

What Food Does Our Body Need

A Reference Work on What the Body Needs, How It Is Grown, Prepared and Kept, and What Can Be Done With Simple Means

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How to use this book

This is a reference work. It follows food along one line: from the body that needs it, back to the ground that grows it, and forward again through the kitchen and the store to the plate.

It has nine parts.

- Part 0 gives the frame in which the book is read.
- Part 1 says what the body needs, in grams, milligrams and micrograms.
- Part 2 says how the ground is worked so that it keeps feeding people.
- Part 3 says what to grow, on how much land, with how much work.
- Part 4 treats the herbs.
- Part 5 treats preparation.
- Part 6 treats keeping.
- Part 7 gives recipes and two weeks of day menus, counted nutrient by nutrient.
- Part 8 treats the people who do the work.
- Part 9 links food to the illnesses it prevents.

Three appendices follow: the core tables, the register of disagreements and open questions, and the annotated references.

The book is written for a temperate climate. The worked case is the Netherlands. Where another climate changes the answer, the text says so.

The question asked everywhere. Each part asks what can be done with simple means: little industry, no cold chain, little money. Where a longer chain is genuinely needed, the book says which link cannot be shortened, and why.

Grades. Interventions carry a grade.

Grade	Meaning
STRONG	Trials, or large studies that agree, or settled physiology
MODERATE	One good trial, or consistent observation
WEAK	Little or indirect evidence
CONTESTED	Good sources disagree; both figures are printed

Reference values. The book uses the adult values of the European Food Safety Authority (EFSA) as its main set. Where the United States or the Netherlands set different values, both are printed. Two reference persons are used throughout: a man of 70 kg and a woman of 60 kg, both aged 30–39 and moderately active.

Numbers. Every number in this book was taken from a named source, or computed from such numbers. Where a computation is the book's own, the arithmetic is shown. Where a value is not known, the book says so. It does not estimate. How the figures were checked is set out in the Methods section at the end.

Readings. Part 0 introduces the frame of the net. Where the book sets a measured fact beside that frame, the sentence is marked “Read in the net” and closes with “This is a reading, not a mechanism.” Every number comes from the literature. The frame supplies the order.

Part 0 — The Net and the Plate

0.1 The fishnet

The standing image of this book is a fishnet under tension.

The net is one strand. Where the strand crosses itself there is a knot. Between the knots lie the meshes. A winding is a stretch of strand that returns on itself in step. One rule decides what stays: only what closes — what returns in phase onto itself — persists. What does not close passes its tension on to the meshes beside it.

The rules come from the Vacuum.Net theory [4]. They were set out for the bottom of the ladder, with one strand and one test. This book applies them upward, to soil, plant, kitchen and body. It does not repeat the derivation. A companion work, *Where Illness Comes From, Completed* [1], uses the same rules for illness. This book uses them for what prevents illness: food.

0.2 The test at the rim

When one form reads another, there are three outcomes. They are the three states of the register: +1, 0 and −1.

State	Outcome	What happens
+1	It fits	The form is taken in and kept
−1	It does not fit	The form is taken apart and discharged
0	It is not read	The form passes through unchanged

The gut is the largest reading surface of the body. Every meal arrives at it. What fits is absorbed. What does not fit is broken down or removed. What is not read passes through. Fibre is the clearest case of the third outcome. It is not absorbed. It passes to the colon, where the resident microbes read it instead.

Read in the net: a meal is a set of windings presented to a rim. Digestion is the test applied at depth after depth — mouth, stomach, small gut, colon — until each part has met the outcome that fits it. This is a reading, not a mechanism.

0.3 What the body cannot make

A body is a closed form that must keep closing. To keep closing it needs material it cannot make itself.

Part 1 lists that material. It is short: nine amino acids, two fatty acids, thirteen vitamins, a set of minerals and trace elements, and water. Everything else the body builds from these and from energy.

Read in the net: an essential nutrient is a winding the body's own net cannot close at its own depth. It must arrive already closed, from a plant, an animal, a microbe or the rock. This is a reading, not a mechanism.

0.4 One winding at several depths

The same nutrient passes through several depths before it reaches a cell.

Selenium is the clearest case. It sits in the rock. The soil holds it or lacks it. The plant takes up what the soil holds. The grain carries what the plant took up. The body receives what the grain carries. Wheat grown on selenium-rich American soil carries several times the selenium of wheat grown on European soil. Part 7 shows what that does to a day's menu.

Read in the net: the selenium in a slice of bread is the same winding as the selenium in the rock, read at another depth. A shortage at the plate is a mesh left open at the bottom. This is a reading, not a mechanism.

0.5 Simple means

A simple means, in this book, is something that feeds, keeps or protects without a long industrial chain behind it. A spade. A heap of compost. A cellar. A crock of salted cabbage. A pot of soup in which the cooking water is eaten.

A simple means is not the same as a cheap means. The companion book [1] showed this for medicine. Amoxicillin is cheap and off patent, and seven companies in the world make the substance in it. The same holds for food. A tin of tomatoes is cheap. The chain behind it is long.

Read in the net: a simple means is a means whose chain closes at the point of need. Price is read at the wrong depth. What decides is whether the thing can be completed where it is used. This is a reading, not a mechanism.

0.6 The ground as a net

Soil is the place where the strand is visible to the naked eye. Fungal threads run between roots. Earthworm channels run between layers. Water runs in the pores between grains. Part 2 gives the measured figures.

Read in the net: a living soil is a mesh held open by what lives in it. Ploughing, bare fallow and compaction close meshes that took years to open. Roots, worms, fungi and organic matter open them again. This is a reading, not a mechanism.

0.7 What a reading is

A reading is not a cause. The book does not say that the net makes a carrot grow. It says which configurations persist, and it orders the measured facts accordingly.

In place of cause the book uses four relations: selection by fit, identity over scale, constitutive relation, and correspondence. Every number comes from the standing literature, and Appendix C says which source.

Part 1 — What the Body Needs

1.1 Energy

EFSA sets energy need as resting expenditure times a physical activity level (PAL) [7]. A PAL of 1.6 means moderately active.

Person (30-39 y, PAL 1.6)	MJ/day	kcal/day
Man	10.8	2,581
Woman	8.7	2,079

The adult range runs from 6.8 MJ (women aged 70-79, PAL 1.4) to 14.0 MJ (men aged 18-29, PAL 2.0). At PAL 1.6 the resting part is $1/1.6 = 62.5$ per cent of the total.

Pregnancy adds 0.29, 1.1 and 2.1 MJ a day in the three trimesters. Lactation adds 2.1 MJ a day.

1.2 Protein and the nine amino acids

EFSA sets the population reference intake (PRI) for protein at 0.83 g per kg body weight a day, for all adults, older adults included [8]. For a 70 kg man that is $0.83 \times 70 = 58.1$ g. For a 60 kg woman it is 49.8 g. EFSA considers twice that amount safe and sets no upper level. The United States uses 0.8 g/kg [17].

Nine amino acids cannot be made by the body. The adult requirements in mg per kg a day are [18]:

His	Ile	Leu	Lys	Met+Cys	Phe+Tyr	Thr	Trp	Val
10	20	39	30	15	25	15	4	26

Cereal and legume close each other. Each staple lacks something the other has. Computed from the USDA composition table [85] against the FAO 2013 scoring pattern [19]:

- Whole-wheat protein carries 27.2 mg lysine per g protein. The pattern asks 48. Wheat reaches 57 per cent.
- Lentil protein carries 69.8 mg lysine per g but only 21.6 mg of the sulphur amino acids. The pattern asks 23. Lentil reaches 94 per cent.
- A 50:50 protein mix gives 48.5 mg lysine and 29.8 mg sulphur amino acids per g. Both meet the pattern.

The measured protein quality scores (DIAAS) are: wheat 0.45, oats 0.67, faba bean 0.66, pea isolate 1.00, casein 1.45 [19].

Simple means: bread or porridge with peas, beans or lentils covers the amino acids without animal food and without a cold chain. Erwtensoeop with rye bread is this rule as a dish.

Read in the net: a cereal and a legume are two open windings that close on each other. Neither suffices alone. Together they close. This is a reading, not a mechanism.

1.3 Fats

EFSA advises 20–35 per cent of energy from fat [9]. Two fatty acids are essential:

- Linoleic acid (omega-6): adequate intake (AI) 4 per cent of energy.
- Alpha-linolenic acid (ALA, omega-3): AI 0.5 per cent of energy.

At 2,000 kcal that is 8.9 g linoleic acid and 1.1 g ALA a day. Linseed carries 22.8 g ALA per 100 g, so 4.8 g of linseed covers the ALA need. Walnuts and rapeseed oil carry about 9 g per 100 g. 23 g of walnuts covers the linoleic acid need.

The long-chain omega-3 fats EPA and DHA have an AI of 250 mg a day [9]. Herring carries 1.57 g per 100 g. One 100 g portion a week gives 224 mg a day on average. Pregnancy and lactation add 100–200 mg DHA.

EFSA advises saturated and trans fats “as low as possible”. WHO sets saturated fat below 10 per cent of energy and trans fat below 1 per cent.

1.4 Carbohydrate and fibre

EFSA advises 45–60 per cent of energy from carbohydrate [10]. WHO advises free sugars below 10 per cent of energy, ideally below 5.

Fibre has an AI of 25 g a day, set on normal bowel function [10]. The largest analysis, 185 cohort studies and 58 trials, compared the highest with the lowest intakes [20]:

Outcome	Risk ratio
All-cause mortality	0.85
Coronary heart disease	0.76
Type 2 diabetes	0.84
Colorectal cancer	0.84

The greatest benefit lay at 25–29 g a day. Each extra 8 g gave a mortality risk ratio of 0.93. The cohort figures are observational. The trial figures in the same paper are smaller and causal: body weight -0.37 kg, systolic pressure -1.27 mmHg, total cholesterol -0.15 mmol/L [20].

Fibre per 100 g: rye grain 15.1 g, oats 10.6 g, whole-wheat flour 10.7 g, cooked split peas 8.3 g, cooked lentils 7.9 g. 100 g oats, 150 g cooked lentils and 100 g carrot give 25.3 g.

1.5 Water

EFSA's AI for total water, from food and drink together, is 2.5 L a day for men and 2.0 L for women [7]. Pregnancy raises it to 2.3 L, lactation to 2.7 L. The United States sets 3.7 and 2.7 L.

The companion book on the body found that the “eight glasses” rule has no study behind it, and that thirst keeps the balance in healthy adults [2]. Measured turnover runs from 2.5 to more than 4 L a day.

1.6 Minerals

Adult values, EFSA first [7, 13, 14, 15]:

Mineral	EFSA	US	Simple temperate source, per 100 g
Calcium	PRI 950 mg	1,000–1,200 mg	Gouda 700, kale 150, milk 113 mg
Phosphorus	AI 550 mg	700 mg	pumpkin seed 1,233, oats 523 mg
Magnesium	AI 350 / 300 mg	400–420 / 310–320 mg	pumpkin seed 592, oats 177 mg
Potassium	AI 3,500 mg	3,400 / 2,600 mg	white beans 561, potato 425 mg
Sodium	2.0 g (safe and adequate)	1.5 g	—
Iron	PRI 11 (men), 16 (women before menopause) mg	8 / 18 mg	pumpkin seed 8.8, lentils 3.3 mg
Zinc	PRI 9.4–16.3 / 7.5–12.7 mg, rising with phytate	11 / 8 mg	pumpkin seed 7.8, oats 4.0 mg
Copper	AI 1.6 / 1.3 mg	0.9 mg	sunflower seed 1.8, hazelnut 1.7 mg
Iodine	AI 150 µg (200 in pregnancy)	150 µg	haddock 320, cod 196, egg 50, milk 31 µg
Selenium	AI 70 µg	55 µg	sunflower seed 53, herring 37, egg 31 µg
Manganese	AI 3 mg	2.3 / 1.8 mg	hazelnut 6.2, oats 4.9 mg
Molybdenum	AI 65 µg	45 µg	no composition value available

Where two values are given, the first is for men and the second for women.

Zinc and phytate. EFSA’s zinc value depends on how much phytate the diet carries. At 300 mg phytate a day a man needs 9.4 mg zinc. At 1,200 mg he needs 16.3 mg. This book uses the 600 mg level: 11.7 mg for men and 9.3 mg for women. Part 5 shows how soaking, sprouting and sourdough lower phytate.

Iodine. In the Netherlands iodine reaches the diet mainly through iodised bakery salt, at up to 65 mg iodine per kg salt [88]. Bakers are not obliged to use it. Home-baked bread without bakery salt carries almost no iodine. Dried kombu carries 440,670 µg per 100 g: a single gram exceeds the EFSA upper level of 600 µg seven times over.

Chromium. EFSA sets no value and finds its essentiality not established. The United States sets an AI. Grade: CONTESTED.

1.7 Vitamins

Adult values, EFSA first [7, 11, 12, 16]:

Vitamin	EFSA	US	Simple temperate source, per 100 g
A	PRI 750 / 650 µg	900 / 700 µg	carrot 835, kale 500 µg RAE
B1 thiamin	PRI 0.1 mg per MJ	1.2 / 1.1 mg	sunflower seed 1.48, oats 0.76 mg
B2 riboflavin	PRI 1.6 mg	1.3 / 1.1 mg	egg 0.46, milk 0.17 mg
B3 niacin	PRI 1.6 mg NE per MJ	16 / 14 mg	mackerel 9.1, sunflower seed 8.3 mg
B5 pantothenic acid	AI 5 mg	5 mg	egg 1.5 mg
B6	PRI 1.7 / 1.6 mg	1.3-1.7 mg	sunflower seed 1.35, potato 0.30 mg
B7 biotin	AI 40 µg	30 µg	egg 19.5, walnut 19 µg
B9 folate	PRI 330 µg (600 in pregnancy)	400 µg	spinach 194, lentils 181, kale 141 µg
B12	AI 4 µg	2.4 µg	herring 13.7, mussels 12, Gouda 1.5, egg 0.9 µg
C	PRI 110 / 95 mg	90 / 75 mg	blackcurrant 181, kale 120, Brussels sprouts 85 mg
D	AI 15 µg	15 µg	mackerel 16, herring 4-19, egg 2 µg
E	AI 13 / 11 mg	15 mg	sunflower seed 35, rapeseed oil 17.5 mg
K	AI 70 µg (1 µg per kg)	120 / 90 µg	parsley 1,640, kale 705 µg
Choline	AI 400 mg	550 / 425 mg	egg 294 mg

Herring appears with two vitamin D values. The US table gives 4.2 µg per 100 g. The UK table gives 19 µg. Part 7 shows the consequence.

B12. B12 is made only by microbes. It reaches people through animal foods. Plant foods carry none unless fortified. The B12 in nori is largely an inactive analogue. The body absorbs at most 1-2 µg per meal through its own carrier.

Vitamin D. EFSA's 15 µg assumes little sun on the skin. In the Netherlands the sun stands too low between October and March for the skin to make it. From March to October it can.

1.8 The essentials in one table

Class	Essential nutrients	Must come from	Simple temperate source
Amino acids (9)	His, Ile, Leu, Lys, Met, Phe, Thr, Trp, Val	any protein; plants need cereal plus legume	bread or oats with peas, beans or lentils; eggs; milk
Fatty acids (2)	linoleic acid, alpha-linolenic acid	plants	walnuts, rapeseed oil, linseed, hemp
Fat-soluble vitamins (4)	A (or carotenoids), D, E, K	D from sun or food; the rest from food	carrot, kale, herring, mackerel, sunflower seed
Water-soluble vitamins (9)	B1, B2, B3, B5, B6, B7, B9, B12, C	B12 only from animal or microbial sources	whole grains, legumes, greens, blackcurrant; fish, dairy, eggs
Macrominerals	Ca, P, Mg, K, Na, Cl	food and salt	dairy, kale, seeds, potato, legumes
Trace elements	Fe, Zn, Cu, I, Se, Mn, Mo	iodine from sea or iodised salt; selenium from soil	fish, mussels, eggs, seeds, oats
Conditionally essential	choline	food; the liver makes too little	egg, liver
Water	2.0-2.5 L total	drink and food	tap water

Of 57 adults kept on a choline-free diet, 37 developed liver dysfunction. That is why choline has an AI although the body makes some.

1.9 Life stages

Pregnancy and lactation. Folate rises to 600 µg in pregnancy and 500 µg in lactation. Iodine rises to 200 µg. B12 rises to 4.5 and 5 µg. Choline rises to 480 and 520 mg. DHA rises by 100-200 mg. Zinc rises by 1.6 and 2.9 mg. EFSA adds no iron in pregnancy (16 mg). The United States sets 27 mg.

The Dutch advice is 400 µg folic acid a day from four weeks before conception until ten weeks into pregnancy. The founding trial, the MRC Vitamin Study of 1991, gave 1,817 women with a previous affected pregnancy 4 mg folic acid. Neural tube defects fell from 21 of 602 to 6 of 593: a risk ratio of 0.28 and 72 per cent protection [22].

Infants. WHO advises exclusive breastfeeding for six months and continued breastfeeding to two years. About 47 per cent of infants are exclusively breastfed. Dutch infants receive vitamin K drops and 10 µg vitamin D a day up to age three.

Older adults. EFSA keeps protein at 0.83 g/kg. B12 deficiency affects 3-43 per cent of older people living at home, depending on the definition. The Netherlands advises 20 µg vitamin D from age 70.

1.10 Supplements against whole food

Supplement	Finding	Grade
Antioxidant pills (78 trials, 296,707 people)	Mortality risk ratio 1.04 (1.01–1.07) in low-bias trials [21]	STRONG: no benefit, possible harm
Beta-carotene in smokers	Lung cancer +18 and +28 per cent in two trials	STRONG: harm
Folic acid before conception	Neural tube defects risk ratio 0.31 (0.17–0.58) [22]	STRONG
Vitamin D in people who are not deficient	No effect on cancer or cardiovascular events (VITAL, 25,871 people); D-Health hazard ratio 0.91 (0.81–1.01) [23]	STRONG: no benefit in replete adults

The supplements that are justified are narrow: folic acid around conception, vitamin D for defined groups and in winter, vitamin K for newborns, and B12 for people who eat no animal food and for some older adults.

