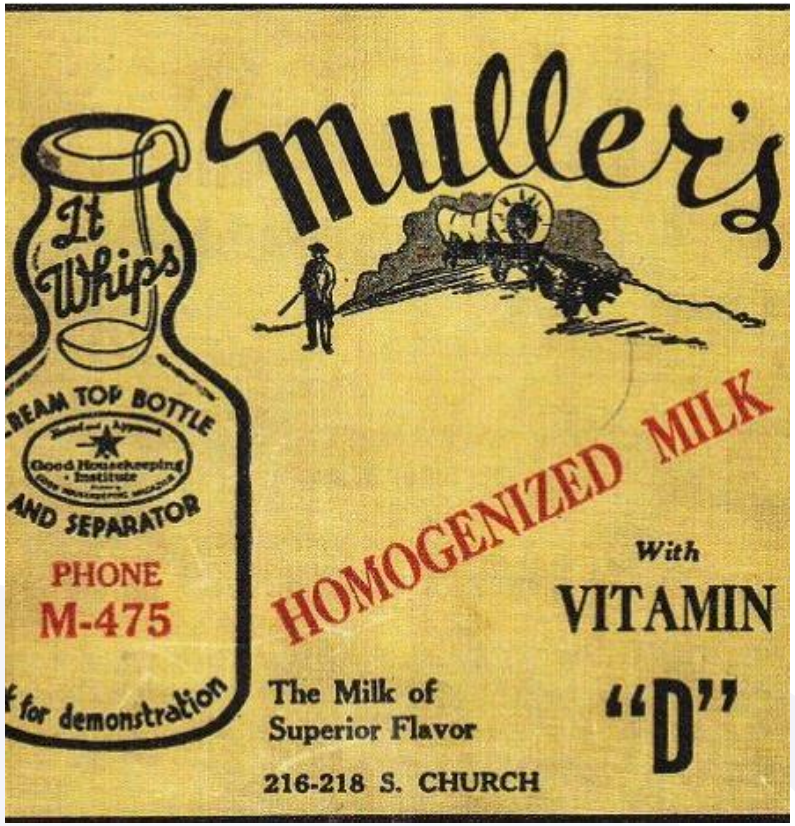


Image:: https://history.rockfordpubliclibrary.org/localhistory/?p=55092

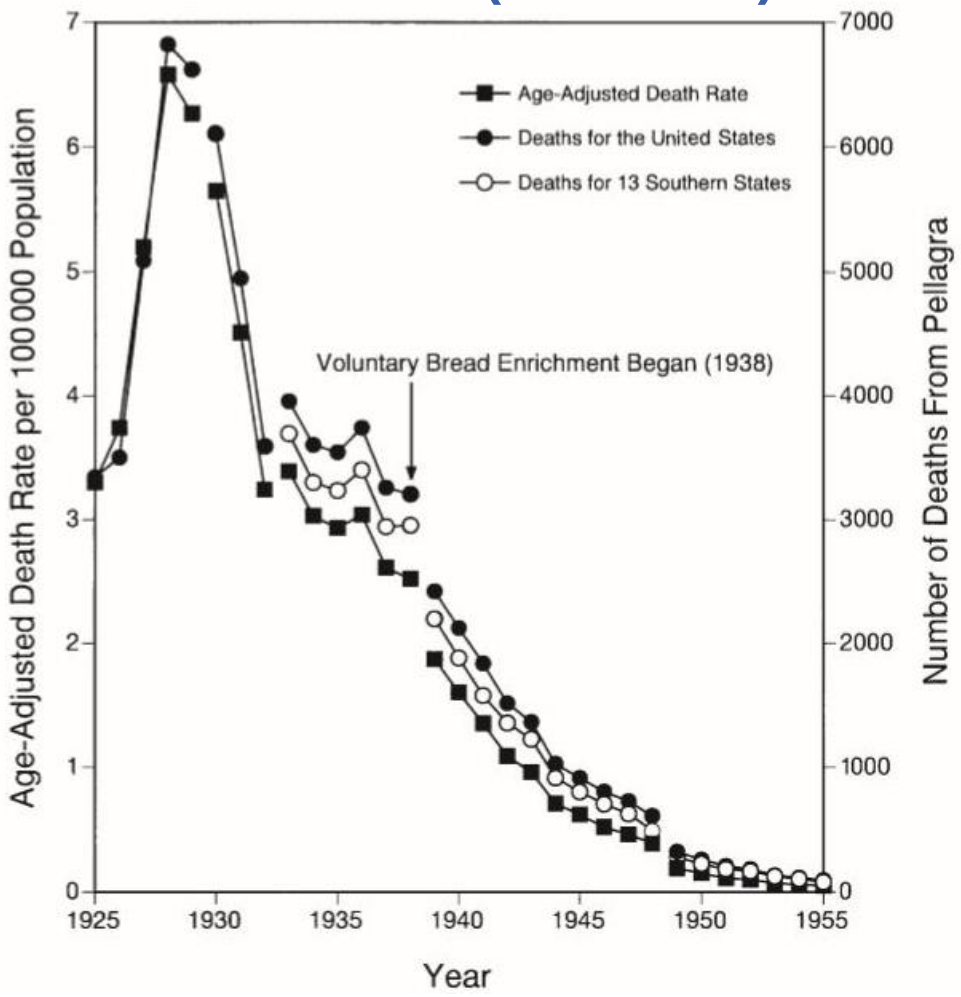
Image: https://www.mortonsalt.com/heritage-era/roaring-20s-and-beyond/

Source:

- Dietary Reference Intakes: Guiding Principles for Nutrition Labeling and Fortification. Institute of Medicine. 2003

Fortification, enrichment and supplementation plays an important role in human health

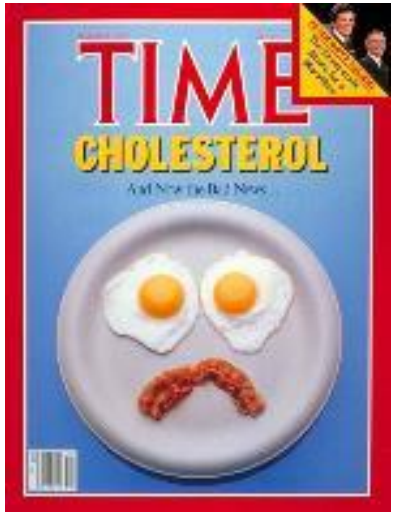
Pellagra Deaths in the United States (1929-1955)

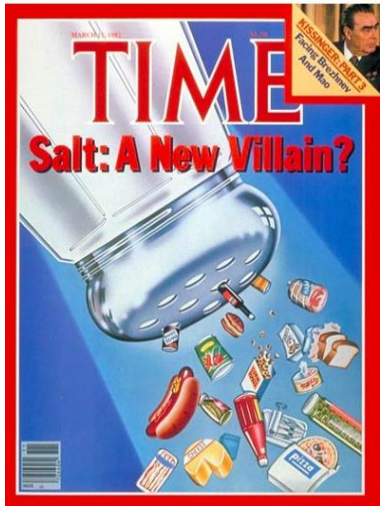


Source:

- Park et al. Effectiveness of Food Fortification in the United States: The Case of Pellagra. *American Journal of Public Health.* 2000; 90.5.

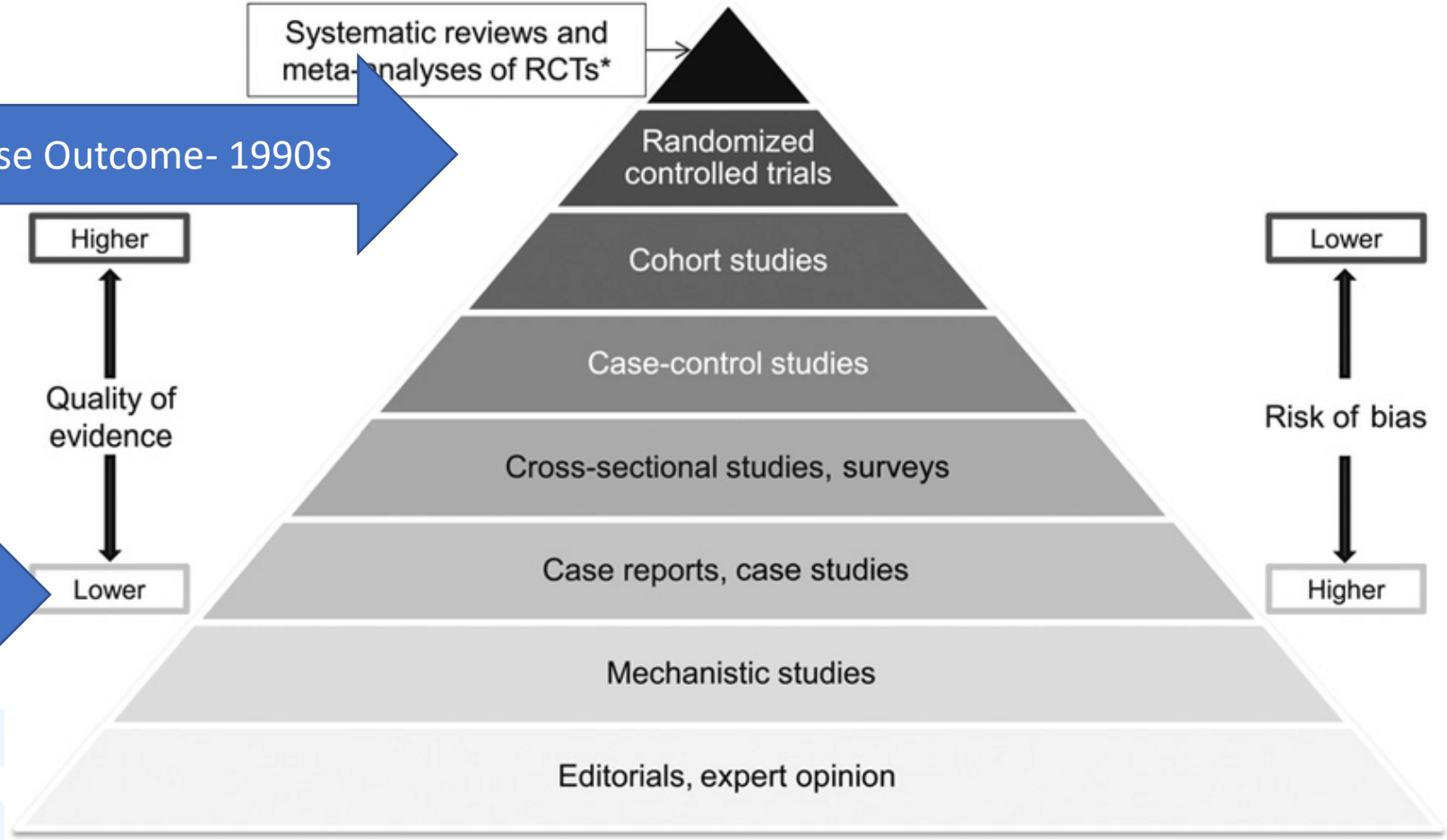
Reductionist Perspective Carried Through to Reduction of Chronic Diseases





Large Trials that Look at Diet and Disease Outcome- 1990s

Early Vitamin Discovery- 1900s



*Meta-analyses and systematic reviews of observational studies and mechanistic studies are also possible.

Adapted from :A Yetley, et al. 2016;105(1). 10.3945/ajcn.116.139097. . Options for basing Dietary Reference Intakes (DRIs) on chronic disease endpoints: report from a joint US-/Canadian-sponsored working group. *American Journal of Clinical Nutrition*

Protective Effects of Fruit Not Explained by Beta-Carotene

IJC International Journal of Cancer

Beta-carotene supplementation and cancer risk: a systematic review and metaanalysis of randomized controlled trials

Nathalie Druesne-Pecollo ✉, Paule Latino-Martel, Teresa Norat, Emilie Barrandon, Sandrine Bertrais, Pilar Galan, Serge Hercberg

Meta-analysis of 13 RCTs

" …Beta-carotene supplementation has not been shown to have any beneficial effect on cancer prevention... This study adds to the evidence that **nutritional prevention of cancer through beta-carotene supplementation should not be recommended**. "

Sources
- Druesne-Pecollo N, et al. Beta-carotene supplementation and cancer risk: a systematic review and meta-analysis of randomized controlled trials. Int J Cancer. 2010.127(1): 172-184

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Heart Health Effects of Fish Not Explained by EPA/DHA

Cochrane Database of Systematic Reviews

Omega-3 fatty acids for the primary and secondary prevention of cardiovascular disease

Cochrane Systematic Review - **Intervention** | Version published: 30 November 2018 see what's new

https://doi.org/10.1002/14651858.CD003177.pub4

Meta-analysis of 79 trails (>112,000 people)
Data current to April 2017

" …Moderate- and high-quality evidence suggests that increasing EPA and DHA has little or no effect on mortality or cardiovascular health (evidence mainly from supplement trials)… **There is evidence that taking omega-3 capsules does not reduce heart disease, stroke or death**."

