EN HELHEDSORIENTERET TILGANG TIL MÆLKEMATRICEN OG DE SUNDHEDS-MÆSSIGE OG ERNÆRINGSMÆSSIGE EFFEKTER HERAF

A holistic approach to the milk matrix and its health and nutritional effects

Henrik Jørgen Andersen

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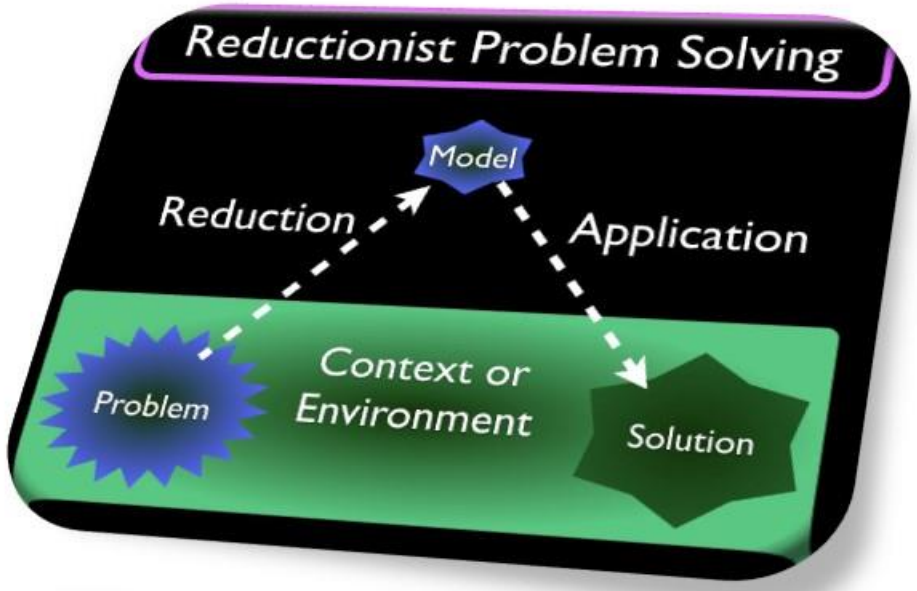
DIETARY GUIDELINES OF TODAY

- The power of chemistry

Focus on individual nutrients to maintain and improve health and prevent disease in the general population

- **Based on the historical focus, developed in the last century, on single nutrients in relation to clinical nutrient deficiency diseases**
  - **Scurvy ↔ Vitamin C**
  - **Beriberi ↔ Vitamin B1 (thiamine)**
  - **Rickets↔ Vitamin D**
  - **Etc.**



MILK FAT DOGMA 2008

- **Limit Total Fat**
  - ≤ 35% en
- **Limit SFA**
  - ≤ 10% en
- **Dairy is a target for SFA**

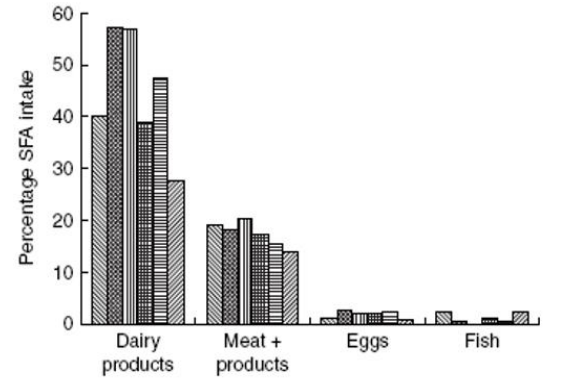


Fig. 1. Contribution of animal-derived foods to intake of SFA in selected European countries. (▧), Iceland; (▩), Germany; (▥), France; (▦), UK; (▤), Italy; (▨), Greece. (Adapted from Hulshof *et al.*[18].)

Givens 2008

Milkfat

Global Concerns about Saturated Fat

- EFSA Dietary Reference Values
- American Heart Assoc: 7%
- UK Campaign
- Denmark Tax

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WHEN DATA START TO SHOW THE UNEXPECTED

STUDIES ON NUTRITION, BONE MINERALIZATION AND METABOLIC MARKERS IN HEALTHY 8-YEAR-OLDS IN AN URBAN SWEDISH COMMUNITY

Susanne Eriksson, Department of Pediatrics, Institute of Clinical Sciences, Sahlgrenska Academy, University of Gothenburg, Göteborg, Sweden

Eight-year-old children who drink full-fat milk every day have a lower BMI than those who seldom drink milk. This is not the case for children who often drink medium-fat or low-fat milk. This is one conclusion of a thesis presented at the Sahlgrenska Academy at the University of Gothenburg, Sweden.