1.11 Who falls short

Worldwide, the modelled share of people with inadequate intake is 68 per cent for iodine, 66 per cent for calcium, 65 per cent for iron and 37 per cent for selenium [24]. Measured deficiency of iron, zinc or folate affects 69 per cent of women aged 15–49. Anaemia affects 30 per cent of these women and 40 per cent of children aged 6–59 months.

In Europe 13 per cent of people have a blood vitamin D level below 30 nmol/L and 40 per cent below 50 nmol/L.

In the Netherlands the national food consumption survey of 2019–2021 found low intakes in some groups of vitamins A, B2, B6, C and folate, and of calcium, iron and potassium [26]. Vitamin D intake is too low at ages 70–79.

1.12 What simple means cover, and what they do not

A temperate diet without a cold chain covers most of the list:

- Grains and legumes give protein, fibre, iron, zinc and the B vitamins.
- Potatoes, cabbages, kale and Brussels sprouts give vitamin C, vitamin K and potassium.
- Stored seeds and nuts give vitamin E, magnesium, zinc and the essential fatty acids.
- Blackcurrants and rose hips give vitamin C through the winter.

Five items need something more:

Nutrient	What closes it
B12	fish, mussels, dairy, eggs; or a supplement
Iodine	sea fish, or iodised salt in bread
Vitamin D	summer sun; fatty fish or a supplement in winter

Nutrient	What closes it
EPA and DHA	fatty fish
Selenium	depends on the soil; fish and eggs in Europe

Herring, mussels and eggs close four of the five in small amounts.

Read in the net: four of the five open meshes — iodine, selenium, B12, vitamin D — close only through the sea, the rock, the microbe or the sun. They are the points where a local food system touches a larger one. This is a reading, not a mechanism.

Part 2 — The Ground

2.1 The occasion

On 21 October 2026 the *Financieele Dagblad* described a farm in Randwijk [6]. André Jurrius grows pumpkins, beetroot, onions, potatoes, lupin and more on 175 ha. Since 2017 he has used no pesticides, no artificial fertiliser and no plough. His yields run about 20 per cent below those of his neighbours. He keeps his potatoes from sprouting with mint oil. He is trying the *aardaker* (*Lathyrus tuberosus*), a tuber that fixes its own nitrogen.

The same article reported a national programme, Re-Ge-NL, run by Wageningen, Groningen and Utrecht with more than fifty partners. Its public funding is confirmed: €129 million from the Nationaal Groeifonds, of which phase 1 (2023–2028) is capped at €72.1 million [45]. The Wageningen project page names a target of 1,000 farmers.

The article also cited a study by the Stichting Family Gupta-Marcusse Foundation. A self-sufficient Netherlands on regenerative farming, with the current diet unchanged, would need 3.1 million ha instead of 1.75 million, and 170,000 workers instead of 100,000. With a vegetarian or vegan diet much less land would be needed. The labour gap could be closed if every Dutch person aged 15 to 75 worked one hour a week on the land. The report itself could not be reached. Section 8.3 checks its figures by arithmetic.

2.2 What soil is

A good soil is about 45 per cent mineral, 25 per cent air, 25 per cent water and 5 per cent organic matter by volume [42]. Half of it is pore space. That half is what people can change quickly.

Soil is alive. In temperate grassland the measured weights per hectare are [42]:

Organisms	t/ha
Bacteria	1–2
Fungi	2–5
Earthworms	up to 2.5
All soil organisms	about 10
Roots	20–90

Arable soil carries about half the microbial biomass of grassland: 1,522 against 2,891 mg carbon per kg.

A field rule: sixteen worms in a spadeful of $20 \times 20 \times 20$ cm signals a healthy soil. That is $16 \div 0.04 \text{ m}^2 = 400$ worms per m^2 .

Mycorrhiza. 72 per cent of flowering plants form a partnership with fungi of one group, the arbuscular mycorrhiza. Only 8 per cent form none [36]. Most crops depend on these partners. Ploughing and bare fallow break the fungal threads.

Nitrogen from the air. Legumes host bacteria that fix nitrogen. Faba bean takes 74 per cent of its nitrogen from the air, pea 62 per cent [37]. Grass with white clover fixes 100–150 kg N per ha a year when little fertiliser is given, and almost none when much is given. Replacing artificial nitrogen entirely with legumes costs land: one estimate puts it at 25–37 per cent extra. That is part of the reason the Gupta-Marcusse scenario needs more land.

Read in the net: the soil is the place where the net is visible. Fungal threads, worm channels and root paths are strands. The pores between them are meshes. A soil holds water and air in the meshes its living strands keep open. This is a reading, not a mechanism.

2.3 Organic matter and water

A popular claim says that each per cent of organic matter makes soil hold much more water. The large measurements say otherwise [30]:

- Over 50,000 measurements: one extra per cent of soil carbon adds 1.16 mm of available water per 100 mm of soil.
- Over a 30 cm root zone that is 3.5 mm per per cent of carbon, or about 2 mm per per cent of organic matter.
- An extension conversion of 3,400 gallons per acre-foot gives 3.2 mm per 30 cm. The two agree.

Organic matter improves structure, crumb and infiltration. Its direct effect on stored water is a few millimetres. Grade: STRONG for the small direct effect.

2.4 Earthworms

Across 58 studies, earthworms raised crop yield by 25 per cent [29]. The effect vanished above 30 kg of fertiliser nitrogen per ha a year. With organic nitrogen it rose to 34 per cent. Earthworms matter most in exactly the low-input systems this book is about. Grade: STRONG.

2.5 Practices and what they measurably do

Practice	Measured effect	Grade
Crop rotation with more crops	maize yield +28.1 per cent; drought losses cut by 14–90 per cent [32]	STRONG
Intercropping	land equivalent ratio 1.16–1.32: 14–24 per cent less land for the same harvest [33]	STRONG
Farmyard manure (Broadbalk, since 1843)	soil organic matter more than doubled at 35 t/ha a year; wheat 4.8 t/ha against 4.9 with fertiliser [31]	STRONG

Practice	Measured effect	Grade
Organic against conventional farming	yields 19–25 per cent lower; only 5 per cent lower for rain-fed legumes and perennials; 8–9 per cent with rotation and mixed cropping [28]	STRONG
No-till	–5.7 per cent yield in the main analysis; –2.4 or –1.2 in a re-analysis; positive in dry climates with residue and rotation [27]	CONTESTED in size
No-till on Dutch clay	–11 to +8 per cent; equal to ploughing after about seven years [43]	MODERATE
Cover crops, soil carbon	0.32 t carbon per ha a year in meta-analyses; 0.03 in the six most robust trials [34]	CONTESTED
Biochar	+25 per cent yield in tropical soils; nothing in temperate soils [35]	CONTESTED
Agroforestry in Europe	biodiversity and soil improve; crop yield falls; alley crops about 71 per cent of sole crop	MODERATE
No-dig beds	+12.8 per cent over 13 years in one unreplicated pair; not significant on independent review	WEAK

The farm in Randwijk sits where the meta-analyses predict: about 20 per cent below conventional.

What the table says. Diversity carries the strongest measured effects: rotation, intercropping and manure. No-till and cover crops help soil structure, and their yield and carbon effects are smaller and disputed. For the Netherlands, biochar is not a yield tool.

Read in the net: a field sown to one crop is one winding repeated. A rotation is several windings that close on each other across the years: the legume leaves nitrogen for the cereal, the cereal leaves straw for the worms, the roots of one open the meshes for the next. This is a reading, not a mechanism.

2.6 Closing the nutrient loop

Phosphorus. World mine production was 250 million tonnes in 2025. Reserves are 73,000 million tonnes, of which Morocco holds 68.5 per cent [39]. Reserves divided by production give $73,000 \div 250 = 292$ years. The near-term question is concentration in one country, not exhaustion. There is no substitute for phosphorus in farming.

Urine and excreta. One adult excretes per year about 2.1–4.0 kg nitrogen and 0.3–0.6 kg phosphorus, depending on diet [38]. 85–90 per cent of the nitrogen and 60–75 per cent of the phosphorus is in the urine. One person’s urine fertilises 300–400 m² a year. 4 kg N over 400 m² equals 100 kg N per ha, a normal dose for vegetables.

Safe use [38]:

- Urine from one household, used on its own plot, needs no storage.
- Pooled urine is stored for six months at 20 °C before use on all crops.
- Dilute about one to three, apply to the soil, keep it off the leaves, and stop one month before harvesting crops eaten raw.
- Faeces must be sanitised first. In compost the benchmark is at least 55 °C for 3 days in a closed or aerated pile, or 15 days with five turnings in an open heap.

Read in the net: food leaves the field, passes the body, and returns as urine to the same ground. Where the return is made, the loop closes. Where it is not, the nutrient must be mined again. This is a reading, not a mechanism.

2.7 Does the soil change the food?

The historical decline. USDA data for 43 crops, compared between 1950 and 1999, show median declines of 6 per cent (protein) to 38 per cent (riboflavin) in six of thirteen nutrients [40]. The authors attribute this to new high-yield varieties, not to the soil. Higher yield dilutes minerals and protein. Grade for dilution: MODERATE.

The regenerative pilot. One study compared eight pairs of farms. The regenerative farms had 6.3 against 3.5 per cent soil organic matter. Their crops carried 34 per cent more vitamin K, 27 per cent more copper and 11–16 per cent more calcium and phosphorus [40]. The farms were chosen for success. Grade: WEAK.

Where soil clearly matters: selenium. Finland has added selenium to fertiliser since 1984. Intake rose to about 80 µg a day, against a recommendation of 55 µg. Blood selenium rose from 1.10 to 1.40 µmol/L [41]. Grade: STRONG. Part 7 shows that selenium decides whether a European menu meets its reference.

Iodine. Spreading iodate on the soil raised vegetable iodine from 1–16 to 50–100 µg per 100 g in one season. The effect was gone in the next. The soil is a weak and short-lived route for iodine.

2.8 Degradation

Worldwide a third of land is moderately to highly degraded. Erosion removes 25–40 billion tonnes of topsoil a year [42].

In the Netherlands [43]:

- Nearly half of all farm subsoils are compacted. On fully compacted subsoil potatoes can lose up to 40 per cent of yield.
- 207,000 ha of peat are farmed. Drained peat meadow emits 22.6 t CO₂ per ha a year and sinks about 1 cm a year. Computed: $22.6 \times 207,000 = 4.7$ million t CO₂ a year.
- Organic matter in mineral farm soils held steady from 1998 to 2018, at about 4 per cent. The national loss comes from peat.

2.9 Working a plot by hand

Know the soil.

- Jar test: fill a jar one-third with soil, top up with water and shake. Mark the sand after 1 minute, the silt after 2 hours and the clay after 48 hours. Each layer divided by the total gives the texture.
- Measure pH with a simple kit. Do not test within three months of liming or adding compost.
- Lime towards pH 6.5. From pH 5.5 that takes about 1,000 g per m² on clay, 800 on loam and 700 on sand. Lime in winter. A low pH favours clubroot in cabbages.

Make compost.

- Mix to a carbon-to-nitrogen ratio near 30:1. Food scraps run near 15:1, fresh grass 19:1, cow manure 20:1, leaves 35–85:1, straw 80:1.
- Keep it as moist as a wrung sponge, 50–60 per cent water. Build at least one cubic metre.
- The core reaches 49–71 °C. Turn the heap when it drops below 49 °C. Let it cure 4–12 weeks.
- A cold heap takes two to three years.

Keep the nitrogen. Put legumes in the rotation. Return crop residues: the worms need them. Use urine as the main nitrogen source.

Start a bed. The no-dig method covers the ground with 15–20 cm of compost and then adds 2–3 cm a year. That means 20–30 L of compost per m² per year, which has to come from somewhere. The method is widely practised and its yield claims are not peer-reviewed.

2.10 How much work

The best-documented hand-scale farm is Le Bec Hellouin in Normandy [44]. On about 1,000 m² of hand-worked beds it took 2,006 hours in 2013 and 3,026 hours in 2014: 1.9–2.9 hours per m² per year. The open-field plots took about 1.2 hours per m². The peer-reviewed version gives 2,236 hours a year on 1,061 m², about 2.1 hours per m². Sales per hour rose from €19 to €35 in three years. Skill lowers the work per unit of food.

These are market-garden figures for vegetables. Staple crops — potatoes, grain, beans — need far less work per m². Part 8 returns to the question of labour.

Part 3 — What to Grow

3.1 Dutch yields

The yields below are computed from the Dutch statistics office (CBS) as harvest divided by area [46]. They are commercial field yields. Garden yields can be higher or lower.

Arable staples (conventional)

Crop	Mean t/ha	Range or note
Potato (consumption)	46.3	41.0–53.5 (2014–2024)
Onion	48.5	35.0–57.3
Wheat	8.9	8.0–9.6; 7.0 in 2024
Spring barley	6.6	—
Oats	5.3	—
Rye	3.7	mainly on sand
Faba bean (dry)	about 6	Wageningen estimate; 6–8 for winter faba
Soy, lupin	2.5–3	—
Dry brown bean	2.8	1.8 in 2018
Rapeseed	3.6	seed
Linseed	0.8	seed

Vegetables and fruit (2018–2025)

Crop	Mean t/ha	Range
White cabbage	78.7	65.9–95.9
Winter carrot	66.7	62.4–72.6
Red cabbage	66.4	54.3–79.8
Beetroot	51.3	43.0–73.2
Apple	40.0	32.6–46.6
Leek	38.3	34.7–45.2
Pear	36.5	32.2–40.3
Strawberry	22.6	19.6–29.5
Kale	21.3	18.6–26.3
Brussels sprouts	21.3	19.3–25.1
Broad beans (fresh)	7.5	6.5–8.3
Green peas (fresh)	6.3	5.4–7.2

One t/ha equals 0.1 kg per m². Potatoes at 46.3 t/ha give 4.6 kg per m².

Organic yields. Organic farming yields 19–25 per cent less on average [28]. Dutch organic potatoes average about 27 t/ha: more than 35 in good years and about 10 in a late-blight year such as 2007. Late blight is the main risk to potatoes grown without chemistry.

The aardaker. *Lathyrus tuberosus* was grown in the Netherlands and on the Lower Rhine in the eighteenth century. Its tubers carry 10–12 per cent protein and 16–20 per cent starch. They reach a usable size only after two to three years. A Wageningen start-up is breeding it as a “protein potato”. No absolute yield has been published.

3.2 The crops and what they give

Crop	Yield, kg/m ²	Main nutrients, per 100 g	Storage without a cold chain
Potato	4.1–5.4; organic about 2.7	77 kcal, 2 g protein, vitamin C 20 mg, potassium	dark, cool, frost-free store until spring
Wheat	0.80–0.96	327 kcal, 12.6 g protein, iron 3.2 mg, zinc 2.7 mg	dry grain below 13–14 per cent moisture
Rye	0.29–0.44	338 kcal, 10.3 g protein, fibre 15 g	as wheat
Oats	0.46–0.60	389 kcal, 16.9 g protein, iron 4.7 mg, zinc 4.0 mg	as wheat; needs dehulling
Faba bean, dry	about 0.5–0.8	341 kcal, 26 g protein, folate 423 µg, iron 6.7 mg	dry seed, closed jar
Pea, dry split	fresh peas 0.54–0.72	352 kcal, 24 g protein	dry seed
Lupin	0.25–0.30	371 kcal, 36 g protein	bitter types need debittering
Kale	1.9–2.6	vitamin C 120 mg, calcium 150 mg, vitamin A 500 µg	stands in the field September to spring
Cabbage	5.4–9.6	vitamin C 37–57 mg	cold cellar 5–6 months, or sauerkraut
Brussels sprouts	1.9–2.5	vitamin C 85 mg, 3.4 g protein	on the stalk
Carrot	6.2–7.3	vitamin A 835 µg	in the ground under straw, or in sand
Beetroot	4.3–7.3	folate 109 µg	sand, cold cellar 4–6 months
Onion	3.5–5.7	—	cured and dry until the next spring
Leek	3.5–4.5	vitamin K 47 µg	stands in the field all winter
Winter squash	courgette 3.3–4.2	butternut vitamin A 532 µg	cured, 10–13 °C, 2–6 months
Apple	3.3–4.7	fibre 2.4 g	cool cellar 1–12 months
Strawberry	2.0–3.0	vitamin C 59 mg	fresh, or jam
Blackcurrant	no Dutch yield	vitamin C 181 mg	dried, jam
Walnut, hazelnut	no Dutch yield	15 g protein, 61–65 g fat	dry, in the shell
Rapeseed	0.29–0.44 seed	oil	needs a press

Nutrients are from the USDA composition table [85]. Storage is from Part 6.

3.3 How much land per person

What the country has. The Netherlands had 1,799,000 ha of farmland in 2024 and 18,044,027 inhabitants on 1 January 2025 [46]. That is 997 m² per inhabitant. Of these, 533 m² is grassland, 294 m² arable crops, 113 m² fodder crops and 57 m² horticulture. Worldwide there is 1,717 m² of arable land per person.

The formula. Area in m² = grams per day × 365 ÷ 1,000 ÷ yield in kg per m². For animal foods, nuts and oil, the book uses the global land factors of Poore and Nemecek [47], in m² per kg.

Diet A: the EAT-Lancet planetary health diet [48], with Dutch crop yields and global factors for the rest.

Item	g/day	Area, m ²
Whole grain (as wheat)	232	94.8
Potato	50	3.9
Vegetables	300	25.7
Fruit (apple)	200	18.2
Milk	250	816.7
Beef from the dairy herd	7	110.5
Pork	7	44.4
Poultry	29	129.3
Eggs	13	29.8
Fish (farmed)	28	86.0
Dry beans (as faba)	50	30.4
Soy	25	33.2
Groundnuts	25	83.1
Tree nuts	25	118.3
Oils (as rapeseed)	40	181.7
Beet sugar	31	20.7
Total		1,827

Milk takes 45 per cent of the area. If the beef comes from beef herds rather than from the dairy herd, the total rises to about 2,550 m².