Source:
- Abdelhamid A, Brown T, Brainard J, et al. Omega-3 fatty acids for the primary and secondary prevention of cardiovascular disease. Cochrane Database of Systematic Reviews 2018. 2018(7).

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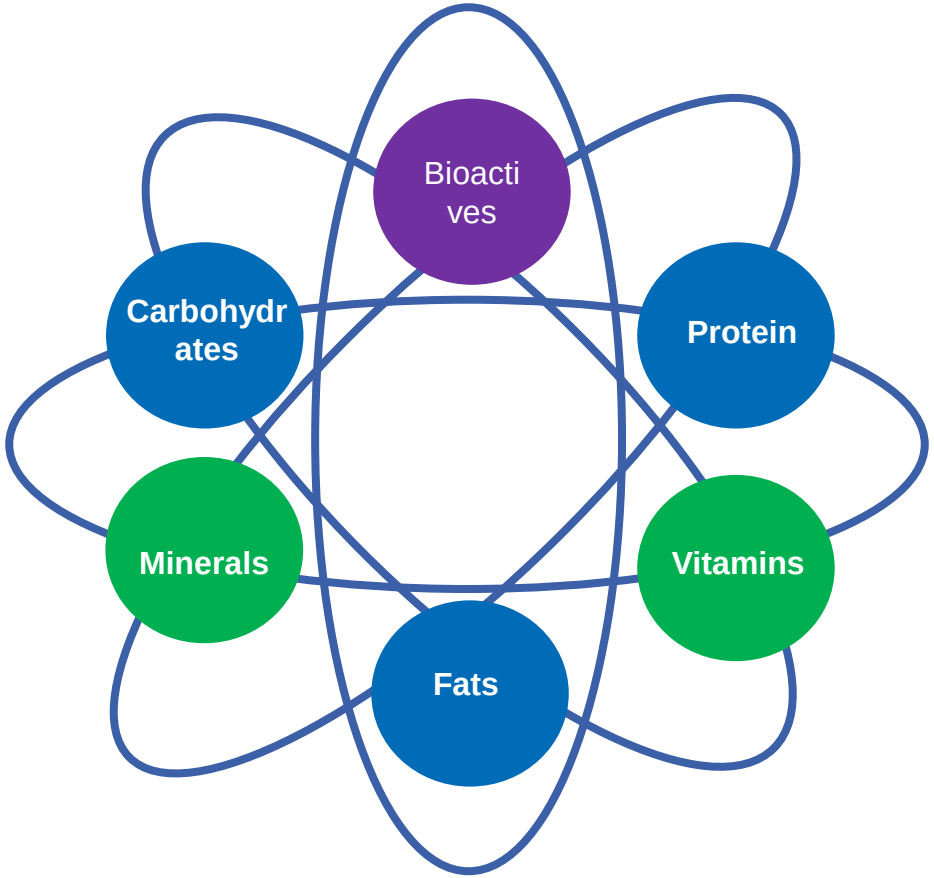
Food Matrix

food ma·trix

noun

The nutrient and non-nutrient components of foods and their molecular relationships, i.e. chemical bonds to each other.

-USDA



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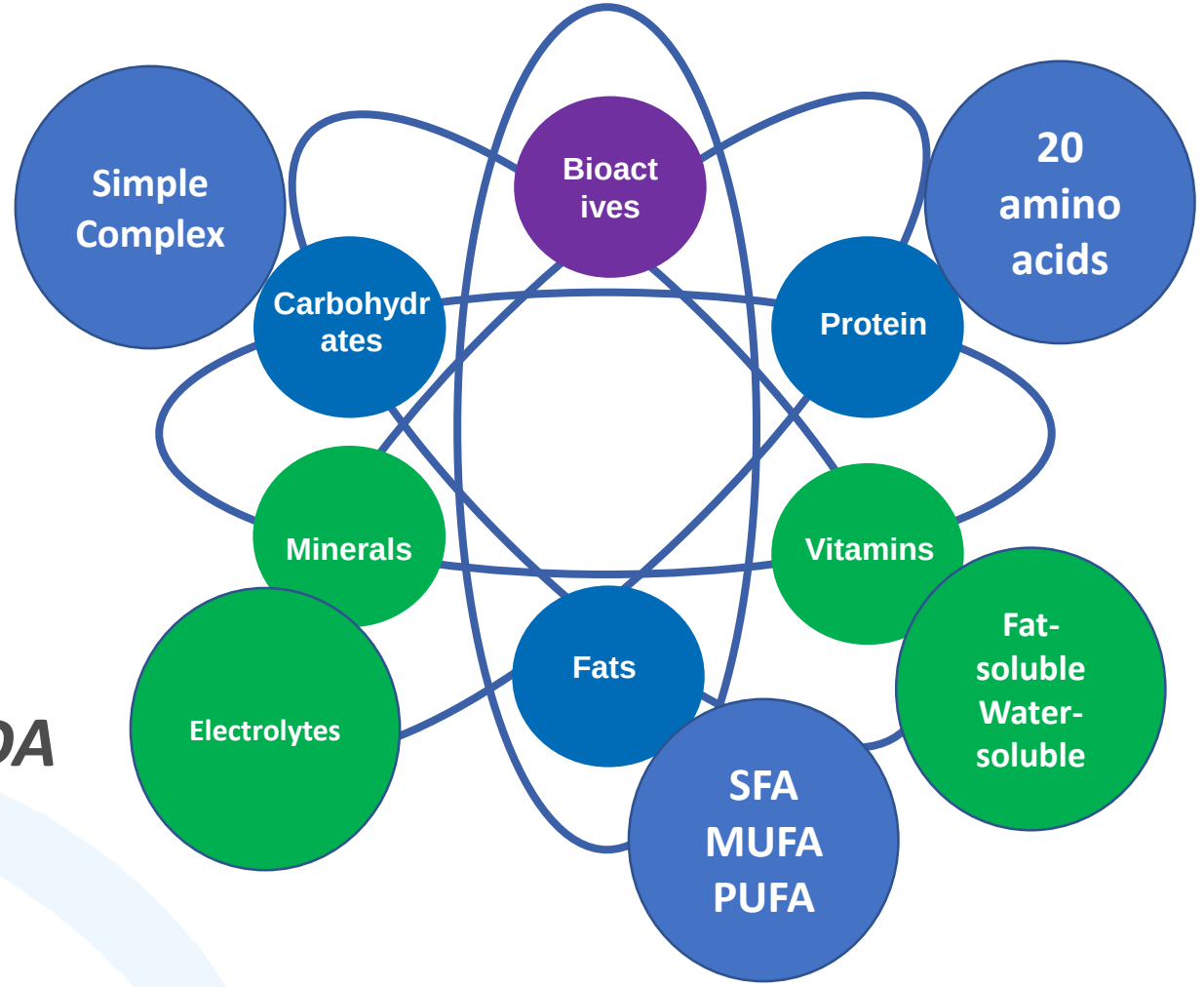
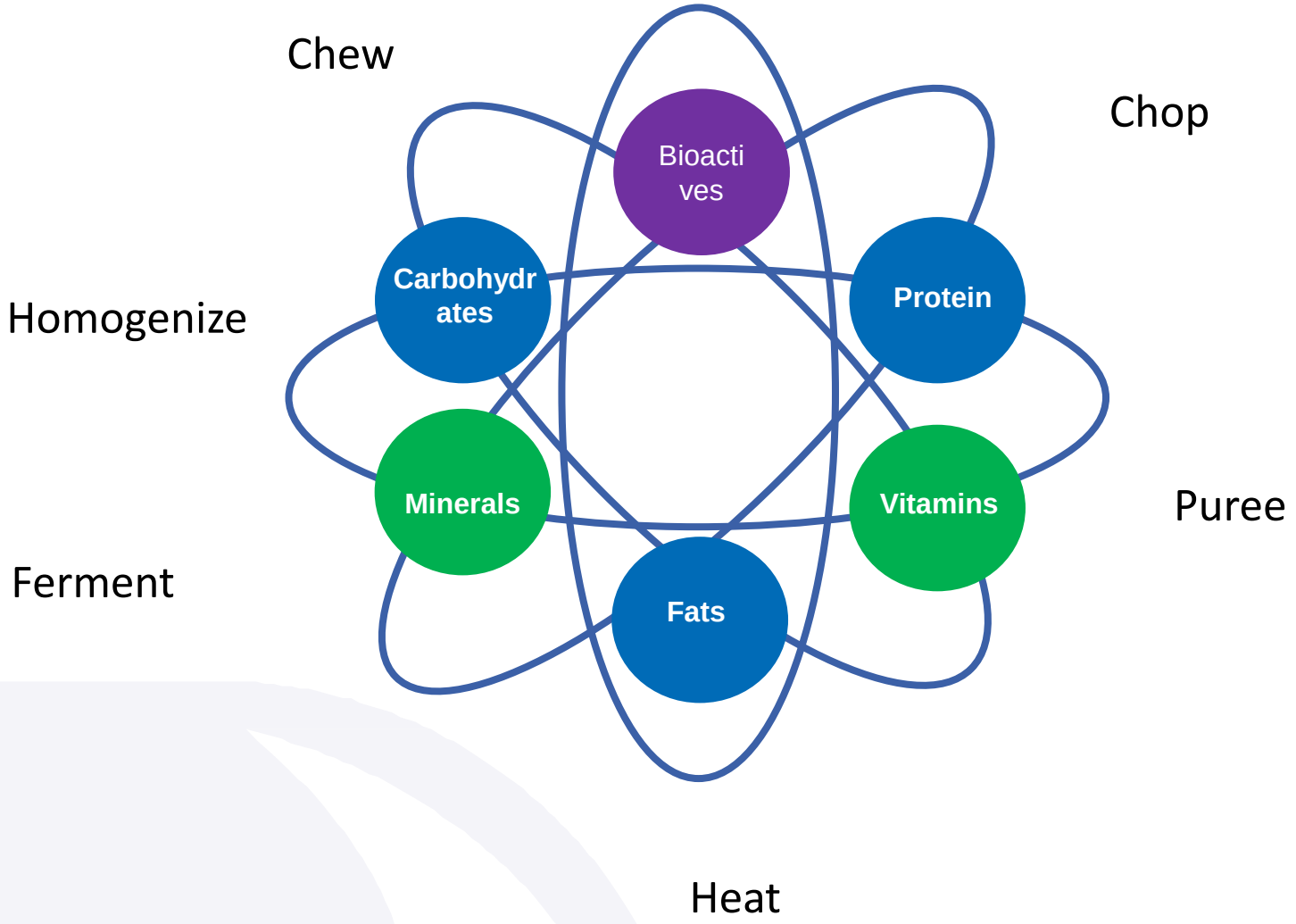


Food Matrix Transformation



The Carrot Matrix

Nutrient Matrix*

- Fiber
- Vitamin A
- Vitamin B6
- Vitamin C
- Biotin
- Potassium
- Folate
- Carotenoids
  - Beta-carotene
  - Alpha-carotene
  - Lutein
- Anthocyanins
- Antioxidants
  - Lycopene
- Polyacetylenes

+ **Preparation**

Physical Matrix

Solid

- 88% water, 12% solid

* Includes but not limited to

Nutrition Data sourced and calculated from FoodData Central: 11124

The Carrot Matrix Impacts Absorption of Carotenoids

Estimation of carotenoid accessibility from carrots determined by an *in vitro* digestion method

E Hedrén[1]*, V Diaz[2] and U Svanberg[1]

Form of carrots	Total carotenoids recovered[1]
Raw, bitesize chunks	3%
Cooked, bitesize chunks	6%
Pulped, raw	21%
Pulped, raw with canola oil	30%
Pulped, cooked	27%
Pulped, cooked with canola oil	39%

[1]. With *in vitro* digestion model, which provides an estimate of the carotenoids released and absorbed from the food matrix with digestion