The study showed that children who drink full-fat milk every day weigh on average just over 4 kg less.

"This is an interesting observation, but **we don't know why it is so**. It may be the case that children who drink full-fat milk tend also to eat other things that affect their weight. Another possible explanation is that children who do not drink full-fat milk drink more soft drinks instead", says dietician Susanne Eriksson, author of the thesis.

The scientists also discovered a difference between overweight children who drink full-fat milk every day and those who do not. Children who often drink milk with a fat content of 3% are less overweight. The thesis shows also that the children eat more saturated fat than recommended, but those children who have a high intake of fat have a lower BMI than the children with a lower intake of fat.

Susanne Eriksson has investigated the nutrition, body composition and bone mineralization of **120 healthy 8-year-olds**. Much of the results can now be used as a standard to determine what is normal for healthy children at that age. The children recounted what they had eaten during the previous day, and answered questions concerning how often they ate certain foods. Various risk markers in the children's blood were also measured.

"Many of these children had been examined when they were four years old, and we discovered that their eating habits were pretty much unchanged four years later. It appears to be the case that eating habits are established early", says Susanne Eriksson.

Source: University of Gothenburg, 2009

Original Research

Does Fat in Milk, Butter and Cheese Affect Blood Lipids and Cholesterol Differently?

Tine Tholstrup, PhD, Carl-Erik Høy, PhD, Lene Normann Andersen, MS, Robin D.K. Christensen, MS & Brittmarie Sandström, PhD

Pages 169-176 | Received 09 Sep 2002, Accepted 04 Jun 2003, Published online: 18 Jun 2013

Objective: To compare the effects of isoenergetic amounts of milk, cheese and butter (adjusted to the same content of lactose and casein) on fasting and postprandial blood lipids and lipoproteins, and on postprandial glucose and insulin response.

Design: The experiments were designed to provide 20% of total energy from dairy fat, as either whole milk, mean (±SD) 2164 (±97) g, butter 93 (±4) g, and hard cheese 305 (±45) g, which were served to 14 healthy young men for three periods of three weeks each, separated by washout periods, in a randomized, cross-over study with strictly controlled dietary intake. Fasting blood samples were taken at the end of the study periods. Measurements of the postprandial effect of the three different dairy test products (0.7 g of milk fat/kg body weight) were carried out on day 4 of each intervention period. Blood samples were taken before and at 2, 4, 6 and 8 hours following intake of the meals.

Results: Fasting LDL cholesterol concentration was significantly higher after butter than cheese diet (p = 0.037), with a borderline significant difference in total cholesterol (p = 0.054) after the experimental periods of three weeks. Postprandial glucose showed a higher response after cheese diet than after milk diet (p = 0.010, diet × time interaction).

Conclusions: A different effect of fat in milk and butter could not be confirmed in this study. The moderately lower LDL cholesterol after cheese diet compared to butter diet should be investigated further.

Keywords:milk fat, cheese, butter, plasma cholesterol, glucose, insulin

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En helhedsorienteret tilgang til mælkematricen og de sundhedsmæssige og ernæringsmæssige effekter heraf

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THE EVIDENCE JUST INCREASED…AND INCREASES

- It's not just a question of single nutrients

NUTRITION

The Soft Science of Dietary Fat

Gary Taubes

Mainstream nutritional science has demonized dietary fat, yet 50 years and hundreds of millions of dollars of research have failed to prove that eating a low-fat diet will help you live longer

Since the early 1970s, for instance, Americans' average fat intake has dropped from over 40% of total calories to 34%; average serum cholesterol levels have dropped as well. But no compelling evidence suggests that these decreases have improved health. Although heart disease death rates have dropped--and public health officials insist low-fat diets are partly responsible--the *incidence* of heart disease does not seem to be declining, as would be expected if lower fat diets made a difference.

…….to the statisticians at the mortality branch of the National Center for Health Statistics (NCHS), the source of all the relevant statistics, the epidemic was illusory. In their view, heart disease deaths have been steadily declining since the late 1940s

Science, Vol 291, Issue 5513, 2536-2545 , 30 March 2001

Outline of meta-analyses

	CVD	CAD	Stroke	Hypertension	MetS	T2D
Total dairy	Neutral	Neutral	Favorable	Favorable	Favorable	Favorable
Regular- or high-fat dairy	Uncertain	Neutral	Neutral	Neutral	Uncertain	Neutral
Low-fat dairy	Uncertain	Neutral	Favorable	Favorable	Uncertain	Favorable
Milk	Uncertain	Neutral	Neutral	Favorable	Favorable	Neutral
Cheese	Neutral	Neutral	Favorable	Neutral	Uncertain	Favorable
Yogurt	Neutral	Neutral	Neutral	Neutral	Uncertain	Favorable

