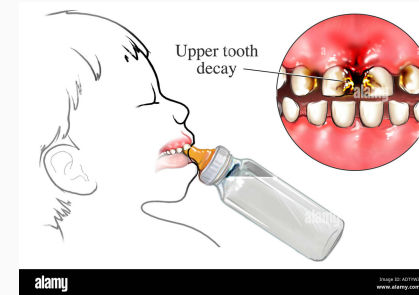


## Oral health: Is dairy "healthy" or "unhealthy"?



*British Journal of Nutrition* (2009), **101**, 376–382  
© The Authors 2008

doi:10.1017/S0007114508020734

### Cariogenic potential of cows', human and infant formula milks and effect of fluoride supplementation

Regina Celia Rocha Peres<sup>1</sup>, Luciane Cristina Coppi<sup>2</sup>, Maria Cristina Volpato<sup>2</sup>, Francisco Carlos Groppo<sup>2</sup>, Jaime Aparecido Cury<sup>2</sup> and Pedro Luiz Rosalen<sup>2\*</sup>

## Dairy ingredients or dairy matrix: a role in dental health?

michael.crowe@dental.tcd.ie

NIDC, Belfast, March 2023

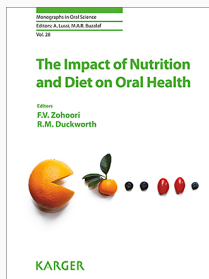
## Outline: dairy and dental

1. Dental caries and erosion
2. Microbiome/plaque matrix- pathways
3. Strategies to reduce cariogenicity/erosivity
4. At-risk clinical subgroups

## Dental caries



Interaction of oral microbiome with fermentable carbohydrate



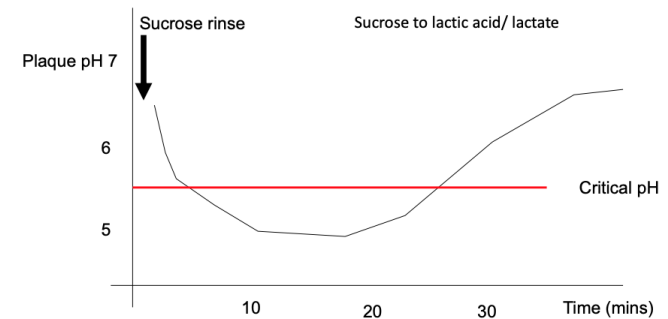
## Dental erosion



- Loss of tooth structure (hard tissues)
- by a chemical process (acid exposure)
- in the absence of plaque biofilm (clean tooth!)

## pH measurements after exposure to sucrose

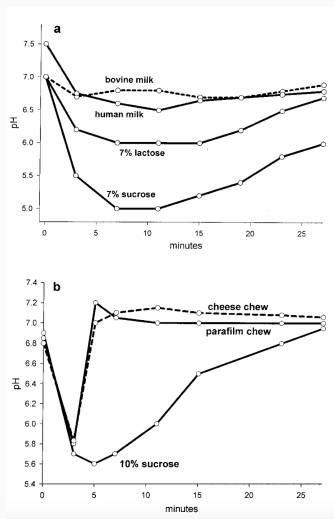
### Stephan's curve



- Stephan, RM, 1940. Changes in the hydrogen ion concentration on tooth surfaces and in carious lesions. J Am Dent Assoc 27: 718

(courtesy Guy Carpenter, Kings College, London)

## Effect of dairy products on Stephan curve



(Johansson, 2002: 'Milk and Dairy Products: Possible Effects on Dental Health')