The Almond Matrix

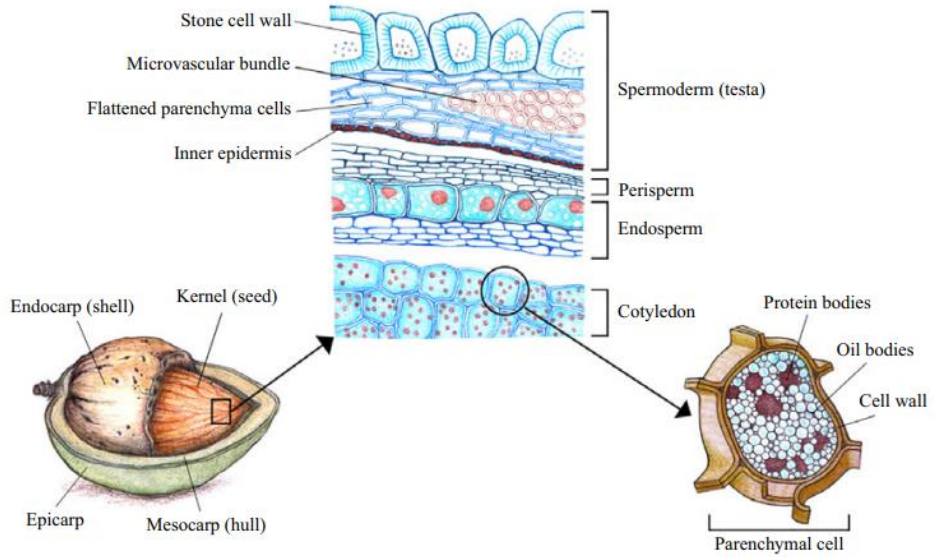


Image: Int'l J Food Sci & Tech 2016

Nutrient Matrix*

- Protein
- Fatty Acids
- Fiber
- Phytosterols
- Vitamins
  - Vitamin E
  - Riboflavin
- Minerals
  - Calcium
  - Copper
  - Magnesium
  - Phosphorus
  - Potassium
  - Zinc
- Phenolic Compounds
- Flavonoids

Cooking & Grinding

Physical Matrix

Solid

- 4.4% water, 95.6% solid

* Includes but not limited to

Nutrition Data sourced and calculated from FoodData Central: 170567

Almond Matrix Impacts Amount of Calories Digested

Food & Function

Food processing and structure impact the metabolizable energy of almonds†‡

Sarah K. Gebauer,[a] Janet A. Novotny,[a] Gail M. Bornhorst[b] and David J. Baer*[a]

WHOLE UNROASTED ALMONDS
123 calories are absorbed versus the current 164 calories shown on the nutrition label.

WHOLE ROASTED ALMONDS
138 calories are actually absorbed versus the current 170 calories as currently shown on the nutrition label.

CHOPPED ROASTED ALMONDS
141 calories are absorbed versus the 170 calories currently shown on the nutrition label.

ALMOND BUTTER
Absorbed calories of almond butter were found to be similar to what would be found on the nutrition label.

Image: Almond Board of California

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The Dairy Matrix

The American Journal of CLINICAL NUTRITION

Whole dairy matrix or single nutrients in assessment of health effects: current evidence and knowledge gaps[1,2]

Tanja Kongerslev Thorning,[3] Hanne Christine Bertram,[5] Jean-Philippe Bonjour,[6] Lisette de Groot,[7] Didier Dupont,[8] Emma Feeney,[9] Richard Ipsen,[4] Jean Michel Lecerf,[10] Alan Mackie,[11] Michelle C McKinley,[12] Marie-Caroline Michalski,[13,14] Didier Rémond,[15] Ulf Risérus,[16] Sabita S Soedamah-Muthu,[17] Tine Tholstrup,[3] Connie Weaver,[18] Arne Astrup,[3] and Ian Givens[19]*

Whole Milk's Composition

~87% Water

~13% Solids

~4.8% Carbohydrate (98-99% lactose)

~3.25% Fat (over 400 types of fatty acids)

65% saturated | 29% monounsaturated | 6% polyunsaturated

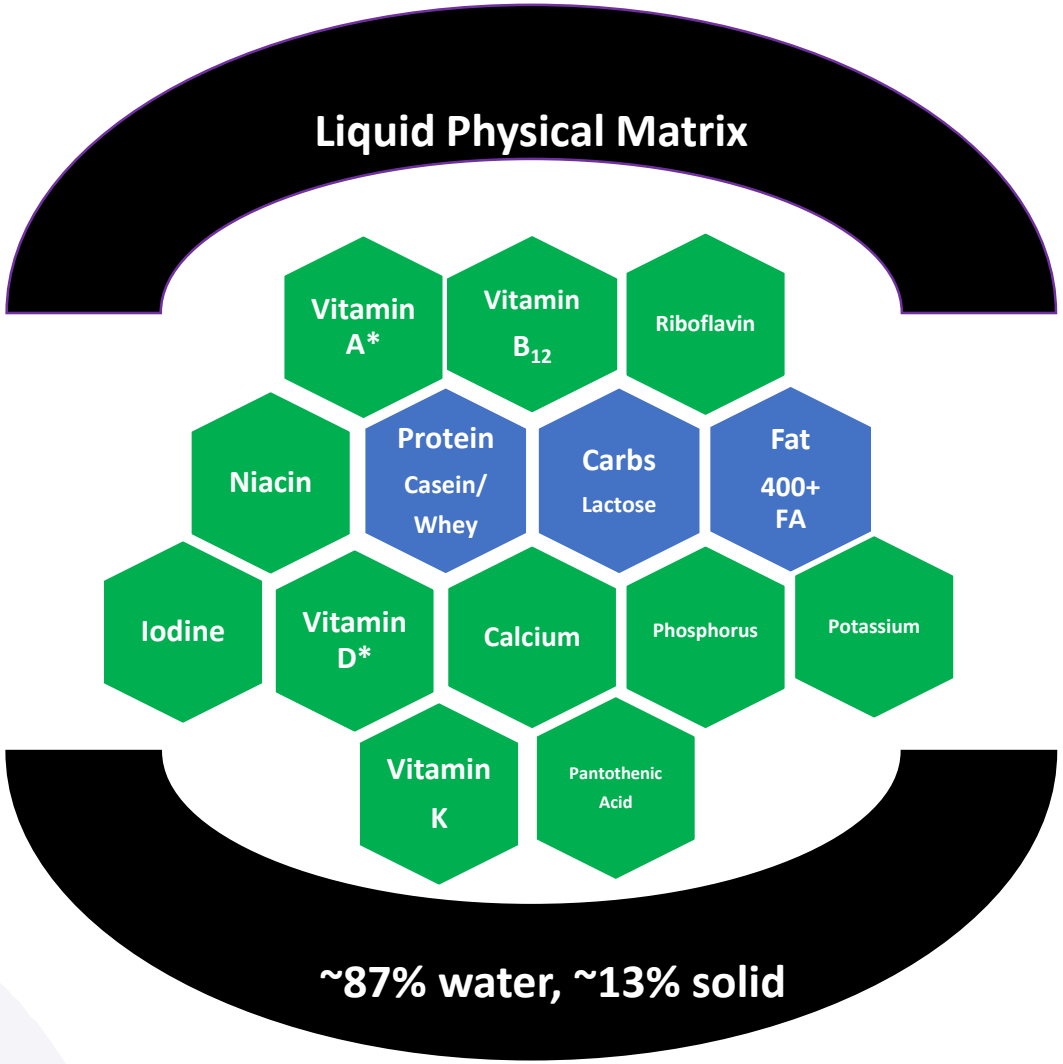
Short, medium, long, odd, branched chain, trans fatty acids
(contained within the milk fat globule membrane (MFGM))

3.2% *Complete* Protein

82% casein | 18% whey

https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?fr=131.110

The Whole Milk Matrix



*Fortified in fat free and low fat milk products

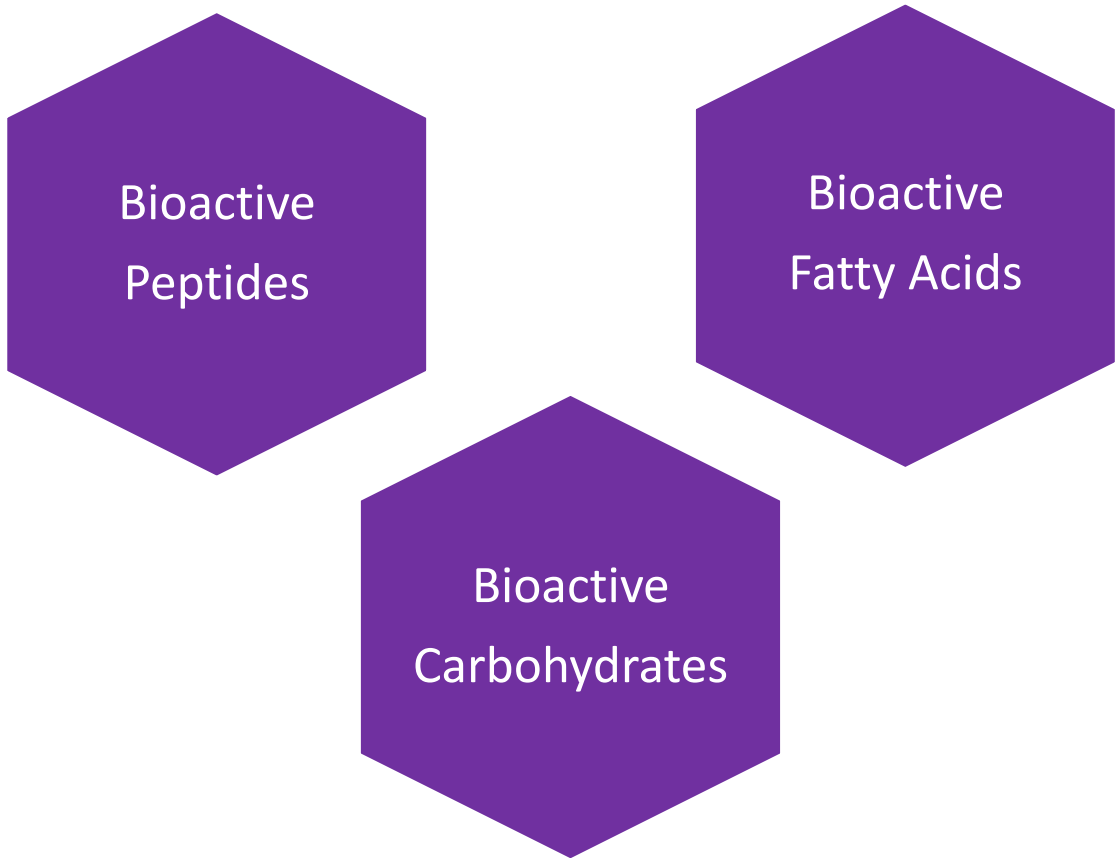
- Includes but not limited to
- Components are not necessarily good source or excellent source defined by FDA.

Source:
- Nutrition Data sourced and calculated from FoodData Central: 602770

Milk Bioactives

"Bioactives are constituents in foods, other than those to meet basic nutritional needs, that are responsible for a change in human health."

-Office of Disease Prevention & Health Promotion



Potential Bioactive Peptides
Emerging Research

Summary of Oregon State University Milk Bioactive Peptide Database (MBPDB)		
Class	**Reported Biological Function**	**# entries**
ACE-inhibitory peptides	• Blood pressure-reducing effects	420
Antimicrobial peptides	• Anti-microbial activity across 49 species of bacteria, fungi, parasites • potential utility as an alternative to chemical preservatives	207
Dipeptidyl peptidase IV (DPP-IV)-inhibitory peptides	• Inhibition of enzymes that inactivate incretin hormones • Help maintain normal blood glucose levels	172
Antioxidant peptides	• Prevent or scavenge free radicals • Prevent lipid oxidation during meat processing (shelf-life extension)	47
Anti-inflammatory peptides	• Inhibition of nuclear factor-$\varkappa$B (NF- $\varkappa$B) signal in macrophages (activation promotes transcription of pro-inflammatory cytokines)	10
Immunomodulatory peptides	• Stimulates lymphocyte activity, promote antibody formation	9
Opioid peptides	• Modulate gastrointestinal transit time, motility	40

Source:
- Table adapted from: Nielsen, S. et al. Milk bioactive peptide database: A comprehensive database of milk protein-derived bioactive peptides and novel visualization. *Food Chem* 232, 673-682. doi:10.1016/j.foodchem.2017.04.056 (2017). .