Drouin-Chartier et al. Adv Nutr 2016;7:1026–40

NOT ONLY DAIRY FOODS

- enhanced mineral uptake in mixed diets

TABLE 1
Iron status and nonheme-iron absorption data[1]

	Meat content of meal			
	0 g (n = 45)	25 g (n = 15)	50 g (n = 15)	75 g (n = 15)
Serum ferritin (μg/L)	—	16.9 (14.4, 19.7)	20.7 (17.8, 24.2)	21.0 (18.0, 24.5)
Hemoglobin (g/L)	—	125.1 (121.7, 128.6)	126.8 (123.3, 130.2)	125.9 (122.4, 129.4)
Absorption from reference dose[2] (%)	—	36.4^{a} (29.2, 45.4)	27.1^{a,b} (21.8, 33.8)	25.0^{b} (20.0, 31.1)
Absorption from meals (%)				
Unadjusted data	4.3^{c} (3.5, 5.4)	5.1^{c,d} (4.0, 6.5)	6.3^{e} (4.9, 8.0)	6.7^{e,f} (5.3, 8.5)
Data adjusted to 40 μg serum ferritin/L	2.1^{c} (1.7, 2.6)	2.4^{c,d} (1.9, 3.1)	3.1^{e} (2.4, 3.8)	3.3^{e,f} (2.6, 4.1)
Data adjusted to 40% absorption from reference dose	5.9^{c} (4.9, 7.2)	7.1^{c,d} (5.7, 8.8)	8.6^{e} (6.9, 10.7)	9.2^{e,f} (7.4, 11.5)
Meat meal:basic meal	—	1.15^{g} (1.02, 1.34)	1.44^{g,h} (1.26, 1.65)	1.57^{h} (1.34, 1.77)

[1] Least-squares means; 95% CI in parentheses. Values in a row with different superscript letters are significantly different (linear mixed models with post hoc Tukey-Kramer tests): $^{ab}P < 0.05$, $^{ce}P < 0.001$, $^{cf}P < 0.001$, $^{df}P < 0.04$, $^{gh}P < 0.05$.

[2] Three milligrams Fe as ferrous sulfate and 30 mg ascorbic acid in 10 mL of a 0.01-mol HCl/L solution.

Bæch et al. Am J Clin Nutr 2003;77:173–9.

WHEN EMPIRICAL EVIDENCE BECOME STRONG

- The Milk Fat Paradigm

FOOD IS MORE THAN THE SUM OF ITS PARTS

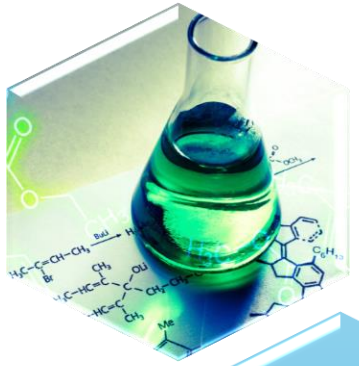
A NUTURAL FOOD IS A COMPLEX COMBINATION OF MACRO AND MICRO CONSTITUANTS AS WELL AS OTHER ELEMENTS WHICH INTERACT WITH MULTIDIMENTIONAL RELATIONS

EACH NUTURAL FOOD HAS ITS OWN NATURAL MATRIX WHICH IS IMPOSSIBLE TO REDUCE TO A SUM OF A FEW ELEMENTS

EVEN IN A DIET NEW MATRIXES ARE ESTABLISHED WHICH TOO INTERACT WITH MULTIDIMENTIONAL RELATIONS

NEW ERA – HOW TO PROCEED?