Diet B: a plant diet from Dutch crops

Item	g/day	kcal	Protein, g	Area, m ²
Potato	600	462	12.3	47.3
Wheat	200	654	25.2	81.7
Oats	60	233	10.1	41.2
Rye	60	203	6.2	58.9
Faba bean (dry)	100	341	26.1	60.8

Item	g/day	kcal	Protein, g	Area, m ²
Kale	100	49	4.3	17.1
Cabbage	100	25	1.3	4.6
Carrot	100	41	0.9	5.5
Leek	50	30	0.8	4.8
Onion	50	20	0.6	3.8
Apple	200	104	0.5	18.2
Rapeseed oil	30	265	0	116.4
Hazelnuts	30	188	4.5	141.9
Total		2,616	92.8	602

The diet supplies about 27 mg iron, 16 mg zinc, 590 mg calcium and 301 mg vitamin C a day. It supplies no B12. At organic yields it needs 774 m². Oil and nuts take 43 per cent of the area, because global factors are used for them.

Diet C: a potato minimum. 1,800 g potato, 150 g oats, 100 g faba, 150 g kale and 150 g carrot give 2,446 kcal and 96 g protein on 340 m², or 507 m² at organic yields. It has no B12 and very little fat. It marks a lower bound, not a recommendation.

Other measured benchmarks.

- A study of ten American diets found 0.13–1.08 ha per person [49]. Lacto-vegetarian diets fed the most people, because they use grassland through the cow.
- The biointensive method claims about 372 m² of beds per person (WEAK).
- A measured food forest in Scotland gave 5.19 million kcal and 123 kg protein per ha [53]. On energy alone that is $2,500 \times 365 \div 5.19 \text{ million} = 0.176 \text{ ha per person}$. Protein limits it to three or four people per ha.

What the numbers show. A plant diet from Dutch crops fits on 340–1,030 m² per person, depending on how simple and how organic it is. A diet with the EAT-Lancet share of animal food needs about 1,800 m². The country has 997 m² per inhabitant, more than half of it grass.

Read in the net: land per person is the area of mesh one body needs to close its daily winding. A diet that routes energy through an animal first needs a larger mesh for the same closure. This is a reading, not a mechanism.

3.4 Animals in the system

Animals do not only compete with people for land. They also use what people cannot eat [50]:

- 86 per cent of livestock feed worldwide, by dry matter, is not edible by humans.
- 57 per cent of the land used for feed cannot grow food crops.
- Livestock fed only on leftovers and on grass from land unfit for crops can supply 9–23 g of animal protein per person per day. Diets that include this need about a

quarter less arable land than vegan diets.

What animal food adds is narrow and important: B12; iron that is absorbed 14–18 per cent from mixed diets against 5–12 per cent from vegetarian diets; iodine and selenium from fish; vitamin D from fatty fish and egg yolk.

Land per 100 g of protein [47]: beef from beef herds 164 m², lamb 185 m², cheese 40 m², milk 27 m², pork 11 m², poultry 7 m², eggs 5.7 m², pulses 7.3 m², peas 3.4 m², wheat and rye 3.2 m², potatoes 5.2 m².

The Netherlands has 962,000 ha of grassland. It feeds people only through ruminants.

3.5 Rotation and calendar

A four-year rotation for a household plot [52]:

Year	Bed 1	Bed 2	Bed 3	Bed 4
1	legumes	cabbages	potatoes	onions and roots
2	cabbages	potatoes	onions and roots	legumes
3	potatoes	onions and roots	legumes	cabbages
4	onions and roots	legumes	cabbages	potatoes

The legumes leave nitrogen for the cabbages that follow. Moving each group limits clubroot in cabbages and white rot in onions. Squash and salads fit anywhere. Perennials stay outside the rotation.

Calendar for the Netherlands [52]:

Crop	Sow or plant	Harvest
Potato	late March – early May	June – October
Broad bean	October – November, or February – May	summer
Pea	March – June	summer
Carrot	April – July, in batches every 3–4 weeks	summer – winter
Leek	March – June	late summer – spring
Kale	March – June	September – spring
Onion	sets in spring	July – September
Squash	indoors in April; out after the last frost	before frost; then cure

Cloches, fleece and cold frames bring sowings forward and protect crops over winter.

Seed saving [52]. Beans, peas, lettuce, endive and chicory are easy: they self-pollinate. Maize, beet, spinach, carrot, onion, leek, cabbages and squash cross with neighbours and need distance or bagging. Beet and cabbage flower only in their second year. Seed keeps 1–2 years for onion and parsnip, 3 years for beans and peas, and 5 years for squash, lettuce and cabbage.

3.6 Pollination

Crops that need animal pollination supply 35 per cent of world food production. Crops that need none supply 60 per cent [51]. Cereals, potatoes, and the leafy and root vegetables need no insects for the part that is eaten. Squash depends on them completely. Apple, pear, cherry, plum, raspberry and blueberry depend on them heavily. Seed crops of cabbage, onion and carrot need insects too.

3.7 Drought

The dry summer of 2018 measured the risk [46]. Against the mean of 2014–2021:

Crop	2018	2022
Dry beans	–41 %	–25 %
Onion	–33 %	–15 %
Rye	–23 %	+11 %
Rapeseed	–18 %	+25 %
Potato	–14 %	–2 %
Wheat	–1 %	+8 %
Spring barley	+4 %	+18 %

Winter cereals and rapeseed mature before the summer drought. Spring and summer crops carry the risk. Some autumn-sown staples — wheat, rye, faba bean — make a household or a region more robust.

3.8 Perennials and food forests

The food forest Ketelbroek in Groesbeek was planted from 2009 on 2.5 ha of former maize land, with about 200 edible species. After planting there is almost no work besides harvesting. No harvest figures have been published, and Wageningen calls a yield comparison premature. Fruit and nut trees take 8–12 years to bear, and a food forest about ten years to reach full harvest.

Part 4 — Herbs

4.1 Two kinds of evidence

The European Medicines Agency recognises two levels for herbal medicines [55]:

- **Well-established use:** at least ten years of medicinal use in the EU, with efficacy and safety shown in the literature.
- **Traditional use:** at least thirty years of use, fifteen of them in the EU. Trials are not required. Efficacy has to be plausible.

This book grades traditional use as WEAK. It grades well-established use MODERATE or STRONG only when independent meta-analyses agree.

4.2 Herbs with measured effects

Herb	Use	Finding	Grade
Peppermint oil (capsules)	irritable bowel	global symptoms risk ratio 2.39, number needed to treat 3; pain 1.78, NNT 4 [56]; dose 0.2–0.4 ml three times a day in gastro-resistant capsules	STRONG
St John's wort	mild to moderate depression	risk ratio 1.28 against placebo; equal to SSRIs [57]	MODERATE
St John's wort	drug interactions	weakens the pill, warfarin, cyclosporine, digoxin, HIV and cancer drugs	STRONG (harm)
Garlic powder or aged extract	blood pressure	about –8 mmHg systolic in hypertensives; Cochrane: imprecise, outcomes unknown [58]	MODERATE
Saffron	depression	Hedges g 0.99; publication bias likely	MODERATE
Ginger	motion sickness	EMA well-established	MODERATE
Ginger	nausea in pregnancy	evidence limited and inconsistent; EMA advises against	WEAK
Valerian	sleep	risk ratio 1.8 (1.2–2.9); publication bias likely	WEAK
Echinacea	colds	Cochrane: no benefit in treatment; 10–20 per cent fewer colds in prevention, post hoc [59]	WEAK

Herb	Use	Finding	Grade
Elderberry	cold symptoms	large effect, 180 participants in total	WEAK
Cinnamon	blood glucose	fasting glucose –24.6 mg/dL, HbA1c unchanged, heterogeneity up to 95 per cent	CONTESTED
Turmeric, curcumin	many claims	poorly absorbed; piperine raises absorption and causes drug interactions; strong formulations linked to liver injury	CONTESTED
Chamomile, lemon balm, thyme, rosemary, caraway	digestion, calm, cough	traditional use only	WEAK

The peppermint evidence is for the oil in capsules, not for mint tea. The garlic evidence is for powders and extracts at 188–2,400 mg a day, not for garlic in a meal and not for wild garlic.

Nearly all positive trials use oils, powders or extracts at medicinal doses. Whether culinary amounts of any herb have measurable health effects is not known.

4.3 Herbs as food

Fresh leafy herbs carry vitamin C, vitamin K and carotenoids. Per 100 g, from the USDA table [85]:

Herb	Vitamin C, mg	Vitamin K, µg	Vitamin A, µg	Calcium, mg	Iron, mg
Parsley	133	1,640	421	138	6.2
Thyme, fresh	160	—	238	405	17.5
Dill	85	—	386	208	6.6
Chives	58	213	218	92	1.6
Coriander leaf	27	310	337	67	1.8
Basil	18	415	264	177	3.2
Dandelion leaves	35	778	508	187	3.1
Nettle, blanched	—	499	101	481	1.6
Rose hips, wild	426	26	217	169	1.1

The portions matter. 10 g of parsley gives 13 mg vitamin C and 164 µg vitamin K. 25 g of rose hips gives about 106 mg vitamin C, a day's need. A gram of dried thyme gives 1.2 mg iron. Dried herbs look rich per 100 g, and a portion is about one gram.

Rose hip, sea buckthorn, nettle and dandelion grow in the Netherlands without inputs. Rose hip and sea buckthorn keep through the winter when dried or made into syrup.

Sea buckthorn vitamin C is given as 360–2,500 mg per 100 g in one source and 53–896 in another.

4.4 Growing herbs

Most herbs need six to eight hours of sun and a soil near pH 6.5–7.0 [63].

Herb	Life	Light and soil	Propagation
Parsley	biennial	sun or light shade, rich, moist	seed; slow to germinate
Chives	perennial	tolerates shade	seed, division
Dill	hardy annual	sun	sow direct; do not transplant
Coriander	hardy annual	sun, rich, well drained	seed
Basil	tender annual	sun, moist	seed; pots
Thyme	woody perennial	sun, dry	seed, cuttings, division
Sage	woody perennial	sun, dry	seed, cuttings; replace after about 5 years
Rosemary	tender woody perennial	sun, dry	cuttings; protect in winter
Oregano, marjoram	perennial, half-hardy	sun	seed, cuttings, division
Mint	perennial	sun or light shade, moist	division, cuttings; invasive
Lemon balm	perennial	sun or light shade	seed, division
Lovage	perennial	light shade, rich, moist	autumn seed; self-seeds
Fennel	perennial	sun, well drained	sow direct
Tarragon	perennial	sun, rich, dry	division, cuttings
Caraway	biennial	sun	seed
Borage	annual	sun, dry	seed; self-seeds

4.5 Harvest, drying and keeping

- Harvest just before the flowers open, in the morning once the dew has gone [63].
- Dry indoors at 21–32 °C in the dark for three to four days, or at 35–46 °C for one to four hours. Sun drying costs flavour.
- Strip leafy herbs from the stem. Dry thyme, rosemary, oregano and marjoram on the stem.
- Keep dried herbs airtight, cool and dark. Quality falls within two to three years.
- To freeze, blanch for 50 seconds. Dill, chives and basil freeze without blanching.

4.6 Safety

Pyrrolizidine alkaloids. These plant toxins damage the liver. The EU sets maximum levels [60]: 200 µg per kg for dried herbal infusions, 400 for chamomile, peppermint, thyme and lemon balm teas, and 1,000 for dried borage, lovage, marjoram and

oregano. EFSA judged frequent or heavy drinkers of tea and herbal tea a possible concern.

Coumarin in cinnamon. The tolerable daily intake is 0.1 mg per kg body weight [61]. Cassia carries about 3,000 mg per kg. A 60 kg adult reaches the limit at about 2 g of cassia a day, a 15 kg child at 0.5 g. Ceylon cinnamon carries at most 185 mg per kg; the limit is then reached at about 32 g a day. For daily use, choose Ceylon.

Estragole in basil, tarragon and fennel is genotoxic in rodents. Culinary use is low risk. Exposure is best kept low for young children and in pregnancy, which bears on fennel tea for infants.

Thujone in sage causes convulsions. The upper limit is 6 mg a day. Sage oil is judged not acceptable.

Pulegone in mint and pennyroyal: the limit is 0.75 mg per kg body weight a day. More than 15 ml of pennyroyal oil has been fatal.

Oxalate in sorrel runs at 273–954 mg per 100 g. 50 g of leaves gives about 342 mg.

Wild garlic look-alikes. In France, 2020–2022, wild garlic was confused with autumn crocus 28 times, and two people died [62]. Lily of the valley is the other look-alike. The smell test can mislead. Grow wild garlic from bought plants.

Not for internal use. Comfrey (only on intact skin, at most ten days), pennyroyal oil, sage oil.

Pregnancy. Avoid St John's wort, valerian, rosemary as medicine, ginger medicines and turmeric supplements. Keep estragole and thujone low.

4.7 Herbs, salt and keeping

Salt. Herbs, spices and acid carry flavour where salt is reduced. In one programme the group taught to cook with herbs and spices ate 966 mg less sodium a day than controls, about 2.5 g of salt. The report is a secondary account of a conference abstract: WEAK. Bread salt can be cut by about 40 per cent before people notice.

Keeping. Oregano, thyme and clove inhibit bacteria in the laboratory. In real food the dose needed rises 2 to 100 times, fat and protein blunt the effect, and the effective dose often spoils the taste [64]. With simple means, drying, salt, acid and cold do the preserving. Herbs add a margin and flavour.

Read in the net: a herb is a plant whose small windings — oils, acids, aromatic rings — are read strongly at the rim of another body. In a capsule the dose is a medicine. On a plate the dose is flavour and a margin of vitamins. This is a reading, not a mechanism.

Part 5 — Preparing Food

5.1 The water carries the loss

The USDA table of retention factors gives the share of each nutrient that survives cooking, corrected for the change in weight [65].

Food and method	Vit C %	Folate %	Thiamin %	B6 %	Potassium %
Greens, boiled in plenty of water, drained	55	60	80	85	85
Greens, boiled in little water, drained	60	65	85	90	90
Greens, boiled, water eaten	70	75	90	95	100
Other vegetables, steamed	85	85	90	90	100
Other vegetables, baked	85	85	90	95	100
Other vegetables, fried	85	70	85	90	100
Roots, steamed	75	80	90	95	100
Potato, baked in the skin	80	90	85	95	100
Potato, boiled in the skin	75	90	80	95	90
Potato, peeled, boiled, drained	75	75	80	95	90
Legumes, boiled 45-75 min, drained	—	45	60	65	70
Legumes, boiled 2-2.5 h, drained	—	30	40	50	65

Three rules follow.

1. **Eat the cooking water.** For greens, vitamin C rises from 55 to 70 per cent, folate from 60 to 75, potassium from 85 to 100. Soup, stampot and dal keep the water by design.
2. **Steam or bake rather than boil.** Steaming and baking keep 85 per cent of vitamin C and folate.

3. **Cook legumes no longer than needed.** After two hours of boiling, legumes keep 30 per cent of their folate and 40 per cent of their thiamin. Soaking and pressure cooking shorten the time.

The skin. Potato flesh boiled in its skin carries 13.0 mg vitamin C per 100 g. Flesh peeled before boiling carries 7.4 mg, 43 per cent less [85]. Potassium falls by 13 per cent. In one potato the skin carries about two-thirds of the fibre. Boil or bake potatoes in their skin. Cut away only green parts and sprouts.

Part 7 measured what this means for a day. When all cooking water was assumed drained, folate, iron, vitamin B6 and vitamin C fell below the reference on several days that otherwise met it.

Read in the net: what leaches from a vegetable into the pot has not left the meal. It has moved to another mesh of the same dish. Pouring the water away opens the loop. Eating it closes it. This is a reading, not a mechanism.

5.2 What cooking adds

Carotenoids. Tomatoes heated to 88 °C for 30 minutes lost 29 per cent of their vitamin C and gained 2.7 times their available lycopene [72]. Tomato paste is up to four times more available than fresh tomato. 3-5 g of fat in a meal is enough for carotenoid uptake. Carrots and kale belong with a little butter or oil.

Protein. Cooked egg protein is about 91 per cent digested, raw egg protein about 51 per cent.

Resistant starch. Cooked rice cooled for 24 hours at 4 °C and reheated carried 1.65 g resistant starch per 100 g, against 0.64 freshly cooked. The rise in blood sugar fell by about 18 per cent. Boiled potatoes cooled overnight carry 2.8 times as much. Cool cooked food quickly and keep it cold.

5.3 Antinutrients and the simple methods that remove them

Phytate binds iron and zinc in grains and legumes. As little as 2-10 mg of phytate in a meal already lowers iron absorption [66]. Zinc absorption is about 50 per cent when the phytate-to-zinc ratio is below 5, about 30 per cent between 5 and 15, and less than 15 per cent above 15.

The simple methods [67]:

- **Sourdough.** Whole-wheat dough fermented with sourdough lost 62 per cent of its phytate, against 38 per cent with yeast. Fermented for a couple of days, it loses almost all.
- **Soaking and sprouting** lower phytate by about 20 per cent.
- **Oats** lose their own phytase in the heat treatment of the mill. Soak them overnight with a spoonful of whole rye or wheat flour as a phytase source, or with an acid.

Lectin in kidney beans. Raw beans carry up to 70,000 haemagglutinating units. Properly cooked beans carry 200–400 [68]. Four or five raw beans can cause severe vomiting within one to three hours. Soak at least 5 hours, discard the water, and boil hard for at least 30 minutes. A slow cooker at 75 °C may not destroy the lectin. A pressure cooker cooks unsoaked beans in 45 minutes.

Trypsin inhibitors in soybeans: 14 minutes of boiling inactivates about 80 per cent, 30 minutes about 90 per cent.

Oxalate in spinach, chard, rhubarb and sorrel: boiling removes 30–87 per cent, steaming 5–53 per cent, baking none. The oxalate goes into the water. This is the one case where the cooking water should be poured away, for people prone to kidney stones.

Solanine in green potatoes: boiling removes only 1–4 per cent. Cooking does not solve it. Cut away green parts and sprouts, and store potatoes in the dark.

Glucosinolates in cabbages are turned into their active form by an enzyme that cooking destroys. Steaming under five minutes keeps some of it. After cooking, gut bacteria convert on average 12 per cent.

Goitrogens. 150 g of cooked Brussels sprouts a day for four weeks had no effect on the thyroid. The risk arises only with iodine deficiency.

Cyanide in bitter cassava and apricot kernels. The acute reference dose is 20 µg per kg body weight. One small raw apricot kernel can exceed it for a toddler. Bitter cassava needs the full sequence of peeling, fermenting, pressing and cooking.

