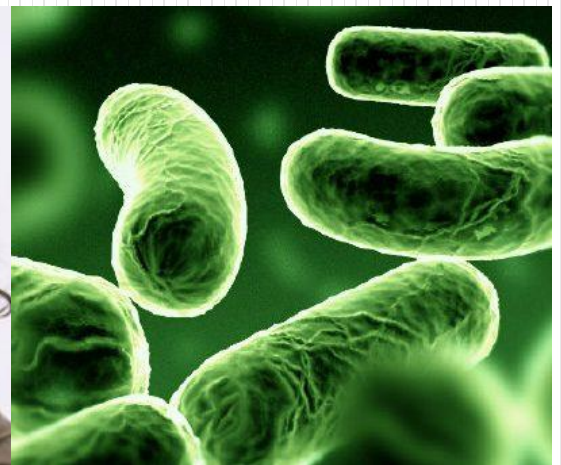


GI and Prebiotic Developments, Weight Management and Health Claims

C. Jeya Henry –Director of Clinical Nutrition Research Centre (CNRC), Singapore Institute for Clinical Sciences (SICS)

jeya_henry@sics.a-star.edu.sg



Our Natural History

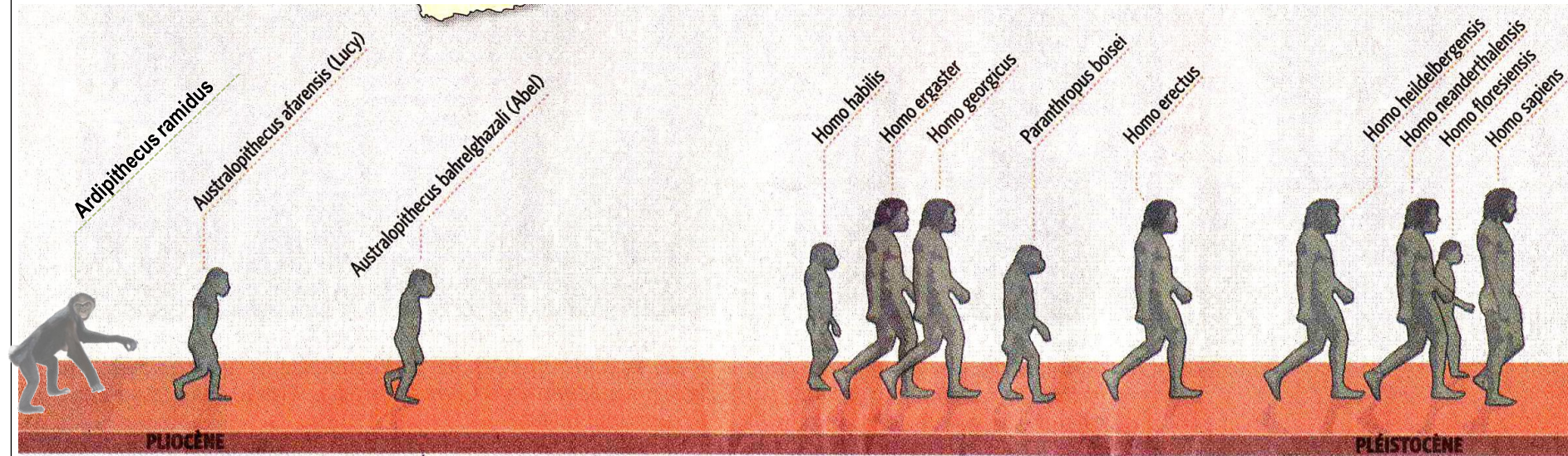
or the emergence of an energy sparing genome

4-5 MY (million years)

3-4 MY

1.3 MY

200' 000 years



The Paleolithic covers the greatest portion of humanity's history (roughly 99%) extending from ~ 3 MY ago to the introduction of agriculture around 10'000 BC

HUNTER-GATHERER

The Neolithic sees the emergence of a production economy based on agriculture and domestication, implying a more sedentary lifestyle

FARMER - BREEDER

The industrial revolution (XIX^e) sees the emergence of industrial production, an economy based on profit as well as a rapid development of transports and automation resulting in plenty of food an even more sedentary lifestyle

SEDENTARY WORKER

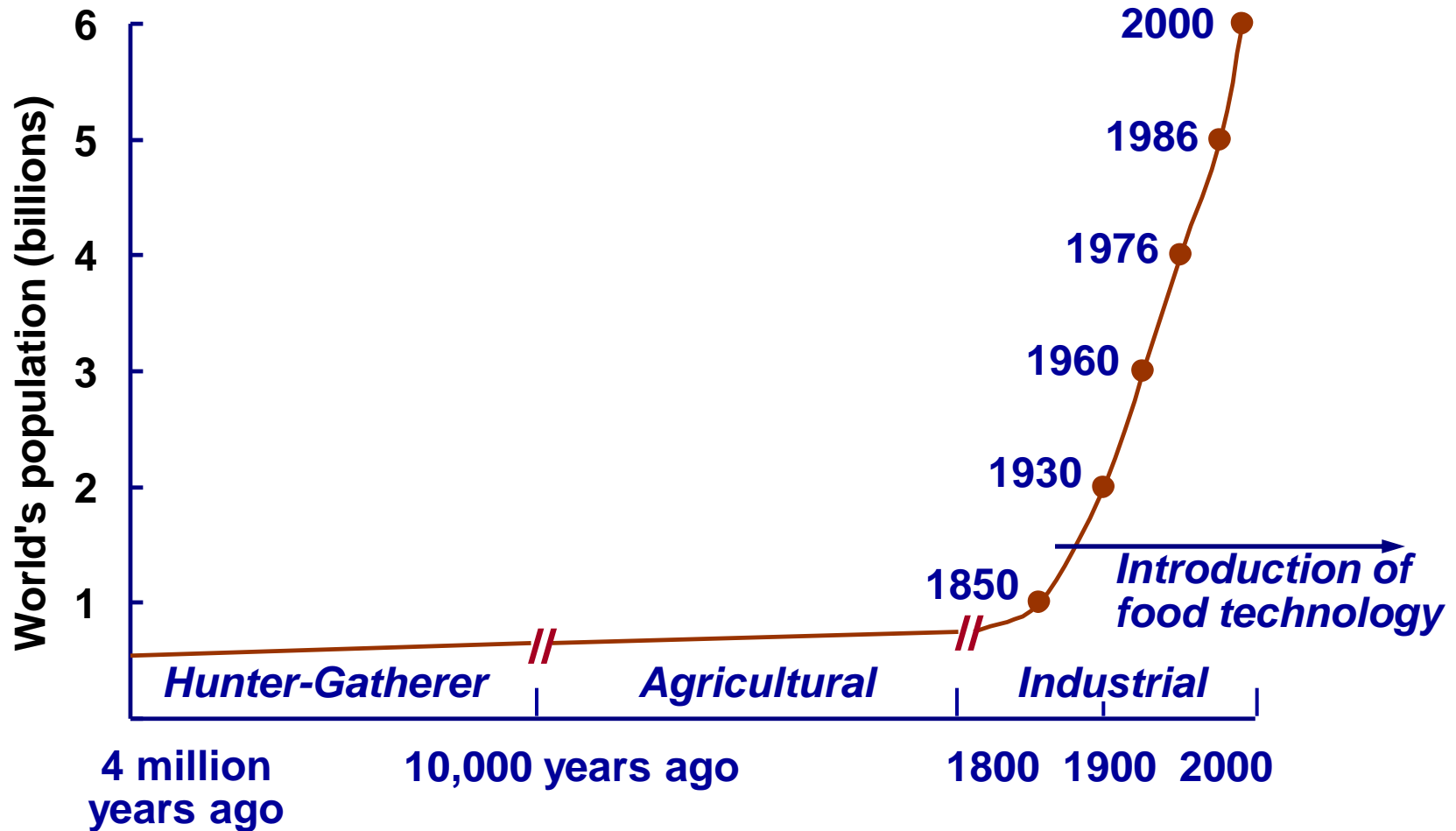


Handuna strings his bow.



The best of the Hennebedde Veddas.—Poromola and Handuna.

Foraging to farming to food technology



Number of Plant Species Used by Hunter-Gatherers

Hunter-gatherer group	No. of plant species used	
	Total	Type
Alyawara (Central Australia)	92	36 seeds 32 flowers 26 fruits 8 roots
Tlokwa (Botswana)	126	47 fruits 31 roots 23 barks & resins 22 leaves & stalks 3 mushrooms



Cereals & Tubers of Global Importance Today

Wheat

Potato

Rice

Cassava

Corn

**Sweet
Potato**



Cereals & Tubers of Global Importance

- Approximately 80 % of the world depend on 4 staples - wheat, rice, corn and potato



Wheat

Is the most versatile amongst all the cereals.
We can produce more than 2100 different types of food from wheat.

- Bread – Bagels, Chapatis, Chibata, Pitta...
- Cakes – Madeira, Swiss roll, Fruit cake...
- Croissant
- Currant bread
- Naan
- Cookies
- Pancakes
- Pizza
- Waffles
- Noodles
- Pasta
- Pastry



Cereals & Tubers of Global Importance Today

- Over 50,000 Foods are predominantly made from wheat, rice, corn, potato, sugar, dairy, palm, soybean, and soybean oil



Food Production Today Characterized By:

