

vitamin C

FACT SHEET



Importance for health

Vitamin C (ascorbic acid) is essential to some key mechanisms in the body and therefore fulfils several important roles in human health. The biochemical function of ascorbic acid is based on its redox systems and as part of the body's antioxidant defence system.¹

Connective tissues

Deficiency in vitamin C can lead to scurvy of which bleeding gums are the first sign since collagen synthesis requires vitamin C. Preliminary data suggests that Vitamin C might also contribute to stabilize atherosclerotic plaques.²

Role in the synthesis of neurotransmitters and peptide hormones

Copper containing enzymes compulsorily depend on vitamin C. One enzyme is involved in the synthesis of signalling compounds in the nerves. Another plays a role in the formation of peptide hormones in the brain.

Absorption of iron from the diet

Vitamin C changes iron in the stomach to a more bioavailable form (ferric iron to ferrous iron). This is particularly important for absorption of iron from vegetable sources (and therefore of particular importance for vegetarians and vegans).³

Maintaining the effectiveness of an efficient immune response

High doses of vitamin C reduce the synthetic capacity of histamine. Histamine concentrations are elevated in several complications of pregnancy like pre-eclampsia, abruption and prematurity.⁴ Vitamin C has been shown to reduce the symptoms and duration of colds.⁵

Eye health

Together with other antioxidants vitamin C can delay the progression of advanced age-related macular degeneration (AMD) and vision loss.⁶

Table 1: Vitamin C content of raw and cooked foods.⁷

Food	Raw (mg/100g)	After boiling (mg/100 g)
Courgettes	21	11
Carrots	6	2
Cabbage, average	49	20
Cauliflower	43	27
Pepper, green	120	
Potatoes, new average	16	9
Potatoes, old, freshly dug	21	
Sweet potatoes	23	17
Tomatoes, raw	17	
Apples	6	
Bananas	11	
Blackcurrants (stewed)	200	115
Grapefruit juice	31	
Kiwi fruit	59	
Mango	37	
Oranges	54	

Dietary Sources

Vitamin C is widely distributed in fruits and vegetables and their juices (see Table 1). Trace amounts are found in milk, grains and meat. Citrus fruits, blackcurrants, peppers, green vegetables, (e.g. Brussels sprouts and broccoli) and some tropical fruits (e.g. kiwi and guava) are particularly rich sources. Potatoes contain a lower level of vitamin C but make a significant contribution to many European diets due to the frequency and quantity of consumption. The body readily absorbs vitamin C whether from natural sources, foods fortified or food supplements.

1 Moser U and Bendich A. Vitamin C. In: Handbook of Vitamins (2nd ed. LJ Machlin Ed.) 1991: 195-232.

2 Nakata-Yukiko, Maeda-Nobuyo. Vulnerable atherosclerotic plaque morphology in apolipoprotein E- deficient mice unable to make ascorbic acid. Circulation 2002; 105: 1485-90.

3 Reddy M B, Hurrell R F, Cook J D. Estimation of nonheme-iron bioavailability from meal composition. American Journal of Clinical Nutrition 2000; 71: 937-943.

4 Van Stratren M, and Josling P. Preventing the common cold with a vitamin C supplement: A double-blind, placebo-controlled survey. Advances in Therapy 2003; 19(3):151-159.

5 Poston L, Chappell L C. Is oxidative stress involved in the aetiology of pre-eclampsia? Acta Paediatrica 2001; 90: 3-5.

6 Age-Related Eye Disease Study Research Group. A Randomized, Placebo-Controlled, Clinical Trial of High-Dose Supplementation with Vitamins C and E, Beta Carotene, and Zinc for Age-Related Macular Degeneration and Vision Loss: AREDS. Archives of Ophthalmology 2001; 119: 1417-36.

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Recommended intakes

All EU Member States have established recommended dietary allowances (RDAs) for vitamin C, normally by population sub-group. The RDAs are normally for all ages from birth to old age, but the definition of the RDA differs by country. France and Germany, for example, take into account the need for optimal nutrition, whereas the UK looks at those levels required to prevent the symptom of deficiency i.e. scurvy. Hence, the actual numbers vary slightly. As more scientific data has become available on human requirements there is a discernible trend for the vitamin C RDAs in Member States to increase. (see Table 2)

Table 2: Recommended Dietary Allowances (RDA) of vitamin C (mg) in all adults and pregnant women in Europe⁸

Country/Organization	Adults	Pregnant women
Belgium, 2000	70	90
France, 2001	110	90
DACH*, 2000	100	110
Ireland, 1999	60	-
Netherlands, 2000	70	90
Nordic countries, 1996	60	-
Portugal, 1982	75	-
Spain, 1994-98	60	-
UK, 1991	40	50
EU Reference Labelling Value, 2003	80	-

