

Pantothenic Acid

bw	body weight
CNS	Chinese Nutrition Society
CRN	Council for Responsible Nutrition
DRI	dietary reference intake
EC SCF	European Commission Scientific Committee on Food
EFSA	European Food Safety Authority
EVM	Expert Group on Vitamins and Minerals
HOI	highest observed intake
ICMR-NIN	Indian Council of Medical Research - National Institute of Nutrition
IOM	Institute of Medicine
IU	international unit
JECFA	Joint FAO/WHO Expert Committee on Food Additives
KNS	Korean Nutrition Society
LOAEL	lowest observed adverse effect level
LOEL	lowest observed effect level
NDA	EFSA Panel on Nutrition, Novel Foods and Food Allergens
NIH	National Institutes of Health
NOAEL	no observed adverse effect level
NOEL	no observed effect level
RCT	randomized clinical trial
SUL	safe upper level
UF	uncertainty factor
UL	tolerable upper intake level

Introduction

Pantothenic acid, also referred to as vitamin B5 or pantothenate, is a water-soluble vitamin that has an essential role in the metabolism of carbohydrates, fatty acids, and amino acids; in acetyl group transfers in the biosynthesis of steroids and porphyrins; and in the acetylation of some drugs (Freese et al. 2023; Chungchunlam and Moughan 2024; Shichkin 2025). This vitamin functions as a precursor in the biosynthesis of coenzyme A, and its 4'-phosphopantetheine form binds to the acyl carrier protein (EFSA 2006; IOM 1998; Freese et al. 2023; Drake 2023).

Pantothenic acid occurs in free and conjugated forms found in plant and animal cells (IOM 1998). This vitamin can be synthesized in plants, fungi, and micro-organisms; humans and animals also obtain pantothenic acid via intestinal microbiota but require dietary intake to obtain sufficient levels (Freese et al. 2023; Shichkin 2025). Pantothenic acid is present in a variety of foods, such as milk, eggs, meat products (e.g., liver and kidneys), whole-grain cereals, vegetables, and nuts (EFSA 2006; Chungchunlam and Moughan 2024; Drake 2023). Estimated daily intake in U.S. adults is approximately 6 mg, while estimated intakes in Canada range from 4-5.5 mg per day in adults (NIH 2026). Similar intakes are reported in several European countries (e.g., France, Germany, Ireland, Austria, Hungary, and Portugal), with daily mean/median intakes ranging from 3.2 to 6.3 mg pantothenic acid in adults (EFSA 2014). Forms of pantothenic acid currently added to foods and food supplements include calcium D-pantothenate and sodium D-pantothenate (both as *D*-isomer and/or *DL*-racemate), as well as the provitamin, dexpantenol (D-panthenol) (EFSA 2006, 2014). D-panthenol converts entirely into pantothenic acid in the body and is therefore considered to be essentially bioequivalent to pantothenic acid when ingested (EFSA 2011a,b).¹

This chapter focuses on the derivation of an HOI value for supplemental pantothenic acid (as D-pantothenate and its calcium and sodium salts) in adults, including D-panthenol as a source of pantothenic acid.

Bioavailability

Dietary sources of pantothenic acid include coenzyme A and protein- or peptide-bound 4'-phosphopantetheine (Freese et al. 2023; EVM 2003). After ingestion, coenzyme A is hydrolyzed and/or dephosphorylated to dephospho-coenzyme A, 4'-phosphopantetheine, pantetheine, or pantothenic acid (IOM 1998; EVM 2003; Freese et al. 2023). The bioavailability of pantothenic acid varies based on dietary source (e.g., animal, plant, or mixture of both diets) and ranges from 40-60% (Chungchunlam and Moughan 2024; Freese et al. 2023). Pantothenic acid is absorbed in the gastrointestinal tract using active transport via a sodium-dependent carrier-mediated process, though the efficiency of absorption decreases as the concentration of pantothenic acid is increased,

¹ D-panthenol converts on a 1:1 molecular basis, yielding ~107% of its weight as free pantothenic acid due to the addition of oxygen atoms.

when passive diffusion is then utilized (EVM 2003; IOM 1998; EFSA 2014; Shichkin 2025).

Entry of pantothenic acid into the blood occurs via passive diffusion, where pantothenic acid is present in free form or bound to coenzyme A within erythrocytes (Freese et al. 2023; EFSA 2014). Once in the blood, pantothenic acid can be taken into tissues (in the form of coenzyme A) using an active sodium-dependent mechanism (EVM 2003; EFSA 2014; Freese et al. 2023). Tissue forms of pantothenic acid include coenzyme A, acyl carrier protein, and free pantothenic acid (EFSA 2014). Pantothenic acid is primarily excreted in urine as free, unmetabolized pantothenic acid (Freese et al. 2023; Shichkin 2025).