**Use of a very narrow range
of plant species**



**Lack of Vitamins
& Minerals**

Highly refined foods



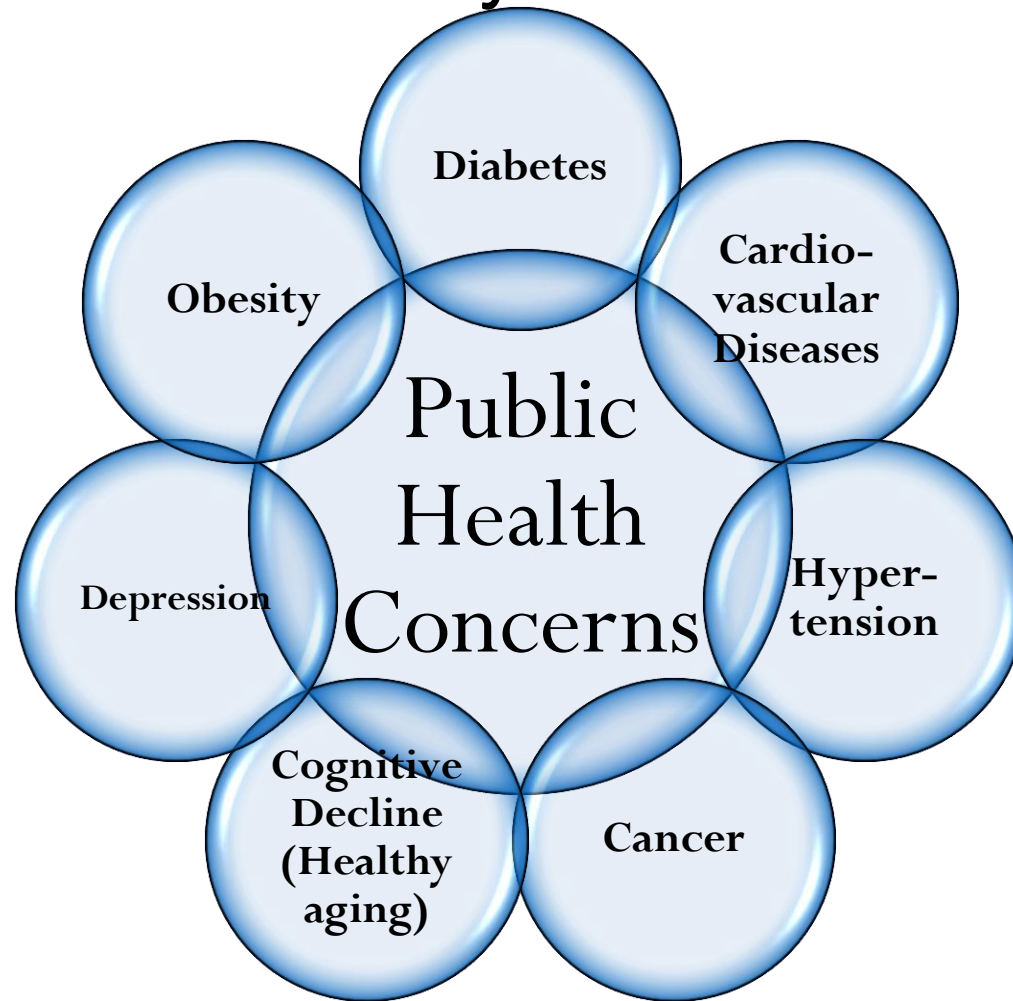
**High Glycaemic
Index**

Large food variety

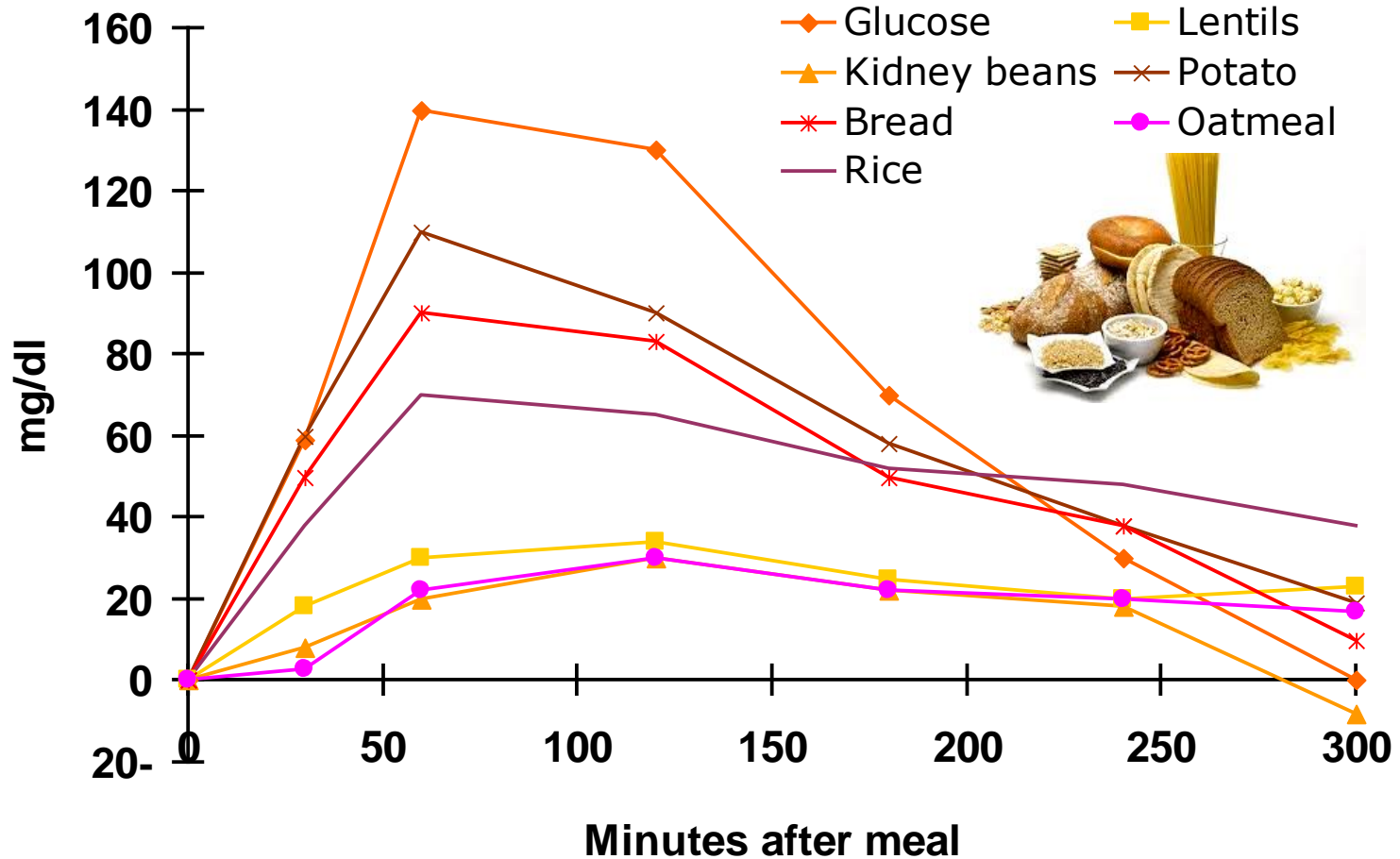


Overconsumption

Issues that are going to Influence and Shape the Food & Nutrition Industry in the 21st Century

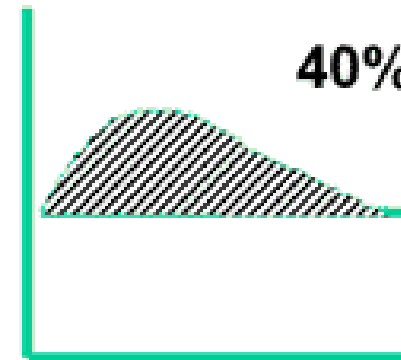
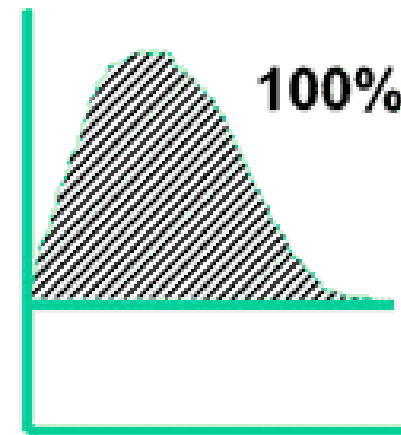


Plasma Glucose Response to Ingestion of 50g CHO



What is the glycemic index?

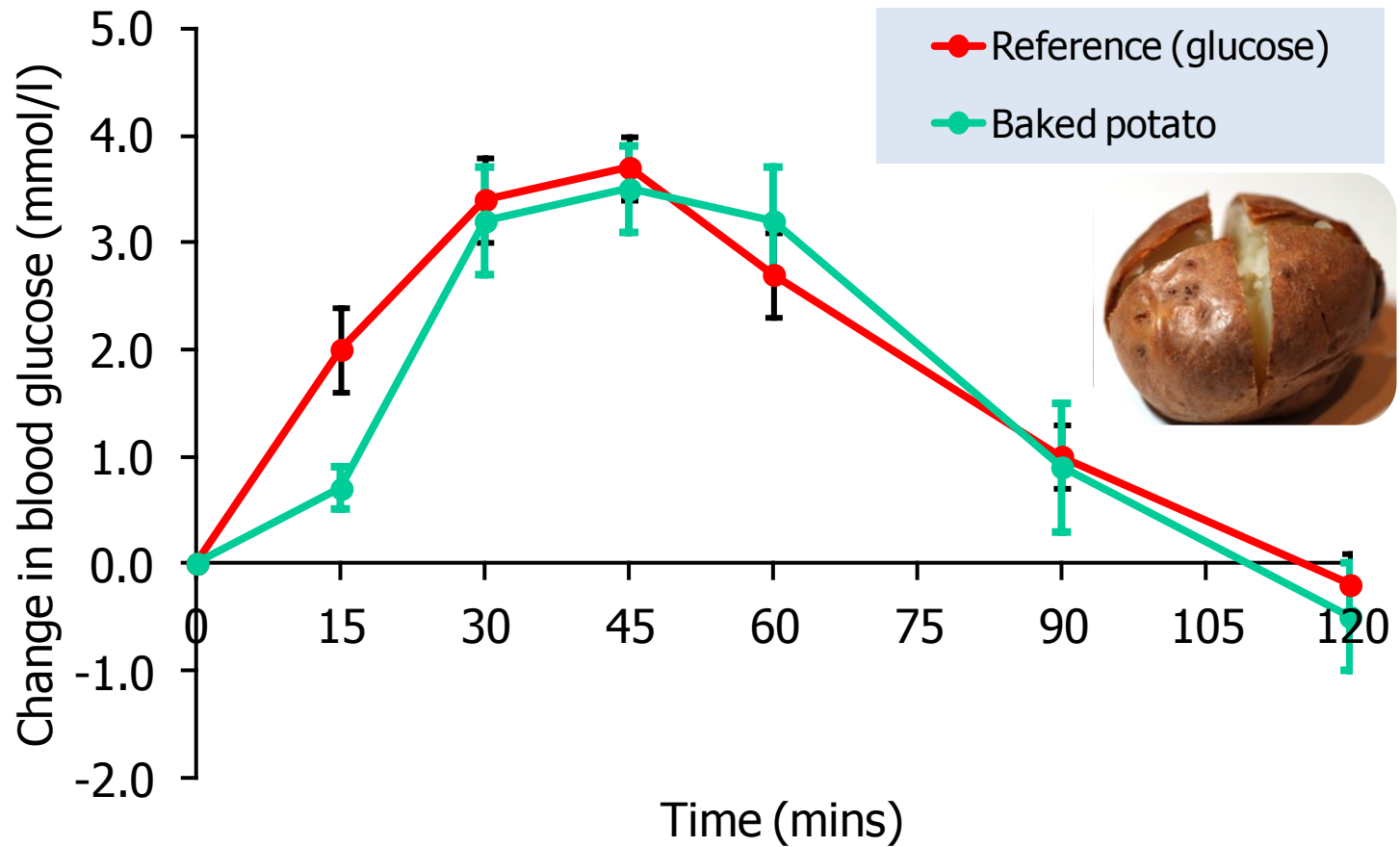
- A ranking of food carbohydrates
 - Based on the incremental area under the blood glucose curve
- Comparing equal amounts of carbohydrate
 - Reference food: glucose or white bread



Time

The two hour blood sugar response of a high-GI food (white bread, GI score = 100%) vs a low-GI food (lentils, GI score = 40%)

Glycaemic Response Curves for Glucose and Baked Potato



GI Classification

Low

55 or less



Medium

56-69 inclusive



High

70 or more



Some examples

Searchable database at www.glycemicindex.com

High GI (>70)

- Potatoes
- White bread
- Wholemeal bread
- Most rices
- Most breakfast cereals
- Most low-fat snacks

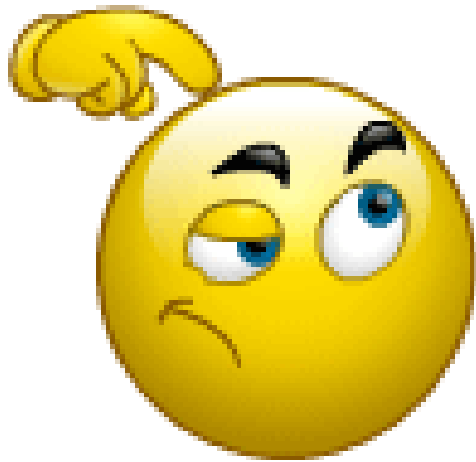
Low GI (<55)

- Some breads
- Some breakfast cereals
- Pasta, Basmati rice
- Legumes
- Dairy foods
- Most fruit & vegies

Wholegrains are often high GI and sweet foods low GI

Ponder...