- New 'tools/technologies' as an integrated part of biology

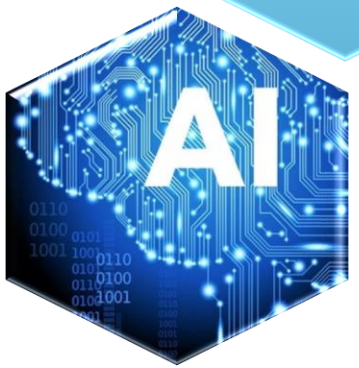


- Comprehensive
- Sensitive
- Accurate

21st century chemistry

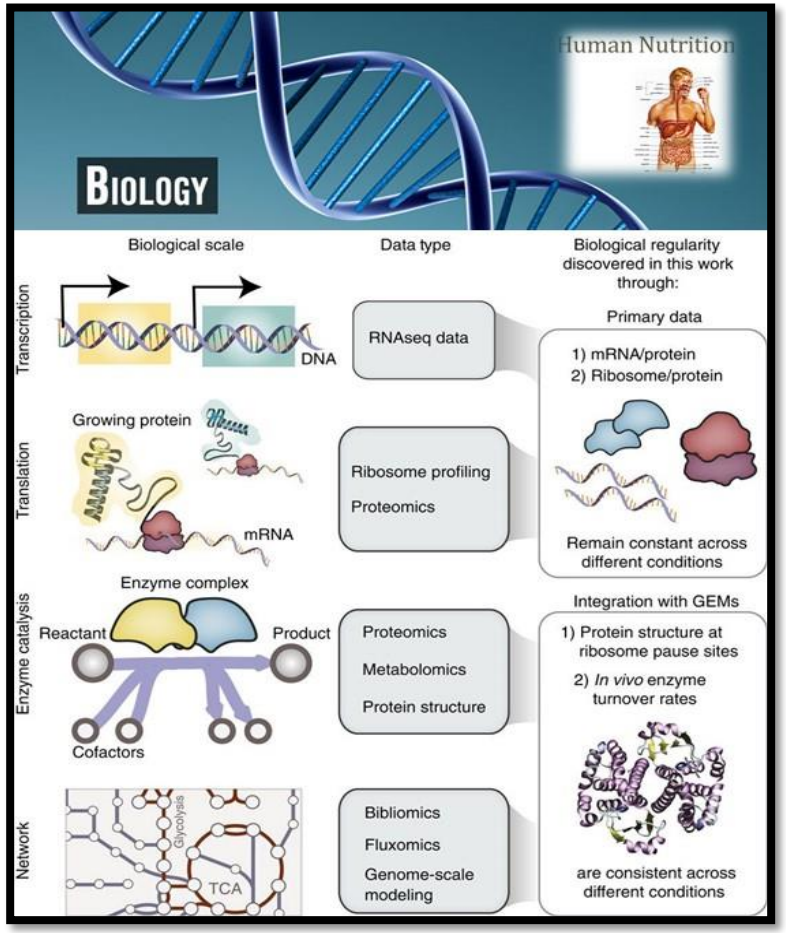
21st century mathematics

- Computational methods
- Massive Databases
- Global networks



- Complex systems
- Devices
- Artificial intelligence

21st century engineering



‘DIGESTION’ OF MILK FAT

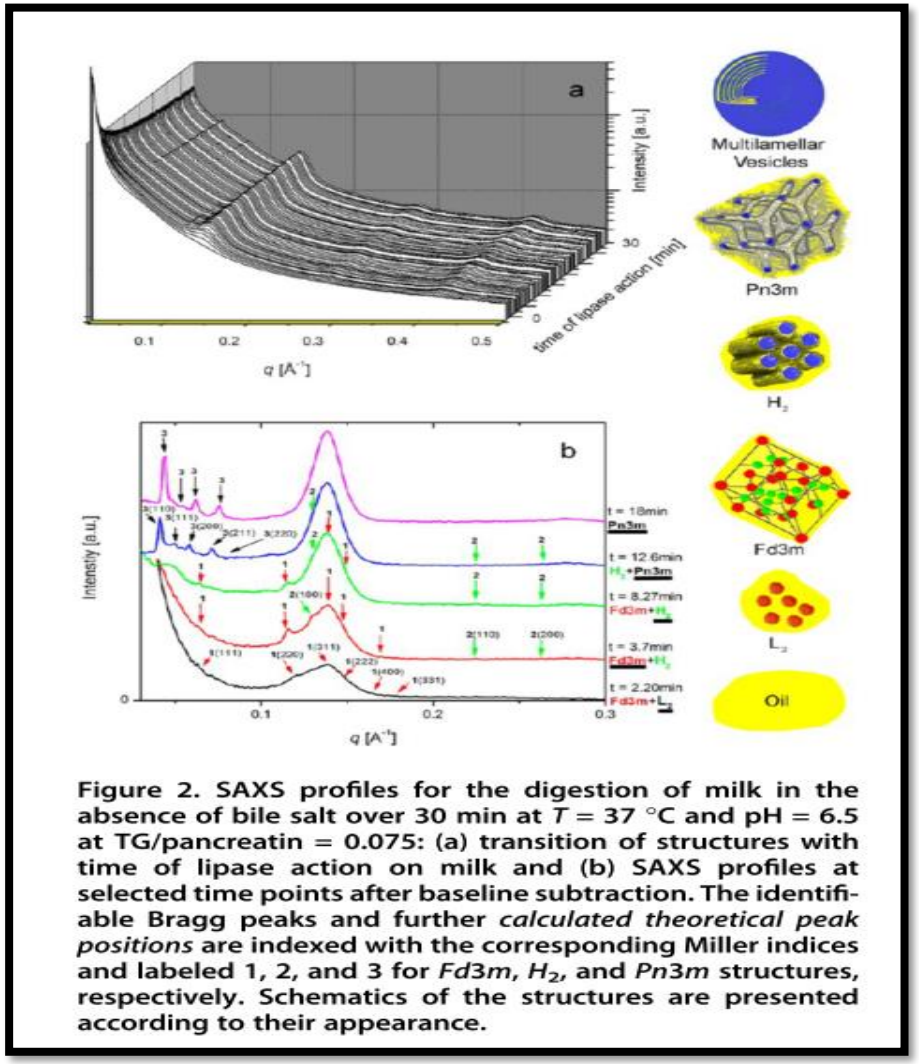


Figure 2. SAXS profiles for the digestion of milk in the absence of bile salt over 30 min at $T = 37$ °C and pH = 6.5 at TG/pancreatin = 0.075: (a) transition of structures with time of lipase action on milk and (b) SAXS profiles at selected time points after baseline subtraction. The identifiable Bragg peaks and further *calculated theoretical peak positions* are indexed with the corresponding Miller indices and labeled 1, 2, and 3 for *Fd3m*, H_2, and *Pn3m* structures, respectively. Schematics of the structures are presented according to their appearance.