## Aetiology of dental caries

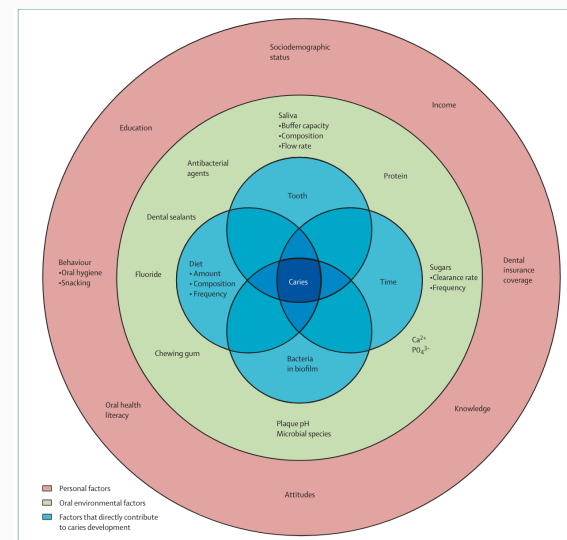


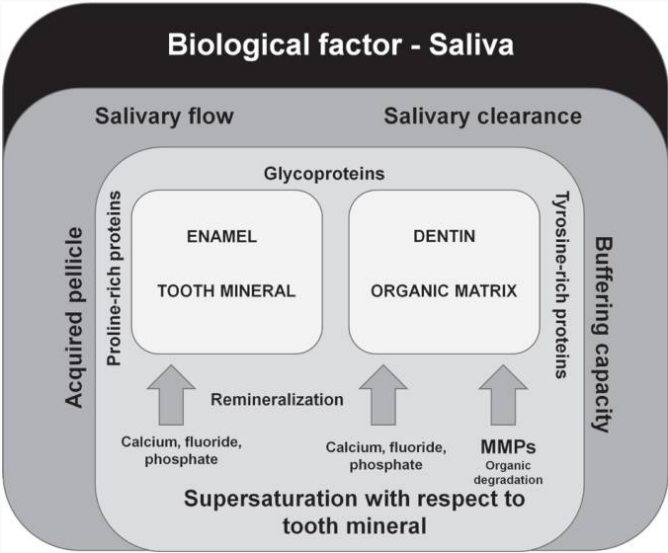
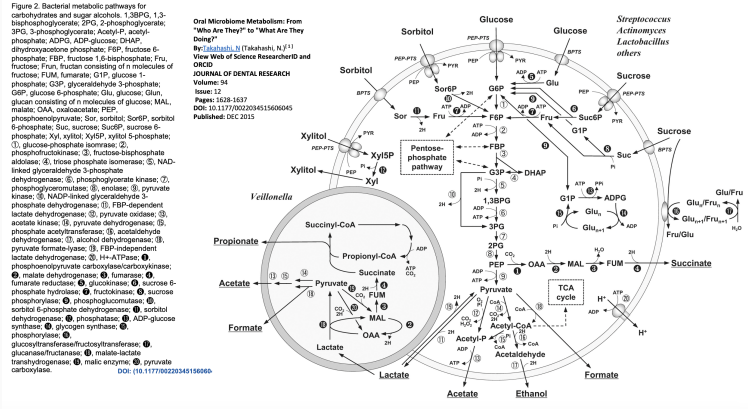
Figure 3: Illustration of the factors involved in caries development  
Adapted from Fejerskov and Manji, 1990<sup>2</sup> with permission of the authors and the publishers.



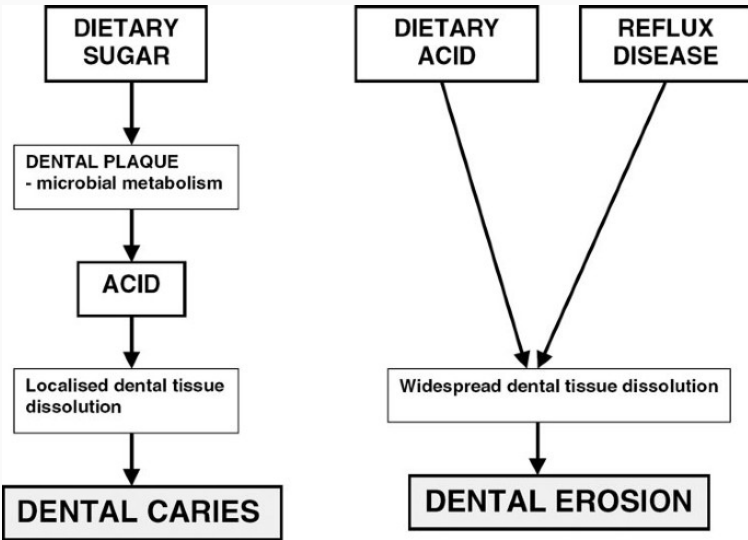
Oral Microbiome Metabolism: From “Who Are They?” to “What Are They Doing?”