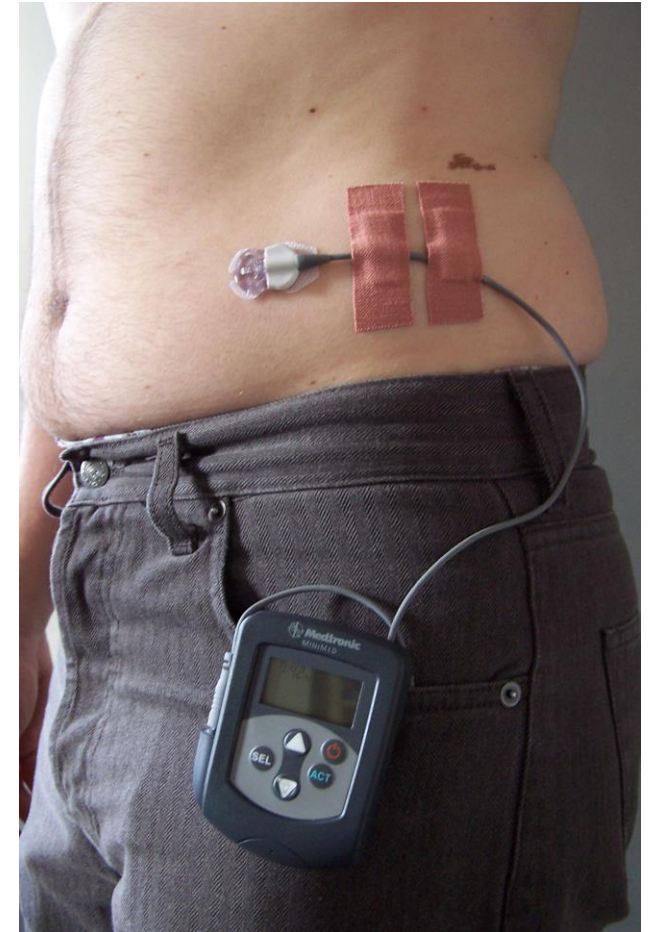
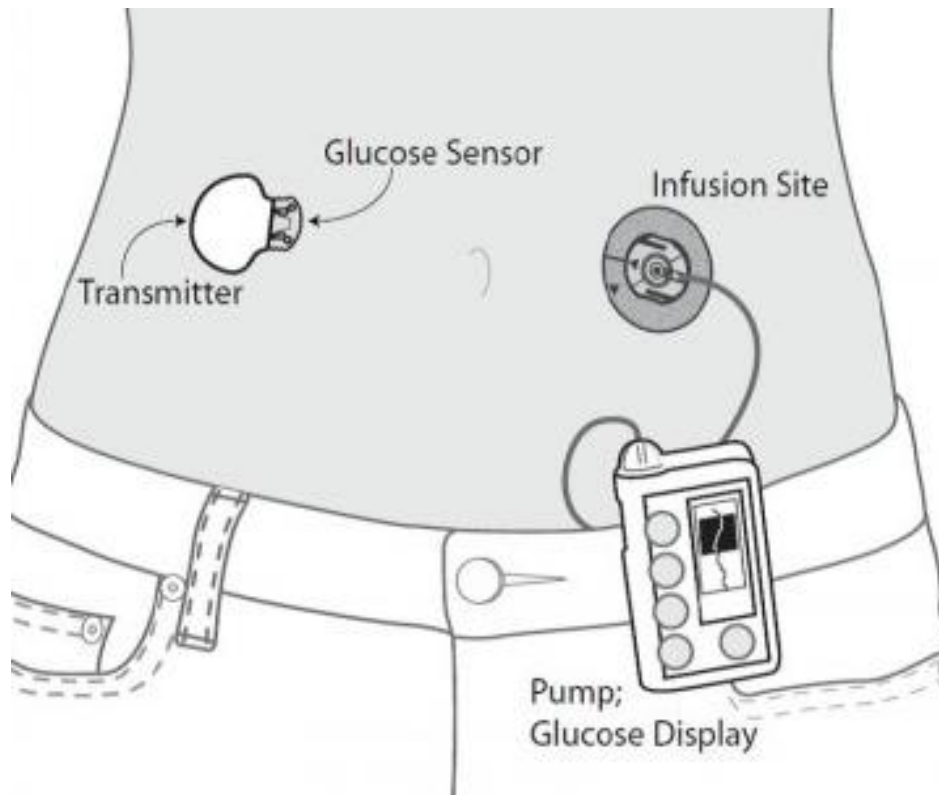
Can a simple dietary change (provisional of low GI bread) influence postprandial and fasting blood glucose?



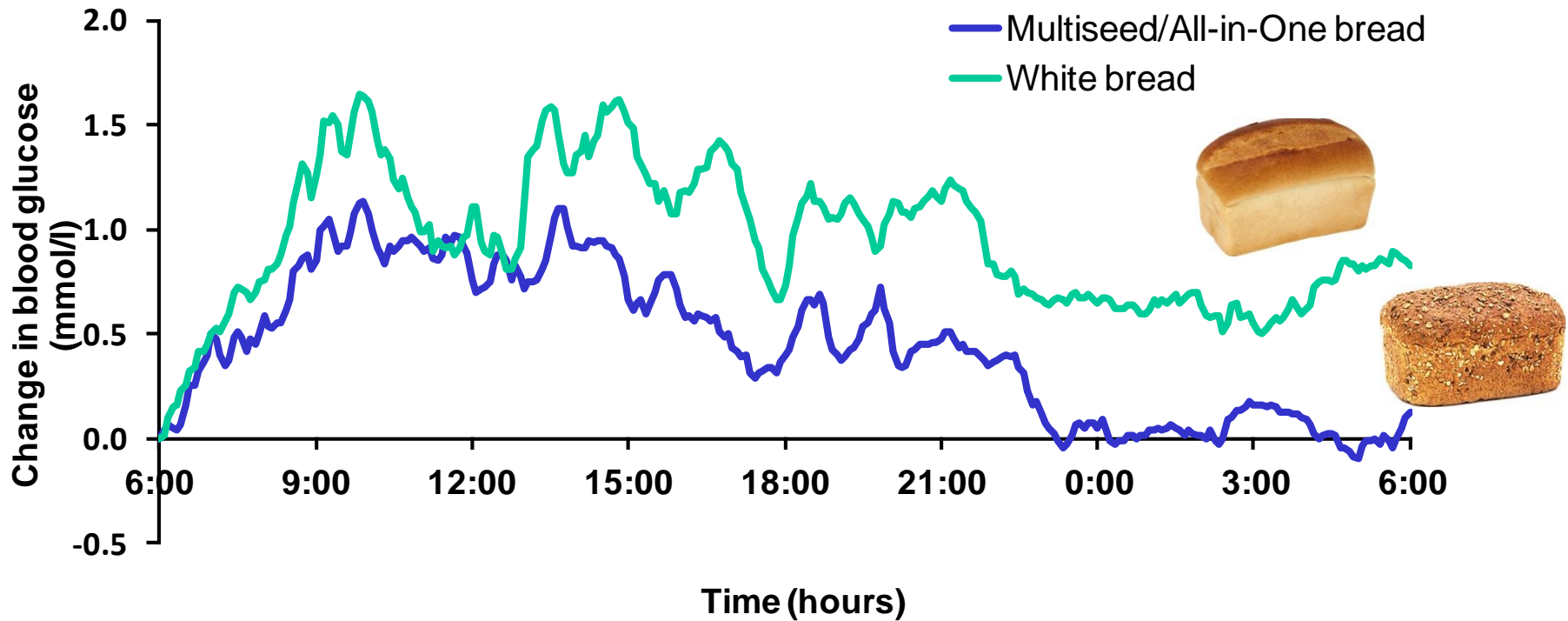
24-hour CGMS – meals

	<i>Low-GI</i>	<i>High-GI</i>
Breakfast	Bread (/All-in-One) Flora margarine Raspberry jam Orange juice Tea or coffee	Bread (white) Flora margarine Raspberry jam Orange juice Tea or coffee
Snack	Apple	Banana
Lunch	Sandwiches (All-in-One): <ul style="list-style-type: none"> • Cheese & tomato • Ham & salad • Tuna mayo & cucumber • Egg mayo & cress 	Sandwiches (white): <ul style="list-style-type: none"> • Cheese & tomato • Ham & salad • Tuna mayo & cucumber • Egg mayo & cress
Snack	Low-GI muffin bar	High-GI cereal bar
Dinner	Sandwiches (All-in-One): <ul style="list-style-type: none"> • Chicken mayo & tomato • Hummus & salad • Cheese & pickle • Ham, cheese & salad 	Sandwiches (white): <ul style="list-style-type: none"> • Chicken mayo & tomato • Hummus & salad • Cheese & pickle • Ham, cheese & salad
Snack	Apple	Banana

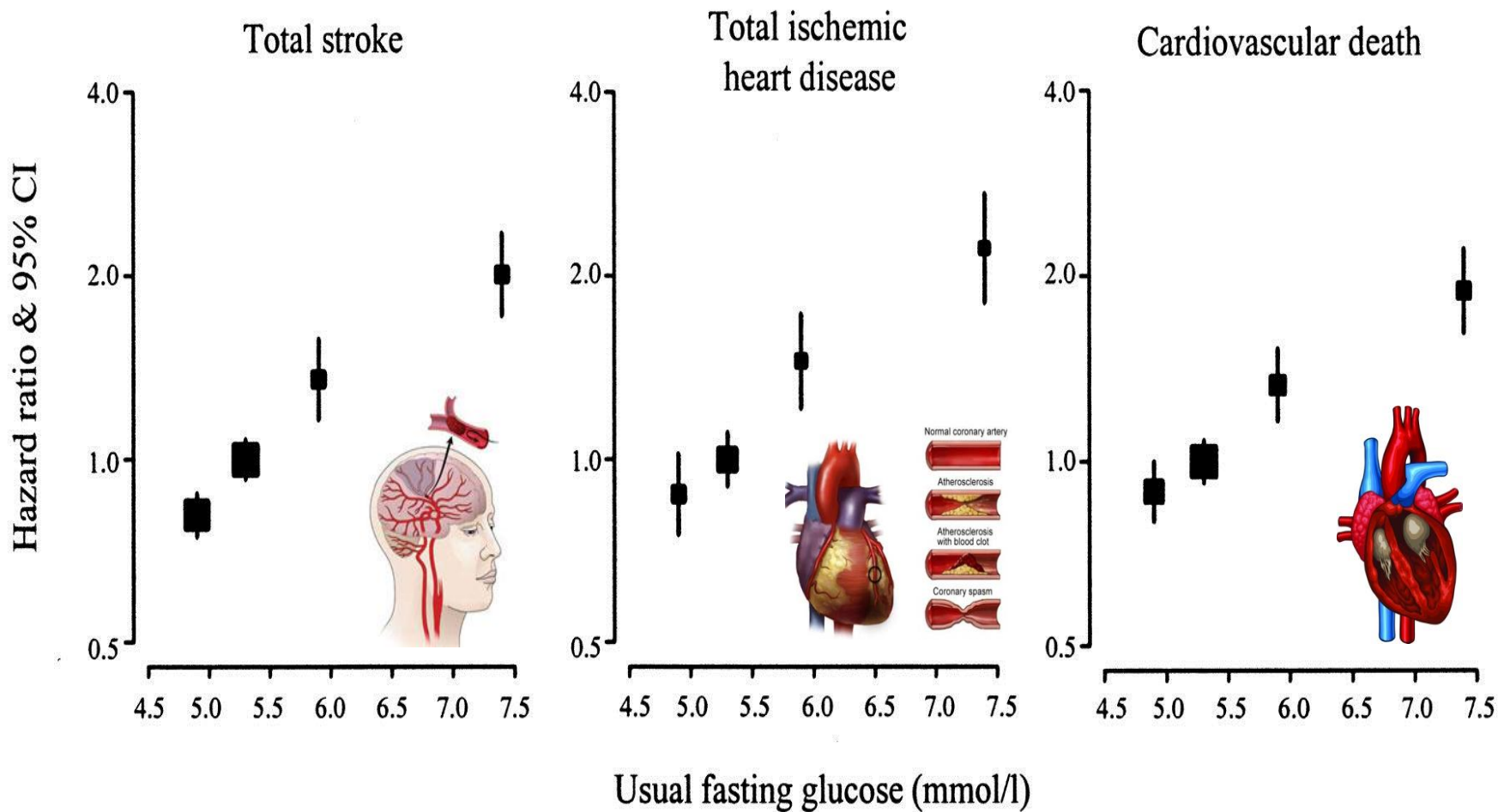
24 Hour Glucose Monitor



24-hour CGMS – All Subjects (*n* 10)