Salentinig et al. (2013) ACS Nano 7(12): 10904–10911

Not a simple process

- Six phases
  - 6 different ways to interact with the surroundings during the digestion process
    - Access to enzymes – lipases – changes
    - Structures are degraded
    - Surfase properties changes
    - Etc.

WE ARE FEEDING TWO WORLDS

- And these are in no way independent

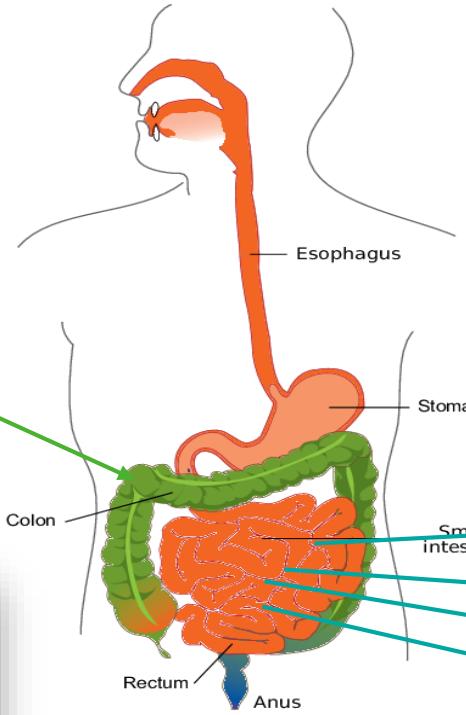
Human Milk

- Micronutrients & Vitamins
- Protein
- HMO (Fiber)
- Fat
- Lactose

Fiber (HMO)

Growth

The 3rd most abundant class of 'nourishing' molecules in human breast milk is un-digestible by human infants!



Fat
Sugar
Protein
Micronutrients & Vitamins

Growth

En helhedsorienteret tilgang til mælkematricen og de sundhedsmæssige og ernæringsmæssige effekter heraf