N. Takahashi | View all authors and affiliations

Volume 94, Issue 12 | https://doi.org/10.1177/0022034515060045



Comparing caries v erosion

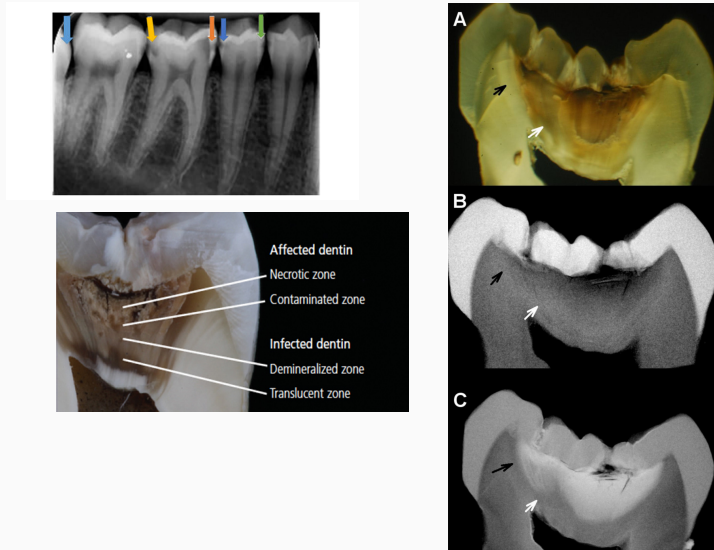


Indices to measure caries (ICDAS) and erosion (BEWE)

ICDAS II	0	1	2	3	4	5	6
Sound tooth surface							
First visual change in enamel							
Distinct visual change in enamel							
Localized enamel breakdown due to caries with no visible dentin							
Underlying dark shadow from dentin (with or without enamel breakdown)							
Distinct cavity with visible dentin							
Extensive distinct cavity with visible dentin							

BEWE	0	1	2	3	4	5	6
Sound tooth surface							
First visual change in enamel							
Distinct visual change in enamel							
Localized enamel breakdown due to caries with no visible dentin							
Underlying dark shadow from dentin (with or without enamel breakdown)							
Distinct cavity with visible dentin							
Extensive distinct cavity with visible dentin							

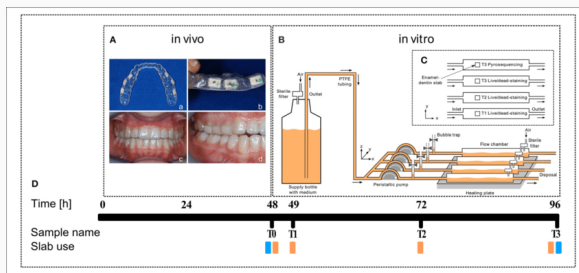
## Stages at which caries is reversible or irreversible



## Potential strategies to reduce or prevent dental caries OR erosion

- Saliva
- Microbiome/plaque matrix
- Time-duration-frequency (behaviour)
- Flouride
- **Food constituents or matrix**

## Food research: dental caries



## Epidemiology

### Association between milk and dairy product intake and the risk of dental caries in children and adolescents: NHANES 2011–2016

Jingjing Wang <sup>1</sup>, Genquan Jin <sup>1</sup>, Kunfang Gu <sup>1</sup>, Jing Sun <sup>1</sup>, Ronghui Zhang <sup>1</sup>, Xiubo Jiang <sup>2</sup>

Comparative Study > J Dent. 2010 Jul;38(7):579–83. doi: 10.1016/j.jdent.2010.04.009.  
Epub 2010 Apr 28.