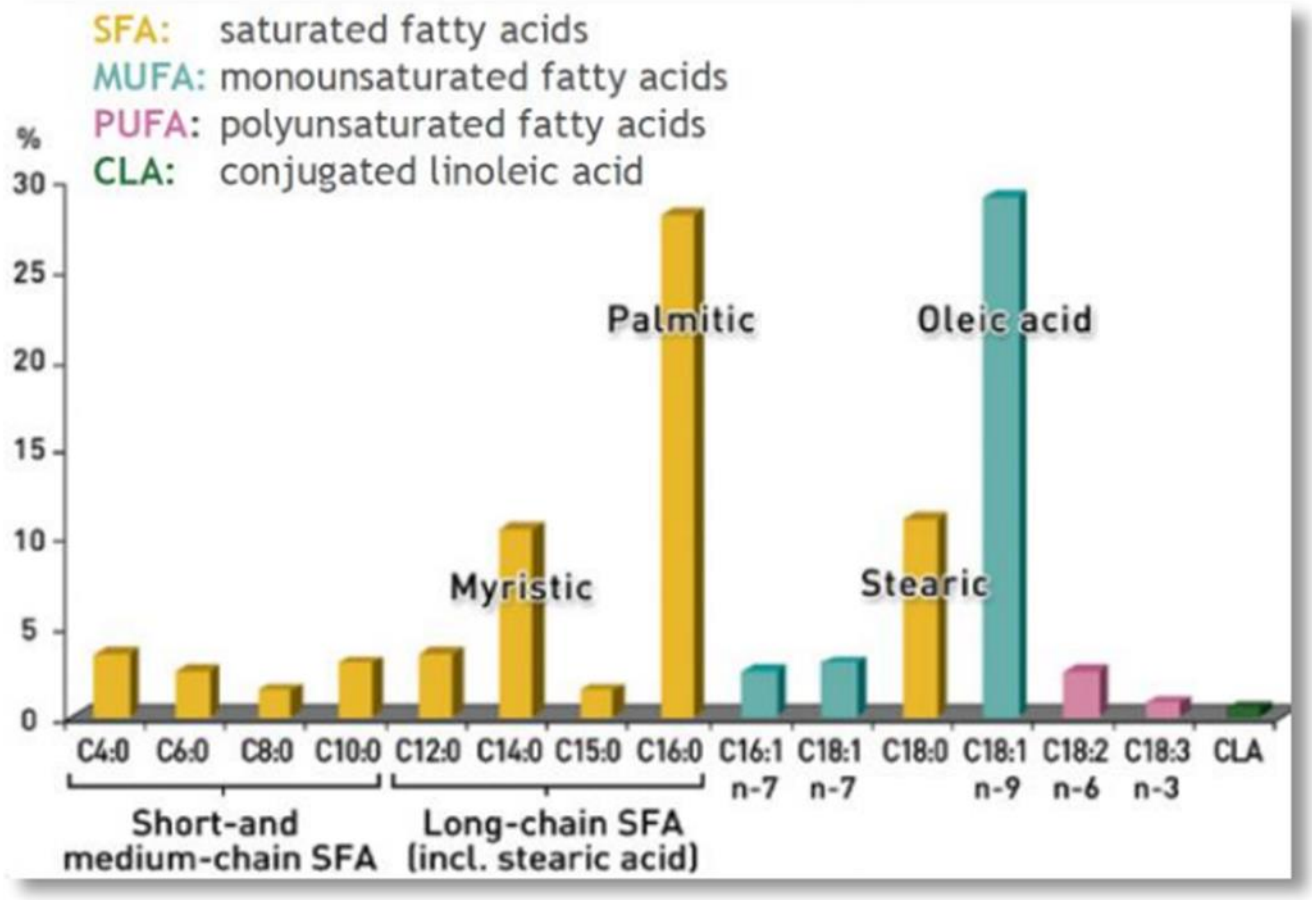
Dairy Fat is Unique and Complex

Dairy fat contains

>400 different fatty acids

- 65-70% Saturated Fatty Acids
- 30-35% Unsaturated Fatty Acids

General Fatty Acid Composition of Milk



Source:
- Masson HL. Fatty acids in bovine milk fat. Food & Nutrition Research, 52:1,

Potential Bioactive Lipids
Emerging Research

Lipid Classes Within the Milk Fat Globular Membrane (MFGM

- Short, medium and long chain fatty acids
- Naturally occurring trans fatty acids
- Branched chain fatty acids
- Polar Lipids
  - Phospholipids
  - Sphingolipids

Milk Fat Globular Membrane

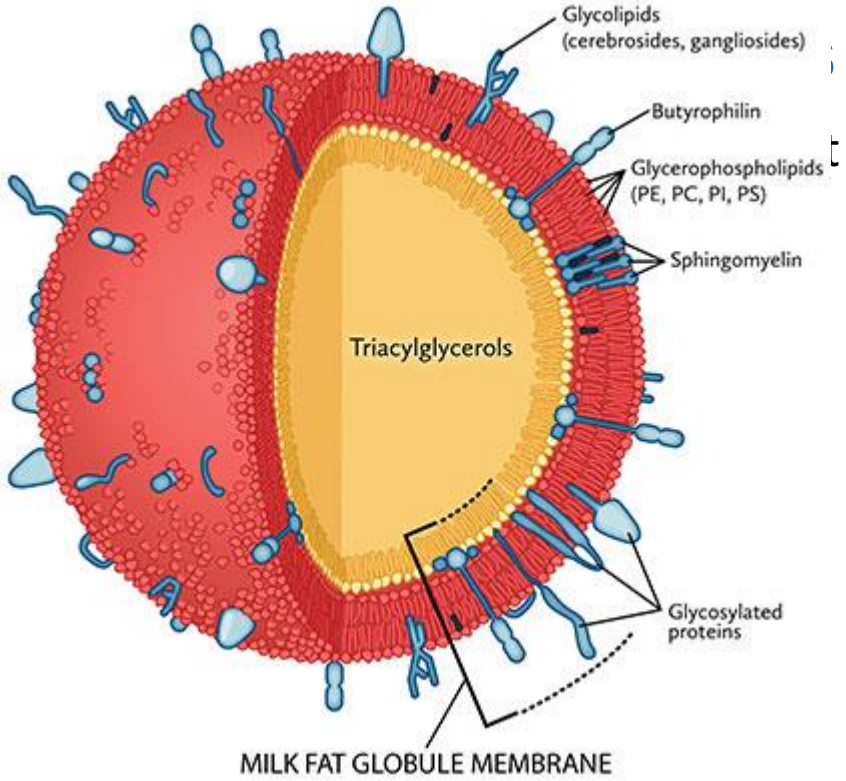


Image: Mead Johnson Nutrition

Potential Bioactive Lipids
Emerging Research

Lipid Classes Within the Milk Fat Globular Membrane (MFGM)

- Short, medium and long chain fatty acids
- Naturally occurring trans fatty acids
- Branched chain fatty acids
- Polar Lipids
  - Phospholipids
  - Sphingolipids

Active Research Areas

- Supportive of weight management
- Mechanistic role in reducing risk for type 2 diabetes
- Anti-inflammatory properties
- Mechanistic role in health-promoting metabolic and blood lipid effects
- MFGM lipids and potential anti-pathogenic activity in the gut

Potential Bioactive Carbohydrates Emerging Research

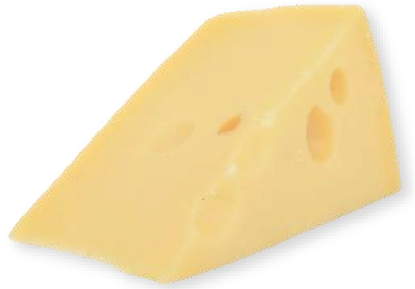
Classes

- Oligosaccharides
- Glycolipids
- Mucins

Active Research Areas

- Prebiotic properties
- Antipathogenic activity (in vitro)
- Other areas

Milk Matrix Transformation



Solid matrix

Liquid matrix

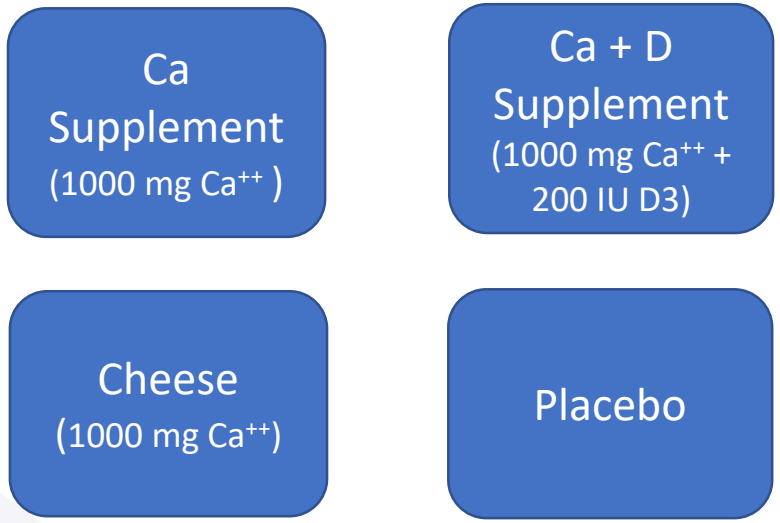
Fermentation
Bacteria

Short chain amino acids

Bioactive peptides

Gel matrix

Consuming Cheese May be More Beneficial Than Supplements for Bone Mass Accrual



Cheese group:

- Significantly higher change in cortical thickness of the tibia than supplement or placebo
- Higher whole-body BMD than placebo when compliance

The American Journal of CLINICAL NUTRITION

Effects of calcium, dairy product, and vitamin D supplementation on bone mass accrual and body composition in 10–12-y-old girls: a 2-y randomized trial[1–3]

2 yr Randomized Intervention Trial
N=195 healthy girls, Tanner I-II, 10-12 years

"The possible benefits of cheese and habitual high calcium intakes from food over the pills may be a result of:

1) a better absorption of calcium from dairy products as a result of the presence of lactose or caseinphosphopeptides
2) ideal distribution of calcium intake during the whole day in the form of food … which may also account for the better absorption
3) higher intakes of protein, magnesium, or some other micronutrients from dairy products than from pills."

Whole Milk May Not Negatively Affect Markers of CVD or Type 2 Diabetes

Table 3 Results after skimmed milk and whole milk periods

	Skimmed	Whole	*P*
Total cholesterol (mmol/L)	4.31 ± 0.15[a]	4.45 ± 0.15	0.06
LDL cholesterol (mmol/L)	2.27 ± 0.11	2.33 ± 0.11	0.54
HDL cholesterol (mmol/L)	1.63 ± 0.10	1.69 ± 0.10	0.04
Total:HDL cholesterol	2.74 ± 0.13	2.73 ± 0.12	0.82
Triacylglycerols (mmol/L)	0.98 ± 0.08	1.06 ± 0.08	0.24
Insulin (pmol/L)[b]	41.99 ± 4.13	45.66 ± 4.23	0.22
Glucose (mmol/L)	5.24 ± 0.07	5.32 ± 0.09	0.38
HOMA-IR[b]	1.37 ± 0.14	1.50 ± 0.14	0.23

HOMA-IR homeostasis model assessment—insulin resistance

[a]All values are mean ± SE. Statistical differences are based on linear mixed models with baseline values as covariates and adjustments for sex, age, BMI, and waist circumference ($n = 17$)

[b]$n = 16$ because one sample was below the detection limit (14.4 pmol/L) and was removed from the analysis

EJCN
European Journal of Clinical Nutrition

Effect of whole milk compared with skimmed milk on fasting blood lipids in healthy adults: a 3-week randomized crossover study

Sara Engel[1] · Mie Elhauge[1] · Tine Tholstrup[1]

Randomized control trial
n= 17 healthy adults
Consumed 0.5 L/d of either milk

"…The content of calcium and protein were similar in the two milk types, but whole milk has a higher content of milk fat globule membranes (MFGM), which encloses the fat…. Thus, one could speculate that an expected higher LDL cholesterol concentration after whole milk may be modified by a dairy matrix effect of MFGM."

