

A young boy with dark skin and short hair, wearing a white shirt, is looking towards the camera with a slight smile. In front of him is a white plate filled with various fruits, including several green apples, a few red apples, and a bunch of yellow bananas. The background is slightly blurred, showing what appears to be a window or a wall with some texture.

# Nutritional knowledge

**Carbohydrates**

Nigeria, March 2005

# Presentation

- Chemical structure
- Different carbohydrate groups
- Function
- Sources
- Digestion & absorption
- Lactose intolerance
- Requirements
- Cow's milk & carbohydrates
- Check your knowledge

## The key lines

- **Carbohydrates:** a readily available source of energy
- **Lactose:** the main carbohydrate in milk
- **Lactose:** a di-saccharide which consist of glucose & galactose

# Chemical structure (1)

-  - mono-saccharide

-  -  - di-saccharide

-  -  -  -  -  -  - etc. oligo or poly-saccharide

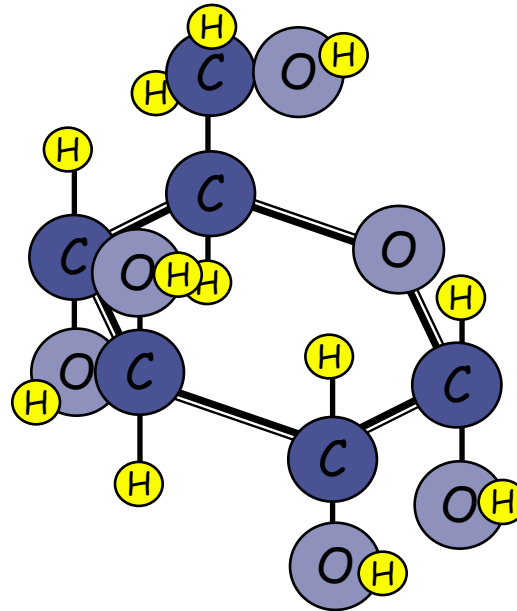
3-10 units = oligo-saccharide

>10 units = poly-saccharide

# Chemical structure (2)

Carbohydrates contain

- C = carbon
- H = hydrogen
- O = oxygen



# Carbohydrates: groups

## Mono-saccharides

- Glucose
- Fructose
- Galactose

## Chemical structure

-△- = 1 mono-saccharide

## Di-saccharides

- Saccharose = sucrose
- *Lactose*
- Maltose

-△-△- = 2 mono-saccharides

glucose + fructose

*glucose + galactose*

glucose + glucose

## Oligo-saccharides

- Fiber e.g. GOS/FOS

-△-△-△-△-△-etc. 3-10 glucose units

## Poly-saccharides

- Fiber e.g. cellulose
- Starch

-△-△-△-△-△-etc. >10 glucose units

# Function

- Primary role sugar & starches: provide energy to body cells
  - 1 g → 4 kcal/17 kJ
- Brain & red blood cells: glucose is vital

## Dietary fiber

- Dietary fibers: different properties → different effects
  - Influenced by: solubility, viscosity, fermentability



# Sources

- Sucrose (di-saccharide)
  - Sugar: white, brown and raw sugar
  - Malt syrup: largely sucrose
  - Honey: comparable with sucrose
- Lactose (di-saccharide): milk and milk products
- Fructose (mono-saccharide): fruits
- Starch (poly-saccharide): grains
  - Corn, tapioca, flour, cereals, pasta, rice, potatoes
- Dietary fiber (oligo / poly-saccharides): cereals, nuts, vegetables, fruits, whole grain legumes

# Carbohydrates: many sources



# Lactose

- Lactose = milk-sugar
- Lactose = di-saccharide
- Lactose = -- + -- = glucose + galactose
- Lactase = enzyme to hydrolyse lactose

**Oligo-saccharides:**

**glucose syrup / corn syrup solids &**

**malto dextrin**

Easily digested and absorbed

and

well tolerated (also by infants & children)

# Digestion and absorption

-Δ-Δ- di-saccharide

-Δ-Δ-Δ-Δ-Δ- etc. oligo-saccharide

-Δ-Δ-Δ-Δ-Δ-Δ-Δ-Δ-Δ-Δ- etc. poly-saccharide



Mono-saccharides

glucose, fructose, galactose

-Δ-

-Δ-

-Δ-

# Digestion

- Carbohydrates are hydrolysed (digested / cleaved) by particular carbohydrate-cleaving enzymes
- Place of action: mouth & small intestine
- Enzymes cleave carbohydrates in smaller units:
  - Glucose, fructose, galactose