Safety Considerations

Pantothenic acid has been shown to have very low toxicity based on data from animal studies and no serious adverse effects in human studies, with only mild gastrointestinal side effects reported in some human intervention studies at very high doses (e.g., 10-20 g per day) (IOM 1998; EFSA 2006; EVM 2003; NIH 2026; Shichkin 2025; Hrubša et al. 2022; Drake 2023; BfR 2021).

Consistent with this conclusion, no serious adverse events have been associated with supplemental pantothenic acid in human clinical trials reviewed as part of this assessment.

CRN previously derived a supplemental UL of 1,000 mg pantothenic acid per day for adults. The 3rd edition of this chapter, published in 2014, also summarized the limited available clinical trial data reviewed by authoritative agencies at that time (IOM 1998; EFSA 2006; EVM 2003). The following clinical studies were considered in the assessment to support CRN's supplemental UL of 1,000 mg per day at that time (General Practitioner Research Group 1980; Komar 1991; Vaxman et al. 1996). The General Practitioner Research Group (1980) conducted a double-blind, placebo-controlled trial in an arthritic patient population experiencing rheumatoid arthritis, osteoarthritis, gout, or spondylitis. Patients (n=47) were administered placebo or escalating doses of calcium pantothenate for a total of 8 weeks (500 mg on days 1-2, 1,000 mg on days 3-5, 1,500 mg on days 6-9, and 2,000 mg starting on day 10). The occurrence of side effects was reported by the authors to be fewer in the pantothenic acid group when compared to that of the placebo group (9% vs. 21%) in this study. An experimental study in individuals undergoing tattoo removal surgery also reported a lack of adverse events (Vaxman et al. 1996). Patients received 0 (n=10),

200 (n=18), or 900 (n=21) mg pantothenic acid per day; supplemented groups also received vitamin C.² In the third study previously reviewed by CRN, calcium pantothenic acid (300 or 600 mg per day) was coadministered with pantetheine (90 or 180 mg per day) for 3-4 weeks to patients with viral hepatitis A (Komar 1991). In its 3rd edition, CRN reported the total pantothenic acid as 1,000 mg per day. Details of the study size and dosing regimen were not available from this Russian language publication.

Currently, the available human clinical evidence base for the safety of pantothenic acid remains small, as only one human clinical trial published since 2014 was identified that met the inclusion criteria for this update (see CRN Methodology Chapter). In this prospective, randomized, controlled trial, women with hair loss received 100 mg pantothenic acid per day for 4 months (Siavash et al. 2017). The authors stated that no adverse effects were reported.

Official Reviews

IOM (1998). The IOM found no reports of adverse effects of oral pantothenic acid in humans. The IOM noted that no evidence of toxicity associated with the intake of pantothenic acid was identified based on a literature search and cited the study by Vaxman et al. (1996) that included doses of 200 or 900 mg per day (together with ascorbic acid). Given that no effect level (i.e., LOAEL or NOAEL) could be identified, the IOM concluded that “a quantitative risk assessment cannot be performed” and an UL could not be derived for pantothenic acid.

EVM (2003). The UK’s EVM found no reports or clinical trial evidence of adverse effects of oral pantothenic acid or calcium pantothenate in humans, citing older case studies and uncontrolled clinical trials at doses of up to 10,000 mg per day for up to several years. While diarrhea and gastrointestinal disturbances³ were reported in some of these studies (Goldman 1950; Welsh 1952, 1954), the EVM noted that more recent controlled studies did not report any side effects at doses up to 2,000 mg per day for shorter periods of time (General Practitioner Research Group 1980). The EVM concluded that there was no basis for a proper risk assessment and a SUL was not set. However, a guidance level was derived from data showing an absence of

² Additional study details were obtained from Baranwal et al. (2024).

³ Gastrointestinal side effects are typically considered *nuisance effects*, as defined in CRN’s Methodology chapter.

adverse effects at supplemental intakes up to 2,000 mg per day in the study by the General Practitioner Research Group (1980). Due to the small number of participants, and the “incomplete investigation of possible adverse effects” in this study, a conservative UF of 10 was selected to calculate a guidance level for a supplemental intake of 200 mg per day and a total intake of 210 mg per day accounting for up to 10 mg from foods.

EFSA (2006). In its 2006 evaluation of pantothenic acid, the EFSA Panel noted the lack of systematic oral dose-response intake studies and “very low toxicity” of pantothenic acid (consumed as calcium pantothenate or panthenol) based on data from a literature search. Occasional diarrhea and water retention were noted by the Panel to have been reported “only at very high intake levels (10-20 g/day).” The Panel confirmed that no data had been reported on pantothenic acid toxicity in humans at doses up to 2,000 mg per day, citing the General Practitioner Research Group (1980) study. It was concluded that no LOAEL or NOAEL could be determined, and thus no numerical UL was established. The EFSA also indicated that intakes of pantothenic acid considerably higher than intake levels⁴ at that time (from all sources) do not represent a health risk for the general population (EFSA 2006).