### Intake of dairy products and the prevalence of dental caries in young children

Keiko Tanaka <sup>1</sup>, Yoshihiro Miyake, Satoshi Sasaki

#### SHORT REPORT

Open Access

### Intakes of calcium, vitamin D, and dairy servings and dental plaque in older Danish adults

Amanda RA Adegoke<sup>1</sup>, Lisa B Christensen<sup>2</sup>, Poul Holm-Pedersen<sup>3</sup>, Kirsten Avlund<sup>4,5</sup>, Barbara J Boucher<sup>6</sup> and Berit L Heitmann<sup>1</sup>

#### Abstract

**Background:** To investigate whether intakes of calcium and dairy servings within recommendations were associated with plaque score when allowing for vitamin D intakes.

- Plaque pH studies
- Animal studies
- Enamel slabs in situ
- Epidemiology/population studies/DMFT index

## Casein, Calcium, Phosphorous - a matrix effect?



Review

### Impact of Dairy Products and Plant-Based Alternatives on Dental Health: Food Matrix Effects

Blerina Shkemi<sup>1</sup> and Thom Huppertz<sup>1,2,\*</sup>

<sup>1</sup> Food Quality & Design Group, Wageningen University & Research, 6708 WG Wageningen, The Netherlands  
<sup>2</sup> FrieslandCampina, 3818 LE Amersfoort, The Netherlands  
 \* Correspondence: thom.huppertz@wur.nl

Dietary Factors	Dental Health Effect	References
Lactose	Limited cariogenicity	[26,45,46]
Sucrose	Cariogenic	[47–51]
Calcium	Protective	[52–55]
Phosphorus	Protective	[52–55]
Casein	Protective	[46,56–63]
Lactoferrin, lysozyme, and lactoperoxidase	Protective	[16,57,64–68]
Milk fat	Protective	[56,69,70]
Fluoride	Protective (not at a high amount)	[41,71–73]

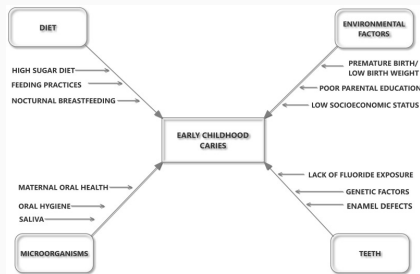
## Constituents derived from dairy products and potential effects on oral health

Constituent	Source/fraction	Potential effects
Casein	Main protein group	Antibacterial, inhibit adhesion, reduce glucan formation
Calcium, phosphorous	Milk, cheese, yoghurt	Remineralisation/pH buffering
Glycomacropeptide (GMP)	Hydrolysis of $\kappa$ -casein	Inhibition of bacterial adhesion
Casein phosphopeptide-amorphous calcium phosphate (CPP-ACP)	Enzymatic digestion and ultrafiltration of casein	Reduced demineralisation and enhanced remineralisation inhibit <i>S. mutans</i>
Lactoperoxidase, lysozyme	Whey protein peptides	Inhibit <i>S. mutans</i>
Lactoferrin	Iron-binding protein	Inhibit bacterial attachment
Proteose-peptones	Hydrolysis of $\beta$ -casein	Inhibit demineralisation