5.4 Iron

What	Effect [66]
Haem iron (meat, fish)	15–35 per cent absorbed
Non-haem iron (plants)	2–20 per cent absorbed
Mixed diet against vegetarian	14–18 against 5–12 per cent; vegetarians need 1.8 times as much
Vitamin C	at least 25 mg in the meal raises absorption two- to threefold
Meat	30 g has the effect of 25 mg vitamin C
Tea	one cup with the meal halves absorption or more; drink it two hours apart
Calcium	up to about 60 per cent inhibition at 300–600 mg in the meal

Simple means. Put a vitamin C source on the plate with plant iron: raw cabbage, sauerkraut, tomato, parsley, lemon. Drink tea and coffee between meals.

Cast iron. Iron pans release iron into acid, wet, long-cooked dishes. Tomato sauce rose from 0.61 to 5.77 mg per 100 g. The iron ingot in the pot (“Lucky Iron Fish”) gave no rise in haemoglobin in a trial of 340 Cambodian women, whose anaemia was not caused by iron deficiency [73].

5.5 Fermentation

Sauerkraut needs 2.0–2.5 per cent salt by weight of cabbage. It ferments at 18–22 °C. Above 24 °C it softens. Below 15.6 °C it may not start. Fermentation takes three to four weeks at 21–24 °C and five to six at 15–18 °C. The pH falls to 3.3–3.7. Below pH 4.6 the botulism organism cannot grow.

Fermented foods raise iron absorption. Fermented gruels gave 33 per cent less diarrhoea in Tanzanian children.

5.6 Maize and lime

Cooking maize in lime water (nixtamalisation) raises calcium from 48 to 104–217 mg per 100 g [74]. It costs 52–72 per cent of the thiamin. Pellagra was endemic where maize was eaten without this step. Why lime prevents it — freed niacin or a better amino acid balance — is CONTESTED.

5.7 What cooking can create

Acrylamide forms above 120 °C in dry starchy food. The margin between average European exposure and the dose that causes tumours in animals is 89–425, against the 10,000 that counts as low concern [69]. Light toast carried 31 µg per kg, dark toast 118. Potatoes kept below 8 °C build up sugar and then form more acrylamide when fried. Fry at no more than 175 °C, to golden yellow.

Charring. Heterocyclic amines and polycyclic hydrocarbons form above about 150 °C, over flame and in smoke. Turn meat and fish often and cut away charred parts. The human evidence is CONTESTED.

Frying oil. Oxidative stability matters more than smoke point. Oils high in monounsaturated or saturated fat suit frying. Reused oil oxidises.

5.8 Salt

WHO advises less than 5 g of salt a day. The world mean is about 11 g [70]. Excess sodium was linked to 1.7 million deaths in 2023.

A salt with 25 per cent potassium chloride lowered stroke by 14 per cent and total mortality by 12 per cent in a trial of 20,995 people in rural China, with no excess of dangerous potassium levels [70, 1]. WHO now suggests potassium-enriched salt. It needs a potassium chloride supply and no pharmaceutical one.

5.9 Safe food with simple means

The WHO Five Keys [71]:

1. Keep clean: wash hands and surfaces.
2. Separate raw and cooked.
3. Cook thoroughly, to 70 °C at the core.

4. Keep food at safe temperatures: do not leave cooked food more than 2 hours at room temperature; keep it below 5 °C or above 60 °C.
5. Use safe water and raw materials.

Unsafe food caused 866 million illnesses and 1.52 million deaths in 2021. A rolling boil makes water safe.

Garlic in oil can carry botulism. Keep it in the fridge and use it within four days, or use dried garlic. Food kept warm in a haybox must not stand long between 5 and 60 °C: bring it back to the boil before eating.

5.10 Fuel

2.1 billion people cook on polluting fuels. In 2021 this caused 2.9 million deaths. A pressure cooker reaches about 121 °C and cooks in about a third of the time. Retained-heat cooking in a haybox is said to save up to 30 per cent of fuel (WEAK). In the Netherlands fuel matters for cost and climate rather than for indoor air.

5.11 When to eat

Eating within an eight-hour window gave no extra weight loss over three ordinary meals: −0.26 kg (−1.30 to 0.78). Breakfast did not help weight loss. Fasting regimens work mainly by eating less. Grade for any timing effect beyond the total: WEAK.

5.12 Ten everyday foods

Food	Best simple preparation	Why
Potato	boil or bake in the skin; cut away green parts; cool leftovers quickly	skin keeps vitamin C and potassium; resistant starch ×2.8 when cooled
Dry beans	soak at least 5 h, discard the water, boil hard 30 min, then simmer; or pressure cook	lectin falls from 70,000 to 200–400 units
Lentils	simmer, eat the liquid as dal or soup, add a vitamin C source	B vitamins leach and are lost with long boiling
Kale	steam under 5 minutes, or cook in little water and eat the water; add a little fat	greens drained lose 45 per cent of vitamin C
Carrots	steam or simmer, with a little fat	cooking and fat raise carotene uptake
Tomatoes	cook into a sauce with oil; eat some raw	lycopene ×2.7 with heat
Eggs	cook until set	protein 91 against 51 per cent digested
Oats	soak overnight with a spoon of whole rye flour; eat with fruit; no tea with the meal	oats lack their own phytase

Food	Best simple preparation	Why
Bread	long sourdough fermentation; toast lightly	phytate falls; less acrylamide
Fish	bake, poach or steam; avoid charring; eat the juices	B vitamins 85-95 per cent retained

Part 6 — Keeping Food

6.1 Three limits

Keeping food rests on three limits. Each is settled physiology or microbiology.

Living tissue breathes. Roots, tubers, cabbages and apples are alive after harvest. Cold slows their respiration. Potatoes respire 12 mg CO₂ per kg per hour at 5 °C and 22 at 20 °C. Shelf life falls by up to a quarter for each 5.6 °C above the ideal [75].

Water feeds decay. Moulds and mites stop below 65 per cent equilibrium humidity. Below a water activity of 0.85 most bacteria and yeasts stop. Below 0.60 nothing grows [84].

Acid and air decide botulism. *Clostridium botulinum* does not grow at pH 4.6 or below. It needs less than 2 per cent oxygen, moisture and 4–49 °C. Every sealed, moist, low-acid jar is therefore a botulism question [78].

Read in the net: keeping is holding a winding closed after it has left the plant. Cold slows the strand. Dryness and acid close the meshes through which decay would enter. This is a reading, not a mechanism.

6.2 Conditions per crop

The commercial optimum [75]:

Crop	°C	Humidity %	Life
Potato, late	3.3–4.4	90–95	5–10 months
Carrot, topped	0	98–100	7–9 months
Celeriac	0	97–99	6–8 months
Cabbage, late	0	98–100	5–6 months
Beetroot, topped	0	98–100	4–6 months
Parsnip	0	98–100	4–6 months
Garlic	0	65–70	6–7 months
Onion, dry	0	65–70	1–8 months
Winter squash	10	50–70	1–6 months
Apple	–1.1 to 4.4	90–95	1–12 months
Pear	–1.7 to –0.6	90–95	2–7 months
Leek	0	95–100	2–3 months
Dry beans	4.4–10	40–50	6–10 months

A home cellar seldom reaches 0 °C and 98 per cent humidity. Home lives are shorter: carrots about 8 months, potatoes 6, cabbage and beetroot 5, onions 4.

Three home regimes cover almost everything:

- **Cold and moist**, 0–4 °C, 90–95 per cent: roots, cabbage, leeks, potatoes, apples.

- **Cold and dry**, 0–4 °C, 60–70 per cent: onions, garlic, dry beans.
- **Cool and dry**, 10–15 °C, 60–70 per cent: pumpkins and winter squash.

6.3 Field, cellar and clamp

Cure first. Potatoes at 10–18 °C for one to two weeks. Onions two to four weeks. Garlic ten days and then two to four weeks more.

The field is the simplest store. Carrots and parsnips stay in the ground into winter under heavy straw. Horseradish, Jerusalem artichoke and salsify stay all winter. Kale is picked from autumn into spring. Leeks stand all winter.

The cellar. Layer roots in moist sand, peat or moss. Keep potatoes undamaged and dry, in paper or hessian, dark and frost-free. Keep apples and pears apart from vegetables: their ethylene shortens vegetable life. Keep cabbage apart for its smell.

The clamp (kuil). The field clamp of Rothamsted, described in 1948 [82], heaps potatoes in a ridge about 2.2–2.6 m wide at the base. It is covered with 13–15 cm of straw and then with soil, 38 cm thick at the base and tapering to 15 cm at the ridge.

6.4 Potatoes and sprouting

The EU ended the sprout inhibitor chlorpropham (CIPC); 2020 was its last season [76]. Mint oil replaced it in many stores. Spearmint oil is about 67 per cent carvone and is applied every four to six weeks.

The Dutch root of this lies in Wageningen. Work on carvone from caraway showed control of sprouting for at least ten months in stores of 250 tonnes [76]. The residue is about 5 mg per kg of tuber, 90 per cent of it in the peel. The acceptable daily intake is 1.25 mg per kg body weight. Computed: 300 g of unpeeled potato gives 1.5 mg, against 87.5 mg acceptable for a 70 kg adult.

At home, dark and cool is the simple means. Cold alone, at 2–4 °C, stops sprouting but makes tubers sweet.

6.5 What keeping costs

Food and method	Loss [77]
Potato, 6 months at 4 °C	vitamin C –25 per cent
Spinach, 4–7 days at 20 °C	all vitamin C
Spinach, 7–21 days at 4 °C	vitamin C –75 per cent
Broccoli, one week	0 per cent at 4 °C; –56 per cent at 20 °C
Peas, 1–2 days after harvest at room temperature	half the vitamin C
Blanching and freezing	vitamin C about –50 per cent (10–80)
A further year at –18 °C	vitamin C –20 to –50 per cent
Canning	vitamin C more than –60 per cent; carotene in carrots +16 per cent

Frozen vegetables match or beat “fresh” vegetables kept five days in the fridge.

Vitamin C is the fragile nutrient. Carotenoids, minerals and fibre are robust. Speed and cold matter more than the method.

6.6 Grain and dry legumes

- Cereals below 13 per cent moisture are stable. Above 14.5 per cent the risk rises. At 18 per cent and more, dry at once [79].
- At 20 °C, grain at 13 per cent keeps about 180 days; at 16 per cent about 30.
- Cooling lowers the risk: 14.5 per cent wheat sits at 56 per cent equilibrium humidity at 5 °C and 66 per cent at 25 °C.

Mycotoxins are detectable in 60–80 per cent of cereal and nut samples worldwide [81]. Cooking does not destroy them. Drying, sorting and undamaged grain do the work.

Hermetic bags. In Niger, beans kept eight months in sealed triple-layer bags lost no weight to weevils; 97–100 per cent of the insects died [80]. They die of drying out when the oxygen is used up. A single hole undoes the protection locally; a patch restores it.

Read in the net: a sealed bag lets the store close itself. The grain’s own breath uses the oxygen, and what would eat the grain cannot complete its winding. This is a reading, not a mechanism.

6.7 Drying

Sun drying needs at least 29 °C and less than 60 per cent humidity. A Dutch summer seldom gives this, so drying happens indoors or by the stove. Fruit is dried to about 20 per cent moisture, vegetables to about 10. Dried fruit keeps a year at 15.6 °C and six months at 26.7 °C; vegetables half that.

6.8 Lactic fermentation and pickling

Salt at 2–3 per cent; cabbage best at 2 per cent and 18 °C. The pH must fall below 4.6, usually within a week; finished sauerkraut reaches 3.1–3.2. Refrigerated, it keeps four to six months. Vinegar pickles need 5 per cent vinegar, undiluted.

6.9 Bottling, and why plain vegetables are different

Food	pH	What makes it safe
Fruit, acidified tomatoes, pickles, sauerkraut	4.6 or below	a boiling-water bath
Carrots, beets, potatoes, cabbage, beans	5.2–6.8	a pressure canner at 116–121 °C for 20–100 minutes

A boiling bath would need seven to eleven hours to do what the pressure canner does [78]. Botulism spores need 121 °C for 20 minutes. The toxin itself is destroyed by 85 °C for 5 minutes.

The traditional Dutch weck of plain vegetables at 100 °C therefore does not make them safe. Boiling three days in a row was abandoned in 1921, after botulinum turned up in four of seven test jars of beans. Home-canned low-acid vegetables are the main source of botulism in the United States. In the Netherlands it is very rare, and home-preserved food is named as a source [78].

The safety net. Bring home-bottled low-acid food to the boil for ten minutes before eating, or hold it above 85 °C for at least five. Discard bulging or spurting jars. Tomatoes need two tablespoons of lemon juice per litre jar.

6.10 Freezing

Blanch to stop the enzymes: beans three minutes, peas one and a half. At –18 °C food is safe indefinitely; the times are for quality. Lean fish keeps six to eight months, fatty fish two to three. A 250 L freezer uses 150–223 kWh a year, €97–145. That is the main long-chain cost of simple keeping.

6.11 Salt, smoke, sugar, honey, cheese, eggs

- Salted fish keeps on the shelf at 20 per cent salt in its water phase, or a water activity of 0.85 or less. Hot smoking needs a core of at least 62.8 °C for 30 minutes [84].
- Jam sits at a water activity of 0.75–0.80. Bacteria cannot grow; moulds can.
- Honey above 19 per cent moisture ferments within a year; at 17 per cent or less it does not.
- Hard cheese is milk's storage form. Parmesan sits at a water activity of about 0.75, Cheddar 0.91.
- Eggs: in the EU, class A eggs are not washed. Keep them at 4 °C. The legal freshness date is 28 days.

6.12 Loss and waste

A third of all food produced is lost or wasted, 1.3 billion tonnes a year [83]. In 2022, 1.05 billion tonnes were wasted, 60 per cent of it in households: 79 kg per person. In the Netherlands the whole chain wasted 161 kg per person in 2020. Dutch consumers wasted about 25–33 kg each; bread, vegetables, fruit and potatoes made up half of it.

6.13 Twenty-five foods

Food	Simplest method	Conditions	Life	Main loss
Potato	cure, dark sacks	cure 10–18 °C, then 4–9 °C	5–10 months	sprouting; vitamin C –25 % in 6 months
Carrot	in the ground under straw, or in sand	0–4 °C, moist	7–9 months	shrivelling
Beetroot	sand, cellar	0–4 °C, moist	4–6 months	shrivelling

Food	Simplest method	Conditions	Life	Main loss
Parsnip	leave in the ground	soil	4-6 months	rot
Celeriac	cellar	0 °C, moist	6-8 months	rot
Late cabbage	cellar, apart	0 °C, moist	5-6 months	leaf decay
Kale	leave standing	field	autumn – spring	2-3 weeks once picked
Leek	leave standing	field	winter	—
Brussels sprouts	on the stalk	cold	3-5 weeks	yellowing
Onion	cure, hang dry	0 °C, 65-70 %	1-8 months	sprouting
Garlic	cure, hang dry	0-10 °C, 60-70 %	6-7 months	sprouting
Winter squash	cure, shelf indoors	10-13 °C	2-6 months	rot below 7 °C
Apple	cool cellar, apart	-1 to 4 °C, moist	1-12 months	rot
Pear	cold cellar	about 0 °C, moist	2-7 months	over-ripening
Dry beans and peas	dry, closed jar	cool, dry	6-10 months	hardening, weevils
Wheat, rye, oats	dry, cool, sealed	≤13-14 % moisture, <15 °C	over a year	mould, insects
Cabbage as sauerkraut	lactic ferment	2-2.5 % salt, pH <4.6	4-6 months cold	some vitamin C
Cucumber	ferment or 5 % vinegar	as above	months	texture
Green beans	blanch and freeze, or ferment	-18 °C	8-12 months	vitamin C; never weck at 100 °C
Tomato	bottle with acid	lemon juice, boiling bath	1 year	vitamin C -29-33 %
Berries, plums	jam or dried	bath; cool, dark	1 year	vitamin C, colour
Herbs	air-dry indoors	21-32 °C, dark	about 1 year	aroma
Eggs	cool, unwashed	4 °C	28 days	<i>Salmonella</i> risk rises with age
Milk	as hard cheese	ripened	months – years	—
Fish, meat	salt, hot smoke, or freeze	aw ≤0.85; -18 °C	months	rancidity

Part 7 — Recipes and Two Weeks of Meals

7.1 What was done

Thirty-one recipes were collected: twenty-seven published recipes from Dutch, European and world kitchens, and four vegetarian versions of Dutch dishes. Every quantity was converted to grams. From these recipes, with bread, milk, yoghurt, eggs, fruit and nuts, fourteen day menus were composed: a mixed week (M1–M7) and a vegetarian week (V1–V7).

The menus alternate between the two reference persons. Odd days are for the man of 70 kg; even days for the woman of 60 kg. Both diets are thus tested against both sets of reference values.

Before any nutrient was counted, the expected outcome of every day was written down and locked: which nutrients would meet the EFSA reference and which would fall short. Then each day was counted against the USDA composition table [85]. A separate count used the UK table, McCance and Widdowson's CoFID [86], which also holds iodine. The Methods section describes the checks.

A general rule for every bean recipe below: soak dry beans at least five hours, discard the water and boil hard for at least 30 minutes before simmering (Part 5.3).

7.2 What the count found

The table gives each day as a percentage of the EFSA reference. Where two numbers are given, the first is from the US table and the second from the UK table. Iodine is given without and with iodised salt in bread and kitchen, at the Dutch maximum levels of 65 mg per kg bakery salt and 25 mg per kg household salt [88].