* Recommendations for Germany, Austria and Switzerland

Current intakes

Recent surveys in Austria⁹, Ireland¹⁰ and the Netherlands¹¹ suggest that close to 50% of the population meet national recommended dietary allowances for vitamin C. Intake of vitamin C is considerably higher in Germany and Italy (see figure 1). In the UK, the proportion of those not meeting current UK national recommendations, namely 40 mg/day is approximately 20% of adults. More recent recommendations of 80 mg/day for vitamin C would not be met by 54% of adults.¹²

Comparative data illustrating trends in intake have generally shown an increase in vitamin C. In the Netherlands, average intake of vitamin C increased by 12% for the total population between 1987 and 1997¹¹ and in the UK, average intake of vitamin C increased by 36% in men between 1987 and 2001 and increased by 53% in women.¹²

In a survey of European consumers, vitamin C was most frequently taken to help protect against infections such as colds and flu especially in the winter months. The second most frequently cited reason was that the individual felt they didn't eat a balanced diet (e.g. not sufficient fruit and vegetables).¹³

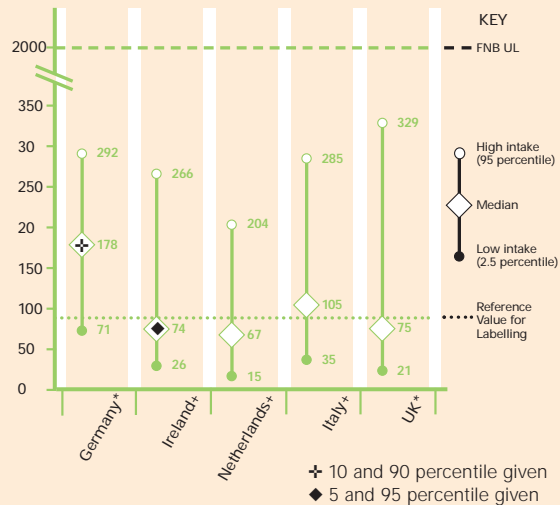


Figure 1: Average daily intake of Vitamin C for adult men (mg - intake from all sources including food supplements* or excluding food supplements-).^{10, 11, 12, 13, 15}

7 Adapted from Holland D, Unwin ID, Buss DH (eds) McCance & Widdowson's The Composition of Foods (1991).

8 EC Scientific Committee on Food. Opinion of the Scientific Committee on Food on the revision of reference values for nutrition labelling (2003).

9 Institut für Ernährungswissenschaften, Österreichischer Ernährungsbericht (1998).
 10 Irish Universities Nutrition Alliance (IUNA), The North-South Ireland Food Consumption Survey (2001).

11 Gezondheidsraad, Enkele belangrijke ontwikkelingen in de voedselconsumptie (2002).

12 UK Office for National Statistics, The National Diet & Nutrition Survey (NDNS): adults aged 19 to 64 years (2003).

13 Turrini A, Saba A, Perrone D, Ciaffa E, & D'Amicis A. Food Consumption Patterns in Italy: the INN-CA Study 1994-96, European Journal of Clinical Nutrition, 55, 7(2001) 571-588.



Food fortification

Throughout Europe, fruit juice based and fruit flavour drinks are the foods most commonly enriched with vitamin C. A number of fruit containing breakfast cereals, fruit based desserts, jellies and dry dessert mixes also have vitamin C added or restored to replace processing losses. These products make a useful contribution to vitamin C intake especially for adolescents. Vitamin C is not frequently added to bread and pasta, as it is not very stable. In accordance with EU legislation vitamin C is also added as defined to specific foodstuffs for particular nutritional uses, for example, formulae milks, meal replacers and dietetic supplement drinks.

Food supplements

A Gallup survey¹³ of 6 European countries in 1999 showed that 23% of the population use food supplements. Of these users, 36% claim to take a vitamin C supplement once a week or more, the largest proportion of vitamin C supplement users being found in Poland. 39% of vitamin C users took dosages of less than 250 mg and 24% of the users took between 250 and 499 mg. The largest proportion of vitamin C supplement users taking 500-1000 mg can be found in France (15%); 6% of vitamin C users in total took products in this range, while 7% of users consumed over 1000 mg. On average, vitamin C supplements provide between 5.8% and 8.3% of total vitamin C intake.¹⁰

UK data indicates a highest average daily intake of vitamin C from supplements of 375 mg in women aged between 50 and 64 years with highest intake (upper 2.5 percentile).¹² In Germany, the highest recorded daily intake from food supplements alone is in men of 128mg (at 75th percentile).¹⁴

Table 3 provides a review of the range of vitamin C content in food supplements currently sold freely in the EU, i.e. those that the consumer can find on the shelves of supermarkets and health stores (including products that in some countries may be registered as medicines). Food supplements sold in pharmacies and subject to specific controls are not included.