# Absorption

- Small units: absorbed by small finger-like projections (villi), lining the intestinal wall
- After absorption, mono-saccharides (glucose, fructose, galactose) → liver

In the liver:

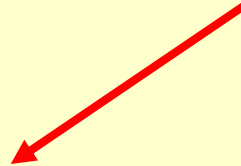
- fructose → glucose
- galactose → glucose

# Dietary fiber

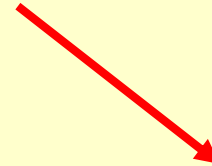
Dietary fiber = indigestible carbohydrate



Arrives in the large intestine



**No fermentation**  
**Bulky faeces**



**Fermentation →**

- **Good intestinal flora: better gut motility**
- **Protection against pathogenic bacteria/viruses**
- **Improved absorption Ca, Fe, Zn, Mg**

# Dietary fiber: indigestible but fermentable

- Non-available carbohydrates
  - Enzymes of human body: not able to hydrolyse (digest) these carbohydrates
- Enter (unchanged) the *large intestine* →  
fermented by bacteria

## **Indigestible but fermentable carbohydrates (prebiotic action)**

- Stimulate a good (desirable) intestinal flora: better gut motility
- Provide a first line of defence against pathogenic bacteria & viruses
- Stimulate absorption of Ca, Fe, Zn, Mg

# Not all lactose is digested

- Part of lactose (unchanged) → large intestine
- Fermented by bacterial flora
- Part of lactose has (comparable to fermentable fibers) a prebiotic action:
  - Stimulates desired intestinal flora
  - Positively influences consistency of faeces
  - Stimulates the absorption of Ca, Zn, Mg, Fe

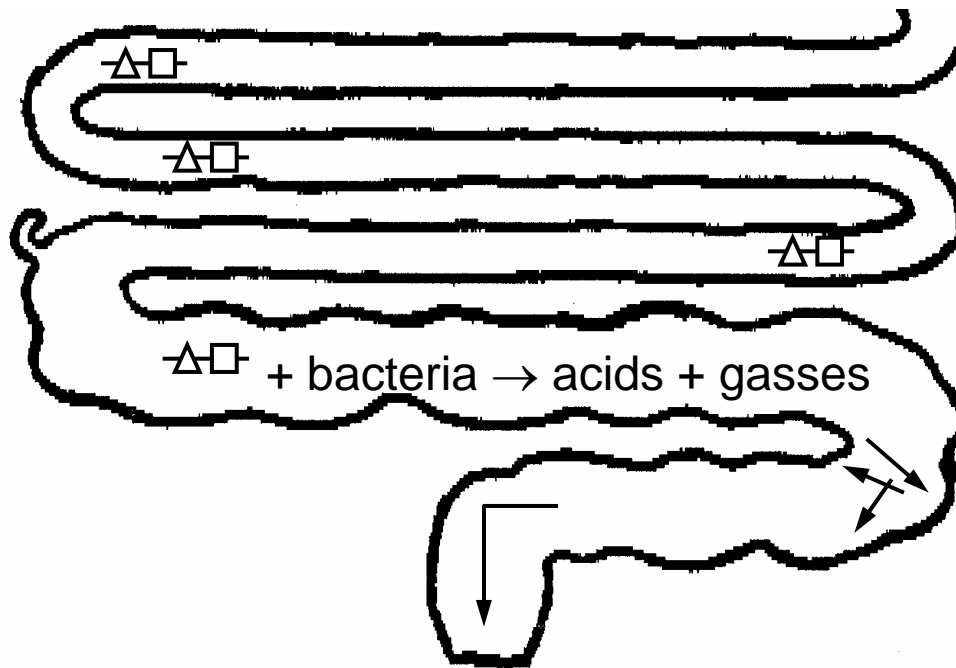
# Lactose intolerance

- Lactose intolerance/lactase deficiency may be a problem in Asian & African communities
- > 4 years old when milk consumption ↓
- Result: enzyme lactase in small intestine ↓
- Influenced by hereditary factors (primary or genetic lactose intolerance) and because no more milk is drunk
- Lactase ↓: will not increase again

# Disturbed mechanism

Lactase ↓

- too much lactose → large intestine → flatulence, diarrhoea, cramps



# Carbohydrate requirements

- Requirement depends on age, gender
- Every country has its own, local nutrient recommendations
  - Internationally: US/Canadian Dietary Reference Intakes (DRIs)

**Cow's milk:  
4.8 g lactose per 100 ml**

**Standard cow's milk:  
macro-nutrients in Energy%**