Day	Person	kcal	Iron	Selenium	Vit C	Folate	B12	Vit D	Vit E	EPA+DHA	Iodine
M1	man	2,588	161 / 151	161 / 77	399 / 375	215 / 205	133 / 233	15 / 13	130 / 128	12	214 / 292
M2	woman	2,012	108 / 111	186 / 239	130 / 150	202 / 102	412 / 441	182 / 91	82 / 58	1,570	100 / 143
M3	man	2,568	177 / 158	244 / 132	219 / 218	198 / 152	149 / 236	31 / 30	90 / 76	134	363 / 446
M4	woman	2,019	78 / 66	188 / 85	168 / 158	135 / 120	140 / 297	16 / 26	66 / 52	24	214 / 270
M5	man	2,475	186 / 153	216 / 112	119 / 88	152 / 101	382 / 392	32 / 110	69 / 82	537	166 / 200
M6	woman	2,259	125 / 109	157 / 82	84 / 80	266 / 200	118 / 141	13 / 18	88 / 66	13	122 / 212
M7	man	2,605	215 / 199	194 / 84	79 / 116	182 / 130	140 / 101	11 / 56	132 / 128	278	128 / 159
V1	man	2,547	169 / 158	196 / 89	398 / 375	226 / 218	141 / 250	15 / 25	118 / 105	23	229 / 306

Day	Person	kcal	Iron	Selenium	Vit C	Folate	B12	Vit D	Vit E	EPA+DHA	Iodine
V2	woman	2,038	124 / 112	137 / 56	56 / 80	230 / 79	58 / 66	1 / 1	81 / 111	0	94 / 147
V3	man	2,670	236 / 276	191 / 225	100 / 107	443 / 199	112 / 193	14 / 24	83 / 91	23	167 / 241
V4	woman	2,008	75 / 64	145 / 78	169 / 158	167 / 128	123 / 256	17 / 24	56 / 55	24	210 / 252
V5	man	2,531	227 / 206	204 / 76	93 / 105	348 / 199	142 / 219	14 / 24	135 / 147	24	224 / 297
V6	woman	2,281	148 / 124	148 / 77	119 / 115	245 / 144	101 / 117	9 / 17	98 / 79	12	120 / 226
V7	man	2,576	197 / 202	160 / 125	345 / 363	225 / 222	84 / 112	7 / 13	139 / 180	12	148 / 165

Protein, fibre, calcium, zinc, magnesium, potassium, thiamin, riboflavin, niacin and vitamin A met the reference on nearly every day in both tables.

Six findings.

1. **Vitamin D falls short on twelve of fourteen days**, in both tables. Only days with oily fish reach the reference. In winter, without sun, a temperate diet needs fatty fish two or three times a week or a supplement.
2. **Selenium is decided by the soil, not the recipe.** The same menus meet the selenium reference in the US table on every day and fall short in the UK table on nine of fourteen. US whole-wheat bread carries 25.7 µg per 100 g, UK bread 7; US oats 28.9, UK oats 3. This is the soil effect of Part 2.7, measured on a plate. In Europe selenium comes from fish, eggs and seeds.
3. **Iodine is decided by the salt.** Without iodised salt, two days fall short. With iodised bakery and household salt every day meets the reference. One day with 150 g of cod exceeds the EFSA upper level of 600 µg; the cod alone gives 294 µg.
4. **Iron falls short for the woman on two days** (M4 and V4, 64–78 per cent), in both tables. These are the days with buttermilk porridge and hutsput, low in legumes and greens. Days built on pulses meet the woman's 16 mg.
5. **Vitamin E falls short on about half the days.** It rises with sunflower seed, rapeseed oil and hazelnuts.
6. **EPA and DHA fall short on every day without oily fish.** One herring or mackerel day lifts the weekly average above the reference: M2 alone gave 1,570 per cent of a day's need.

Where the two tables disagree, and why. Herring carries 4.2 µg vitamin D per 100 g in the US table and 19 in the UK table; mackerel 16.1 and 8.0. Lentils carry 479 µg folate in the US table and 110 in the UK table. UK apple juice is fortified with vitamin C. US energy values ran up to 11 per cent higher. The tables measure different foods from different soils. A shortfall that appears in only one table is uncertain; a shortfall that appears in both is not.

Cooking losses. The counts use raw weights. Applying the USDA retention factors of Part 5 to the cooked items, as each recipe is cooked, moved folate below the reference on two days. Assuming all cooking water drained moved iron, vitamin B6, folate and vitamin C below the reference on further days. Eating the cooking water is therefore not a detail. It decides several days.

How well the shortfalls were foreseen. The locked predictions named 55 of the 56 shortfalls the count found (recall 0.98). They also named 71 shortfalls that did not occur (precision 0.44). The prediction was cautious: it expected more gaps than a varied temperate menu has.

Read in the net: the menus close most windings without help. The open meshes are the same four as in Part 1.12 — vitamin D, selenium, iodine, the long omega-3 fats — and each closes through the sea, the soil or the sun, not through the recipe. This is a reading, not a mechanism.

7.3 What closes the gaps, with simple means

Gap	Simple closure
Vitamin D (winter)	herring or mackerel two to three times a week; egg yolk; sun from March to October; otherwise a supplement of 10-20 µg
Selenium (Europe)	fish, eggs, sunflower seed
Iodine	iodised salt in bread and kitchen; fish; dairy
EPA and DHA	one or two portions of oily fish a week
Iron (women)	pulses, greens and seeds daily, with a vitamin C source in the same meal; tea between meals
Vitamin E	a handful of sunflower seed or hazelnuts; rapeseed oil
B12 (vegetarian)	dairy and eggs daily; for people eating no animal food, a supplement

7.4 The two weeks

The days below give every item in grams or in servings of the recipes in section 7.5.

M1 (man, 70 kg) - Breakfast: oats 70 g; semi-skimmed milk 300 g; apple 150 g; walnuts 15 g. - Lunch: wholemeal bread 175 g; butter 15 g; Gouda 40 g; egg 50 g; tomato 100 g. - Dinner: Stampot boerenkool ×1; smoked sausage 100 g; rapeseed oil 10 g. - Snacks: low-fat yoghurt 200 g; pear 170 g; hazelnuts 20 g; buttermilk 250 g.

M2 (woman, 60 kg) - Breakfast: Bircher muesli ×1.5; semi-skimmed milk 200 g. - Lunch: Lentil soup ×0.75; rye bread (pumpernickel) 64 g; butter 5 g. - Dinner: Baked mackerel with potatoes and thyme ×0.75; Healthy coleslaw ×1.5. - Snacks: apple 150 g; wholemeal bread 35 g; Gouda 30 g.

M3 (man, 70 kg) - Breakfast: wholemeal bread 105 g; butter 15 g; egg 100 g; tomato 100 g; semi-skimmed milk 250 g. - Lunch: Erwtensoepp ×0.7. - Dinner: Salsa verde cod

tray bake ×1; potatoes (in skin) 200 g. - Snacks: low-fat yoghurt 250 g; strawberries 150 g.

M4 (woman, 60 kg) - Breakfast: Karnemelkse pap ×1.5; rye bread (pumpernickel) 32 g; Gouda 20 g; wholemeal bread 35 g; butter 5 g. - Lunch: Mushroom and spinach omelette ×1; tomato 100 g. - Dinner: Hutspot met klapstuk ×0.9; Rodekool met appel ×1. - Snacks: pear 170 g; walnuts 20 g; semi-skimmed milk 200 g; low-fat yoghurt 150 g.

M5 (man, 70 kg) - Breakfast: Porridge with yoghurt and berries ×2; semi-skimmed milk 250 g; apple 150 g. - Lunch: Hummus ×1; Wholemeal chapati ×3; carrots 100 g; herring 85 g; rye bread (pumpernickel) 64 g. - Dinner: Zuurkoolstampot met rookworst en appel ×1.2; Baechu kimchi ×1. - Snacks: low-fat yoghurt 200 g; plums 150 g; hazelnuts 20 g.

M6 (woman, 60 kg) - Breakfast: wholemeal bread 105 g; butter 10 g; Gouda 30 g; semi-skimmed milk 250 g; apple 150 g. - Lunch: Borscht ×1.5; rye bread (pumpernickel) 64 g; egg 50 g. - Dinner: Bruine bonensoep ×1; wholemeal bread 35 g. - Snacks: Apple and blackberry oat crumble ×1; low-fat yoghurt 150 g.

M7 (man, 70 kg) - Breakfast: Bircher muesli ×2; semi-skimmed milk 250 g. - Lunch: Three bean spring minestrone ×1; wholemeal bread 70 g; Gouda 40 g. - Dinner: Red lentil dal ×1.25; Wholemeal chapati ×2; Healthy coleslaw ×1; pickled herring 50 g. - Snacks: pear 170 g; walnuts 15 g; low-fat yoghurt 200 g.

V1 (man, 70 kg) - Breakfast: oats 80 g; semi-skimmed milk 300 g; apple 150 g; walnuts 20 g; linseed 10 g. - Lunch: wholemeal bread 175 g; butter 15 g; Gouda 50 g; tomato 100 g. - Dinner: Stampot boerenkool ×1; egg 100 g; rapeseed oil 15 g; walnuts 15 g. - Snacks: low-fat yoghurt 250 g; pear 170 g; buttermilk 250 g.

V2 (woman, 60 kg) - Breakfast: Bircher muesli ×1.5; semi-skimmed milk 200 g. - Lunch: Hummus ×1; Wholemeal chapati ×2; carrots 100 g; cucumber 100 g. - Dinner: Erwtensop, vegetarian adaptation ×1; Gouda 20 g. - Snacks: apple 150 g; hazelnuts 20 g; low-fat yoghurt 150 g.

V3 (man, 70 kg) - Breakfast: wholemeal bread 105 g; butter 15 g; egg 100 g; Gouda 30 g; semi-skimmed milk 250 g. - Lunch: Lentil soup ×1; rye bread (pumpernickel) 64 g; butter 10 g. - Dinner: Falafel ×1; Wholemeal chapati ×2; Healthy coleslaw ×1.5; low-fat yoghurt 100 g. - Snacks: apple 150 g; walnuts 25 g; semi-skimmed milk 200 g.

V4 (woman, 60 kg) - Breakfast: Karnemelkse pap ×1.5; rye bread (pumpernickel) 32 g; Gouda 20 g. - Lunch: Mushroom and spinach omelette ×1; tomato 100 g. - Dinner: Hutspot, vegetarian adaptation ×0.9; Rodekool met appel ×1; cooked kidney beans 100 g. - Snacks: semi-skimmed milk 200 g; pear 170 g; walnuts 15 g; low-fat yoghurt 150 g.

V5 (man, 70 kg) - Breakfast: Porridge with yoghurt and berries ×2; semi-skimmed milk 300 g; blueberries 100 g. - Lunch: Borscht ×1.5; rye bread (pumpernickel) 96 g; cottage cheese 100 g; egg 50 g. - Dinner: Ful medames ×1; wholemeal bread 70 g; butter 10 g; egg 50 g; tomato 150 g. - Snacks: low-fat yoghurt 200 g; apple 150 g; hazelnuts 25 g; semi-skimmed milk 200 g.

V6 (woman, 60 kg) - Breakfast: wholemeal bread 105 g; butter 10 g; Gouda 30 g; semi-skimmed milk 250 g; apple 150 g. - Lunch: Nettle soup ×1.5; rye bread (pumpernickel) 64 g; egg 50 g. - Dinner: Bruine bonensoep, vegetarian adaptation ×1.2; wholemeal bread 35 g; Sauerkraut ×1. - Snacks: Apple and blackberry oat crumble ×1; low-fat yoghurt 150 g.

V7 (man, 70 kg) - Breakfast: Bircher muesli ×2; semi-skimmed milk 250 g. - Lunch: Red lentil dal ×1.5; Wholemeal chapati ×3; cucumber 100 g. - Dinner: Boerenkool met kikkererwten en couscous ×1; egg 50 g; Sauerkraut ×1. - Snacks: low-fat yoghurt 250 g; strawberries 150 g; walnuts 20 g.

7.5 The recipes

Erwtensoep (Dutch split pea soup)

Dutch. Serves 4. Source: Janny de Moor, "Dutch Pea Soup (Hollandse Erwtensoep)", jannydemoor.nl (from her Dutch cookery writing).

Ingredients. 500 g green split peas; 500 g fresh arm picnic / knuckle (390 g); 250 g sirloin chops / spare rib chops (195 g); 250 lean salt pork in one piece (no unit printed) (250 g); 1 teaspoon salt (6 g); 100 g onion, peeled; 200 g leek (white only) (200 g); 300 g peeled celeriac; 250 g smoked sausage; 40 g celery leaves; 8 slices of black rye bread (256 g).

Method. 1. Rinse peas; cover with cold water, add meats, onion, salt; bring slowly to boil, skim. 2. Simmer 3 h on low heat, stirring now and then. Remove meat. 3. Add sliced leek, diced celeriac and the sausage; simmer 30 min. 4. Dice meat off the bone; slice salt pork and sausage; return to soup with chopped celery leaves. 5. Serve with rye bread, mustard and a slice of salt pork.

What protects the nutrients. All cooking water is eaten as soup, so water-soluble B vitamins and potassium that leach from peas and vegetables stay in the dish (USDA retention: legumes with liquid used retain more folate and potassium than drained).

Keeping. Source: make the day before for a thicker soup. Refrigerate covered; freezes well (freezing advice not on source page).

Per serving (computed from USDA values, raw weights, before cooking losses): 1626 kcal; protein 76.1 g; fibre 38.9 g; iron 11.2 mg; calcium 193 mg; vitamin C 17 mg; folate 477 µg.

Erwtensoep, vegetarian adaptation

Dutch. Serves 4. Source: Adapted from R01 (Janny de Moor): meats, salt pork and sausage omitted; 15 g rapeseed oil added for fat (adaptation made for this book, not a published recipe).

Ingredients. 500 g green split peas; 1 tsp salt (6 g); 100 g onion, peeled; 200 g leek; 300 g celeriac; adaptation: 200 g carrot; 40 g celery leaves; adaptation: 1 tbsp

rapeseed oil (15 g); 8 slices rye bread (256 g).

Method. 1. As R01 without meat: simmer peas with onion and salt 2.5-3 h; add leek, celeriac, carrot 30 min; stir in oil and celery leaves.

What protects the nutrients. Cooking water eaten; oil added at the end supports carotenoid uptake from carrot.

Keeping. As R01.

Per serving (computed from USDA values, raw weights, before cooking losses): 727 kcal; protein 38.0 g; fibre 40.3 g; iron 9.7 mg; calcium 178 mg; vitamin C 19 mg; folate 484 µg.

Bruine bonensoep (Dutch brown bean soup)

Dutch. Serves 4. Source: The Dutch Table (Nicole Holten), "Bruine Bonensoep", 2011.

Ingredients. 2 cups of beans, dry (368 g); 1 small onion, diced (70 g); 1 leek, sliced (89 g); 1/2 cup diced celeriac root (78 g); 2 potatoes, peeled and diced (426 g); 1 carrot (61 g); 1 handful celery leaves (10 g); 2 tomatoes, diced (246 g); 4 slices of bacon, diced (112 g); 1 kielbasa or 10 smokies (250 g).

Method. 1. Rinse beans; soak overnight in plenty of water. 2. Drain, rinse, cover with fresh water; add clove-studded onion, bay leaf, thyme; simmer 1-2 h until tender. 3. Remove aromatics; set aside 2 cups beans; puree the rest. 4. Add leek, onion, celeriac, potato, carrot, celery leaves, tomato, bacon; simmer 20 min. 5. Add sausage, heat through; stir in whole beans; season.

What protects the nutrients. Overnight soaking (Voedingscentrum: soak in 3x their weight of water) shortens cooking by 10-20 min; boiling until tender destroys lectins (Voedingscentrum). The bean cooking liquid is pureed into the soup, keeping leached minerals and B vitamins. Tomato adds vitamin C to the non-haem iron of the beans.

Keeping. Not stated on source page.

Per serving (computed from USDA values, raw weights, before cooking losses): 752 kcal; protein 36.4 g; fibre 27.4 g; iron 9.8 mg; calcium 191 mg; vitamin C 40 mg; folate 412 µg.

Bruine bonensoep, vegetarian adaptation

Dutch. Serves 4. Source: Adapted from R02 (The Dutch Table): bacon and sausage omitted; 20 g rapeseed oil added (adaptation made for this book).

Ingredients. 2 cups dry beans (368 g); 1 small onion (70 g); 1 leek (89 g); 1/2 cup celeriac (78 g); 2 potatoes (426 g); 1 carrot (61 g); handful celery leaves (10 g); 2 tomatoes (246 g); adaptation: rapeseed oil (20 g).

Method. 1. As R02 without bacon and sausage; stir oil in at the end.

What protects the nutrients. As R02.

Keeping. Not stated on source page.

Per serving (computed from USDA values, raw weights, before cooking losses): 479 kcal; protein 25.4 g; fibre 27.4 g; iron 9.3 mg; calcium 182 mg; vitamin C 40 mg; folate 411 µg.

Stamppot boerenkool (kale and potato mash)

Dutch. Serves 2. Source: Voedingscentrum, "Receptkaart Boerenkool" (Schijf van Vijf materials).

Ingredients. 600 g fresh chopped kale; 600 g potatoes (to be peeled) (450 g); 150 ml half-skim milk (154.7 g).

Method. 1. Peel potatoes, cut in pieces. 2. Put in large pot with a little water; add kale on top. 3. Cook 30 min until tender. 4. Bring milk to the boil; add to pot. 5. Mash to a puree; season with pepper.

What protects the nutrients. Cooked in "a little water" with the kale steaming on top, which loses less vitamin C than boiling covered in water (USDA retention: greens boiled in little water 60% vitamin C vs 55% water-covered). Serving suggestion on card: 1 tbsp liquid margarine - fat with the kale supports carotenoid uptake.

Keeping. Not stated on card.

Per serving (computed from USDA values, raw weights, before cooking losses): 359 kcal; protein 20.0 g; fibre 15.5 g; iron 6.2 mg; calcium 570 mg; vitamin C 404 mg; folate 461 µg.

Hutspot met klapstuk (Dutch hotchpotch)

Dutch (Leiden, 3 October). Serves 4. Source: Janny de Moor, "Dutch Hotchpotch (Hutspot)", jannydemoor.nl.

Ingredients. 500 g lean boneless beef flank; 1 kg potatoes, sliced (750 g); 800 g carrots, diced (712 g); 500 g onions, finely chopped (450 g).

Method. 1. Simmer beef in 300 ml salted water, covered, about 2 h. 2. Remove beef; add potatoes, carrots, onions; set beef on top; simmer 30 min. 3. Drain, keep the liquid; slice beef; mash vegetables with some of the liquid; serve topped with meat.

What protects the nutrients. Vegetables steam in a small volume of meat stock which is partly mashed back in; beef fat accompanies the carotenoid-rich carrots.