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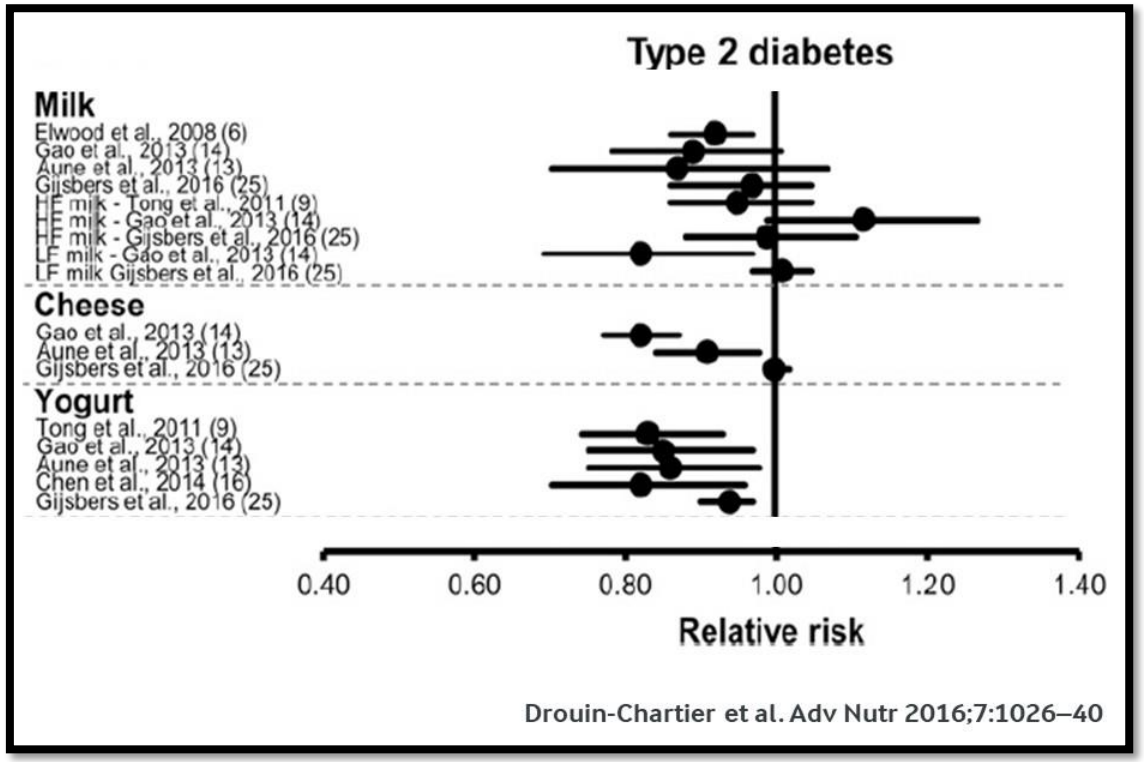
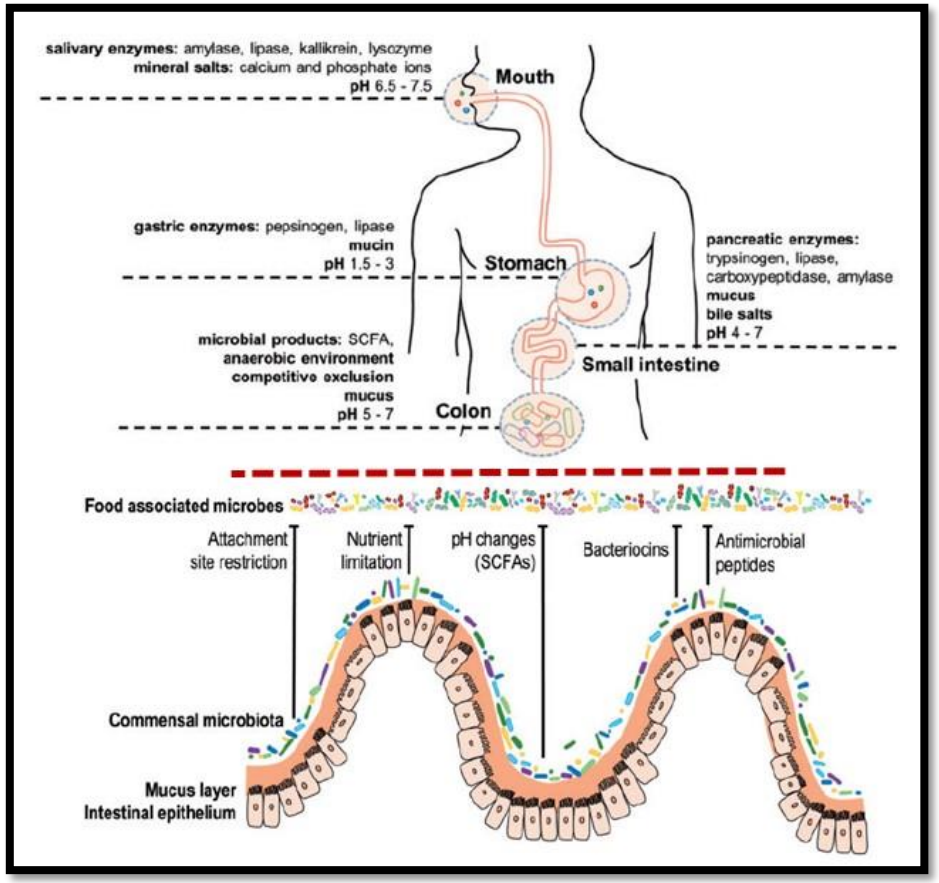
MULTIDIMENTIONAL MATRIX EFFECTS

