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Component conventions and expressions

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Units, denominators, modes of expression

- Units (how much of the component):
  - g, mg, mcg, kJ (kcal)
- Denominators (in where):
  - per 100g edible portion (usually used in FCDB)
  - per kg
  - per g nitrogen
  - per 100g total fatty acids
  - per 100g dry matter
  - per 100g total food (as purchased)
  - per 100ml
- Mode of expression
  - calculation method (e.g. in monosaccharide equivalent or vitamin equivalents, algorithms using conversion factors such as energy or protein
  - units and denominators
  - significant figures
  - rounding

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Table 9.1 Modes of expression of food composition values in reference and user databases (per 100 g edible portion of food)

Constituent	*Unit*	*Number of significant digits*	*Suggested limits in database*		*Trace = less than*
			Value	*Limit*	
Energy	kJ (kcal)	3	1–999	±1	0.6
			>1000	±10	6
Major constituents (water, protein, fat, carbohydrates, dietary fibre, alcohol, organic acids)	g	3		±0.1	0.06
Amino acids	mg	3		±0.1	0.06
Fatty acids	g	3		±0.1	0.06
	mg	3		±0.1	0.06
Cholesterol	mg	3		±1	0.6
Inorganic constituents	mg	3	1–9	± 0.1	0.06
	mg	3	10–99	±1	
	mg	3	>100	±10	
	µg	2	100–1000	±10	6

Source: Greenfield & Southgate, 2003

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Constituent	*Unit*	*Number of significant digits*	*Suggested limits in database*		*Trace = less than*
			Value	*Limit*	
Vitamins					
Vitamin A					
Retinol	µg	3		±1	0.6
Carotenes	µg	3		±1	0.6
Vitamin D	µg	2		±0.1	0.06
Vitamin E					
Tocopherols	mg	2		±0.01	0.006
Vitamin K	µg	2		±0.1	0.06
Group B vitamins					
Thiamin	mg	2		±0.01	0.006
Riboflavin	mg	2		±0.01	0.006
Niacin	mg	2		±0.01	0.006
Vitamin B_6	mg	2		±0.01	0.006
Pantothenic acid	mg	2		±0.01	0.006
Biotin	mg	2		±0.01	0.006
Vitamin B_{12}	µg	2		±0.01	0.006
Folates	µg	2		±0.1	0.06
Vitamin C	mg	3		±0.1	0.06

Source: Greenfield & Southgate, 2003

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Significant figure

- The last digit should reflect the precision of the analysis and the value cited should not give a false impression on the precision the constituent can be measured
- is different from decimal places
- 123 or 12.3 or 1.23 or 0.123 have all three significant figures
- in reference DB useful to have one more significant figure than in user DB
- record values as reported from lab or from calculations (may be more than useful number of significant figures)

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Rounding

- mostly after aggregation of calculation use rounding
- convention:
  - 0-4 rounded down
  - 6-9 rounded up
  - 5 rounded down with even figures (0.25 --> 0.2) and rounded up with uneven figures (0.55 --> 0.6)

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Data values

- Analytical values
- Missing values (never assign zero value)
- Zero values (presumed or assumed)
- Trace values (Tr, present but < LOD or LOQ, should not have zero value)
- Imputed values
- Calculated values

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Why would we calculate values?

- some nutrients are always calculated
  - energy
  - protein
  - Retinol equivalents
  - beta carotenes equivalent
  - vitamin D
  - alpha tocopherol equivalent
  - niacin equivalent
  - dietary folate equivalent
  - fatty acids in food
- missing data in FCDB but important for users

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Energy

Energy value depend on:

- macronutrient definitions (CHO, protein, fat, fibre)
- conversion factors used
  - Gross energy ’ (for Protein, CHO, fat, alcohol, fibre in kJ/g: 24, 17 (16), 40,30,17 (in kcal/g : 5.65, 4.0 (3.7), 9.4, 7, 4),
  - general Atwater factors (for Protein, CHO, fat, alcohol in kJ/g: 17, 17, 37, 29 (in kcal/g: 4,4,9,7)
  - specific Atwater factors as indicated in Merrill & Watt (1973)
  - dietary fibre 8 kJ/g (2 kcal) applied or not

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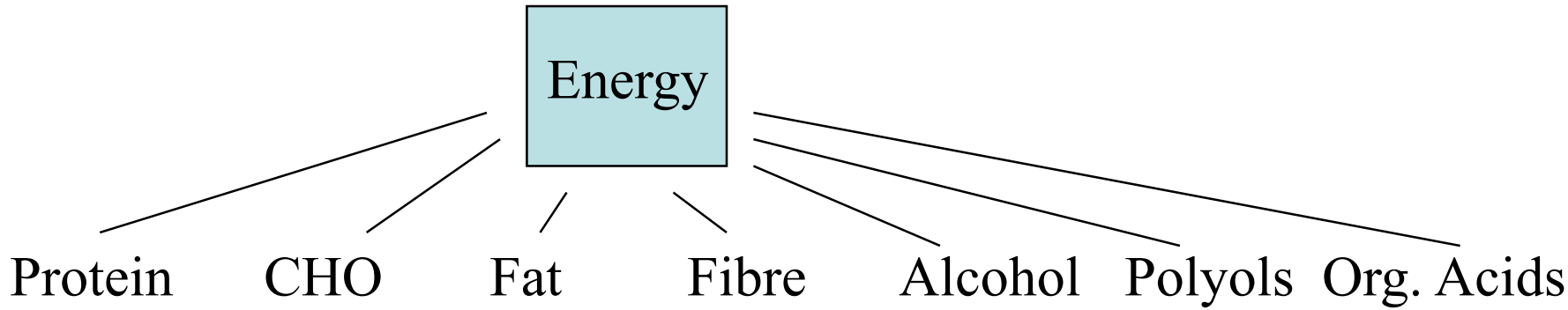
Combination of macronutrient values



Def.	13	5	2	5	1	1	1

==> theoretical 650 combinations of definitions, meaning different nutrient values, before even applying the different energy conversion factors

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Energy

kcal/g

- 4, 4, 7, 9: most
- 3.75, 4, 7, 9: UK
- USDA: specific Atwater factors + 4, 4, 7, 9
- dietary fibre: 2 kcal/g

kJ/g

- 17 (16), 17, 29, 37 kJ/g
- or kcal x 4.2 (or 4.184) – not recommended
- dietary fibre: 8 kJ/g

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Protein

- **Selection of nitrogen value (3)**
  - total N (= as analysed through Kjeldahl) *
  - amino N
  - protein N
- **Selection of nitrogen conversion factors (4)**
  - N x 6.25 for all foods
  - N x Jones factors(4.17 - 6.38) depending on food
  - N x adapted Jones factors
  - N x lower factors (5.7 or 5.33 and specific factors)
- **Sum of amino acids**

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Fat

- Fat, total. Sum of triglycerides, phospholipids, sterols and related compounds. The analytical method is a mixed solvent extraction (Tagname: FAT)
- Fat, total. Derived by analysis using continuous extraction (Soxhlet method). The nutrient values are lower for cereals but comparable for other food groups (Tagname: FATCE)
- Total fat by NLEA definition (triglyceride equivalents of fatty acids). This is used for labelling in the United States of America (Tagname: FATNLEA)
- = fatty acids/ fatty acid conversion factor

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Table 9.2 Conversion factors to be applied to total fat to give values for total fatty acids in the fat

Food	*Factor*
Wheat, barley and rye[1]	
wholegrain	0.72
flour	0.67
bran	0.82
Oats, whole[1]	0.94
Rice, milled[1]	0.85
Milk and milk products	0.945
Eggs[2]	0.83
Fats and oils, all except coconut	0.956
Coconut oil	0.942
Vegetables and fruit	0.80
Avocado pears	0.956
Nuts	0.956