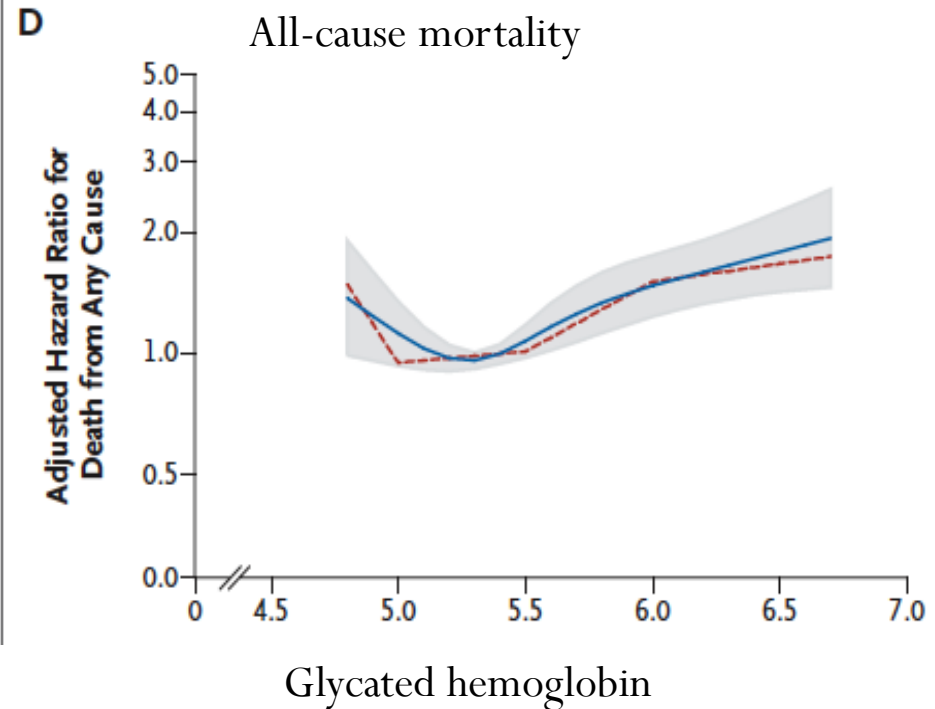
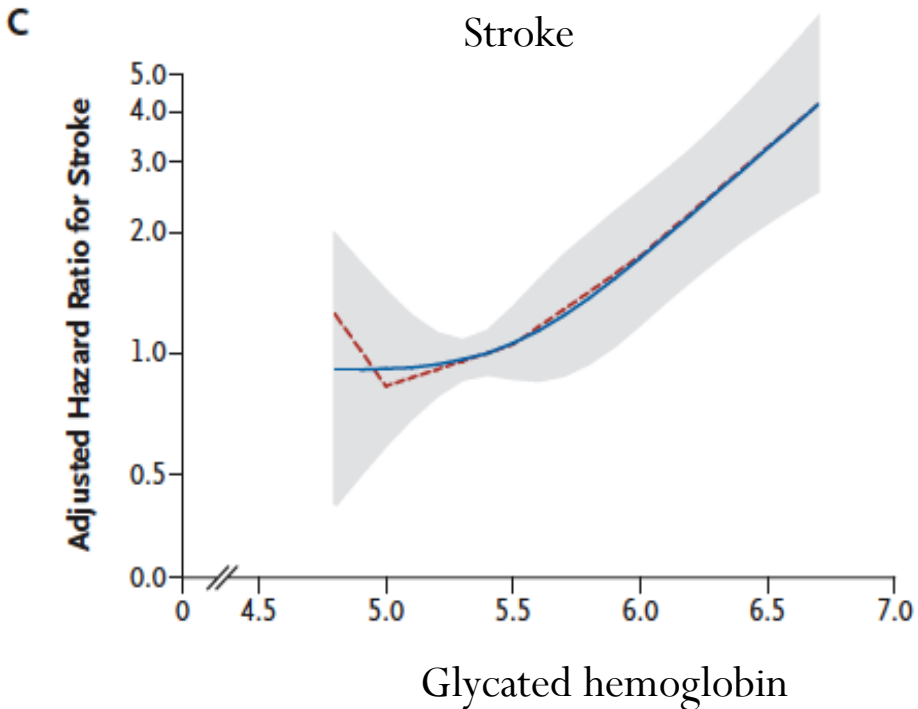


Blood Glucose and Risk of CVD



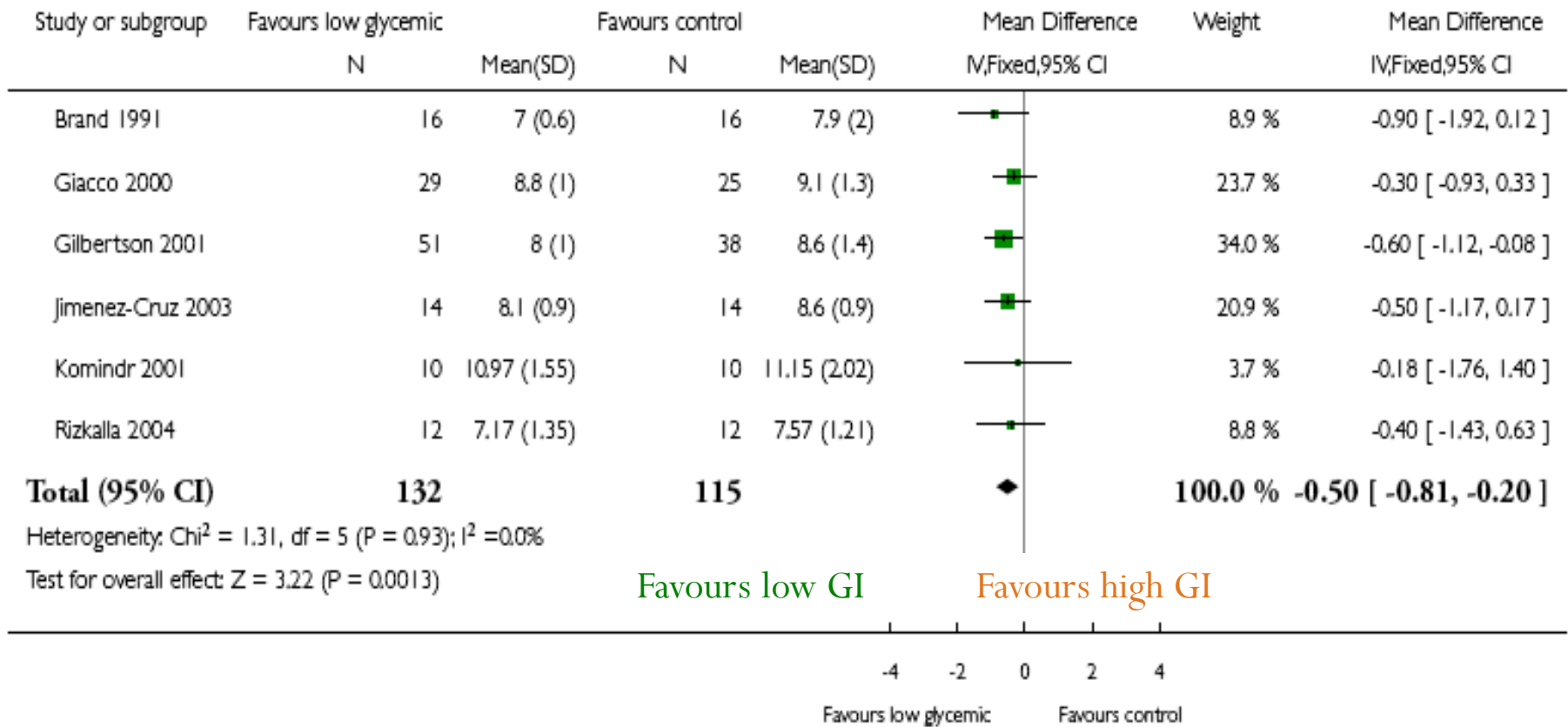
HbA_{1c} predicts stroke and mortality

The ARIC Study 11,092 healthy adults followed up for ~14 years



Meta-analysis of GI in T2DM

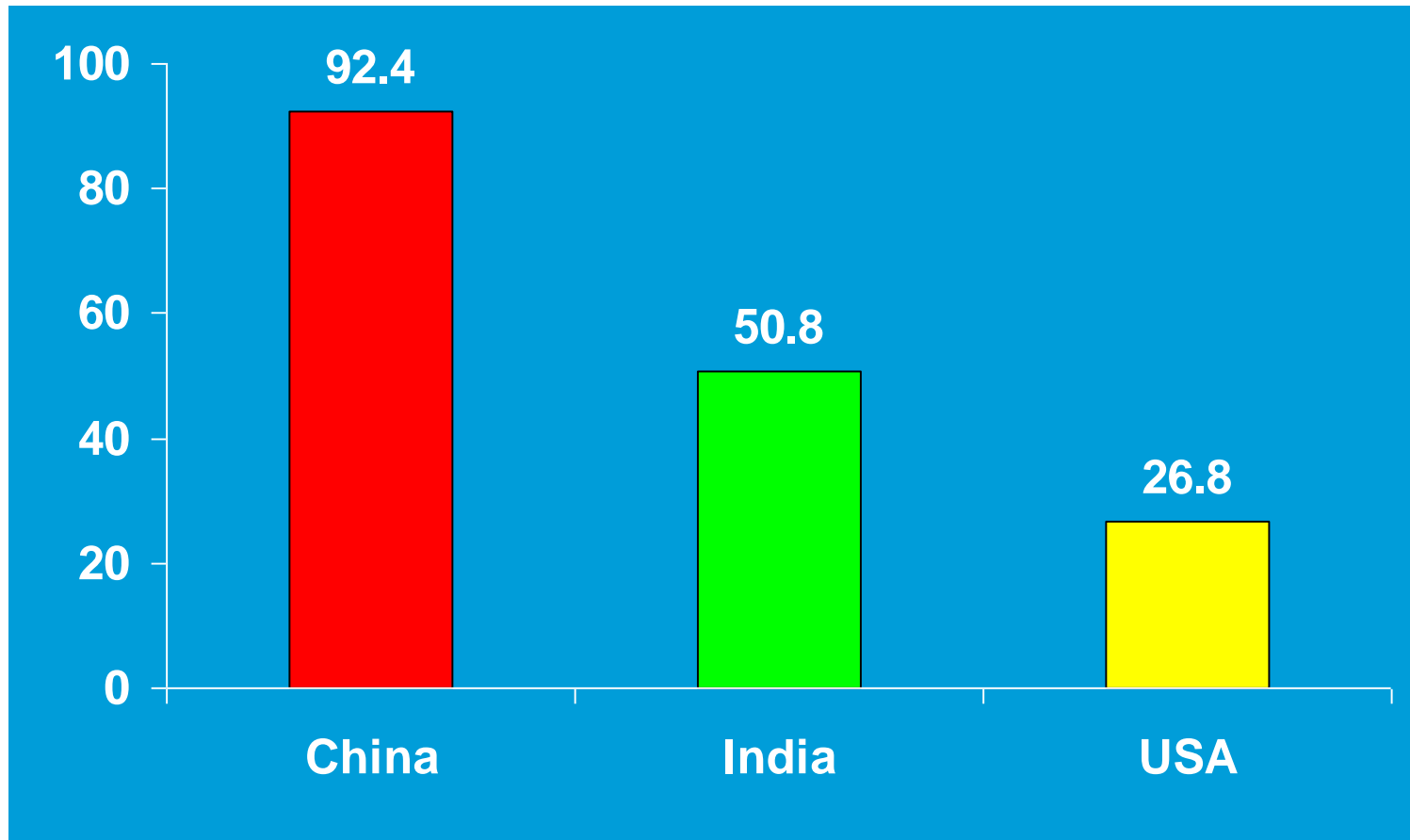
Glycated hemoglobin mean $\Delta = -0.5\%$