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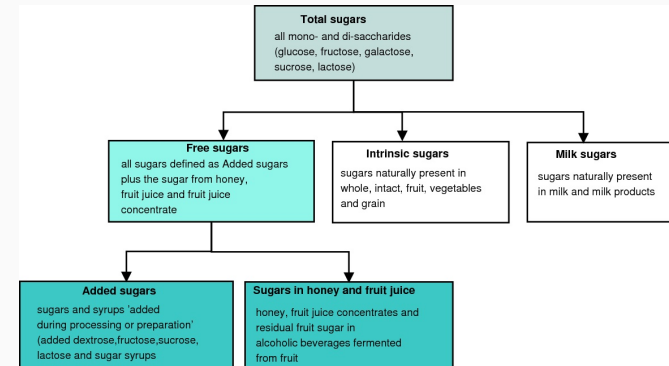
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## Lactose and ECC ("nursing caries")



- Early childhood caries (ECC)
- Lactose least acidogenic sugar
- Intake of sugars at night time to aid the child's sleep.

## WHO Sugar classification (2015)



- WHO recommends reducing the intake of free sugars to less than 10% of total energy intake (strong recommendation).
- WHO suggests a further reduction of the intake of free sugars to below 5% of total energy intake (conditional recommendation).

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# Frequency versus amount of sugar?

**Caries Research**

Current Topic

Caries Res 2019;53:168–175  
DOI: 10.1159/000489571

Received: January 30, 2018  
Accepted after revision: April 17, 2018  
Published online: August 8, 2018

**Sugar Restriction for Caries Prevention: Amount and Frequency. Which Is More Important?**

Cor van Loveren

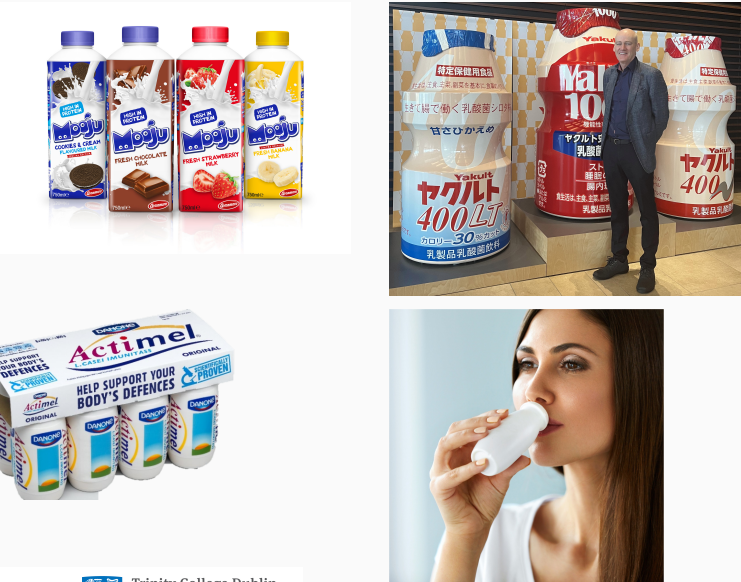
frontiers  
in Nutrition

METHODS  
published: 07 September 2018  
doi: 10.3389/fnut.2018.00032

**Data Mapping From Food Diaries to Augment the Amount and Frequency of Foods Measured Using Short Food Questionnaires**

Michael Crowe<sup>1</sup>, Michael O'Sullivan<sup>1</sup>, Breige A. McNulty<sup>1</sup>, Oscar Cassidy<sup>1</sup> and Aine O'Sullivan<sup>1\*</sup>

# Sugar in dairy products



# Fractions and peptides inhibiting dental plaque

**Randomized Controlled Study to Evaluate Microbial Ecological Effects of CPP-ACP and Cranberry on Dental Plaque**

N. Philip<sup>1</sup>, S.J. Leishman<sup>1</sup>, H.M.H.N. Bandara<sup>2</sup>, D.L. Healey<sup>1</sup>, and L.J. Walsh<sup>1</sup>

The inhibitory effect of glycomacropeptide on dental erosion

Effet inhibiteur du glycomacropeptide sur l'érosion dentaire

Anita Setareh Nejad Ara Kanekanian & Arthur Tatham

Dairy Science & Technology 89, 233–239 (2009) | [Cite this article](#)