Keeping. Not stated on source page.

Per serving (computed from USDA values, raw weights, before cooking losses): 456 kcal; protein 33.3 g; fibre 10.8 g; iron 4.2 mg; calcium 138 mg; vitamin C 56 mg; folate 97 µg.

Hutspot, vegetarian adaptation (with cheese and butter)

Dutch. Serves 4. Source: Adapted from R04 (Janny de Moor): beef replaced by 160 g aged Gouda and 40 g butter for 4 (adaptation made for this book).

Ingredients. 1 kg potatoes (750 g); 800 g carrots (712 g); 500 g onions (450 g); adaptation: Gouda cheese (160 g); adaptation: butter (40 g).

Method. 1. Simmer vegetables in a little water 25-30 min; mash with some cooking liquid and the butter; serve with cheese cubes.

What protects the nutrients. Cooking liquid mashed back in; butter fat with carrots supports carotenoid uptake.

Keeping. Not stated.

Per serving (computed from USDA values, raw weights, before cooking losses): 476 kcal; protein 16.8 g; fibre 10.8 g; iron 2.4 mg; calcium 390 mg; vitamin C 56 mg; folate 92 µg.

Zuurkoolstampot met rookworst en appel

Dutch. Serves 4. Source: Albert Heijn Allerhande, "Stampot zuurkool".

Ingredients. 520 g zuurkool; 1 kg kruimige aardappelen (750 g); 150 ml volle melk (154.7 g); 40 g ongezouten roomboter; 1 eetlepel grove mosterd (15 g); 375 g Gelderse rookworsten; 3 Elstar appels (peeled, cored) (483 g).

Method. 1. Drain sauerkraut. Peel and cut potatoes; boil 20 min, adding sauerkraut for last 10 min. 2. Drain, keep a cup of cooking water; mash coarsely with milk, half the butter and mustard. 3. Heat sausage per packet. 4. Fry apple wedges 5 min in remaining butter; serve on the mash with the sausage.

What protects the nutrients. Sauerkraut is added only for the last 10 minutes and not rinsed by the recipe; part of the cooking water goes back into the mash.

Keeping. Not stated on source page.

Per serving (computed from USDA values, raw weights, before cooking losses): 625 kcal; protein 18.0 g; fibre 9.4 g; iron 4.3 mg; calcium 127 mg; vitamin C 61 mg; folate 64 µg.

Zuurkoolstampot, vegetarian adaptation (with walnuts and cheese)

Dutch. Serves 4. Source: Adapted from R05 (AH): rookworst replaced by 100 g walnuts and 120 g Gouda for 4 (adaptation made for this book).

Ingredients. 520 g sauerkraut; 1 kg potatoes (750 g); 150 ml whole milk (154.7 g); 40 g butter; 1 tbsp mustard (15 g); 3 apples (483 g); adaptation: walnuts (100 g); adaptation: Gouda (120 g).

Method. 1. As R05; toast walnuts in the pan before frying apples; serve with cheese cubes.

What protects the nutrients. As R05.

Keeping. Not stated.

Per serving (computed from USDA values, raw weights, before cooking losses): 595 kcal; protein 18.1 g; fibre 11.1 g; iron 4.4 mg; calcium 350 mg; vitamin C 61 mg; folate 93 µg.

Karnemelkse pap (buttermilk porridge)

Dutch. Serves 4. Source: Albert Heijn Allerhande, "Karnemelk-pap".

Ingredients. 80 g tarwebloem; 1 l karnemelk (1034.71 g); 4 el schenkstroop (80 g).

Method. 1. Sift flour, mix with 150 ml buttermilk to a paste. 2. Warm rest of buttermilk 5 min on low heat; add paste; simmer 15 min stirring. 3. Serve with syrup.

What protects the nutrients. Nothing is drained; buttermilk keeps its calcium and riboflavin in the dish. Traditional variant uses barley groats (gort) instead of flour, raising fibre (not in this source).

Keeping. Not stated on source page.

Per serving (computed from USDA values, raw weights, before cooking losses): 223 kcal; protein 10.6 g; fibre 0.5 g; iron 0.4 mg; calcium 304 mg; vitamin C 3 mg; folate 18 µg.

Spelt-rye bread (yeast)

Dutch/North European rye. Serves 12. Source: VPRO, Koken met Van Boven, "Recept: Spelt-roggebrood".

Ingredients. 7 g instant gist; 1 tl honing (7 g); 300 g speltbloem; 200 g roggemeel; een snuf zout (0.4 g).

Method. 1. Activate yeast 7 min in 50 ml lukewarm water with honey. 2. Mix flours, salt; add yeast and most of 250 ml water; knead 10 min. 3. Rise 1 h; knock back; shape; rise 30 min. 4. Slash, brush with water; bake 35 min at 180 C; cool before slicing.

What protects the nutrients. Yeast fermentation and rye flour lower phytate (degradation by phytase during proofing; claim status open - phytate source not fetched). Home bread has no iodised bakery salt: Voedingscentrum says such bread "contains almost no iodine" and advises using bakery salt at home.

Keeping. Not stated on source page.

Per serving (computed from USDA values, raw weights, before cooking losses): 146 kcal; protein 5.7 g; fibre 4.8 g; iron 1.5 mg; calcium 11 mg; vitamin C 0 mg; folate 31 µg.

Red lentil dal (masoor dal)

South Asian. Serves 4. Source: BBC Good Food Middle East, "Red lentil dal (Masoor dal)".

Ingredients. 200 g red lentils; 1/2 tsp ground turmeric (1.5 g); 4 tbsp sunflower oil (54.4 g); 1 1/2 tsp cumin seeds (3.15 g); 1 onion, diced (110 g); 25 g ginger; 1/2 tsp Kashmiri chilli powder (1.35 g); 3/4 tsp garam masala (1.5 g); 25 g unsalted butter; 1 tbsp chopped coriander (1 g).

Method. 1. Wash lentils, soak 1 h in hot water. 2. Drain; cover with water 4 cm deep, add turmeric; simmer ~30 min until soft. 3. Fry cumin in oil 30 s; add onion and ginger, fry until brown. 4. Add chilli and garam masala; tip into dal; stir in butter; finish with coriander.

What protects the nutrients. 1 h soak; cooking water is not drained but eaten as dal; fat-based tadka supplies fat for fat-soluble compounds.

Keeping. Not stated on source page.

Per serving (computed from USDA values, raw weights, before cooking losses): 366 kcal; protein 12.7 g; fibre 6.5 g; iron 4.7 mg; calcium 44 mg; vitamin C 3 mg; folate 109 µg.

Wholemeal chapati (roti)

South Asian flatbread. Serves 8. Source: British Heart Foundation, Heart Matters recipe finder, "Wholemeal chapati or roti".

Ingredients. 225 g (8 oz) wholemeal flour (225 g).

Method. 1. Mix flour and hot water. 2. Knead 5 min with wet hands; rest 10 min. 3. Divide into 8-12 balls, roll 15 cm rounds. 4. Cook in dry pan ~10 s + 1 min; puff over flame 30 s.

What protects the nutrients. Whole grain kept; no fat needed (source: serve without spreading fat).

Keeping. Not stated; best eaten fresh (source: serve immediately).

Per serving (computed from USDA values, raw weights, before cooking losses): 96 kcal; protein 3.7 g; fibre 3.0 g; iron 1.0 mg; calcium 10 mg; vitamin C 0 mg; folate 12 µg.

Lentil soup (Scottish)

British/Scottish. Serves 2. Source: NHS Grampian, Equally Well team, "Lentil soup" (2025).

Ingredients. leek (no quantity printed) (89 g); 1 onion (110 g); 2 carrots (122 g); 1 small turnip (61 g); 200 g lentils; 1/2 teaspoon pepper (1.15 g); 1 litre vegetable stock

(934.11 g).

Method. 1. Wash lentils; chop leek, onion, carrot, turnip. 2. Put stock, lentils, vegetables and pepper in a pan. 3. Cook 40 min. 4. Serve with bread.

What protects the nutrients. One-pot; nothing drained.

Keeping. Not stated on source.

Per serving (computed from USDA values, raw weights, before cooking losses): 459 kcal; protein 27.9 g; fibre 14.8 g; iron 8.2 mg; calcium 120 mg; vitamin C 26 mg; folate 534 µg.

Three bean spring minestrone

Italian. Serves 3. Source: BBC Good Food Middle East, "Three bean spring minestrone".

Ingredients. 2 tbsp olive oil (plus drizzle) (27 g); 1 banana shallot (40 g); 1 fennel bulb (234 g); 2 garlic cloves (6 g); 400 g can cannellini beans (drained, some liquid kept) (400 g); 400 g can borlotti beans; 700 ml vegetable stock (653.88 g); 100 g green beans; 30 g grated vegetarian hard cheese (+ rind) (30 g); 150 g frozen peas; handful of basil leaves (6 g).

Method. 1. Soften shallot, fennel, garlic in oil with a pinch of salt. 2. Add drained beans (keep starchy water from half a can), stock, green beans, cheese rind; simmer 15 min. 3. Add peas 2 min; stir in lemon zest and cheese. 4. Serve with basil and olive oil.

What protects the nutrients. Short simmer (15 min); peas added last for 2 min; stock eaten.

Keeping. Not stated on source page.

Per serving (computed from USDA values, raw weights, before cooking losses): 478 kcal; protein 25.9 g; fibre 20.9 g; iron 8.3 mg; calcium 341 mg; vitamin C 26 mg; folate 255 µg.

Borscht (beetroot soup)

Eastern European. Serves 6. Source: Sainsbury's Magazine, "Borscht beetroot soup recipe".

Ingredients. 1 tbsp olive oil (13.5 g); 2 red onions (220 g); 2 large celery sticks (128 g); 1 large carrot (72 g); 750 g raw beetroot (trimmed weight), peeled (750 g); 1 litre vegetable stock (934.11 g); 2 garlic cloves (6 g); about 50 g feta; 1 tbsp dill (0.56 g).

Method. 1. Sweat onions, celery, carrot in oil covered 8-10 min. 2. Add beetroot 8-10 min; add stock and garlic; simmer 30-40 min. 3. Rest 5 min; blend smooth. 4. Serve with feta and dill.

What protects the nutrients. Soup blended with its cooking liquid; nothing drained.

Keeping. Source: make up to 3 days ahead, cool, cover, refrigerate; can be frozen.

Per serving (computed from USDA values, raw weights, before cooking losses): 128 kcal; protein 4.3 g; fibre 4.8 g; iron 1.3 mg; calcium 89 mg; vitamin C 11 mg; folate 156 µg.

Porridge with yoghurt and berries

British/Scottish. Serves 4. Source: NHS Healthier Families, "Porridge with yoghurt and berries".

Ingredients. 150 g porridge oats; 8 tablespoons low-fat natural yoghurt (122.5 g); 100 g defrosted frozen summer berries.

Method. 1. Heat oats and water, stir until boiling, simmer 5 min. 2. Top each bowl with 2 tbsp yoghurt and berries.

What protects the nutrients. Fruit eaten raw keeps its vitamin C. Oats are a cold-chain-free staple.

Keeping. Not stated.

Per serving (computed from USDA values, raw weights, before cooking losses): 174 kcal; protein 6.8 g; fibre 5.4 g; iron 1.8 mg; calcium 82 mg; vitamin C 7 mg; folate 21 µg.

Bircher muesli

Swiss. Serves 4. Source: Irish Nutrition and Dietetic Institute (INDI), Get Cooking, "Bircher muesli".

Ingredients. 120 g jumbo porridge oats; 300 ml apple juice (314.47 g); 2 tbsp mixed seeds - linseed part (10.3 g); 2 tbsp mixed seeds - sunflower part (8.75 g); 2 apples, grated (364 g); blueberries or fruit of choice (148 g); 4 tbsp natural low-fat yogurt (61.25 g).

Method. 1. Combine oats, apple juice and seeds; soak overnight in the fridge. 2. Next morning stir in grated apple, berries and yoghurt; sprinkle cinnamon.

What protects the nutrients. Overnight soak in acidic juice (raw, uncooked oats); apple grated just before eating limits vitamin C loss to air (Voedingscentrum: limit exposure of cut fruit to air and light).

Keeping. Oat-juice mix keeps overnight in fridge (source); add apple fresh.

Per serving (computed from USDA values, raw weights, before cooking losses): 254 kcal; protein 6.3 g; fibre 7.2 g; iron 1.9 mg; calcium 66 mg; vitamin C 9 mg; folate 23 µg.

Ful medames (Egyptian fava beans)

Egyptian. Serves 8. Source: Global Pulse Confederation (pulses.org), "Egyptian Ful Medames".

Ingredients. 1 kg whole dried fava beans (1000 g); 45 g fresh coriander; 20 g fresh parsley; 1/4 tsp cayenne (0.45 g); 1/4 tsp cinnamon (0.65 g); 3 tsp (heaped) cumin (6.3 g); 3 tsp (heaped) sugar (12.6 g); 1 large jar passata (500-700 ml) (634.01 g); 2 tsp (heaped) tomato paste (10.67 g); juice of 2 or 3 large lemons (120 g); 1 garlic clove (3 g); 1 red onion (110 g); 1 small hot chilli (45 g); 100 ml sunflower oil (+ extra for frying) (92.14 g).

Method. 1. Soak beans overnight; drain; cook in fresh water ~60 min (pressure cooker ~20 min). 2. Fry chopped onion and garlic gently. 3. Mix chopped herbs with oil, lemon juice, chilli, spices; add to onion; cook a few minutes. 4. Add passata, paste and 100 ml water; simmer; add beans; season.

What protects the nutrients. Overnight soak; lemon juice and raw herbs (vitamin C) are cooked only a few minutes and are eaten with the non-haem iron of the beans (Voedingscentrum: vitamin C improves non-haem iron uptake).

Keeping. Source: serve at once or cool and freeze in portions.

Per serving (computed from USDA values, raw weights, before cooking losses): 583 kcal; protein 34.7 g; fibre 33.6 g; iron 10.7 mg; calcium 165 mg; vitamin C 30 mg; folate 552 µg.

Hummus

Levantine. Serves 3. Source: safefood (Ireland), "Hummus".

Ingredients. 200 g chickpeas (tinned, or dried soaked and cooked) (200 g); 2 teaspoons lemon juice (10.17 g); 1 clove garlic (3 g); 50 ml tahini (50.72 g).

Method. 1. Blend chickpeas, lemon juice, tahini, garlic, salt, pepper. 2. Add water gradually to a stiff paste. 3. Adjust seasoning.

What protects the nutrients. Raw lemon juice with chickpea and sesame non-haem iron; no heat after blending.

Keeping. Source: fridge; eat leftovers within three days.

Per serving (computed from USDA values, raw weights, before cooking losses): 212 kcal; protein 8.9 g; fibre 6.7 g; iron 3.5 mg; calcium 107 mg; vitamin C 2 mg; folate 132 µg.

Falafel

Levantine/Egyptian. Serves 4. Source: Brighton and Hove Food Partnership, "Falafel".

Ingredients. 400 g dried chickpeas; 1/2 tsp bicarbonate of soda (2.3 g); 1 bunch fresh parsley (60 g); 1/2 bunch fresh coriander (20 g); 1/2 bunch fresh dill (8.9 g); 1 small onion (70 g); 5 garlic cloves (15 g); 1 tbsp ground black pepper (6.9 g); 1 tbsp ground cumin (6 g); 1 tbsp ground coriander (5 g); 1 tsp cayenne (1.8 g); 1 tsp baking powder (4.6 g); 2 tbsp toasted sesame seeds (18 g); oil for frying (absorbed part) (40 g).

Method. 1. Soak chickpeas ~18 h (longer if hard); drain; boil 20 min; drain. 2. Blend with herbs, onion, garlic, spices. 3. Chill 1 h. 4. Mix in baking powder and sesame; shape patties. 5. Fry 3-5 min in 5 cm oil until brown.

What protects the nutrients. Long soak (18 h) and boiling lower phytate and remove lectins; raw herbs blended in add vitamin C and folate.

Keeping. Not stated on source page.

Per serving (computed from USDA values, raw weights, before cooking losses): 528 kcal; protein 23.0 g; fibre 15.0 g; iron 7.8 mg; calcium 239 mg; vitamin C 30 mg; folate 595 µg.

Sauerkraut (home fermented)

German/Dutch/Central European. Serves 16. Source: Joyce Amsden, University of Vermont Extension, "Sauerkraut DIY: fabulous fermented food".

Ingredients. 800 g cabbage ribbons; 16 g fine salt (2% of cabbage weight) (16 g).

Method. 1. Slice cabbage thin, discard core. 2. Weigh 800 g; add 16 g salt; rest 30 min. 3. Pack in jar under its own brine; weight down. 4. Ferment at 65-72 F (18-22 C) up to 4 weeks.

What protects the nutrients. No heat: lactic fermentation preserves the cabbage without a cold chain. Eat raw (cooking and rinsing would lose water-soluble vitamins; USDA retention data).

Keeping. Source: refrigerate up to one year after fermentation.

Per serving (computed from USDA values, raw weights, before cooking losses): 12 kcal; protein 0.6 g; fibre 1.2 g; iron 0.2 mg; calcium 20 mg; vitamin C 18 mg; folate 22 µg.

Baechu kimchi (napa cabbage kimchi)

Korean. Serves 58. Source: OHSUN kimchi recipe (PDF hosted by discovergates.org), "Baechu Kimchi".

Ingredients. 2 large napa cabbages (4-5 lb) (2041.2 g); 1 large Fuji apple (223 g); 2 medium carrots (122 g); 10 Asian chives (or 5 green onions) (75 g); 1/2 cup garlic cloves (68 g); 1 (2-inch) knob ginger (20 g); 1 medium yellow onion (110 g); 1 cup coarse gochugaru (128 g); 3 tablespoons fish sauce (54 g); 4 anchovy fillets (16 g); 1/2 cup coarse salt (dry brine, rinsed off) (20 g).

Method. 1. Quarter cabbages; salt every leaf; rest 4 h; rinse and drain. 2. Pulse apple, onion, ginger, garlic, fish sauce, anchovies; add gochugaru. 3. Mix paste with carrot and chives; coat every leaf. 4. Pack; leave cool until bubbles appear (2-6 days); refrigerate; ~3 weeks total.