Table 3: Range of vitamin C in food supplements on free sale (via health stores and supermarkets) in the major EU markets.¹⁶

Country	Vitamin C (mg/day)
Denmark	25 – 1000
France	25 – 500
Germany	25 – 1000
Italy	25 – 90
Netherlands	25 – 1500
Portugal	25 – 1000
Spain	25 – 60
Sweden	25 – 1000
UK	25 – 1500

¹⁴ Gallup European Consumers Awareness and Behaviour Survey on Vitamin and Mineral Supplements and Fortified Foods (Roche Vitamins Europe, 1999).

¹⁵ Robert Koch Institut, Was essen wir heute?: Beiträge zur Gesundheitsberichterstattung des Bundes. (2002).

¹⁶ Market survey undertaken by the European Responsible Nutrition Alliance in 2001-2003.

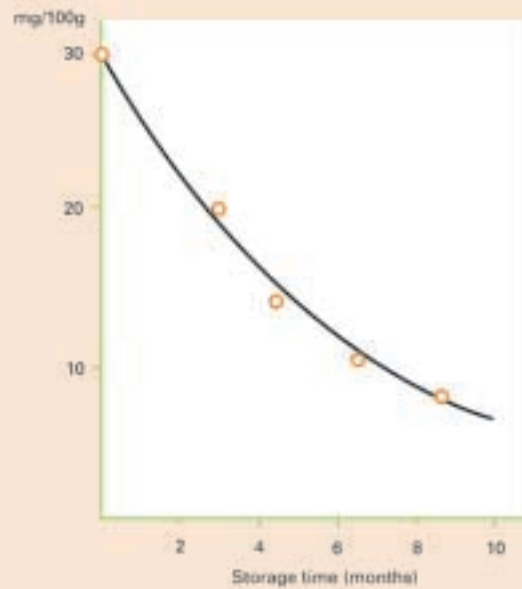
Stability

Vitamin C, or ascorbic acid, is an excellent antioxidant both in the body and in food and is nature's way of protecting fruits and vegetables from oxidative attack. When food is processed however, the structure of the food can be changed, for example in pressing an orange. This means that the tissues and cells are exposed to oxygen in the atmosphere and vitamin C is lost due to oxidation.

Vitamin C is lost from foods during cooking and storage. Potatoes for example will lose 15% of their vitamin C activity each month during storage at room temperature and a further 30-50% during boiling (see also Table 1). Losses of vitamin C in milk are 25% on average after pasteurisation and 30% after UHT processing.

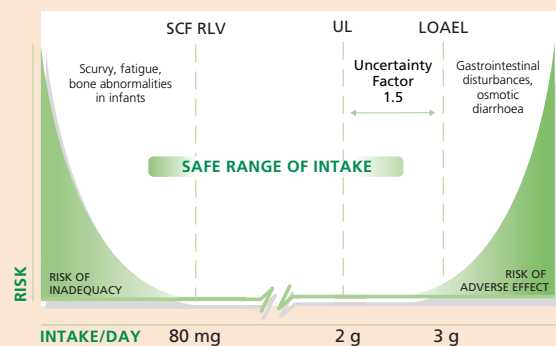
Processing, storage and cooking losses should be compensated where possible by restoration as part of good manufacturing practice. This cannot be done in unprocessed fruits and vegetables for technological reasons. Products such as soft drinks, milk and breakfast cereals are ideal products for restoration.

Figure 2: Effect of storage on vitamin C content of potatoes¹⁷



Safety

The Food and Nutrition Board made a detailed risk assessment of all major micronutrients recently and published the vitamin C work in 2000. Based on various studies it was concluded that an intake of 3 g/day may cause osmotic diarrhoea and this level was therefore taken as the LOAEL or Lowest Observed Adverse Effect Level. This figure was then divided by an Uncertainty Factor of 1.5 as the data was consistent to produce a Tolerable Upper Intake Level of 2g/day.¹⁸ The SCF (now EFSA) has not yet completed a risk assessment of vitamin C.



¹⁷ Berry Ottaway P, The Technology of Vitamins in Food, (Aspen Publishers, 1992)

¹⁸ Institute of Medicine, Food and Nutrition Board, Dietary Reference Intakes for Vitamin C, Vitamin E, Selenium and Carotenoids, National Academy Press, Washington (2000).