-Health effects of fermented dairy in relation to Type 2 Diabetes





Kok & Hutkins (2018) Nutrition Reviews76(S1):4–15

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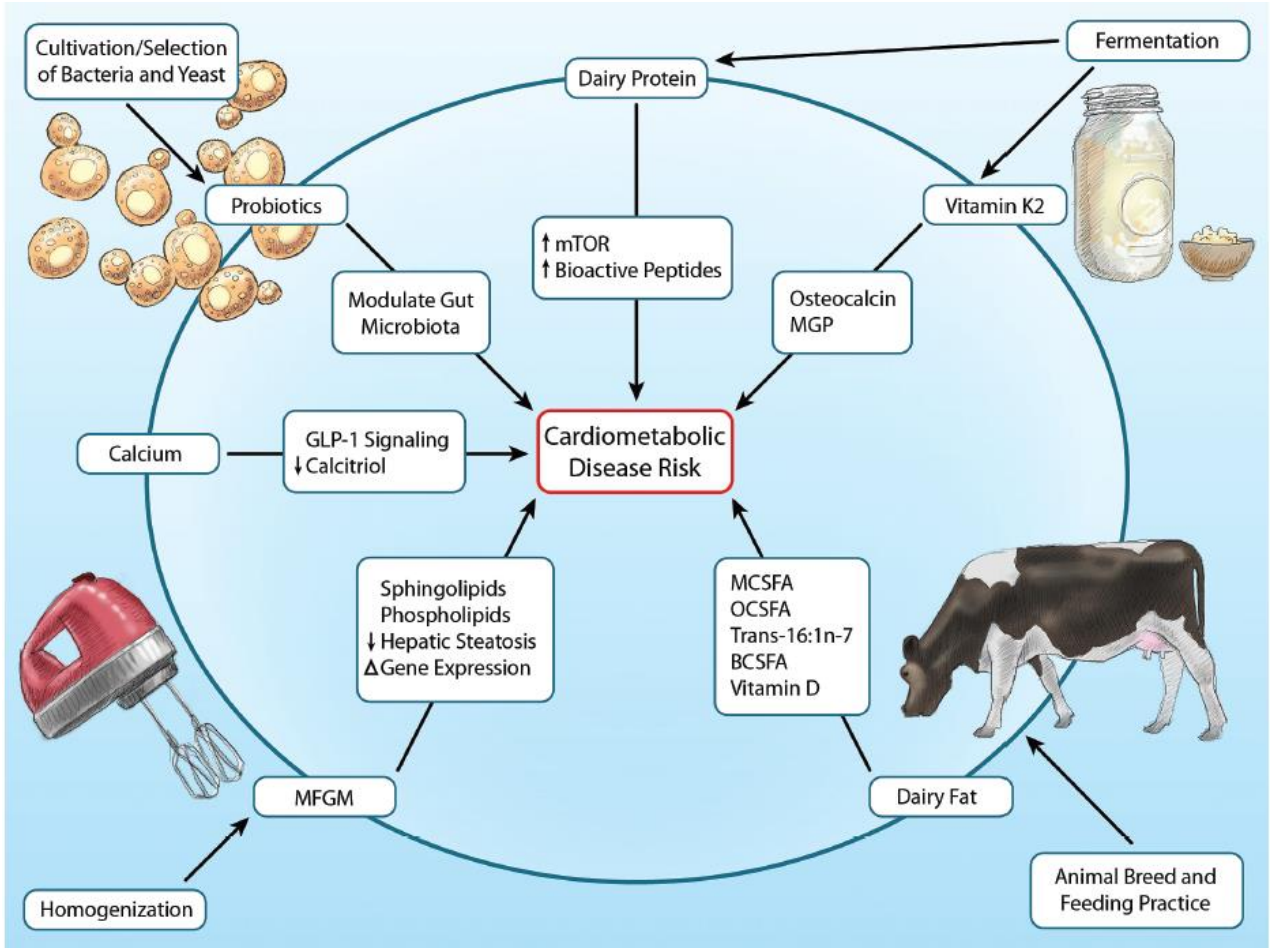
THEN HOW TO UNDERSTAND THE DAIRY MATRIX?

- Relevant characteristics of dairy foods and selected molecular pathways linked to non communicable diseases



Mozaffarian D. (2019)
Adv Nutr 10:917S–923S

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TOMORROWS DIETARY RECOMMENDATIONS