Take home messages

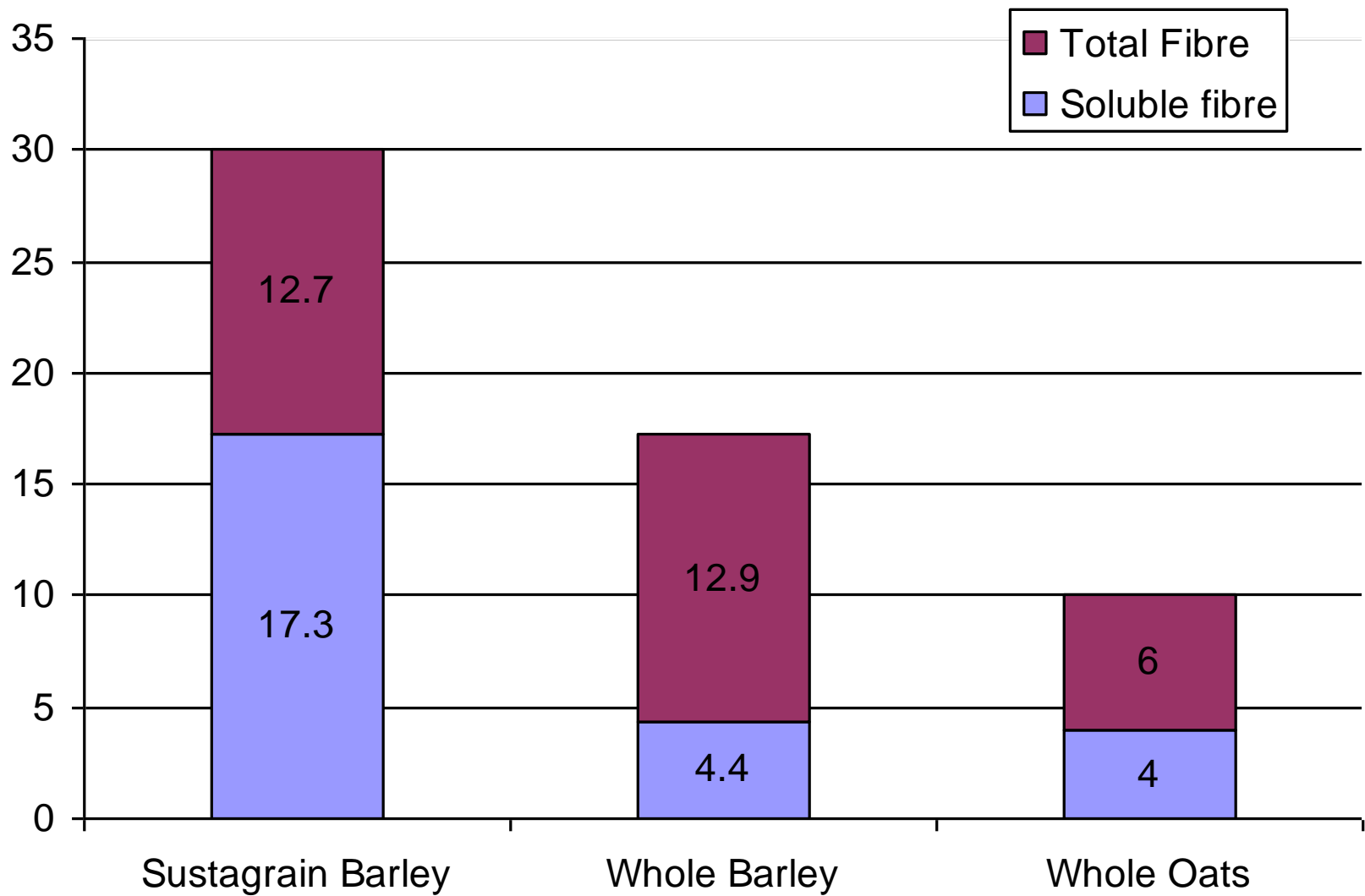
- High glucose levels are undesirable and have metabolic consequences
- Low fat diets not a not a panacea
- Most carbohydrate foods today tend to be high GI
- Efforts should be made to reduce their GI
- Food innovations that lower GI are feasible

Diabetes: Top 3 Countries in the World in 2010



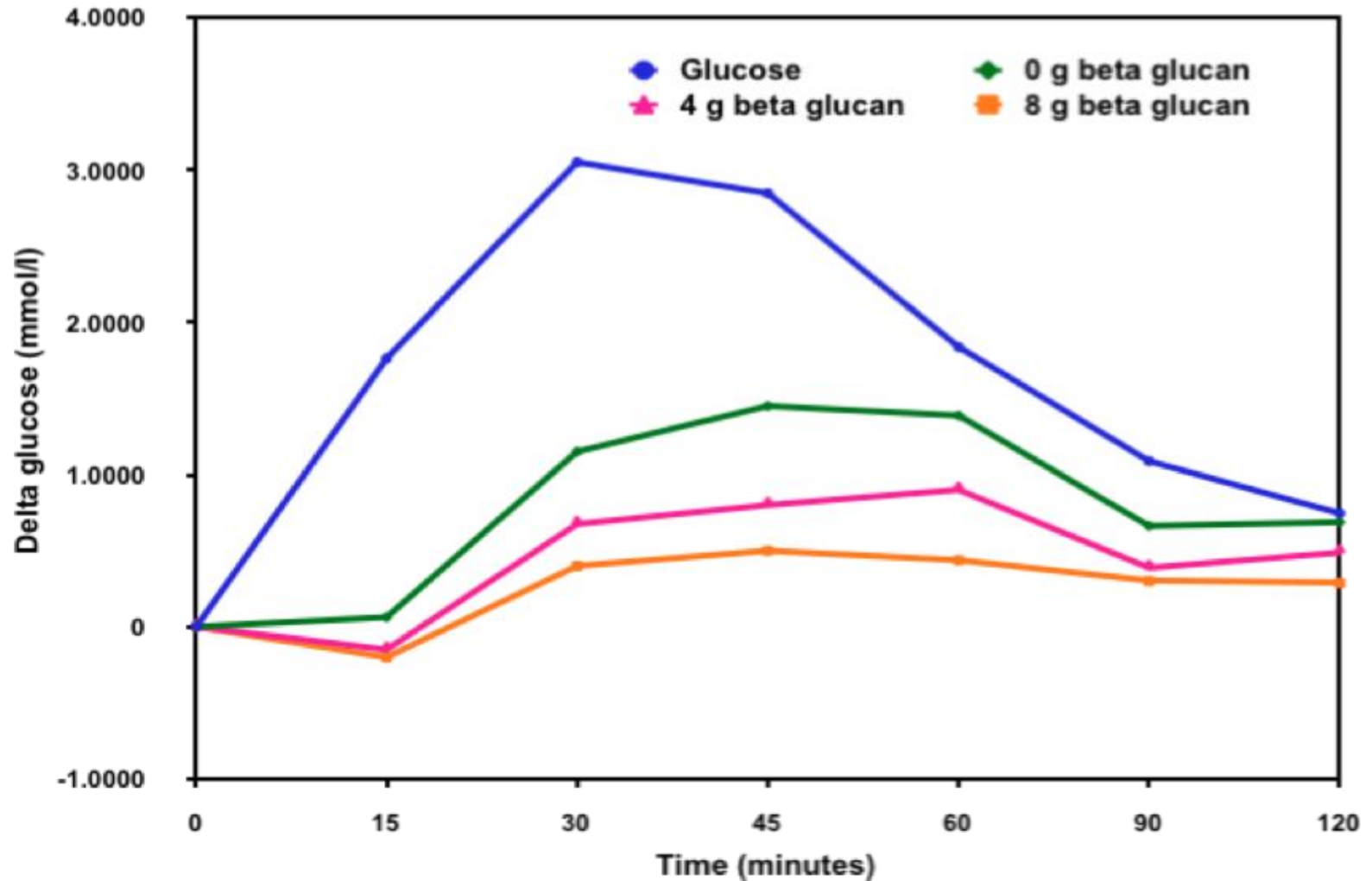
IDF Diabetes Atlas, 4th Edition, International Diabetes Federation, 2009

Yang et al, N Engl J Med 2010;362:1090-1101



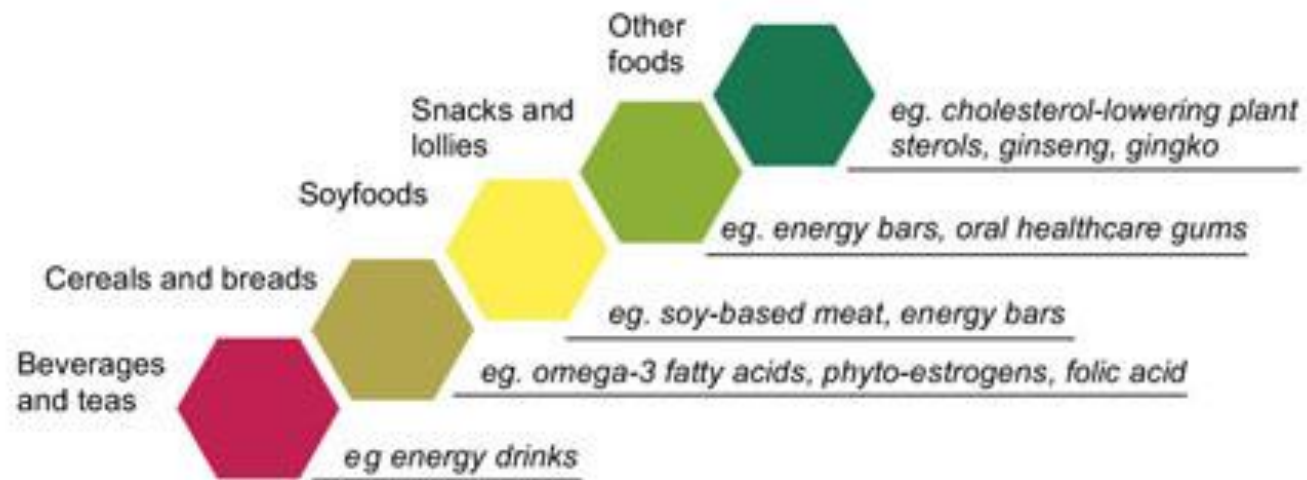
Agric Food Chem, 2001, 49, 2437; Cereal Chem, 2000, 77, 673; Cereal Chem, 1999, 76, 788)

Glycaemic response to flatbreads containing barley β -glucan



What are Functional Foods

- There is no universally accepted term for functional foods
- A *functional food* is similar in appearance to a conventional food that is consumed as part of a usual diet, and is demonstrated to have health benefits and/or reduce the risk of chronic disease beyond basic nutritional functions, i.e. they contain bioactive compound



