
Nutritional knowledge
Protein
Nigeria, March 2005

Presentation

- Chemical structure
- Amino acids: essential & non-essential
- Function
- Sources & quality
- Digestion & absorption
- Milk constituents: casein & whey-protein
- Requirements
- Cow’s milk & protein
- Check your knowledge

The key lines

- Protein is essential for life
- Protein is the main building component of the body
- Protein forms the basic structure of each cell in the body

Protein consists of amino acids

- Can be compared with a chain of beads

  -O-O-O-O-O-O-O-O- etc

  poly-peptide = protein

- Building unit

  -O- = *amino acid*

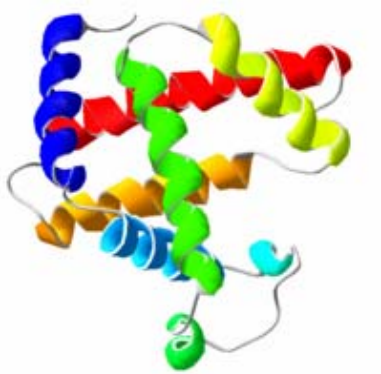
- A few amino acids linked together

  -O-O- -O-O-O- *di-, tri-, or oligo-peptides*

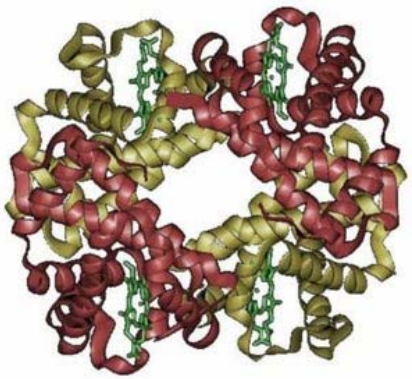
Amino acids folded in a 3-dimensional structure

Protein contains

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



N= key element for building tissues



Amino acids: 2 groups

- Essential amino acids
  - Must be supplied with food
  - Cannot be synthesised (made) by our body

- Non essential amino acids
  - Can be synthesised by our body

Essential (indispensable) amino acids

- Isoleucine
- Leucine
- Lysine
- Methionine
- Phenylalanine
- Threonine
- Tryptophan
- Valine
- Histidine

Function of protein (1)

- Major functional & structural component of all cells in body ➔ required for growth, maintenance, renewal (repair) of all body cells
- Functions as enzyme, transport carrier, hormone
  - All enzymes, many hormones, blood transport molecules, hair, fingernails, etc. are proteins

Function of protein (2)

- Amino acids play a role as precursors (forerunner) for e.g. many enzymes, hormones, vitamins
- Constituent of antibodies which protect against infection & disease
- Supplies energy in particular circumstances (e.g. in malnourishment),
  - When fat & carbohydrate intake is inadequate

Sources & quality

- Protein in food: different quantity & quality
- Nutritional value of protein: determined by amino acid composition
  - Biological value (BV)

High biological value

Protein that contains all essential amino acids in sufficient proportions

Low biological value

Protein which is deficient (poor) in 1/more essential amino acids

Animal & vegetable protein

Animal protein

- Sources: e.g. meat, poultry, fish, eggs, milk, dairy products
- Almost same proportion of each essential amino acid as human protein
  - *Complete protein:* high BV