Source:
Engel S., *et al.* Effect of whole milk compared with skimmed milk on fasting blood lipids in healthy adults: a 3-week randomized crossover study *Eur J Clin Nutr. 2018*

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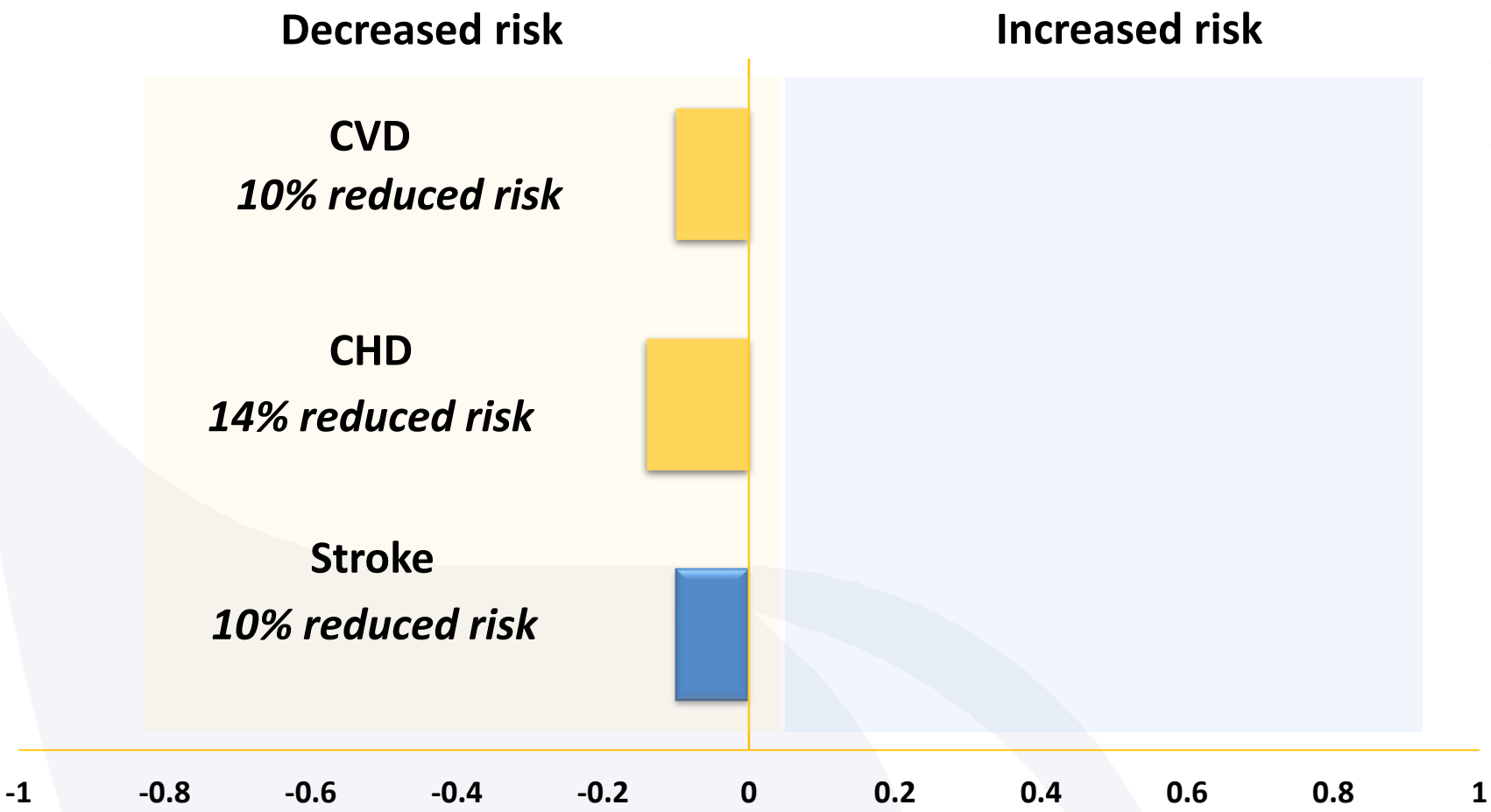
Meta-Analysis: Cheese Consumption is Associated with Reduced CVD Risk



EJCN
European Journal of Clinical Nutrition

Cheese consumption and risk of cardiovascular disease: a meta-analysis of prospective studies

15 Prospective Observational Studies
~340,000 participants

""This meta-analysis of prospective studies suggests a nonlinear inverse association between cheese consumption and risk of CVD."

"…the largest risk reductions observed at the consumption of approximately 40 g/d (~1.3 oz)"

Source:
- Chen et al. *Eur J Nutr.* 2017; 56(8):2565-75.

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Adding Cheese to a High Sodium Diet May Protect Against Negative Effects

Sodium, calories, and macronutrient content of dietary treatments.

	85g cheddar cheese	85g soy cheese	65g pretzel	170g cheddar cheese	130g pretzel
Sodium (mg)	560	560	560	1120	1120
Calories (kcal)	360	210	255	720	509
Fat (g)	28	21	0	56	0
Carbohydrate (g)	0	6	56	0	112
Protein (g)	20	3	5	40	10

BJN BRITISH JOURNAL OF NUTRITION

Dairy cheese consumption ameliorates single-meal sodium-induced cutaneous microvascular dysfunction by reducing ascorbate-sensitive oxidants in healthy older adults

Anna E. Stanhewicz[1], Billie K. Alba[2], W. Larry Kenney[1,2], and Lacy M. Alexander[1,2]

Randomized Control Trial
N=14 healthy adults (61±2 yr)

"… our data suggest that the antioxidant properties of dairy likely contribute to this association by protecting against dietary sodium-induced impairments in vascular function…"

"… increasing dietary dairy intake may represent a modifiable and non-pharmacological lifestyle factor that can increase vascular health and function…"

Supported by the National Dairy Council.

Source:
- Stanhewicz AE, et al. Dairy cheese consumption ameliorates single-meal sodium-induced cutaneous microvascular dysfunction by reducing ascorbate-sensitive oxidants in healthy older adults. Br J Nutr; 2016 ;116:658–65

NDC NATIONAL DAIRY COUNCIL

Consistent Evidence Demonstrates Eating Yogurt is Associated with Reduced Risk for Type 2 Diabetes

BMC Medicine

Dairy consumption and risk of type 2 diabetes: 3 cohorts of US adults and an updated meta-analysis

Mu Chen[1,2], Qi Sun[1,3], Edward Giovannucci[1,2,3], Dariush Mozaffarian[1,2,3,4], JoAnn E Manson[2,3,5], Walter C Willett[1,2,3] and Frank B Hu[1,2,3*]

14 Prospective Cohort Studies
>450,000 participants

Yogurt intake (one serving/day) associated with a 17% reduced risk for type 2 diabetes

The American Journal of CLINICAL NUTRITION

Consumption of dairy foods and diabetes incidence: a dose-response meta-analysis of observational studies[1,2]

*Lieke Gijsbers,[3] Eric L Ding,[4,5] Vasanti S Malik,[4] Janette de Goede,[3] Johanna M Geleijnse,[3] and Sabita S Soedamah-Muthu[3]**

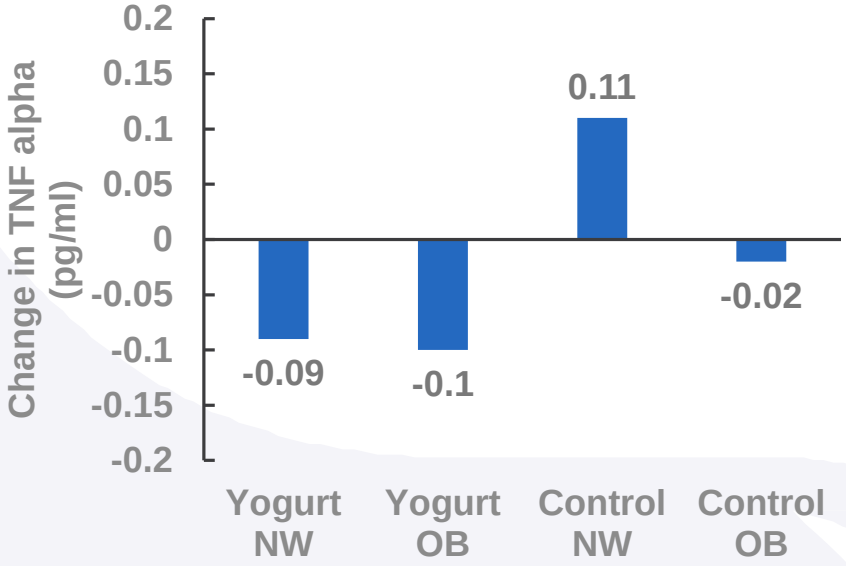
22 Cohort Studies
>570,000 individuals

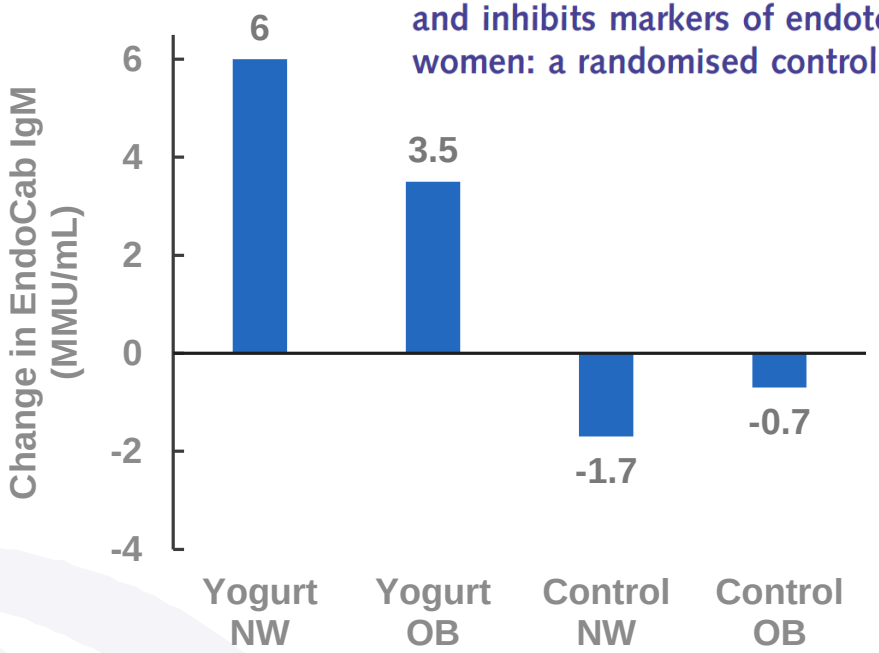
14% reduced risk per 80 g/day (~1/3-1/2 cup per day) compared to 0 g/day yogurt intake

Chen et al. *BMC Med.* 2014; 92:215.
Gijsbers et al. *Am J Clin Nutr.* 2016;103(4):1111-24.

Eating Yogurt Linked to Reduced Inflammation and Improved Markers of Gut Integrity

Low-fat yogurt consumption reduces biomarkers of chronic inflammation and inhibits markers of endotoxin exposure in healthy premenopausal women: a randomised controlled trial





Randomized Controlled Trial
120 premenopausal women

"Preclinical studies suggest milk oligosaccharides and lactoferrin promote intestinal barrier function and have anti-inflammatory properties. Dairy product fermentation also liberates peptides with hypotensive activity."

NW = normal weight
OB = obese

Yogurt = Yoplait Low-fat
Control = ZenSoy SoyPudding

*NDC sponsored study

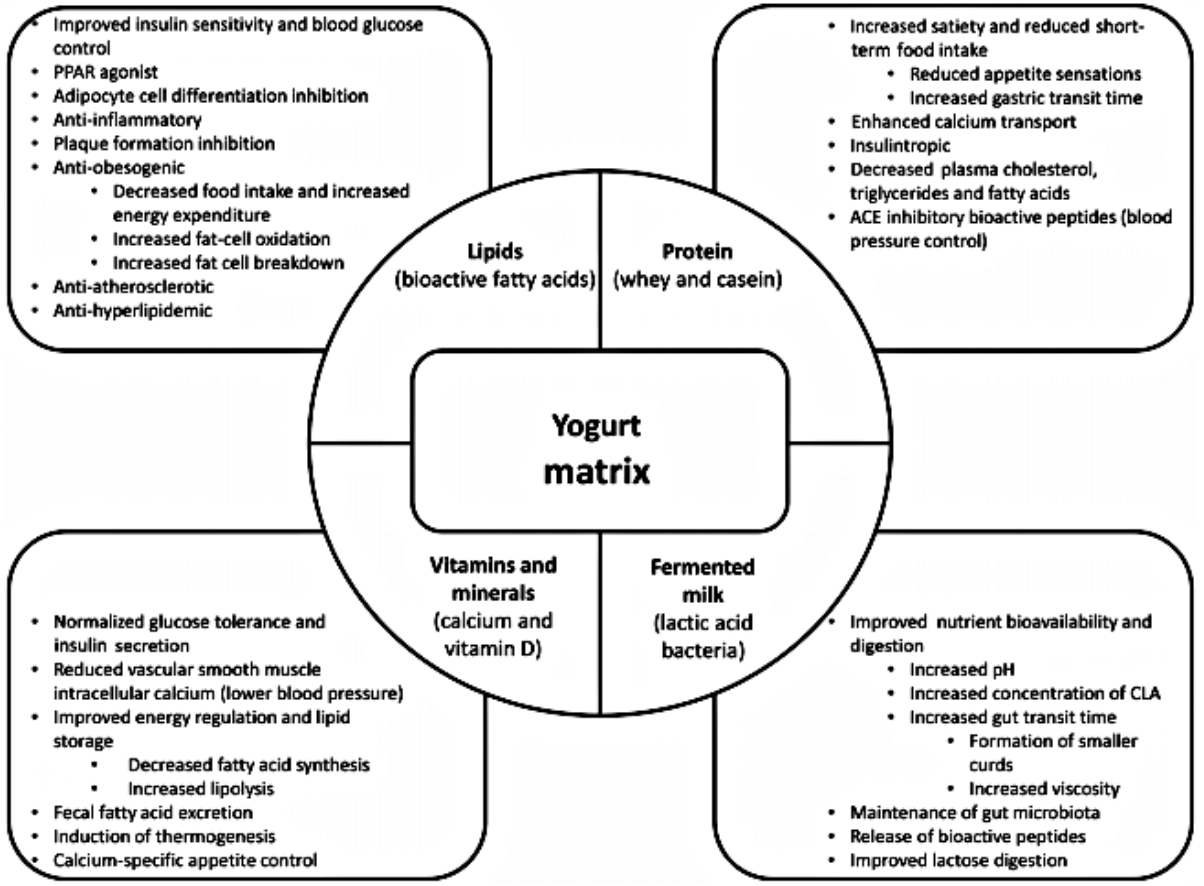
Source:
- Pei R et al. *Br J of Nutrition*. 2017; 118:1043-51.