- Holistic.....or even diet based rater than food based

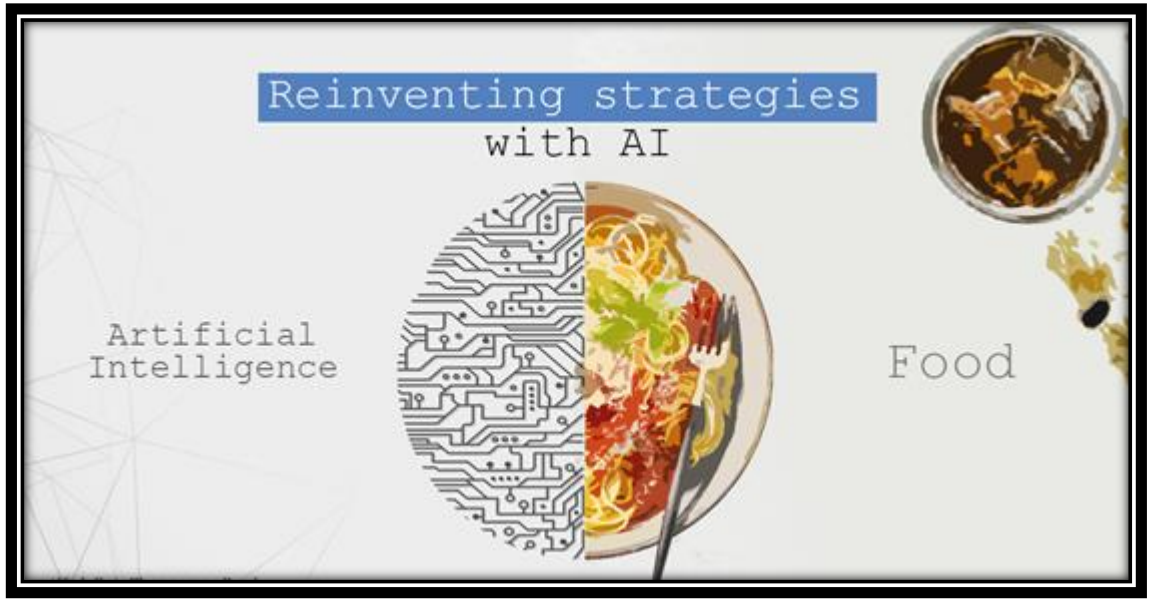
A process in several steps

STEP 1

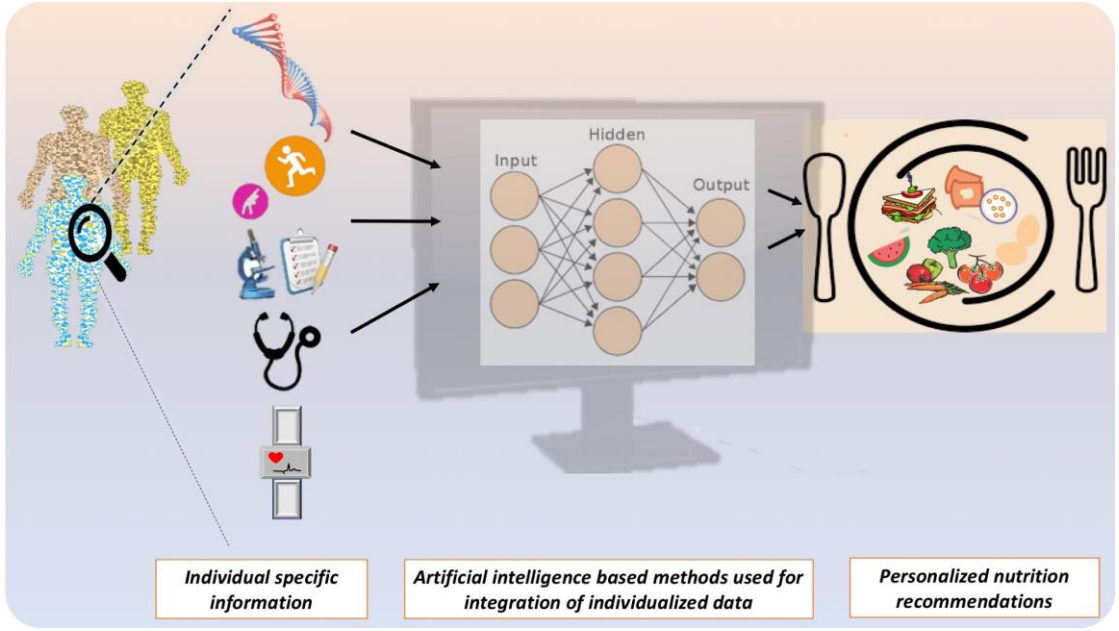
✓Include empiric evidence on health effects of different food products e.g. for dairy products on weight, body composition, CVDs and diabetes

STEP 2

- When more mechanistic understanding regarding matrix effects become evident these can be incorporated at a diet level.....this is complex, however...



PERSONALIZED DIET RECOMMENDATIONS



En helhedsorienteret tilgang til mælkematricen og de sundhedsmæssige og ernæringsmæssige effekter heraf

The food matrix:

Food is more than the sum of its nutrients

It's the unexpected that changes our lives.