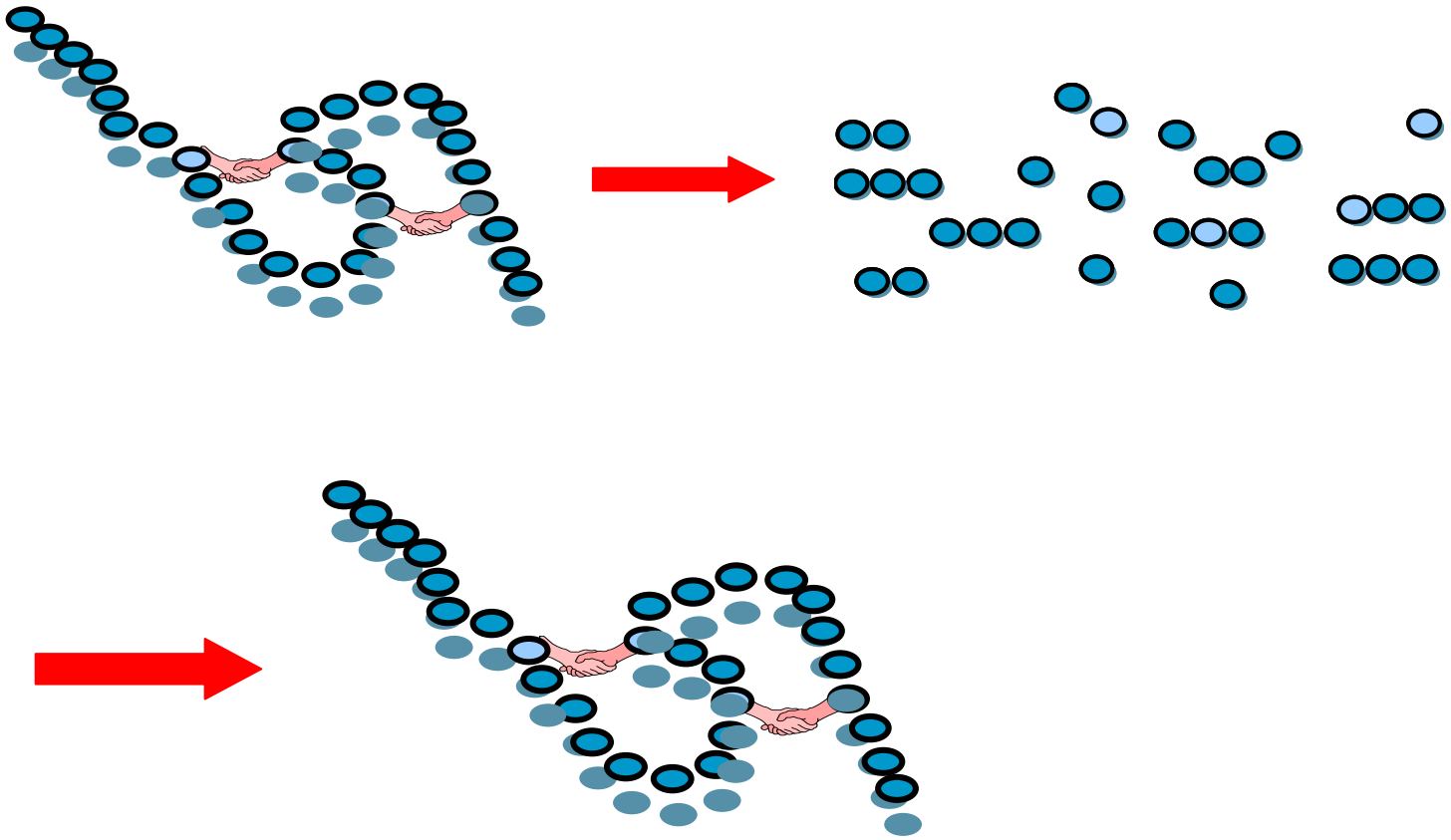
Vegetable protein

- Sources: e.g. vegetables, legumes, plants, grains, nuts, seeds
- Deficient in 1/more essential amino acids
  - *Incomplete protein*: low BV
- Deficient (poor) amino acid = *limiting amino acid*

Animal protein = complete protein

Vegetable protein = incomplete protein

Digestion, absorption and synthesis



Digestion

- Protein is hydrolysed (digested / cleaved) by particular protein-cleaving enzymes
- Place of action: stomach & small intestine
- Enzymes cleave protein in small units:
  - amino acids & short chain peptides

Absorption

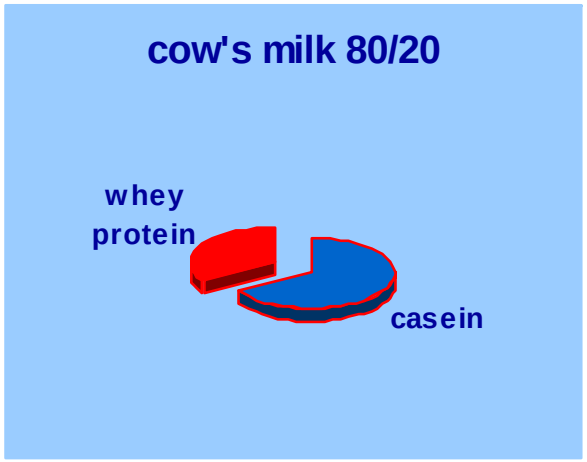
- Small units: absorbed by small finger-like projections (villi), lining the intestinal wall
- Small peptides → free amino acids
- Free amino acids → blood → liver

Synthesis

- Amino acids → new (cell specific) protein = synthesis = continuing process
- Body protein is continuously broken down (into amino acids) and re-synthesised (amino acids are re-built to protein)

Milk = high quality protein

- Cow's milk (and dairy products) = excellent source of high quality protein
  - All essential amino acids in proportions needed by the body



Casein

- In milk: salt of calcium
- Fraction *that forms curds*
- Not coagulated by heat
  - Precipitated (separated) by acids (action of acid in e.g. stomach) or by enzyme obtained from stomach of calves (production of cheese)
- Does not denature easily: proteins denature when they lose their 3-dimensional structure

Whey-protein

- Occurs in whey fraction: watery part of milk
- Whey = liquid remaining after milk has been curdled and strained
- By-product of cheese production: used for nutritional (and commercial) uses