Suspected Mechanisms of Action Responsible for Yogurt's Protective Cardiometabolic Properties

Advances in Nutrition
AN INTERNATIONAL REVIEW JOURNAL

Yogurt and Cardiometabolic Diseases: A Critical Review of Potential Mechanisms

Melissa Anne Fernandez,[1–3] Shirin Panahi,[4] Noémie Daniel,[1–3] Angelo Tremblay,[1,3,4] and André Marette[1,2,5]



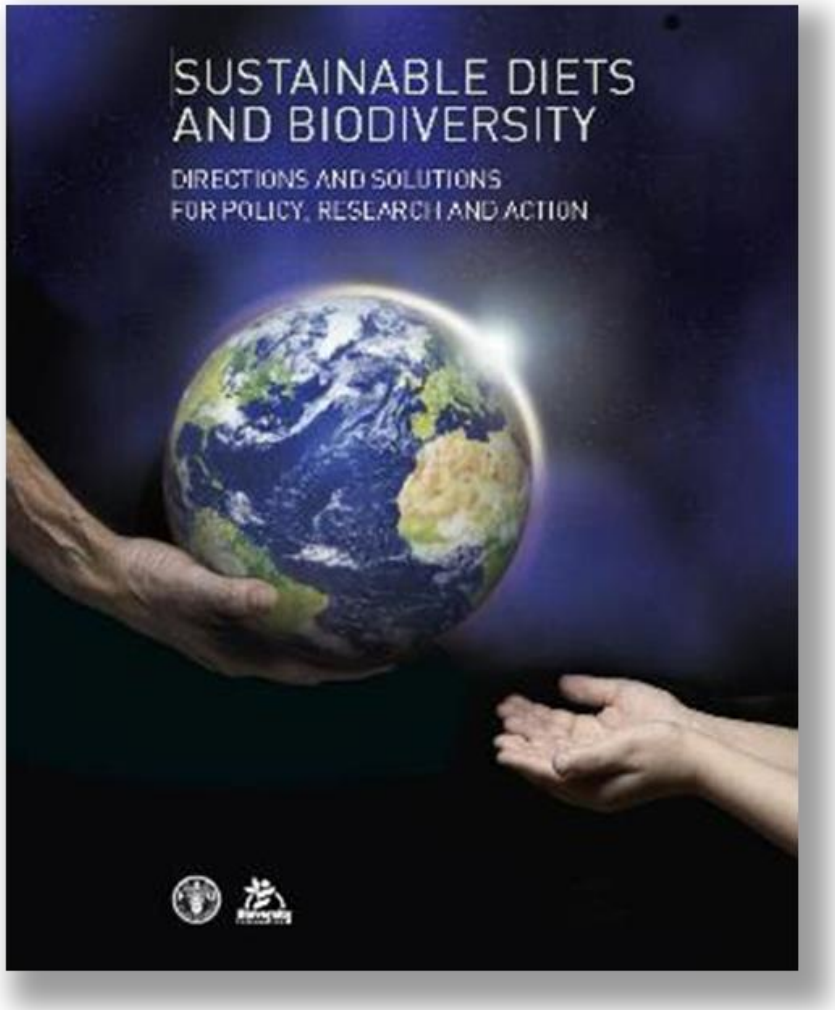
Reviews of Body of Evidence on Dairy Foods and Various Health Conditions

NationalDairyCouncil.org

Definition: Sustainable Diets

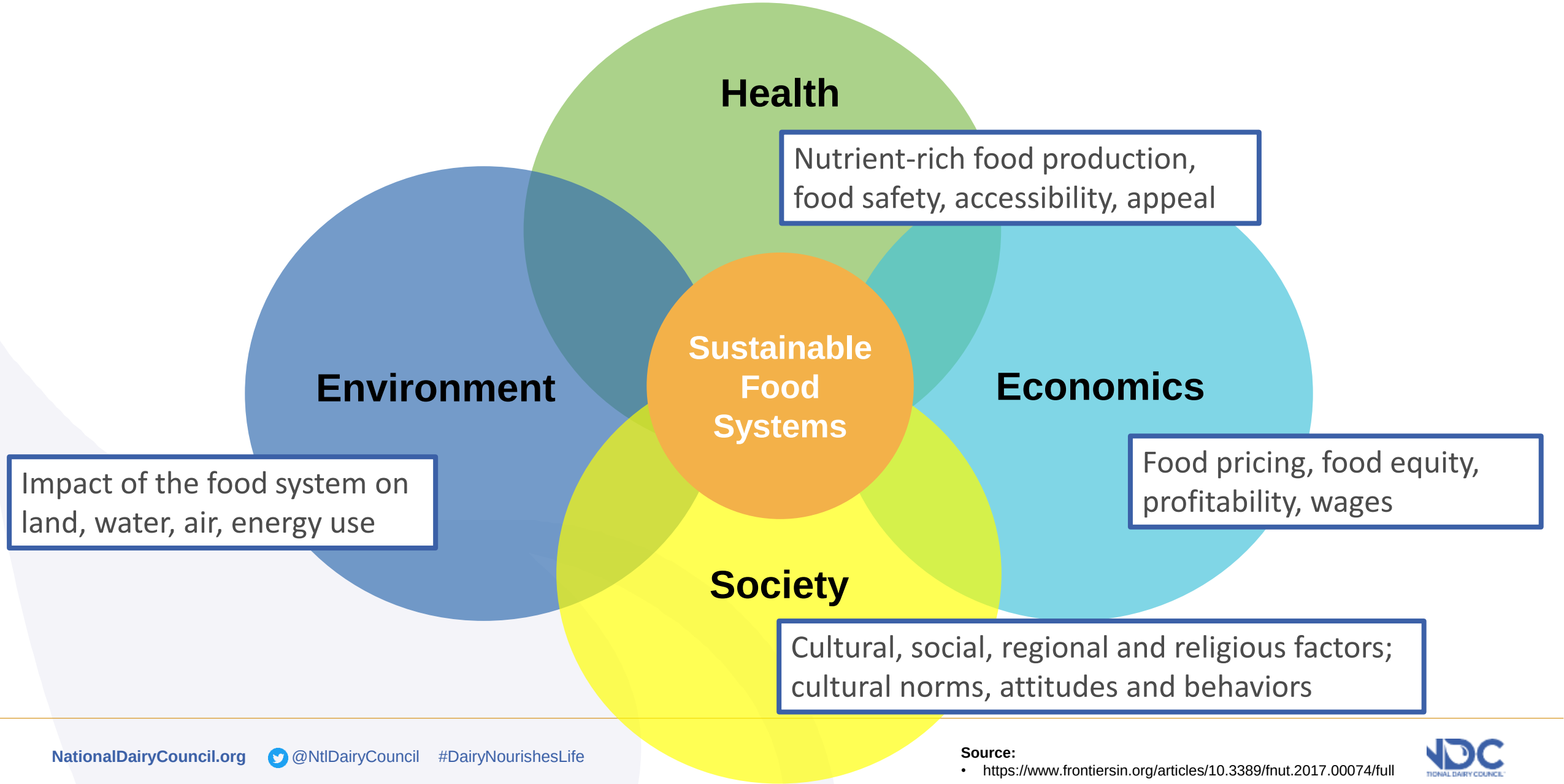
"Sustainable Diets are those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources."