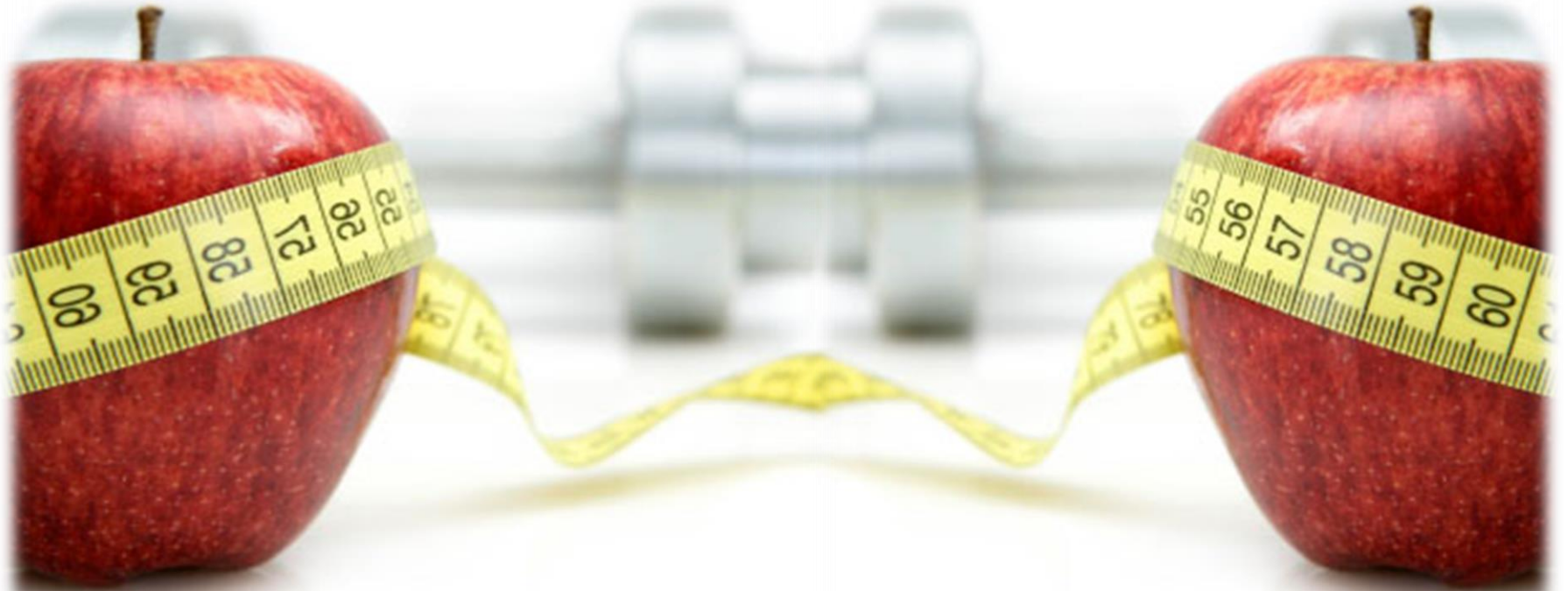
Why Functional Foods

- Nutrition now moving away from treating deficiencies to reducing the risk of chronic disease
- Preventive nutrition
- Healthier food and diets are an integral part of the solution
- Certain food components now established as having health benefits



Definition of Health Claim

- Health claim is any statement about a relationship between food and health



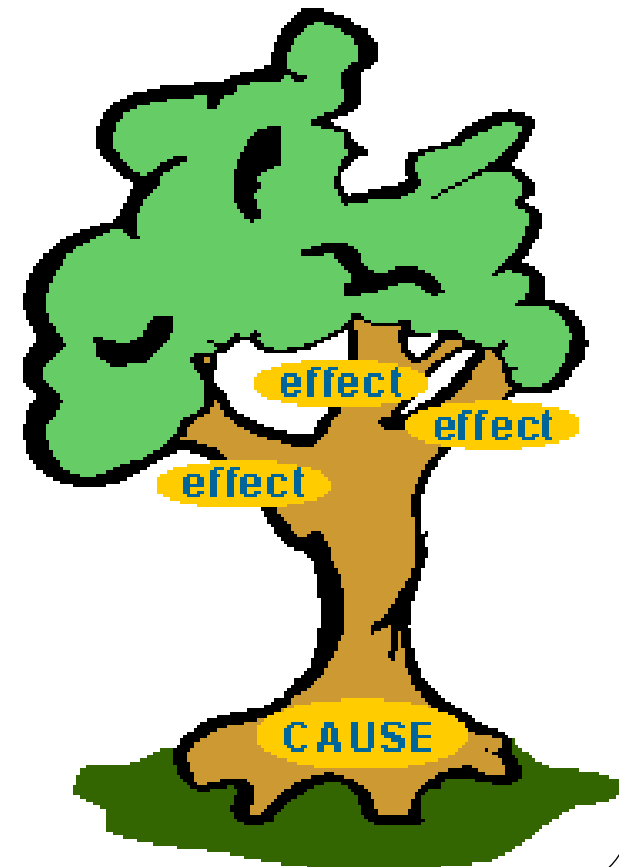
Considerations for Health Claims

- Is the food ingredient well-defined?
- Is the claim effect-defined?
- What is the scientific evidence?



Considerations for Health Claims

- The claimed effect of the food/constituent is relevant for human health
- A cause and effect relationship is established between the consumption of the food/constituent and the claimed effect in humans
 - Such as the strength, consistency, specificity, dose-response, and biological plausibility of the relationship



Considerations for Health Claims

- The quantity of the food/constituent and pattern of consumption required to obtain the claimed effect could reasonably be achieved as part of a balanced diet
- The specific study group(s) in which the evidence was obtained is representative of the target population for which the claim is intended



Health Claims Come Under the Following:

- **General function health claims**
 - Article 13.1 of the EU Regulation
- **New function health claims**
 - Article 13.5 of the EU Regulation
- **Claims regarding disease risk reduction and child development or health**
 - Article 14 of the EU Regulation



EFSA Opinion on Sugar Replacers, Dental Health & Glycaemic Responses



European Food Safety Authority

EFSA Journal 2011;9(4):2076

Scientific Opinion on the substantiation of health claims related to the **sugar replacers** xylitol, sorbitol, mannitol, maltitol, lactitol, **isomalt**, erythritol, D-tagatose, **isomaltulose**, sucralose and polydextrose and **maintenance of tooth mineralisation by decreasing tooth demineralisation** (ID 463, 464, 563, 618, 647, 1182, 1591, 2907, 2921, 4300), and **reduction of post-prandial glycaemic responses** (ID 617, 619, 669, 1590, 1762, 2903, 2908, 2920) pursuant to Article 13(1) of Regulation (EC) No 1924/2006¹



EFSA Panel on Dietetic Products, Nutrition and Allergies (NDA)^{2,3}

European Food Safety Authority (EFSA), Parma, Italy



Permitted Lower Blood Glucose-Related Claims



Consumption of foods/drinks containing Isomaltulose instead of other sugars induces a lower blood glucose rise after their consumption compared to sugar-containing foods/drinks

EFSA Opinion on Dietary Fibre



European Food Safety Authority

EFSA Journal 2010;8(10):1735



**Rejection:
Insufficient
characterisation**

SCIENTIFIC OPINION

Scientific Opinion on the substantiation of health claims related to dietary fibre (ID 744, 745, 746, 748, 749, 753, 803, 810, 855, 1415, 1416, 4308, 4330) pursuant to Article 13(1) of Regulation (EC) No 1924/2006¹

EFSA Panel on Dietetic Products, Nutrition and Allergies (NDA)^{2,3}

European Food Safety Authority (EFSA), Parma, Italy

SUMMARY

Following a request from the European Commission, the Panel on Dietetic Products, Nutrition and Allergies was asked to provide a scientific opinion on a list of health claims pursuant to Article 13 of Regulation (EC) No 1924/2006. This opinion addresses the scientific substantiation of health claims in relation to dietary fibre. The scientific substantiation is based on the information provided by the Member States in the consolidated list of Article 13 health claims and references that EFSA has received from Member States or directly from stakeholders.

The food constituents that are the subject of this opinion are “dietary fibre”, “rich in dietary fibre” and “soluble fibre” related to the following claimed effects: **satiety, weight management, normal blood glucose concentrations, normal blood cholesterol concentrations, normal bowel function and regularity, reduction of postprandial glycaemic response, decreasing potentially pathogenic gastrointestinal microorganisms, increasing the number of gastrointestinal microorganisms, and fat absorption.** Dietary fibre is the common name for all carbohydrate components occurring in foods that,



Rejected Dietary Fibre Claims

Non-compliance with the Regulation because on the basis of the scientific evidence assessed, **this food is not sufficiently characterized** for a scientific assessment of this claimed effect and the claim could not therefore be substantiated.

dietary fibre
promotes bowel
regularity

dietary fibre helps
to maintain normal
bowel/colonic
function

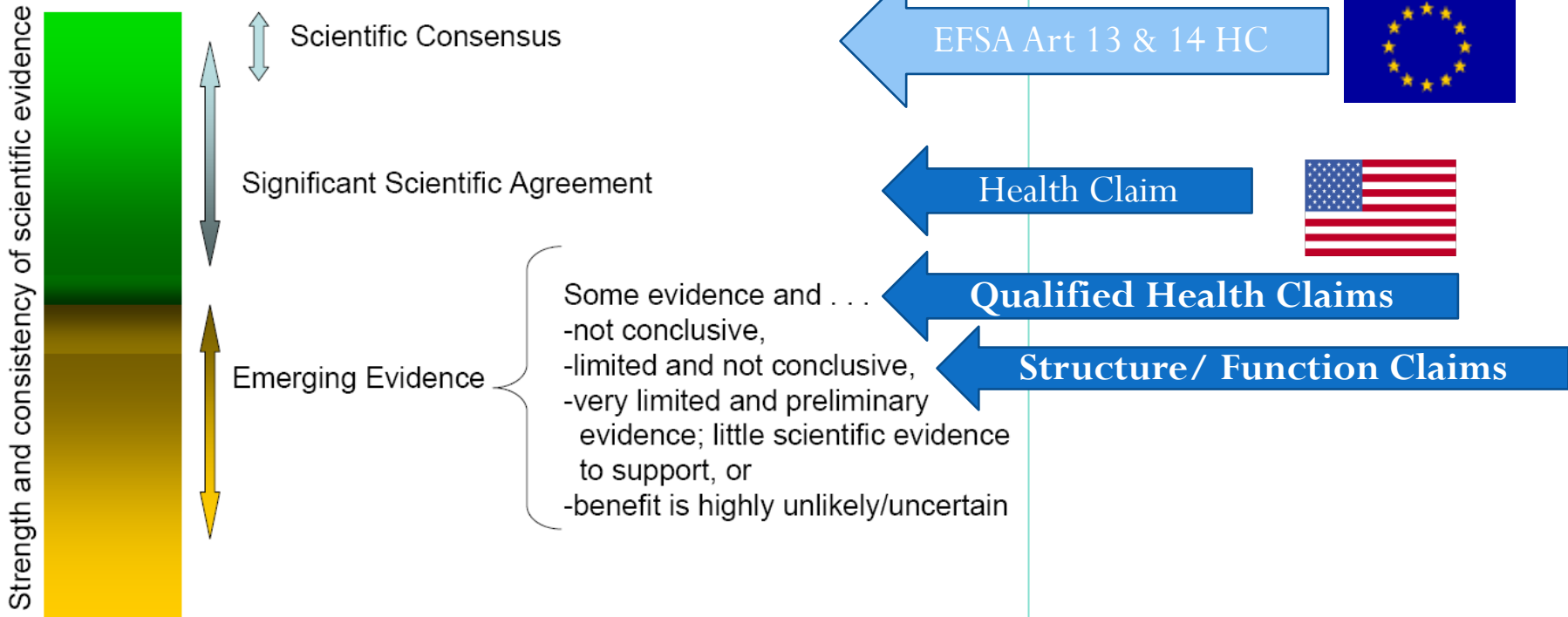
Dietary fibre helps to
maintain normal blood
lipid levels and a
healthy cardiovascular





Quality & Strength of Scientific Evidence for Claims Addressing Disease Risk Reduction

Continuum of Scientific Evidence



Absolute proof is difficult to obtain in science... Science is rarely conclusive. Also emerging evidence can be revealed truthfully ! – for consumer benefit!