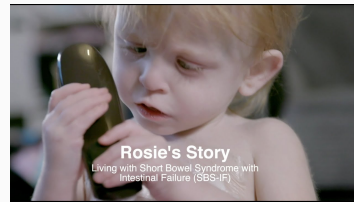
106 Accesses | 7 Citations | [Metrics](#)

# Application of CCP-ACP





## Specific subgroups: increased caries risk



## Advice to mitigate oral health problems



## Elite athletes and oral health

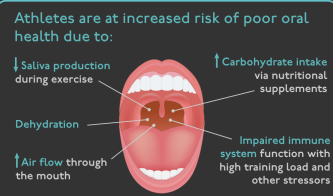


### Oral health and impact on performance of athletes participating in the London 2012 Olympic Games: a cross-sectional study

I Needleman,<sup>1</sup> P Ashley,<sup>2</sup> A Petrie,<sup>3</sup> F Fortune,<sup>4</sup> W Turner,<sup>4</sup> J Jones,<sup>4</sup> J Niggli,<sup>4</sup> L Engebretsen,<sup>5,6,7</sup> R Budgett,<sup>7</sup> N Donos,<sup>1</sup> T Clough,<sup>8</sup> S Porter<sup>9</sup>

© Sports Med. first published as 10.1080/17445019.2013.828888

#### What is the Problem?



## Erosion: clean teeth- intrinsic and extrinsic acid



Severe dental erosion related to bulimic purging. Produced with permission from Dr S. Weinstein



Erosive and abrasive lesions on the teeth of a 35-year-old woman with anorexia and bulimia (from BDJ 2014; **216**: 463-468)



Initial cervical erosive lesions in a young patient with anorexia (from BDJ 2014; **216**: 463-468)



Reflux from vomiting led to acidic dissolution of the lingual side of the maxillary incisors in this patient (from BDJ 2014; **216**: 463-468)



A bizarre palatal haematoma in a 30-year-old female bulimic (from BDJ 1999; **186**: 109-113)

(Douglas, L, Nature.comBDJteam)



## Prevention versus "Restoration"



- Current emphasis is minimal intervention
- Maximise prevention
- Restorative treatment is costly
- Use food diaries or repeated 24HR
- Personalised dietary advice

## Conclusions

- Dairy foods and ingredients have a positive role in impacting dental health
- Specific dairy constituents and foods have proven efficacy in 'perturbing the matrix'
- Future research- how to use foods or constituents as therapeutics within the plaque matrix



[https://twitter.com/crowe\\_dentist](https://twitter.com/crowe_dentist)

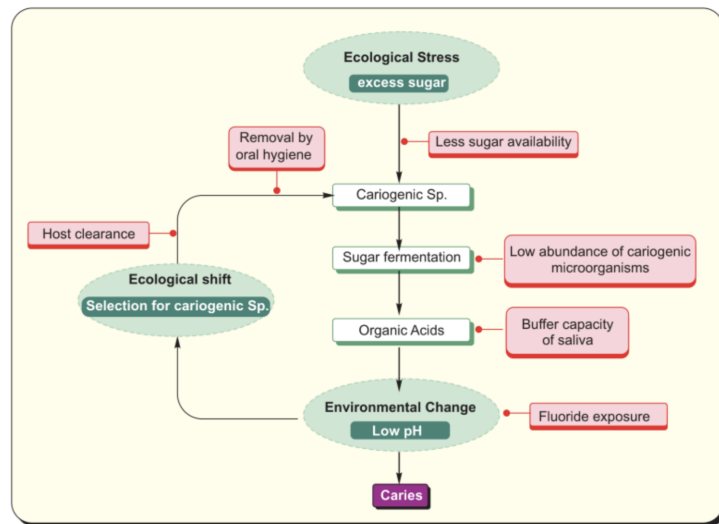


Fig. 11.4 Ecological plaque hypothesis of dental caries. (Adapted and modified from Rosier et al., 2014.)