- FAO and Bioversity International 2010



Source:
- http://www.fao.org/3/i3004e/i3004e.pdf

Four Dimensions of Sustainable Food Systems

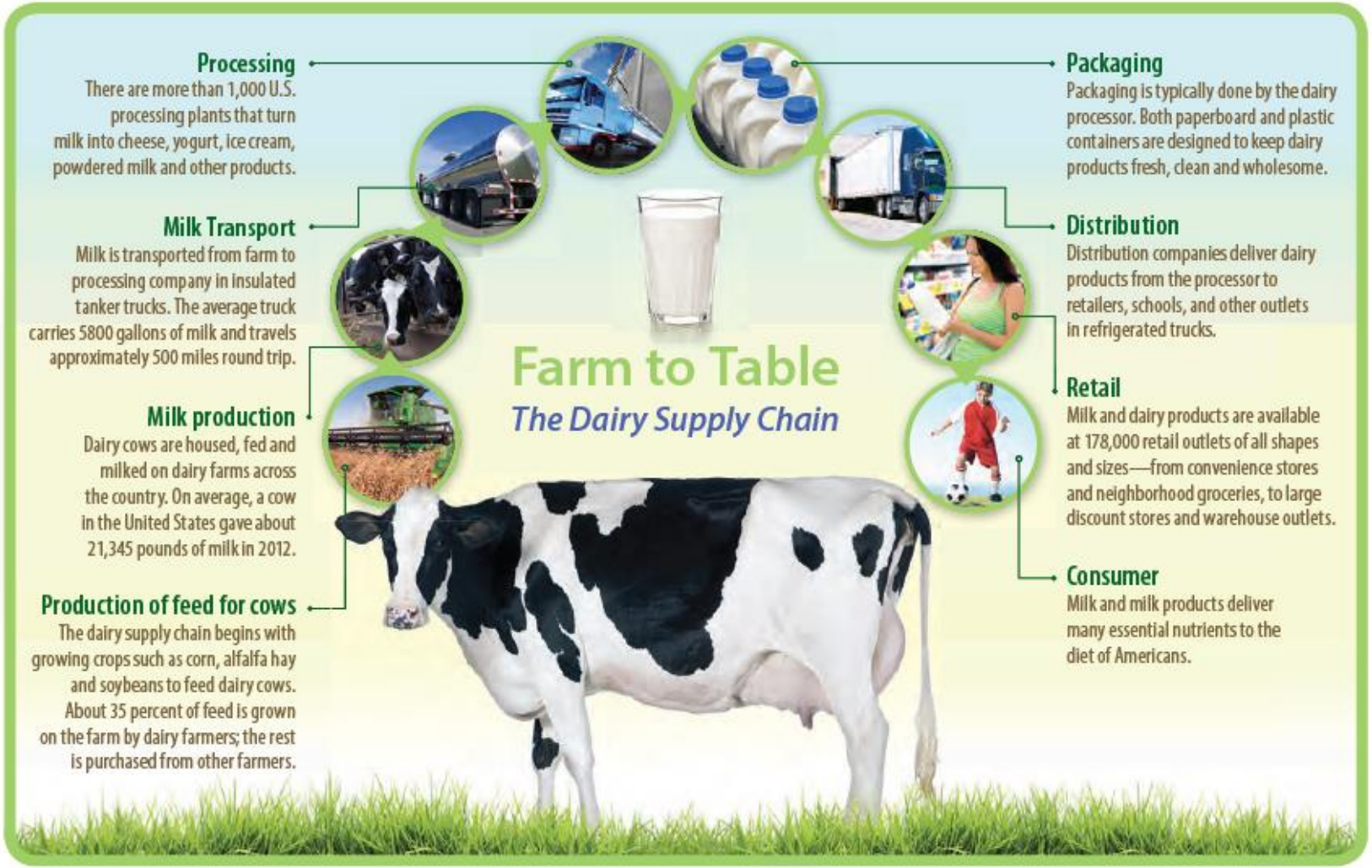


Source:
- https://www.frontiersin.org/articles/10.3389/fnut.2017.00074/full

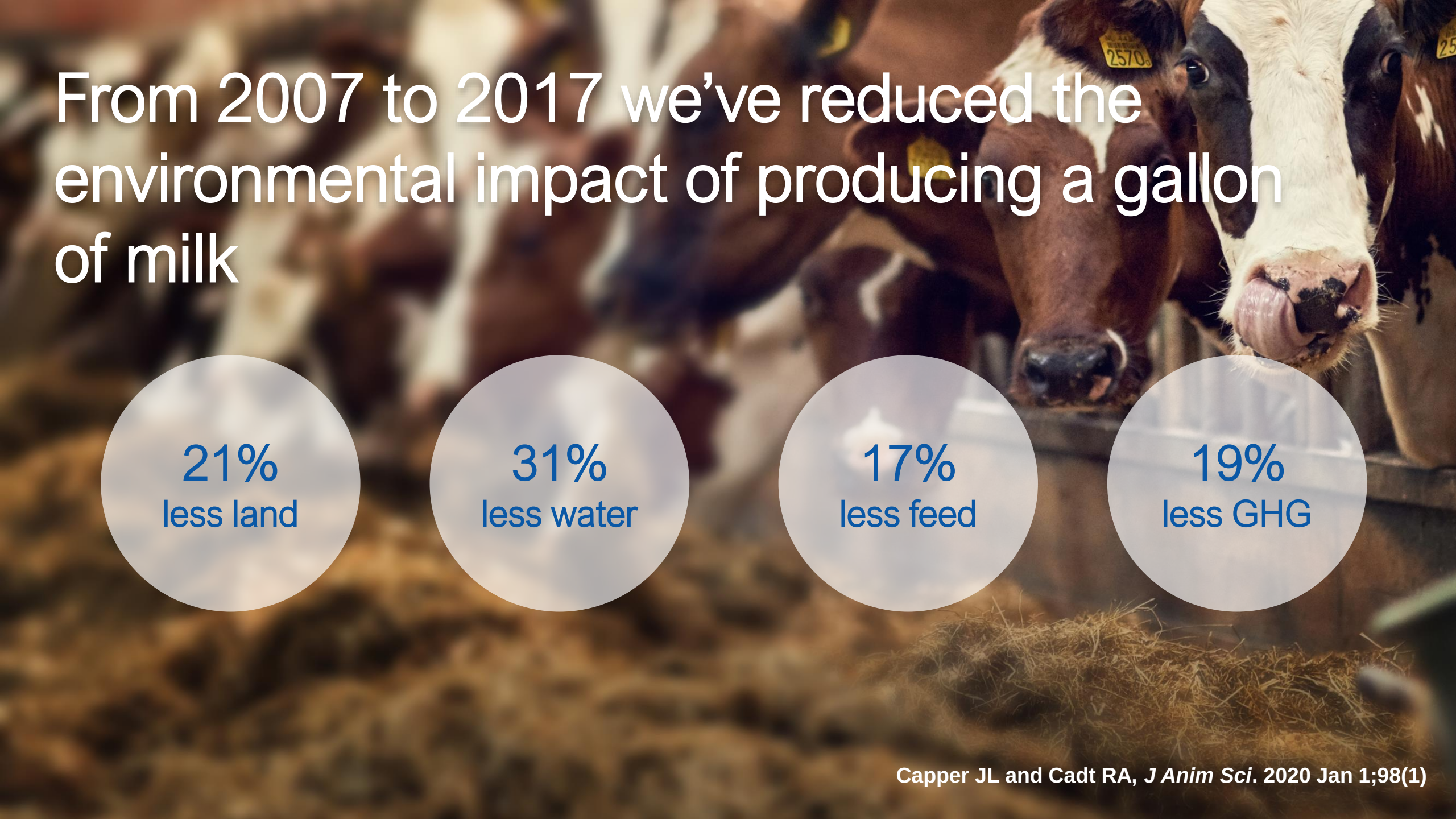
Dairy Life Cycle Assessment (LCA):

U.S. Dairy is:

- **2%** of U.S. GHG emissions
- **5.1%** total water withdrawal
- **3.7%** of total U.S. farmland



Dairy's Environmental Footprint. A Summary of Findings, 2009-2012. Production of Feed: USDA Economic Research Service, 2007; Milk Production: USDA, National Agricultural Statistics Service, 2012; Milk Transport: "Greenhouse Gas Emissions of Fluid Milk in the U.S.", University of Arkansas, 2010 Processing: USDA, National Agricultural Statistics Service, Agricultural Statistics Board, 2010; Retail: Progressive Grocer, 2008



From 2007 to 2017 we've reduced the environmental impact of producing a gallon of milk

21%
less land

31%
less water

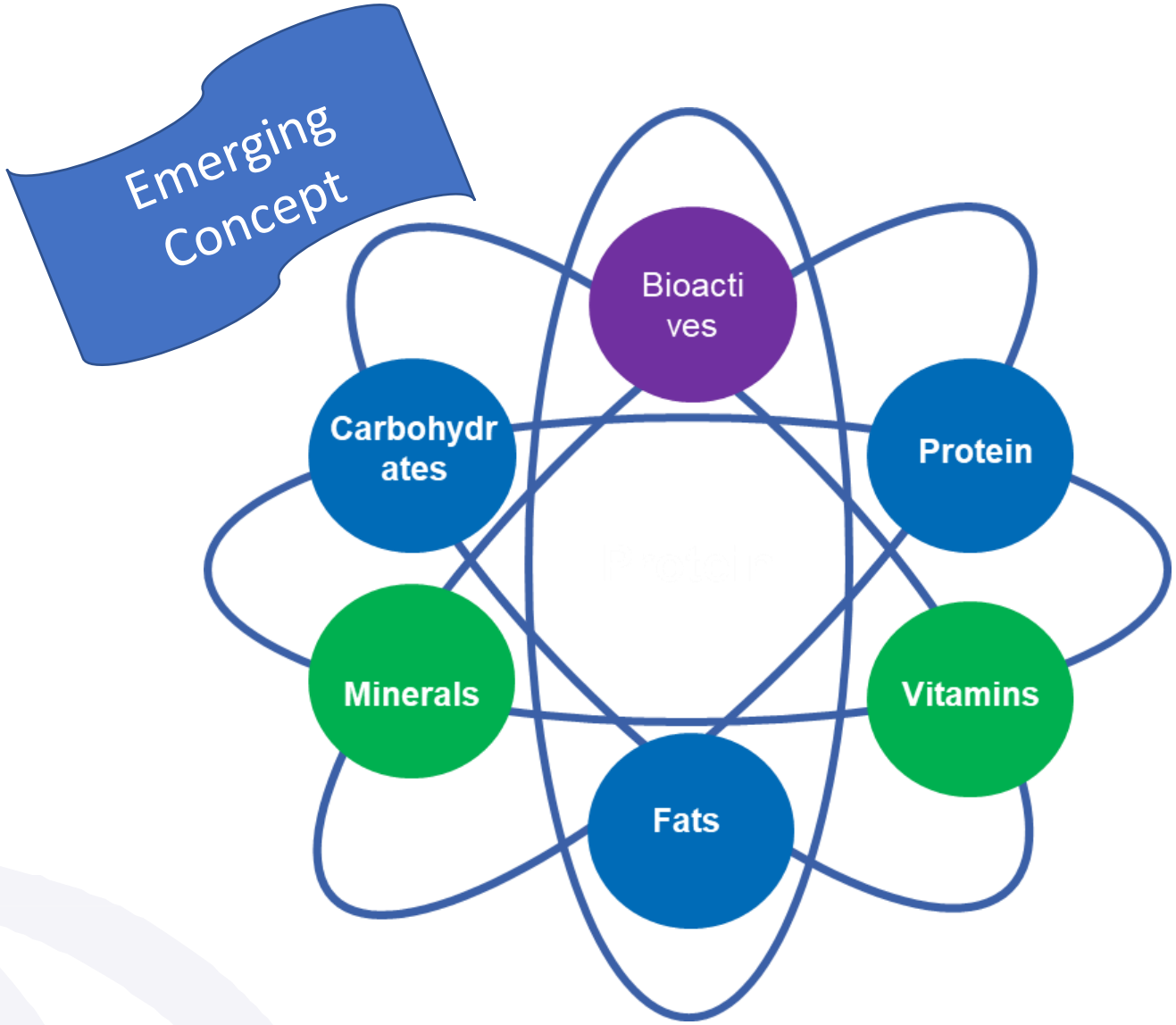
17%
less feed

19%
less GHG

Capper JL and Cadt RA, *J Anim Sci*. 2020 Jan 1;98(1)

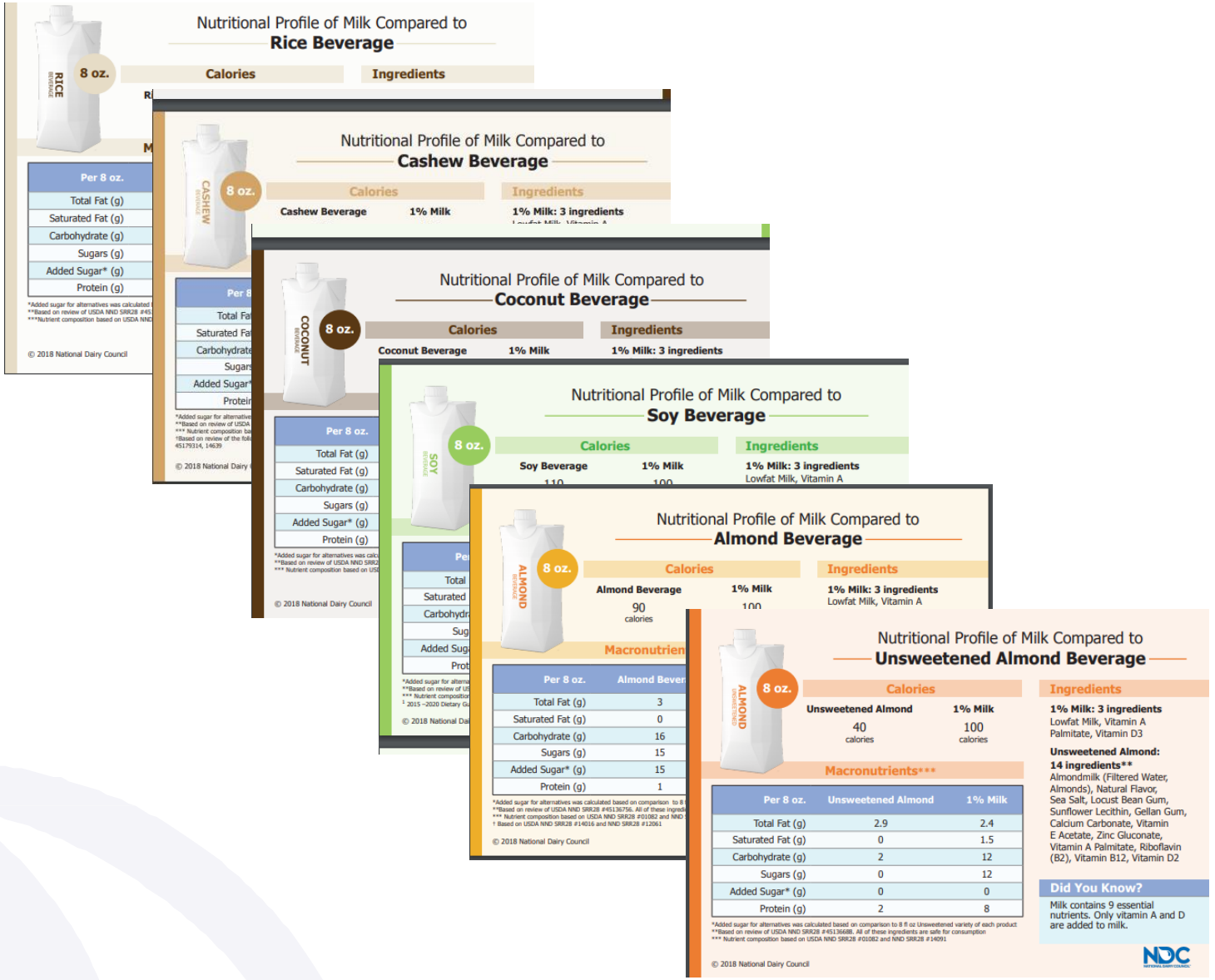

Bringing Science to the Table
NDC
NATIONAL DAIRY COUNCIL™

Stay curious while critically evaluating discovery and debate



Remember

1 + 1 ≠ 2



https://www.nationaldairycouncil.org/content/2018/how-milk-compares-to-various-plant-based-alternative-beverages