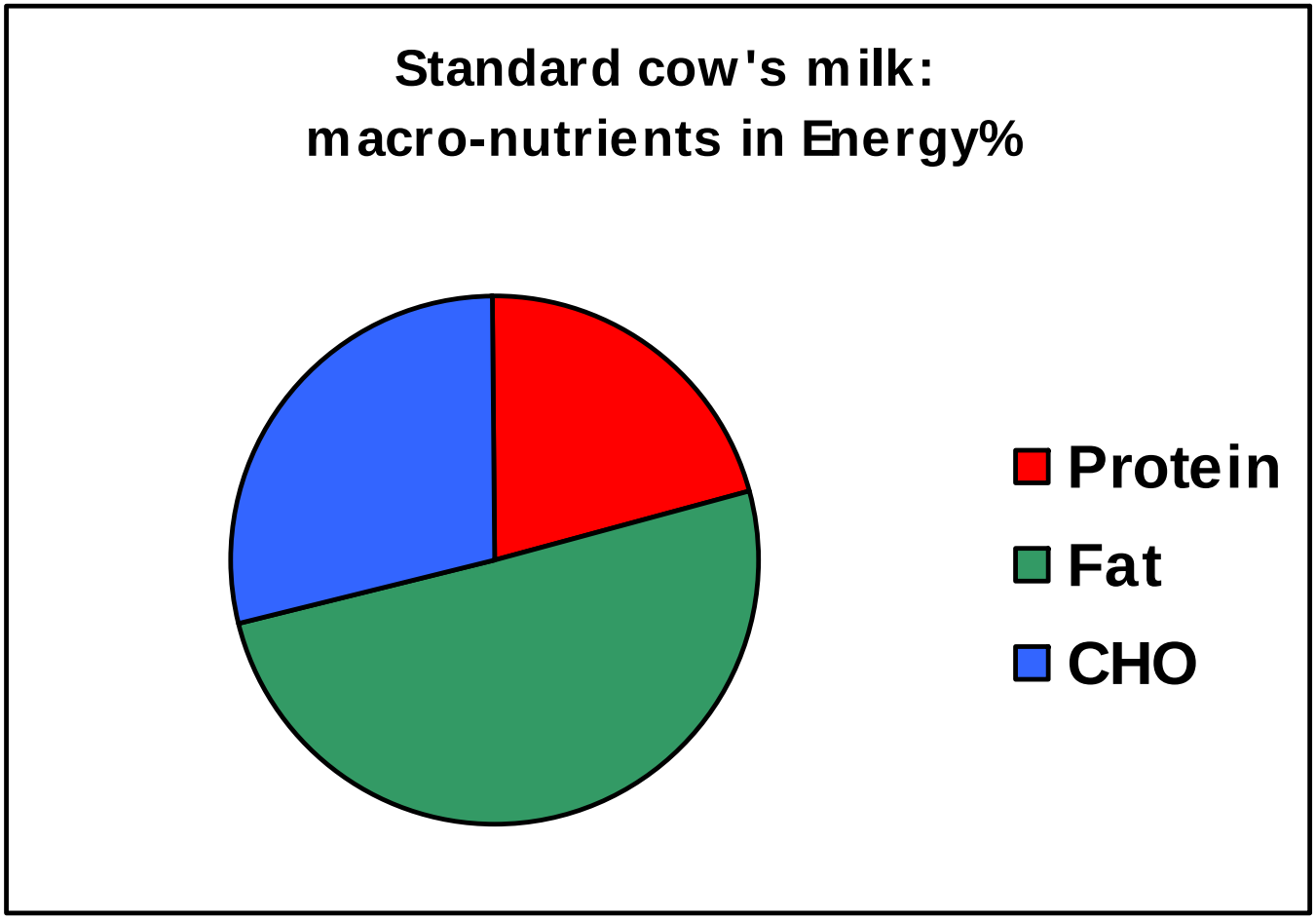
Protein in milk

	Characteristics	Nitrogen fraction	Non-protein nitrogen (NPN) fraction
Casein	Cow's milk: 80% Tryptophan ↓ Cysteine ↓	α-casein β-casein γ-casein κ-casein	Various Enzymes Nucleotides Urea Free Amino Acids
Whey-protein	Cow's milk: 20% Tryptophan ↑ Cysteine ↑	β-lactoglobulin, α-lactalbumin	
Other whey-Proteins		Serum albumin Immunoglobulins (e.g. IgA, IgG, IgM) Lactoferrin Lysozyme	

Protein requirements

- Requirement depends on age, gender (and situation)
- Infants, children, pregnant & lactating need additional protein (essential amino acids)
  - Synthesis of new body tissues → healthy growth & development
- Healthy adults require continuous supply of protein → tissue maintenance & repair
- Every country: own, local nutrient recommendations
  - Internationally: US/Canadian Dietary Reference Intakes (DRIs)

Cow's milk:
3.4 g protein per 100 ml



High quality protein

- Cow's milk (and dairy products) = excellent source of high quality protein
  - All essential amino acids in proportions needed by the body ➔ for good growth & development
  - BV ↑ = complete protein
  - Casein/whey protein = 80/20

3.4 g protein/100 ml:

500 ml/day = 17 g of protein = RDA

30% (men) and 37% (women)