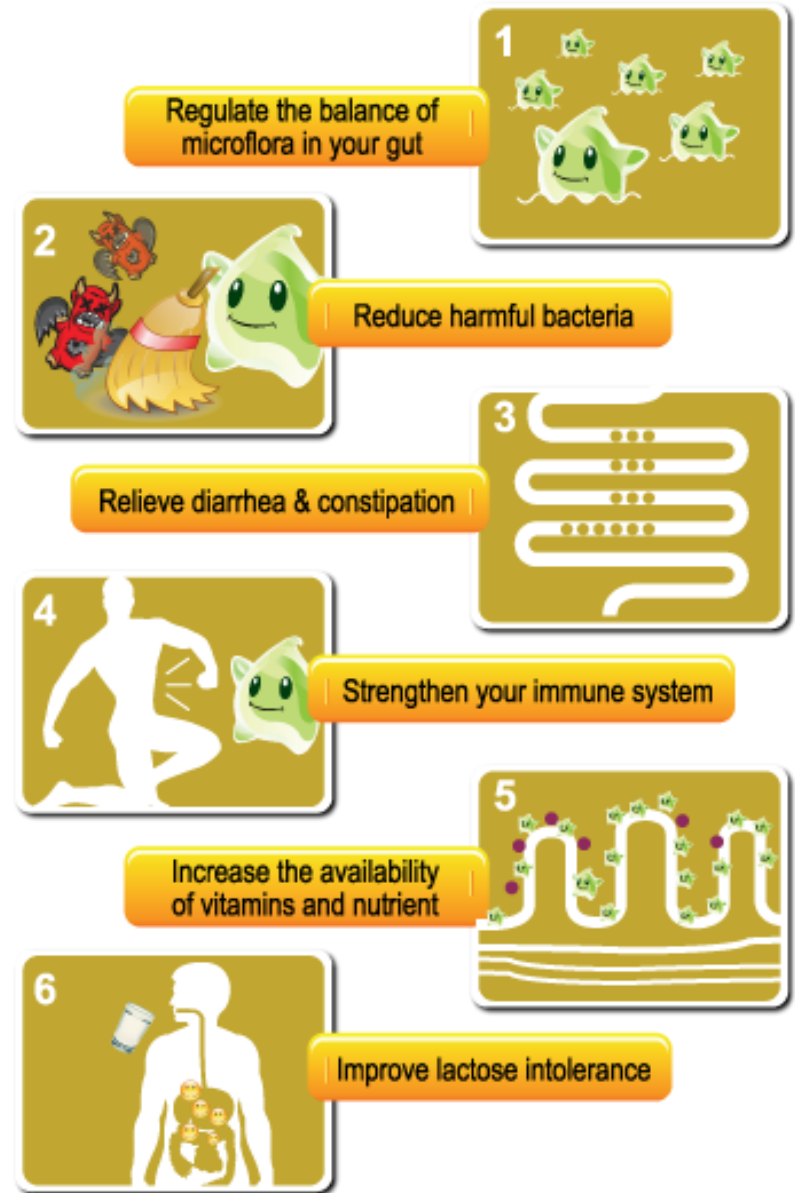
Qualified Health Claims

- **Qualified health claims about cancer risk**
 - Tomatoes and/or tomato sauce and prostate
 - Green tea and cancer
 - Selenium and cancer
 - Antioxidant vitamins and cancer
- **Qualified claims about cardiovascular disease risk**
 - Nuts and heart disease
 - Walnuts and heart disease
 - Omega-3 fatty acids and coronary heart disease
 - Monounsaturated fatty acids from olive oil and coronary heart disease
 - Unsaturated fatty acids from canola oil and coronary heart disease
 - Corn oil and heart disease

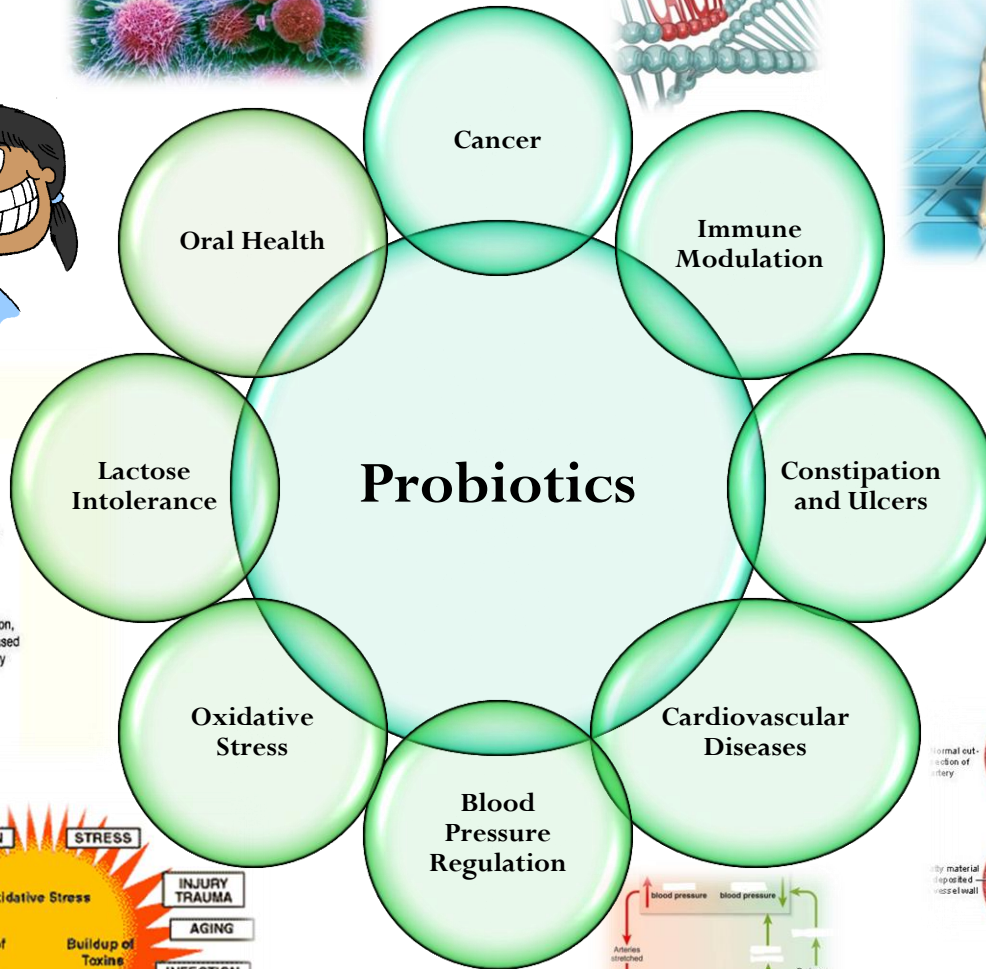
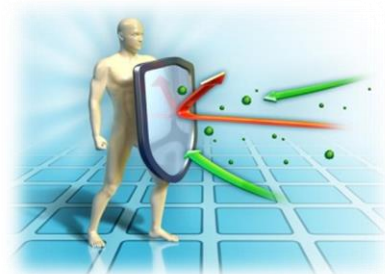
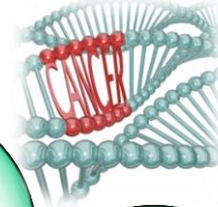
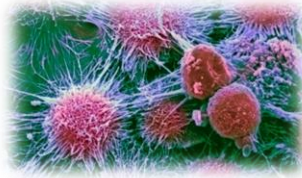


Definition

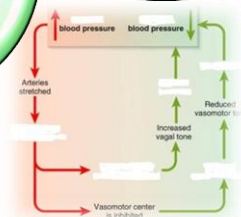
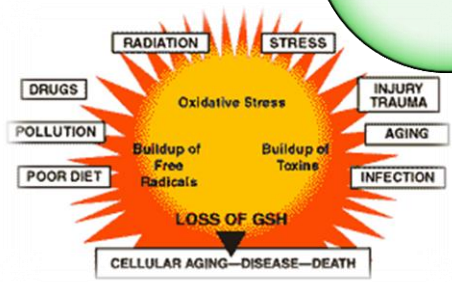
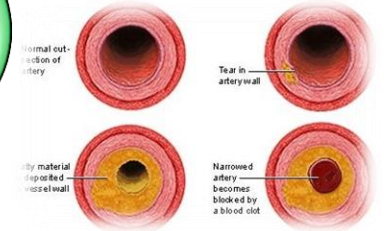
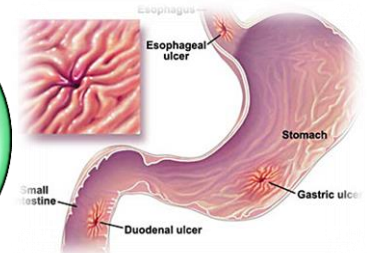
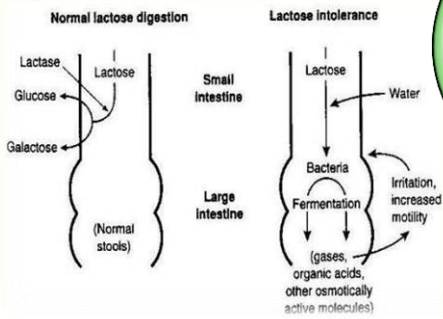
- “Probiotic has been defined as a ‘live microorganism which when administered in adequate amount confers health benefits to the host’” (FAO/WHO, 2002)



Role of Probiotics

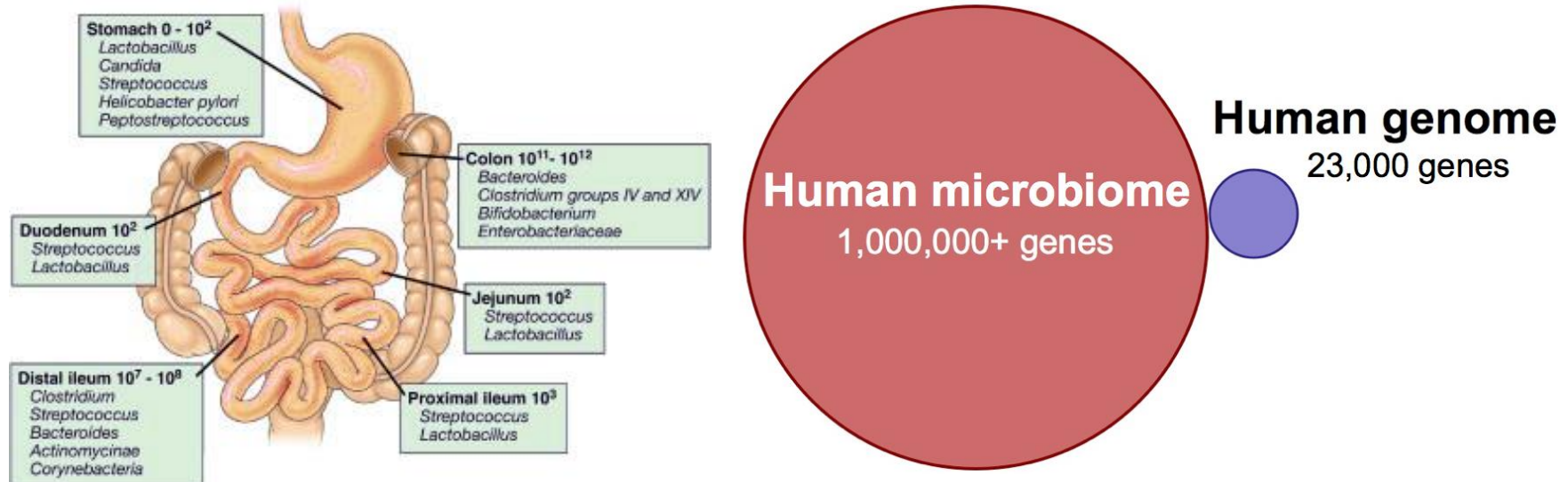


Lactose Intolerance



Our Gut Microbiome

- In man, the intestinal microbiota is estimated to be composed of 10^{13} and 10^{14} microorganisms whose collective genome, the microbiome, contains at least 100-fold more genes than the complete human genome



