Food chemistry

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1 Vitamins

Fat-soluble vitamins

- Carbon and hydrogen
- Non-polar (few or no polar groups)
- Soluble in other non-polar solvents e.g. fats, oils
- Can be synthesised endogenously

Water-soluble vitamins

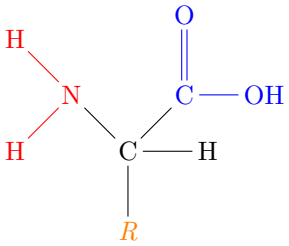
- Absorbed directly into bloodstream
- Catalyse cellular reactions
- Excreted through kidneys in urine
- Must be obtained from food

2 Proteins

- All proteins contain C, H, O, N
- Plants make proteins from inorganic compounds, animals cannot
- Built from monomers called **amino acids**

Aminio acids

- Contains amino ($-NH_2$) and carboxyl ($-COOH$)
- Most have four groups bonded to central atom
- May be polar or non-polar (amphoteric), acidic or basic
- **Essential amino acids** - cannot be synthesised, must be supplied in diet
- Amino acids (except glycine) are enantiomers due to chiral centres
- Must be correct chirality to act as a biological catalyst



Zwitterions

- Zwitterion = *dipolar ion*
- Behaves as a base in acidic environments: $-\mathrm{COOH}- + \mathrm{H}^+ \longrightarrow -\mathrm{COOH}$
- Behaves as an acid in basic environments: ammonium group loses $\mathrm{H}^+ \implies$ anionic form

$$\underset{\text{acid form}}{{}^+\mathrm{H_3N}-\mathrm{CH_2}-\mathrm{COOH}} \overset{+\mathrm{H}^+}{\rightleftharpoons} \underset{\text{zwitterion form}}{{}^+\mathrm{H_3N}-\mathrm{CH_2}-\mathrm{COO}^-} \overset{-\mathrm{H}^+}{\rightleftharpoons} \underset{\text{basic form}}{\mathrm{H_2N}-\mathrm{CH_2}-\mathrm{COO}^-}$$

cationic anionic

Formation of proteins

Amino acid $\rightarrow$ peptide (polymerisation)

Peptide group (amide): $-\mathrm{C}{=}\mathrm{ONH}$ (condensation reaction produces $\mathrm{H_2O}$)
Amino acid *residue* - product of peptide formation reaction
Large polypeptides are called *proteins*

Protein structure

1. **Primary structure** - order of amino acids in peptide chain
2. **Secondary structure** - coils/pleats/folds in polymer
3. **Tertiary structure** - three-dimensional structure, e.g. H-bonding, ionic bonding
4. **Quaternary structure** - arrangement of multiple protein molecules

Enzymes

- Biological catalysts (lowers E_A)
- Names usually end in *-ase*
- Every enzyme has a unique 3D shape
- Rate of reaction $\propto$ concentration up to *saturation point*
- **Substrate** - reactant molecule
- **Active site** - destination of substrate

Lock and key model

Reactants and enzymes must have complementary shapes

Indicued fit model

Active site may change to fit subtrate

Coenzymes

"Helper" molecules to enzymes. Non-protein molecules. Temporarily forms a loose bond with protein molecule to form active enzyme. Coenzymes are not specific to the substrate (different to enzymes).

Digestion of protein

Proteins are hydrolysed by the *pepsin* enzyme ($\implies$ addition of $\mathrm{H_2O}$).

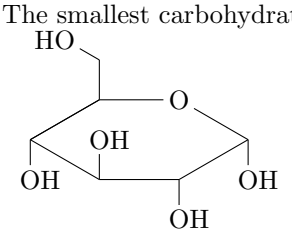
Hydrolysis: breaking of strong covalent (peptide) bonds

Denaturation: breaking of weak bonds (dispersion, H-bonds)

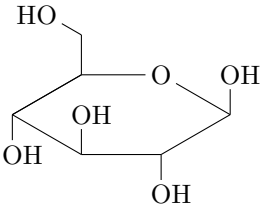
3 Carbohydrates

Monosaccharides

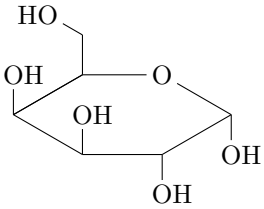
The smallest carbohydrates.



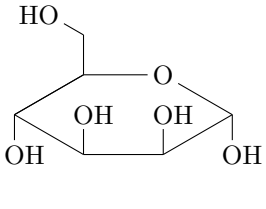
α glucose
$C_6H_{12}O_6$



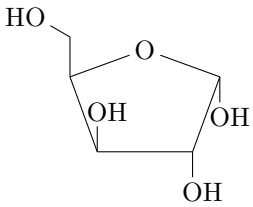
β glucose
$C_6H_{12}O_6$



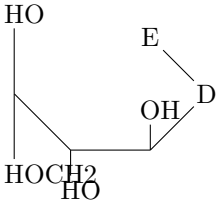
galactose
$C_6H_{12}O_6$



mannose
$C_6H_{12}O_6$



xylose
$C_5H_{10}O_5$



fructose
$C_6H_{12}O_6$