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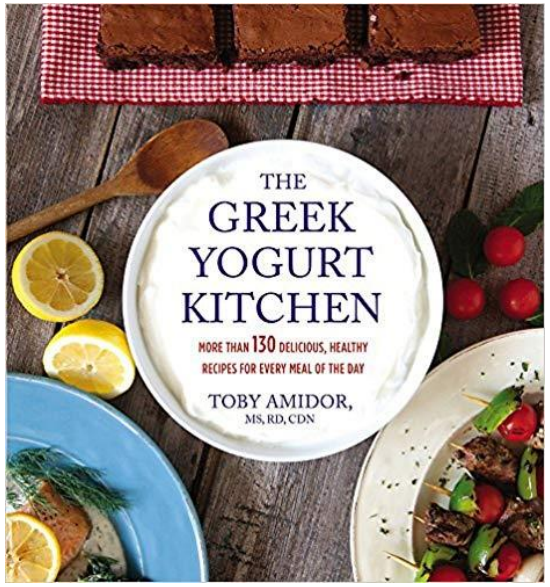
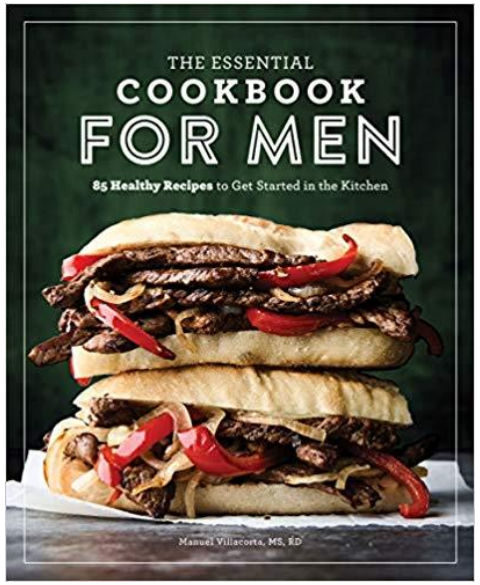
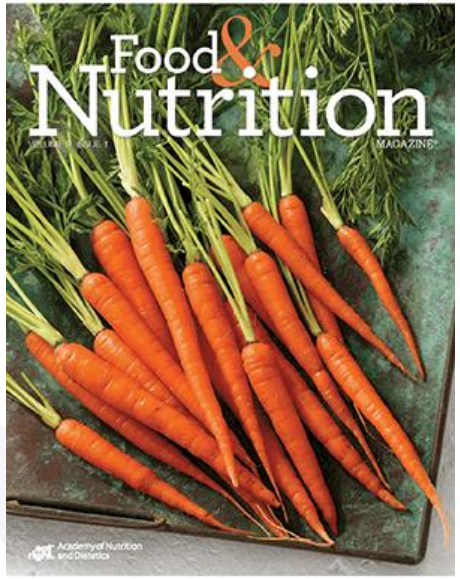
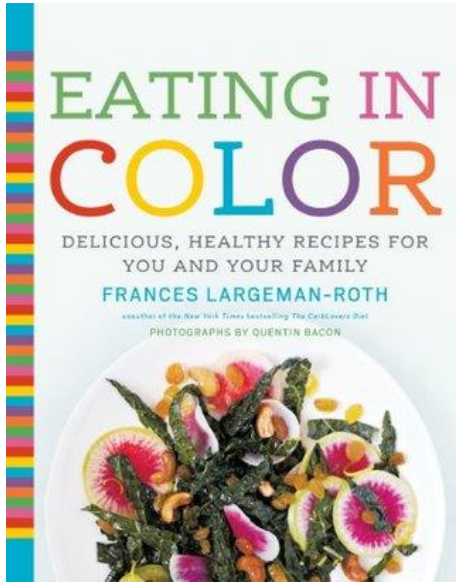
Focus on Food

Foods, Patterns, Synergies!









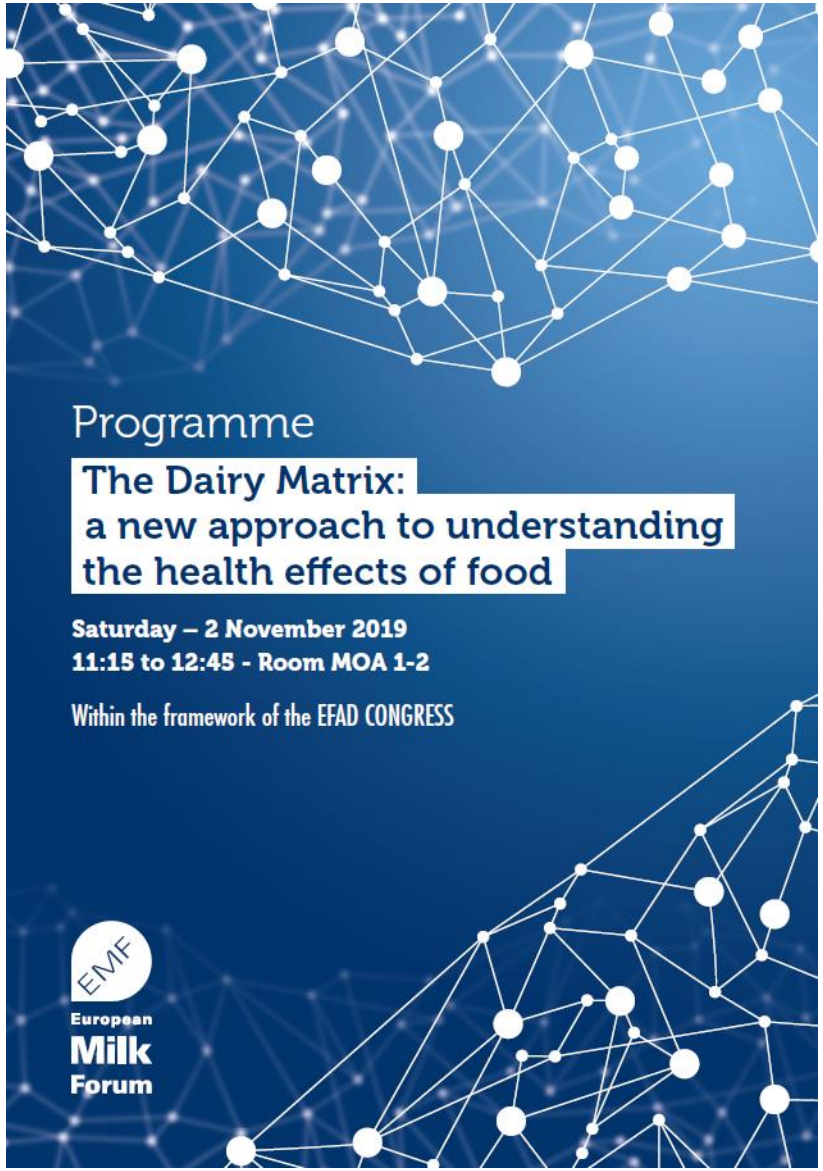
SET yourself up for fat flexibility

Swap less nutritious sources of fat for fuller-fat, nutrient-rich dairy foods

Ensure snacks stack up

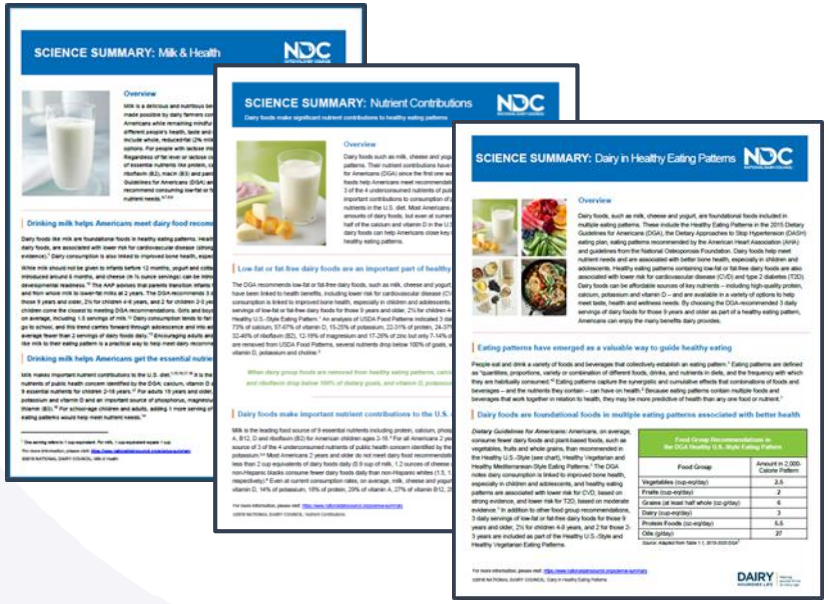
Think about portions

Acknowledgements

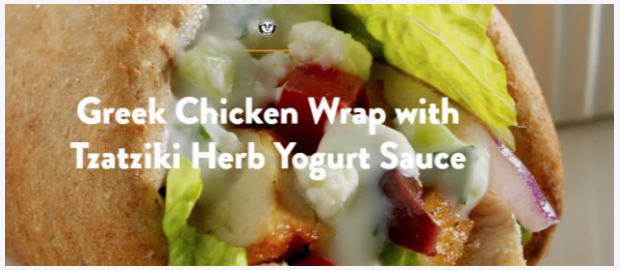


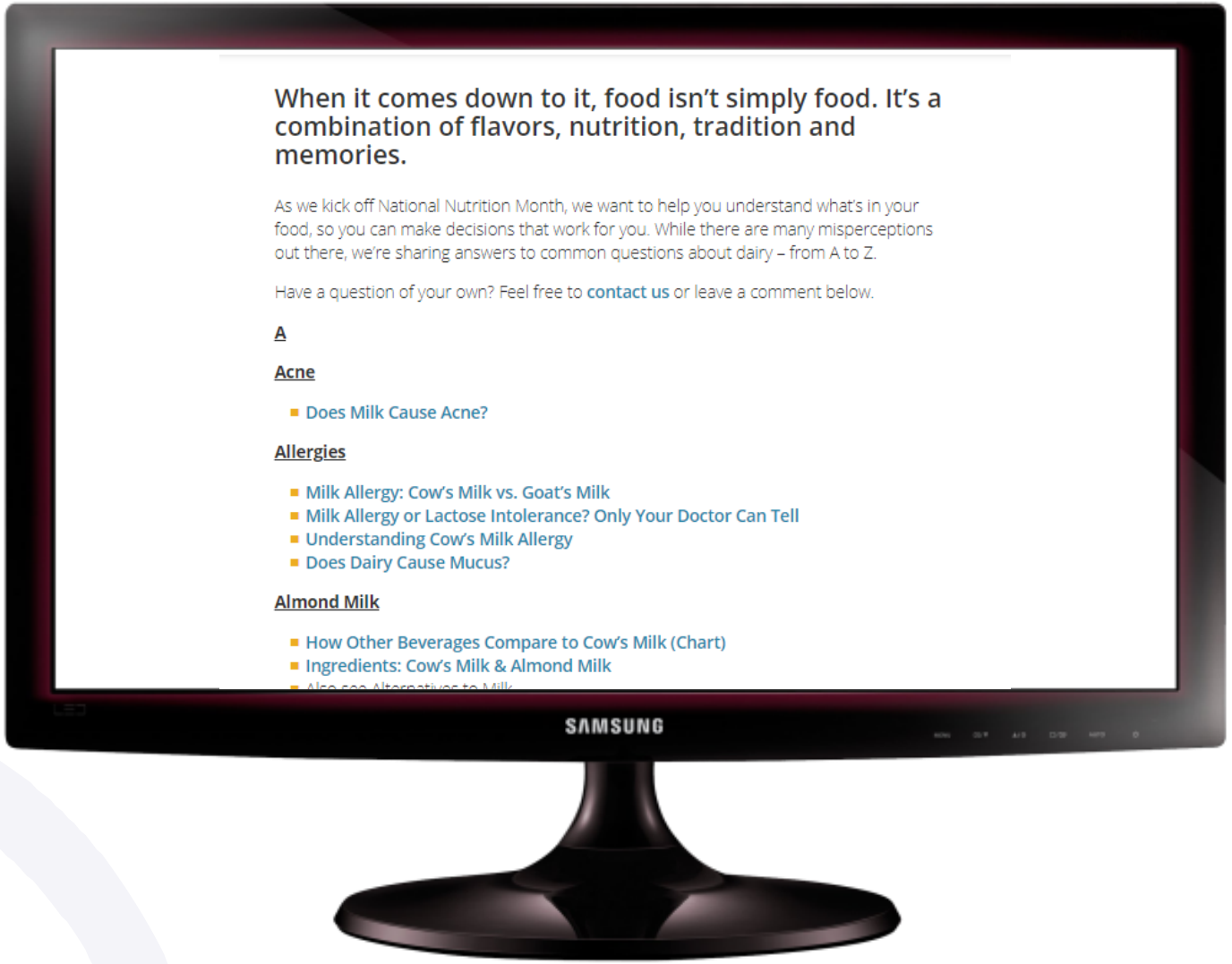
Host of Resources on www.nationaldairycouncil.org

10+ Science Summaries



Recipes





Dairy Nourishes Network Members receive:

- Quarterly updates
- Advance notice of webinars
- Recipe ideas/meal tips
- Engaging contests
- Opportunities to be highlighted on NDC's social
- In-person educational and networking events

Dairy Nourishes
NETWORK

To join
visit NationalDairyCouncil.org