High-fat Diet and Altered Microbiota Mechanism Leading to Obesity

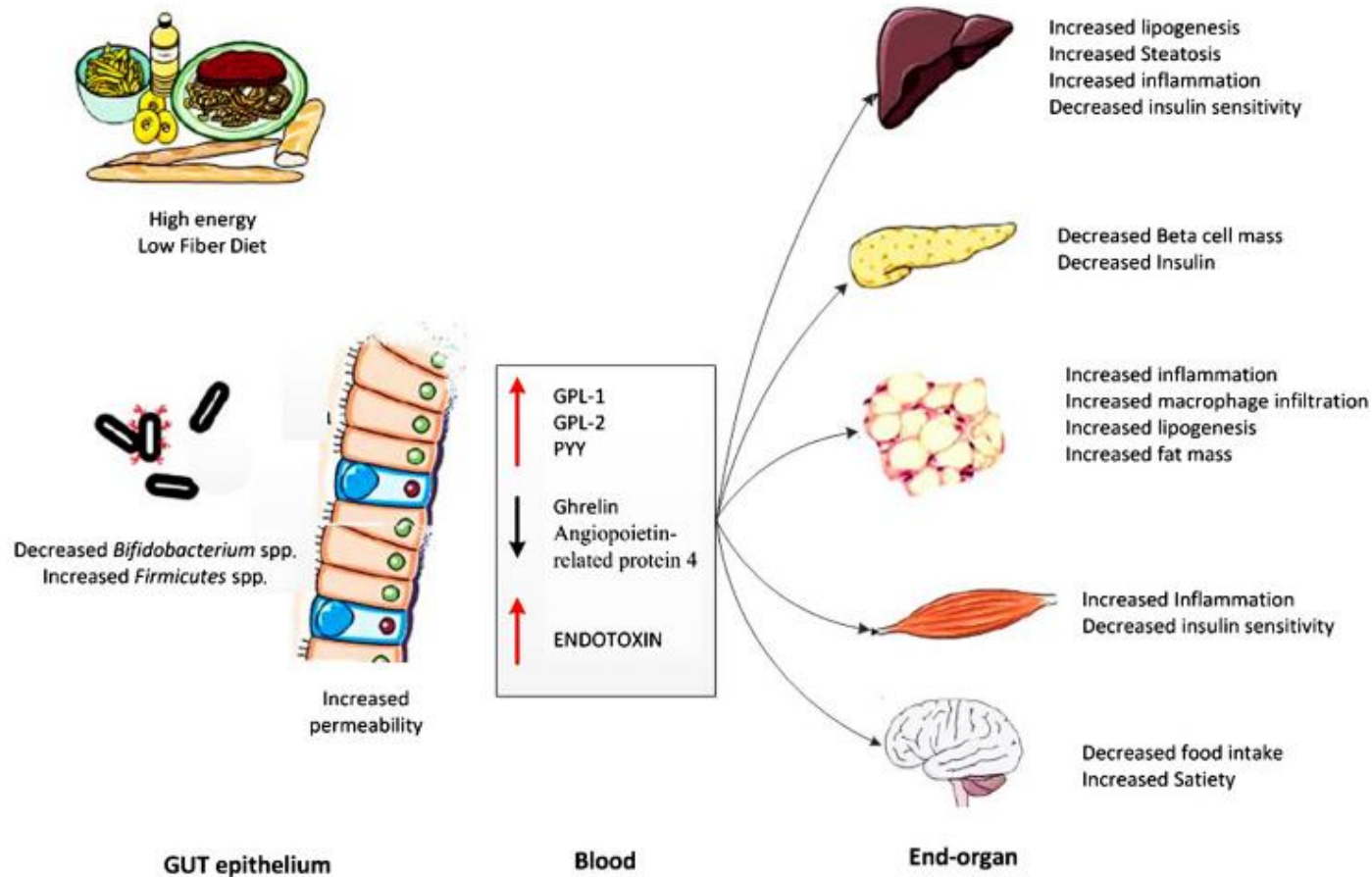


FIGURE 1 | Proposed mechanism whereby alteration of the bowel flora with a high-fat low-fiber diet alters the microbiota leading to metabolic endotoxemia with increased lipid storage and decreased insulin sensitivity. Adapted with permission from Cani and Delzenne (2009).

Gut Microbiota Affects Nutrient Intake and Energy Regulation

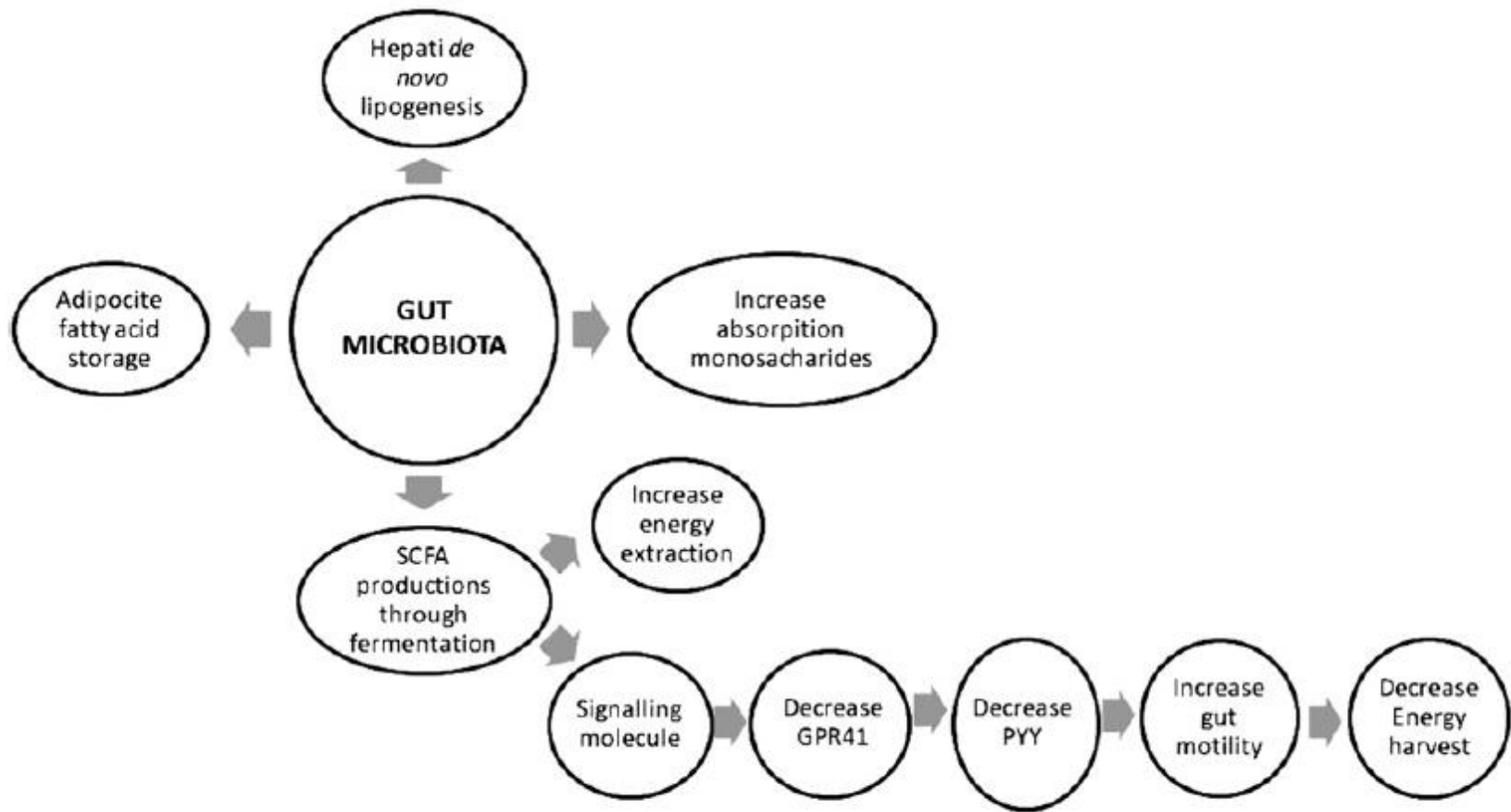


Fig. 1. Gut microbiota affects nutrient acquisition and energy regulation.

Cristina Stewart B. Bogdan, A. C. R. E., Natalia Perina, Ricardo C. Barbuti, Tomas Navarro-Rodriguez, Jaime N. Eisig and Marice N. Oliveira (2011). "Probiotics intake and metabolic syndrome: A proposal." *Trends in Food Science & Technology* 22: 457-464.

Limitations & Future Directions

Study Populations

- Small sample sizes
- Ethnically homogenous populations (e.g., Chinese; African-Americans)
- Highly selected populations (e.g., pregnant women; adolescents; patients after surgery)

Intervention Duration

- Current studies ranged from only 4 weeks to 10 weeks

Methodological Issues

- Most clinical studies used a single analytical method which can result in unreliable results for specific bacterial taxa (e.g., bifidobacteria may be underestimated by 16S total or partial sequencing)

Other Issues

- Lack of information on the macronutrient composition (with special reference to digestible carbohydrates) of the diet
- Lack of information on the protocol adherence which may represent a source of confounding (e.g., age, sex, ethnicity, physical activity, genetic background, immune function)

Conclusions

Practice Points

- Gut microbiota composition is directly dependent on nutrient intake (e.g., fat, digestibility of carbohydrates)
- Metabolic endotoxaemia and gut barrier dysfunction are involved in the onset of metabolic diseases associated with obesity
- Prebiotic-induced changes in the gut microbiota improve glucose, lipid and inflammation homeostasis

Research Agenda

- The exact taxonomic composition of the gut microbiota or associated metabolic functions needs to be defined to design novel targeted approaches
- Detailed studies are necessary to study gut permeability and related gut barrier dysfunctions in obese and type 2 diabetic patients
- The role of 'novel' beneficial microbes (e.g., *F. prausnitzii* and *A. muciniphila*) as therapeutic tools warrants controlled human studies

Issues that are going to Influence and Shape the Food & Nutrition Industry in the 21st Century




Demographic Changes



Social Changes



Nutritional/
Health
Concerns



Food as
Medicine

21st
century

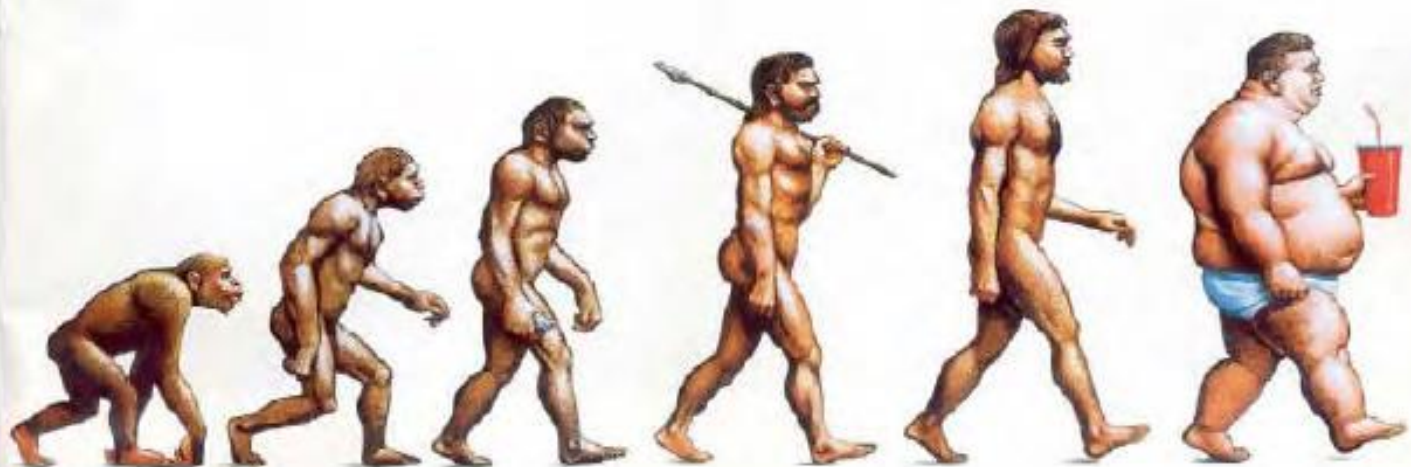
Conclusion

- Food is the new medicine!
- Food ingredients will play a major role in the health and well-being of the elderly
- Consumer protection was the basis for evolving health claims
- EFSA health claims are currently too prescriptive
- Rigorous control of health claims will stifle creativity and innovation



The
Economist

The shape of things to come



December 13-19, 2003