What protects the nutrients. Raw lactic fermentation; no heat.

Keeping. Source: keep refrigerated sealed; keeps a long time; discard only if mould appears. Not vegetarian (fish sauce, anchovy).

Per serving (computed from USDA values, raw weights, before cooking losses): 19 kcal; protein 1.0 g; fibre 1.4 g; iron 0.6 mg; calcium 40 mg; vitamin C 11 mg; folate 31 µg.

Baked mackerel with potatoes and thyme

British (Mitch Tonks, "Fish Easy"). Serves 4. Source: Mitch Tonks, Fish Easy (Pavilion Books), extract published 9 May 2020.

Ingredients. 50 g butter (+ a little extra) (50 g); olive oil (no quantity) (27 g); 2 onions (220 g); 4 salted anchovy fillets (16 g); 4 potatoes, thinly sliced (852 g); 8 mackerel fillets (896 g); 1 tbsp fresh thyme leaves (2.4 g); dressed green leaves to serve (200 g).

Method. 1. Oven 220 C. 2. Fry onions in half the butter with oil ~8 min; melt anchovies in. 3. Fry potato slices in rest of fat ~6 min. 4. Layer potatoes, mackerel, thyme, pepper, onion mix, potatoes. 5. Add water, dot with butter; bake 10-12 min.

What protects the nutrients. Short bake (10-12 min) of an oily fish; potatoes cooked with skin-on option keeps more potassium (USDA retention).

Keeping. Not stated on source page. Cooked fish: refrigerate and eat soon (general).

Per serving (computed from USDA values, raw weights, before cooking losses): 811 kcal; protein 48.6 g; fibre 6.1 g; iron 6.3 mg; calcium 98 mg; vitamin C 52 mg; folate 65 µg.

Salsa verde cod tray bake

European. Serves 2. Source: World Cancer Research Fund, "Salsa verde cod tray bake".

Ingredients. 2 cod fillets (300 g); 200 g Jersey Royal potatoes; 180 g green beans; 1 tsp + 1 tsp + 1 tbsp olive oil (22.5 g); 4 cloves garlic + 2 tsp garlic (17.6 g); 250 g cherry tomatoes; 200 g chopped tinned tomatoes; 1 tsp paprika (2.3 g); 20 g fresh coriander; 20 g fresh parsley; 1/2 lemon, juiced (24 g); 2 tsp reduced fat and salt pesto (10 g).

Method. 1. Oven 180 C. 2. Toss potatoes and beans with 1 tsp oil; bake 25 min. 3. Fry garlic, cherry tomatoes; add tinned tomatoes, water, paprika; simmer 15 min. 4. Blend salsa verde (herbs, garlic, lemon, pesto, water, oil). 5. Stir sauce through vegetables; add cod topped with salsa verde; bake 15 min.

What protects the nutrients. Raw herb sauce (vitamin C, folate) added without long heating; vegetables roasted, not boiled.

Keeping. Not stated on source page.

Per serving (computed from USDA values, raw weights, before cooking losses): 412 kcal; protein 33.8 g; fibre 9.2 g; iron 4.5 mg; calcium 163 mg; vitamin C 85 mg; folate 107 µg.

Mushroom and spinach omelette

European. Serves 1. Source: Diabetes Australia, "Mushroom and spinach omelette".

Ingredients. 2 teaspoons olive oil (9 g); 1/2 cup mushrooms, sliced (35 g); 1/4 small onion (17.5 g); 1 cup fresh baby spinach (30 g); 2 large eggs (100 g); 1 tablespoon milk (15 g); 1/4 cup shredded cheddar (28.25 g); 1 slice low-carb toast (replaced) (32 g).

Method. 1. Fry mushrooms and onion in 1 tsp oil 5 min; wilt spinach; set aside. 2. Whisk eggs with milk. 3. Cook eggs in remaining oil; add vegetables and cheese; fold.

What protects the nutrients. Spinach only wilted; fat (oil, egg yolk, cheese) present for carotenoids and vitamin K.

Keeping. Eat fresh.

Per serving (computed from USDA values, raw weights, before cooking losses): 449 kcal; protein 24.4 g; fibre 3.2 g; iron 3.8 mg; calcium 333 mg; vitamin C 11 mg; folate 171 µg.

Nettle soup

British/Northern European foraged. Serves 4. Source: BBC Countryfile, "Nettle soup".

Ingredients. 500 g fresh nettles; 1 onion (110 g); 50 g butter; 1 carrot (61 g); 2 celery sticks (80 g); 2 garlic cloves (6 g); 1 potato, cooked and diced (213 g); 1 l vegetable stock (934 g); 40 ml double cream (40.31 g).

Method. 1. Wear gloves; pick over and wash nettles; discard tough stalks. 2. Fry onion, carrot, celery, garlic in butter; add stock and potato; simmer 15 min. 3. Add nettles; boil 2 min until wilted; blend with cream; season.

What protects the nutrients. Nettles boiled only ~2 min and blended with the liquid; butter and cream supply fat for carotenoids.

Keeping. Not stated on source page.

Per serving (computed from USDA values, raw weights, before cooking losses): 252 kcal; protein 6.1 g; fibre 11.0 g; iron 2.8 mg; calcium 646 mg; vitamin C 16 mg; folate 42 µg.

Healthy coleslaw

Dutch/US (koolsla). Serves 6. Source: BBC Good Food Middle East, "Healthy coleslaw".

Ingredients. 6 tbsp plain yogurt (91.88 g); 1/2 tsp Dijon mustard (2.5 g); 2 tbsp mayonnaise (27.6 g); 1/2 white cabbage (454 g); 2 carrots (122 g); 1/2 onion (55 g).

Method. 1. Mix yogurt, mustard, mayonnaise. 2. Grate cabbage and carrots; grate or finely chop onion. 3. Stir vegetables into dressing.

What protects the nutrients. Raw cabbage: no cooking loss of vitamin C; oil in mayonnaise accompanies carrot carotenoids.

Keeping. Source: keeps in the fridge up to 3 days.

Per serving (computed from USDA values, raw weights, before cooking losses): 72 kcal; protein 2.1 g; fibre 2.6 g; iron 0.5 mg; calcium 68 mg; vitamin C 30 mg; folate 40 µg.

Apple and blackberry oat crumble

British. Serves 3. Source: British Heart Foundation, Heart Matters, "Apple & blackberry oat crumble".

Ingredients. 55 g plain wholemeal flour; 25 g rolled oats; 25 g sunflower spread; 25 g soft light brown sugar; 1/2 tsp ground cinnamon (1.3 g); 2 eating apples, 375-400 g unprepared, peeled and cored (298.38 g); 150 g fresh blackberries; 2 tbsp apple juice (31 g); 1 1/2 tsp clear honey (10.5 g).

Method. 1. Oven 180 C. 2. Rub spread into flour and oats; add sugar and cinnamon. 3. Slice apples into dish with blackberries; pour over juice + honey. 4. Top with crumble; bake ~40 min.

What protects the nutrients. Fruit baked in its own juice, nothing drained; wholemeal flour and oats instead of white flour.

Keeping. Source: can be frozen up to 1 month; reheats well.

Per serving (computed from USDA values, raw weights, before cooking losses): 256 kcal; protein 4.5 g; fibre 7.0 g; iron 1.5 mg; calcium 44 mg; vitamin C 15 mg; folate 23 µg.

Rodekool met appel (red cabbage with apple)

Dutch. Serves 4. Source: Albert Heijn Allerhande, "Rodekool met appel".

Ingredients. 600 g rodekool (480 g); 1/2 tl zout (3 g); 2 goudrenet-appels, peeled, cored (322 g); 1 plak ontbijtkoek (25 g); 1 el rietsuiker (12.6 g).

Method. 1. Shred cabbage; stud shallot with cloves. 2. Simmer cabbage, shallot, salt in 200 ml water, covered, 25 min. 3. After 10 min add diced apple and ontbijtkoek; cook 15 min more. 4. Remove shallot and cloves; season with sugar.

What protects the nutrients. Small water volume (200 ml for 600 g) that is not drained; apple acidity helps keep the red colour (anthocyanins) and vitamin C (Voedingscentrum: vitamin C keeps better in acid foods).

Keeping. Not stated on source page.

Per serving (computed from USDA values, raw weights, before cooking losses): 110 kcal; protein 2.2 g; fibre 3.6 g; iron 1.2 mg; calcium 63 mg; vitamin C 72 mg; folate 25 µg.

Boerenkool met kikkererwten en couscous

Dutch (Voedingscentrum variant). Serves 2. Source: Voedingscentrum, "Receptkaart Boerenkool" (second recipe on card).

Ingredients. 400 g fresh chopped kale; 1 onion (110 g); 2 garlic cloves (6 g); 150 g canned chickpeas, drained; 200 g couscous; 1 tablespoon oil (14 g); 1/2 bouillon cube (2.4 g).

Method. 1. Fry onion and garlic in oil. 2. Add kale in portions until wilted. 3. Add drained chickpeas, couscous, water, bouillon; boil. 4. Off heat, cover 10 min; season.

What protects the nutrients. Kale wilted in oil, not boiled; all water absorbed by couscous so nothing is drained.

Keeping. Not stated on card.

Per serving (computed from USDA values, raw weights, before cooking losses): 669 kcal; protein 27.6 g; fibre 18.0 g; iron 5.0 mg; calcium 378 mg; vitamin C 245 mg; folate 349 µg.

Part 8 — The People Who Do the Work

8.1 Food is a chain of hands

Every number in Parts 2 to 7 stands for work. Someone sows the faba beans in October. Someone lifts the potatoes in September and lays them in the dark. Someone salts the cabbage, weighs it down and waits four weeks. Someone teaches a child why the bean water is poured away and the soup water is not.

Industry took most of these hands off the land. In the Netherlands about 100,000 people now work in farming, for 18 million inhabitants [6]. The knowledge that went with the work — when to sow, how to cure an onion, why a week jar of beans is unsafe — went with them. Much of what this book sets out was ordinary household knowledge two generations ago.

8.2 What the farm in Randwijk shows

The farmer in Randwijk harvests about 20 per cent less per hectare than his neighbours. He also spends less on fertiliser and sprays, and he receives a better price for organic pumpkins and onions. “I keep it up financially,” he told the paper, “but it is an enormous struggle” [6]. The Wageningen researchers add that most of the risk now lies with the farmer. Regenerative farming hands control back to nature, and that makes it uncertain.

The measured yield gap of Part 2.5 is the same 20 per cent. The farm is not an exception. It is the meta-analysis in one person.

8.3 Land and labour for the whole country

The Gupta-Marcusse study, as reported, found that a self-sufficient regenerative Netherlands on the current diet would need 3.1 million ha and 170,000 workers [6]. The report itself could not be reached. Its figures can be set beside the book’s own arithmetic.

Land. Multiply land per person (Part 3.3) by 18,044,027 inhabitants:

Diet	m ² per person	Total, million ha
Potato minimum, conventional	340	0.61
Plant diet, Dutch yields	602	1.09
Plant diet, organic yields	774	1.40
Plant diet, organic, one green-manure year in four	1,032	1.86
EAT-Lancet, dairy-herd beef	1,827	3.30
EAT-Lancet, beef-herd beef	about 2,550	4.60
The country’s farmland, 2024	997	1.80

The reported 3.1 million ha lies close to the EAT-Lancet figure computed here, and it is about nine-tenths of the Dutch land surface of about 3.4 million ha [46]. A plant diet,

even at organic yields, fits on the farmland the country already has.

Labour. The reported gap is $170,000 - 100,000 = 70,000$ workers. At 1,500 hours a year per worker that is 105 million hours. Divided over 52 weeks, it equals one hour a week from 2.0 million people. The Dutch population aged 15 to 75 is several times larger. “Everyone one hour a week” therefore covers the reported gap with room to spare. The 1,500 hours is this book’s assumption; the report’s own assumptions were not available.

Garden scale. In the plant diet of Part 3.3, the vegetables occupy $17.1 + 4.6 + 5.5 + 4.8 + 3.8 = 35.8$ m² per person. At the market-garden rate of about 2 hours per m² a year (Part 2.10), that is about 72 hours a year: under one and a half hours a week. The staples — potatoes, grain, beans — are field crops and take far less work per m².

Read in the net: a food system is a net of hands as much as a net of soil. Where the hands withdraw, a longer chain of machines and fuel closes the same winding. Where they return, the chain shortens again. This is a reading, not a mechanism.

8.4 What a household can close

A household with a garden or an allotment cannot grow its grain or its oil. It can grow and keep the parts of the diet that spoil soonest and cost most to transport: greens, roots, beans, herbs and soft fruit. It can keep potatoes and roots through the winter in a cellar or in the ground, ferment cabbage, dry beans and herbs, and return its urine and compost to the same plot.

The parts it cannot close alone are the ones Part 1.12 named: iodine, selenium, vitamin D in winter, the long omega-3 fats, and B12 for those who eat no animal food. They come from the sea, from the soil elsewhere, from the sun, or from a small and simple chain: iodised salt, a herring, a supplement.

8.5 What disappears, and what can return

What has largely disappeared is the household store: the cellar, the clamp, the crock, the drying loft. It went with refrigeration, supermarkets and year-round supply. Its loss shows in the waste figures: Dutch households throw away 25–33 kg of food per person a year, and bread, vegetables, fruit and potatoes make up half of it (Part 6.12).

What can return is the knowledge. It costs no industry. Cure before you store; keep apples from vegetables; eat the cooking water; soak the beans and boil them hard; put lemon on the lentils and drink the tea later; ferment at two per cent salt; never weck plain vegetables at 100 °C. Each of these is a sentence. Each is measured in this book.

Part 9 — Where Food Meets Illness

The companion work *Where Illness Comes From, Completed* [1] gives one entry per condition, with what prevents and cures it by simple means. The conditions below are those in which food is itself the prevention or the treatment. The figures are taken from that book's entries.

Condition	What food does	Measured effect	Grade
Iodine deficiency	iodised salt; sea fish; dairy	eliminated endemic cretinism in most of the world; household coverage near 89 per cent	STRONG
Neural tube defects	folic acid before conception; fortified flour	trial protection about 70 per cent; 25–50 per cent fall in every country that fortified	STRONG
Vitamin A deficiency	liver, eggs, milk, small fish; carrots and greens eaten with fat	the fat is essential: carotene conversion runs about 12:1	STRONG for sources
Rickets	sun; oily fish; egg yolk; dietary calcium	Finnish fortification cut levels below 50 nmol/L from about 55 to 9 per cent	STRONG
Iron deficiency	pulses, greens, small amounts of meat or fish; vitamin C with the meal; tea between meals; soaking, sprouting, fermenting	vitamin C raises non-haem absorption several-fold	STRONG for absorption
B12 deficiency	regular animal food: milk, eggs, fish	a few portions a week prevent dietary deficiency outright	STRONG
Zinc deficiency	animal food; soaking, sprouting, sourdough	absorption about 15 per cent at high phytate against about 50 per cent at low	MODERATE
Protein-energy malnutrition	breastfeeding; complementary food from local grains, legumes, eggs, small fish	the entry is almost entirely simple means	STRONG
Type 2 diabetes	weight loss; walking; fewer sugary drinks; whole food	lifestyle cut incidence by 58 per cent; each kg lost about 16 per cent lower risk	STRONG
Hypertension and stroke	less salt; potassium-enriched salt; DASH-type diet	salt substitute: stroke –14 per cent, mortality –12 per cent; DASH	STRONG

Condition	What food does	Measured effect	Grade
		–5.5 mmHg (–11.4 in hypertensives)	
Dyslipidaemia	vegetable oils in place of animal and hydrogenated fat; oats, barley, legumes, nuts	soluble fibre and legumes lower LDL 3–10 per cent; diets 10–30 per cent	MODERATE
Constipation	fibre from fruit, vegetables, legumes, whole grain; prunes; walking	prunes beat psyllium in a head-to-head trial	MODERATE
Diverticular disease	fibre; plant-based eating; nuts, seeds and popcorn freely	highest fibre fifth hazard ratio 0.59; vegetarians 0.69; popcorn 0.72	MODERATE
Kidney stones	water; normal dietary calcium with less salt and animal protein	water: recurrence 12 against 27 per cent; diet: 20 against 38 per cent	STRONG
Gout	less beer and sugary drink; coffee, low-fat dairy, cherries; plant purines need not be restricted	beer risk ratio 1.5–2.5 per daily serving	MODERATE
Osteoporosis	calcium from food: dairy, small fish with bones, greens, calcium-set tofu	calcium with vitamin D cuts hip fracture 25–30 per cent in deficient older people	STRONG in the deficient
Lactose intolerance	yoghurt, fermented milk, hard cheese; lactose spread through the day	aged hard cheese is effectively lactose-free	STRONG
Coeliac disease	removing gluten; naturally gluten-free staples	the treatment is the diet	STRONG
Food allergy	introducing peanut and egg early in infancy	peanut allergy about 81 per cent lower in high-risk infants	STRONG
Stomach cancer	fresh rather than salt-preserved food	grade weak for the cancer effect	WEAK
Diarrhoea	breastfeeding; clean water; handwashing with soap; continued feeding during illness	handwashing about 30 per cent fewer episodes	STRONG

Three patterns run through the table.

Deficiency is cured by the missing food. Iodine, folate, vitamin A, vitamin D, iron, B12 and zinc deficiency end when the nutrient arrives. In each, the simple means is the cure as well as the prevention.

Excess is prevented by the plain kitchen. Diabetes, high blood pressure, high cholesterol and gout respond to less salt, less sugar, less beer, more fibre, vegetable oils and walking. None of these needs a product.

Several old prohibitions were wrong. Low-calcium diets for kidney stones raised recurrence. Forbidding nuts, seeds and popcorn in diverticular disease had it backwards. Delaying peanut and egg in infancy raised allergy. Restricting vegetable purines in gout removes cheap, nourishing food for no benefit.

Read in the net: illness at the level of nutrition is a mesh that stays open because the winding that closes it does not arrive. Food is the arrival. This is a reading, not a mechanism.

Methods

The book was compiled under the Respondent-Judge Protocol [5]. Its working rules, adapted to food, were these.