Food	*Factor*
Beef [3]	
lean	0.916
fat	0.953
Lamb, take as beef	
Pork[4]	
lean	0.910
fat	0.953
Poultry	0.945
Brain[4]	0.561
Heart[4]	0.789
Kidney[4]	0.747
Liver[4]	0.741
Fish[5]	
fatty	0.90
white	0.70

Source: Greenfield & Southgate, 2003

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Fat

- total fat: most countries
- Fat (Soxhlet): China, Egypt, (Lesotho)
- triglycerides: NZ
- fatty acid conversion factor: in introduction but not at food level
- FA fractions (sat., monounsat., polyunsat.): many in g, some also in % but contributing FAs might be different
- trans FA: NZ, USDA, Norway, Denmark, NEVO, UK
- individual FAs: few, e.g. UK, USDA, NZ, China
- need for revised nomenclature of fatty acids

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Retinol equivalent

- Total vitamin A activity (mcg) in retinol equivalent
  = mcg retinol + 1/6 mcg beta-carotene + 1/12 mcg alpha-carotene + 1/12 mcg beta-cryptoxanthin
  = mcg retinol + 1/6 mcg beta-carotene equivalent
- RAE (retinol activity equivalent) in mcg in USDA, DK
  = mcg retinol + 1/12 mcg beta-carotene + 1/24 mcg 1/12 alpha-carotene + 1/24 mcg beta-cryptoxanthin
- all-*trans* retinol equivalents in mcg (UK)
  = all-*trans* retinol + 0.75 13-*cis* retinol + 0.90 retinaldehyde

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β-carotene equivalent

- = 1 β-carotene + 0.5 α-carotene + 0.5 β-cryptoxanthin

- = 1 β-carotene + 0.5 α-carotene + 0.5 α-cryptoxanthin + 0.5 β-cryptoxanthin

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Vitamin D

- = ergocalciferol (vitamin D2) + cholecalciferol (vitamin D3)
- = cholecalciferol (vitamin D3)
- = Vitamin D3 + 5x 25-hydroxycholecalciferol (used in UK, DEN)

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Vitamin E

- alpha-tocopherol (TOPHA)
- α-TE (VITE) = α-tocopherol + 0.5 β-tocopherol + 0.1 γ-tocopherol + 0.3 α-tocotrienol
- UK: α-TE (VITE) = α-tocopherol + 0.4 β-tocopherol + 0.1 γ-tocopherol + 0.01 δ-tocopherol + 0.3 α-tocotrienol + 0.05 β-tocotrienol + 0.01 γ-tocotrienol
- α-TE (VITE) = α-tocopherol + 0.4 β-tocopherol + 0.1 γ-tocopherol + 0.01 δ-tocopherol

BUT: DRI (2001) found that only TOPHA and 3 synthetic forms have vitamin E activity

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Niacin equivalent

- niacin + 1/60 tryptophan

vs.

- niacin

- but in case of limited protein supply tryptophan is not available for niacin activity

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Folates

- folate (= food folate)
- total folate = food folate + folic acid
- Dietary Folate Equivalent (DFE in mcg) = food folate (pteroylpolyglutamates) + 1.7 x synthetic folic acid (pteroylmonoglutamic acid)

Example for USDA all-purpose flour, enriched

Total folate	194 mcg			
Food folate	29 mcg	* 1	=	29
Folic Acid	165 mcg	* 1.7	=	280
				309 mcg DFE

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Usage of units and expressions

- important that every value has a clear unit and denominator, and a well-defined expression
- all necessary elements to calculate the different expressions should be stored in the DB, if possible with other components
- less errors occur in user DBs when nutrient values of calculated components are calculated in own DB (instead of copied from other sources)

For more on food composition, visit www.fao.org/infoods