Seven research lines. One researcher per line worked from the question alone: need, soil, crops, herbs, preparation, keeping, recipes. Each number was recorded with its source, as opened, and with a status: read off a source, read from a secondary copy of it, computed from such figures, or open. In total 1,094 claims were recorded; 1,048 rested on a source opened during the work.

Predict, then count. For the fourteen day menus, the expected outcome of each day was written down and fixed with a cryptographic hash before any nutrient was counted. The counting script refused to run without the matching hash. A separate script scored the prediction against the count.

Three independent computations. The menus were counted against the USDA SR28 table. They were recounted with separate code and exact fractions; the largest difference was 0.029 per cent. They were counted a third time with new code against a later release of the same data, and a fourth time against an independent table, the UK CoFID 2019, which adds iodine. Section 7.2 reports where the tables disagree.

An independent check of the literature. A separate judge drew a random sample of claims from every line, with the seed fixed in advance, and reopened their sources. Of 129 claims checked, 115 were confirmed as written, 12 were confirmed with a correction, none was refuted, and 2 could not be reopened. The corrections are in this edition. The same judge closed 20 of the 48 claims that had been left open.

What could not be reached. Several sources resisted retrieval: the Gupta-Marcusse report, parts of the EMA monographs, the full EAT-Lancet table and some publisher pages. Appendix B lists what remains open.

Appendix A — Reference Values Used in the Count

EFSA adult values for the two reference persons [7].

Nutrient	Man, 70 kg	Woman, 60 kg
Energy	2,581 kcal	2,079 kcal
Protein	58.1 g	49.8 g
Fibre	25 g	25 g
Linoleic acid	4 % of energy	4 % of energy
Alpha-linolenic acid	0.5 % of energy	0.5 % of energy
EPA + DHA	250 mg	250 mg
Vitamin A	750 µg	650 µg
Thiamin	1.08 mg (0.1 mg/MJ)	0.87 mg
Riboflavin	1.6 mg	1.6 mg
Niacin	17.3 mg NE (1.6 mg/MJ)	13.9 mg NE
Pantothenic acid	5 mg	5 mg
Vitamin B6	1.7 mg	1.6 mg
Folate	330 µg DFE	330 µg DFE
Vitamin B12	4 µg	4 µg
Vitamin C	110 mg	95 mg
Vitamin D	15 µg	15 µg
Vitamin E	13 mg	11 mg
Vitamin K	70 µg	60 µg
Choline	400 mg	400 mg
Calcium	950 mg	950 mg
Phosphorus	550 mg	550 mg
Magnesium	350 mg	300 mg
Potassium	3,500 mg	3,500 mg
Iron	11 mg	16 mg
Zinc (at 600 mg phytate a day)	11.7 mg	9.3 mg
Copper	1.6 mg	1.3 mg
Selenium	70 µg	70 µg
Manganese	3 mg	3 mg
Iodine	150 µg	150 µg
Sodium (upper bound)	2,000 mg	2,000 mg

The Dutch reference values differ in places: folate 300 µg, B12 2.8 µg, vitamin D 10 µg (20 µg from age 70), vitamin C 75 mg [25].

Appendix B — Register of Disagreements and Open Questions

B.1 Where good sources disagree

Subject	One source	The other
B12 reference	EFSA 4 µg	US 2.4 µg; NL 2.8 µg
Folate reference	EFSA 330 µg	US 400 µg; NL 300 µg
Iron in pregnancy	EFSA 16 mg	US 27 mg
Vitamin B6 upper level	EFSA 12 mg	US 100 mg
No-till yield effect	–5.7 per cent (Pittelkow)	–2.4 or –1.2 per cent (re-analysis)
Cover crops and soil carbon	0.32 t C/ha a year	0.03 t C/ha a year in the most robust trials
Organic matter and stored water	“more than doubled” (Hudson 1994)	1.16 mm per 100 mm per per cent carbon (50,000 measurements)
Cause of falling nutrient content	new high-yield varieties (Davis)	soil health (one regenerative pilot)
Echinacea for colds	EMA: well-established	Cochrane: no benefit in treatment
Valerian for sleep	EMA: well-established	publication bias, no firm conclusion
Garlic and blood pressure	–8 mmHg (Ried)	imprecise, outcomes unknown (Cochrane)
Ginger in pregnancy	EMA: do not use	Cochrane: may help, inconsistent
Folate loss in cooking	USDA: 60–90 per cent retained	FAO/WHO: “50 per cent or more” destroyed
Kidney beans	boil at least 10 min after 12 h soak (Hong Kong)	boil at least 30 min after 5 h soak (FDA); this book uses 30
Vitamin D in herring	4.2 µg per 100 g (USDA)	19 µg (CoFID)
Folate in lentils	479 µg per 100 g (USDA)	110 µg (CoFID)
Selenium in wheat bread	25.7 µg per 100 g (USDA)	7 µg (CoFID)
Split pea folate	274 µg per 100 g (SR28, 2016)	15 µg (SR Legacy, 2018)
Dutch household food waste, 2022	33.4 kg per person	28 kg per person
Mechanism of lime-treated maize against pellagra	freed niacin	amino acid balance

B.2 What is not known, or could not be reached

- The Gupta-Marcusse report itself: its farm data, diets and labour assumptions.
- Absolute yields for the aardaker and for Dutch food forests.
- Dutch yields for spelt, lentils, dry peas, sunflower, hemp seed, nuts and winter squash.

- Whether culinary amounts of any herb have a measurable health effect.
- Human data for the “chop and wait” and mustard-seed methods for cabbages.
- Molybdenum content of foods: neither composition table carries it.
- A validated Dutch process for bottling low-acid vegetables: none exists.
- Whether higher soil organic matter raises the nutrient content of crops, beyond one pilot.
- Labour per person fed for a complete diet grown by hand.
- The yield gain from unheated tunnels and cold frames in the Netherlands.

Appendix C — Annotated References

Each reference has two parts: why it is worth reading, and where useful, how to read it. Numbers match the citations in the text.

C.1 The companion works and the occasion

- 1. Konstapel, J. (2026). *Where Illness Comes From, Completed: A Reference Work on Every Chapter of Human Illness, Its Prevention, Its Cure, and What Can Be Done With Simple Means*. Version 1.0. Constable Research, Leiden.** *Why read?* The companion to this book. One entry per ICD-11 condition, each with a section on simple means. Part 9 draws on it. *Reading advice:* Read its Part 3 (simple means, audited) beside Part 5 of this book.
- 2. Konstapel, J. (2026). *From Atom to Body*. Constable Research, Leiden. constable.blog.** *Why read?* The layers from first chemistry to the body, with graded advice on food, water and movement. Its water section underlies Part 1.5.
- 3. Konstapel, J. (2026). *The Weaving of Life: How the Kingdoms Became Interwoven*. Constable Research, Leiden.** *Why read?* Fungi, nitrogen fixers and gut microbes as partners across kingdoms; background for the soil and gut readings of Part 0.
- 4. Konstapel, J. (2026). *The Vacuum.Net Theory: Foundational Paper*. Eighth edition, version 8.1. constable.blog.** *Why read?* The rules of the net used in Part 0: one strand, closure as the selection rule, the three-valued register.
- 5. Konstapel, J. (2026). *The Respondent-Judge Protocol*. constable.blog, 17 October 2026.** *Why read?* The method behind the Methods section: separate respondent and judge, prediction locked before counting, independent recomputation.
- 6. Blankestijn, M. (2026). “Regeneratieve landbouw is veelbelovend, maar ook nog een ‘enorme strijd’.” *Het Financieele Dagblad*, 21 October 2026.** *Why read?* The occasion of this book: a regenerative farm in Randwijk, the national programme, and the Gupta-Marcusse land and labour figures.

C.2 What the body needs

- 7. EFSA (2017). *Dietary Reference Values for Nutrients: Summary Report*. EFSA Supporting Publication 2017:e15121.** *Why read?* All EU adult reference values in one place. The main set of this book. *Reading advice:* Use the individual EFSA opinions (8–16) for the reasoning behind each value.
- 8. EFSA Panel (2012). *Scientific opinion on dietary reference values for protein*. *EFSA Journal* 10(2):2557.** *Why read?* 0.83 g per kg for all adults, older adults included; twice that is safe.
- 9. EFSA Panel (2010). *Dietary reference values for fats*. *EFSA Journal* 8(3):1461.** *Why read?* The essential fatty acids and the 250 mg EPA+DHA value.

- 10. EFSA Panel (2010). Dietary reference values for carbohydrates and dietary fibre. *EFSA Journal* 8(3):1462.** *Why read?* Why fibre is set at 25 g, on bowel function.
- 11. EFSA Panel (2016). Dietary reference values for vitamin D. *EFSA Journal* 14(10):4547.** *Why read?* The 15 µg value and why it assumes little sun.
- 12. EFSA Panel (2015). Dietary reference values for cobalamin (vitamin B12). *EFSA Journal* 13(7):4150.** *Why read?* Why the EU value (4 µg) is higher than the US value.
- 13. EFSA Panel (2015). Dietary reference values for iron. *EFSA Journal* 13(10):4254.** *Why read?* Why EFSA adds no iron in pregnancy.
- 14. EFSA Panel (2014). Dietary reference values for zinc. *EFSA Journal* 12(10):3844.** *Why read?* Zinc need rising with phytate: the key value for grain-based diets.
- 15. EFSA Panel (2014). Dietary reference values for iodine. *EFSA Journal* 12(5):3660.** *Why read?* The urinary basis of the 150 µg value.
- 16. EFSA Panel (2016). Dietary reference values for thiamin. *EFSA Journal* 14(12):4653.** *Why read?* Thiamin expressed per MJ of energy: average requirement 0.072, PRI 0.1 mg/MJ.
- 17. National Academies (NASEM). *Dietary Reference Intakes, summary tables* (NCBI Bookshelf NBK545442).** *Why read?* The US values printed beside EFSA throughout.
- 18. WHO/FAO/UNU (2007). *Protein and Amino Acid Requirements in Human Nutrition*. WHO Technical Report Series 935; and Millward, D. J. (2012), *British Journal of Nutrition*, Table 6.** *Why read?* The adult requirement for each of the nine indispensable amino acids.
- 19. FAO (2013). *Dietary Protein Quality Evaluation in Human Nutrition*. FAO Food and Nutrition Paper 92.** *Why read?* The DIAAS method and the scoring pattern used in Part 1.2.
- 20. Reynolds, A. et al. (2019). Carbohydrate quality and human health: a series of systematic reviews and meta-analyses. *The Lancet* 393:434-445.** *Why read?* 185 cohorts and 58 trials on fibre; the main dose-response evidence. *Reading advice:* Read the trial results beside the cohort results; only the trials are causal.
- 21. Bjelakovic, G. et al. (2012). Antioxidant supplements for prevention of mortality. *Cochrane Database of Systematic Reviews* CD007176.** *Why read?* 78 trials and 296,707 people: antioxidant pills do not lower mortality.
- 22. De-Regil, L. M. et al. (2015). Effects of periconceptional folic acid. *Cochrane Database of Systematic Reviews* CD007950; and MRC Vitamin Study Research Group (1991), *The Lancet* 338:131-137.** *Why read?* The trial basis of folic acid before conception: 72 per cent protection in the founding trial.

23. Neale, R. E. et al. (2023). D-Health trial. *BMJ* 381:e075230; and the VITAL trial as summarised by NIH ODS. *Why read?* Vitamin D in people who are not deficient prevents neither cancer nor cardiovascular events.

24. Passarelli, S. et al. (2024), global inadequate micronutrient intake; Stevens, G. A. et al. (2022), *Lancet Global Health*, measured deficiency in women and children. *Why read?* How many people worldwide fall short, nutrient by nutrient.

25. Gezondheidsraad (2015). *Richtlijnen goede voeding 2015*; Voedingscentrum, *Schijf van Vijf*. *Why read?* The Dutch dietary guidelines and the Dutch reference values that differ from EFSA.

26. RIVM. *Dutch National Food Consumption Survey 2019-2021*. *Why read?* Which nutrients fall short in Dutch intakes.

C.3 The ground

27. Pittelkow, C. M. et al. (2015). Productivity limits and potentials of the principles of conservation agriculture. *Nature* 517:365-368. *Why read?* 5,463 paired observations on no-till yields. *Reading advice:* Read with the statistical re-analysis (bioRxiv 179358), which halves the estimated loss.

28. Seufert, V. et al. (2012), *Nature* 485:229-232; Ponisio, L. C. et al. (2015), *Proc. R. Soc. B* 282:20141396; de Ponti, T. et al. (2012), *Agricultural Systems* 108:1-9. *Why read?* Three meta-analyses of the organic yield gap, agreeing on 19-25 per cent, and showing where it narrows.

29. van Groenigen, J. W. et al. (2014). Earthworms increase plant production: a meta-analysis. *Scientific Reports* 4:6365. *Why read?* Earthworms raise yields by a quarter, mainly in low-input systems.

30. Minasny, B. & McBratney, A. B. (2018). Limited effect of organic matter on soil available water capacity. *European Journal of Soil Science* 69:39-47; and Hudson, B. D. (1994), *Journal of Soil and Water Conservation* 49:189-194. *Why read?* The large-data correction to a popular claim about organic matter and water.

31. Rothamsted Research. *Broadbalk Wheat Experiment*, handout 2024 and e-RA data. *Why read?* The world's longest field experiment: manure against fertiliser since 1843.

32. Bowles, T. M. et al. (2020). Long-term evidence shows that crop-rotation diversification increases agricultural resilience. *One Earth* 2:284-293. *Why read?* Rotation raises yields and cuts drought losses.

33. van der Werf, W. et al. (2021). Comparing performance of crop species mixtures and pure stands. *Frontiers of Agricultural Science and Engineering*. *Why read?* All the land-equivalent-ratio meta-analyses of intercropping in one table.

34. Chaplot, V. & Smith, P. (2023). Cover crops do not increase soil organic carbon stocks as much as has been claimed. *Global Change Biology*; and

Poeplau, C. et al., Swedish long-term cover-crop data (EGU 2015). *Why read?* The strongest challenge to the carbon claims for cover crops.

35. Jeffery, S. et al. (2017). Biochar boosts tropical but not temperate crop yields. *Environmental Research Letters* 12:053001. *Why read?* Why biochar is not a yield tool in the Netherlands.

36. Brundrett, M. C. & Tedersoo, L. (2018). Evolutionary history of mycorrhizal symbioses and global host plant diversity. *New Phytologist* 220:1108-1115. *Why read?* The definitive shares of plants with fungal partners.

37. Peoples, M. B. et al. (2021), on the share of legume nitrogen fixed from the air (Wageningen e-depot 555959); and Herridge, D. F., Peoples, M. B. & Boddey, R. M. (2008), the global nitrogen fixation budget. *Why read?* How much of a legume's nitrogen comes from the air, crop by crop.

38. EcoSanRes Factsheet 6; SSWM, urine fertilisation and storage; WHO (2006). *Guidelines for the Safe Use of Wastewater, Excreta and Greywater, Volume IV.* *Why read?* Nutrients per person, doses per m², and safe handling of urine and faeces.

39. US Geological Survey (2026). *Mineral Commodity Summaries: Phosphate Rock.* *Why read?* Reserves, production and the concentration in Morocco.

40. Davis, D. R. et al. (2004), *Journal of the American College of Nutrition* 23:669-682; Davis, D. R. (2009), *HortScience* 44:15-19; Montgomery, D. R. et al. (2022), *PeerJ* 10:e12848. *Why read?* The historical nutrient decline, its explanation by dilution, and the one regenerative pilot. *Reading advice:* Read Davis 2009 before Montgomery 2022.

41. Natural Resources Institute Finland (Luke). Selenium monitoring 2000-2001. *Why read?* The cleanest case of soil deciding the nutrient content of a nation's food.

42. FAO & ITPS (2015). *Status of the World's Soil Resources*; JRC/Aarhus soil biodiversity data. *Why read?* World degradation figures and the weight of soil life per hectare.

43. Bakker, G. et al. (2021). Wageningen Environmental Research report 3109 (compaction and non-inversion tillage); Kamerstuk 32 813 nr. 562 (peat areas). *Why read?* Dutch compaction, the Lelystad no-till trial and the official peat figures.

44. Guégan, S. & Léger, F. (2015). *Maraîchage biologique permaculturel et performance économique* (Bec Hellouin); and Morel, K. et al. (2016), peer-reviewed summary. *Why read?* The best-documented labour figures for hand-scale growing.

45. RVO (2024). Maatwerkbesikking NGFRL2401; Wageningen University & Research, Re-Ge-NL project page. *Why read?* The public money and the scope of the Dutch regenerative programme.

C.4 What to grow

46. CBS StatLine, tables 7100oogs, 37738, 84499NED and 37230ned; CBS (2025), *Feiten en cijfers over de landbouw*. *Why read?* Official Dutch harvests, areas, land use and population, from which all Dutch yields in Part 3 are computed.
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48. Willett, W. et al. (2019). Food in the Anthropocene: the EAT-Lancet Commission. *The Lancet* 393:447-492. *Why read?* The planetary health diet used as Diet A.
49. Peters, C. J. et al. (2016). Carrying capacity of U.S. agricultural land: ten diet scenarios. *Elementa* 4:000116. *Why read?* Why a lacto-vegetarian diet can feed more people than a vegan one.
50. Mottet, A. et al. (2017), *Global Food Security* 14:1-8; Van Zanten, H. H. E. et al. (2018), *Global Change Biology* 24:4185-4194. *Why read?* What livestock eat that people cannot, and how much animal food leftovers can supply.
51. Klein, A.-M. et al. (2007). Importance of pollinators in changing landscapes for world crops. *Proc. R. Soc. B* 274:303-313. *Why read?* Which crops need insects and which do not.
52. Royal Horticultural Society, crop rotation and grow-your-own guides; University of Maine Extension Bulletin 2750 (seed saving). *Why read?* Rotation, sowing and harvest times, and which seeds are easy to save, for a climate like the Dutch.
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62. ANSES (France). Confusion between autumn crocus and wild garlic. *Why read?* Case numbers for a common and fatal mistake.
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- 69. EFSA Panel (2015). Scientific opinion on acrylamide in food. *EFSA Journal* 13(6):4104.** *Why read?* Exposure, the margin of exposure, and household measures.
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- 71. WHO. *Five Keys to Safer Food*.** *Why read?* Five household rules with their temperatures.
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C.8 Data

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