CNS (2023). The CNS included pantothenic acid in its assessment but did not establish an UL.⁵

ICMR-NIN (2020). The ICMR-NIN did not include pantothenic acid when deriving UL values.

KNS (2020). The KNS published its general approach to evaluating data for setting DRI values. The KNS did not derive an UL for pantothenic acid when considering this nutrient.

CRN Recommendations

CRN previously derived a supplemental UL value for pantothenic acid of 1,000 mg per day. The goal of the current chapter was to determine whether more recent human clinical data are available that might impact the conclusions published in the 3rd edition. While not all human

⁴ Based on information presented by the EFSA (2006), intake levels included mean and/or 97.5th percentile data from multiple countries.

⁵ No additional details provided.

clinical trials are specifically designed to evaluate adverse effects, no new trials were identified that reported any serious adverse effects with supplemental pantothenic acid. Following CRN's methodology (see Methodology Chapter), and due to the lack of any known adverse effects for pantothenic acid, an HOI was established by CRN in this update. As with any assessment in which not all available data are reviewed, inherent uncertainties with the risk assessment and selection of the HOI are recognized.

CRN's safety methodology for deriving supplemental HOI values prioritizes data from human clinical studies when available. The table below summarizes the key human clinical studies considered in deriving the supplemental HOI value by CRN according to its principal points of departure for risk assessment (as described in the Methodology Chapter).

Studies Considered for the CRN HOI for Pantothenic Acid in Adults

Reference	Study Design	Participant Description	No. of Subjects	Supplemental Dose(s) (mg/day)	Duration	NOAEL (mg/day)
Key studies from 3rd Edition						
General Practitioner Research Group 1980	Double-blind, placebo-controlled	Patients with arthritis	47	0, ≤2,000 ^a	8 weeks	2,000
Vaxman et al. 1996	Experimental	Patients undergoing tattoo removal surgery	29	0, 200, 900 ^b	3 weeks	900 ^b
Komar 1991	Clinical trial	Patients with viral hepatitis A	Unclear ^c	300, 600 ^c	3-4 weeks	600 ^c

^a Escalating doses of calcium pantothenate for a total of 8 weeks (500 mg on days 1-2, 1,000 mg on days 3-5, 1,500 mg on days 6-9, and 2,000 mg starting on day 10).

^b Pantothenic acid groups also received concomitant vitamin C.

^c In its 3rd edition, CRN reported the total pantothenic acid as 1,000 mg per day. In addition, details of the study size and dosing regimen are not available from this Russian language publication.

ULs for pantothenic acid have not been established by authoritative agencies, such as the IOM (1998), the EFSA (2006), or the EVM (2003), due to insufficient data from which to conduct a quantitative risk assessment (see *Official Reviews*). More recently, the German Federal Institute

for Risk Assessment (BfR 2021) concluded that, based on available data, it was not necessary to set a maximum level for pantothenic acid for the addition to food supplements and fortification of conventional foods.

No serious adverse events have been associated with supplemental pantothenic acid in the human clinical trials reviewed. In its 3rd edition, CRN derived a supplemental UL of 1,000 mg per day based on data from the limited clinical studies available at that time, which administered up to 2,000 mg pantothenic acid per day for a duration of 3 to 8 weeks and did not report any adverse effects (General Practitioner Research Group 1980; Komar 1991; Vaxman et al. 1996). Since that time, no new data have become available that identify any serious adverse effects in clinical trials with supplemental pantothenic acid. The only new study identified that met the inclusion criteria for this update was conducted with 100 mg pantothenic acid per day.

While CRN recognizes the available human clinical data for pantothenic acid are limited, the scope of the current update was to determine if more recent human clinical data impact the conclusions published in the 3rd edition. Given the absence of new information pertinent to an updated safety evaluation, the long-standing supplemental CRN UL of 1,000 mg per day as derived in the 3rd edition is maintained and carried forward as an HOI for adults for pantothenic acid (as D-pantothenate and its calcium and sodium salts).⁶ While no studies on D-panthenol were identified, the HOI applies to this provitamin as a source of pantothenic acid given its bioequivalence following oral ingestion.

⁶ The previous CRN UL was derived based on the following information; “There are no reports of toxicity from oral administration on which a LOAEL value could be based. The clinical trial data (General Practitioner Research Group 1980) identified by the EVM provided evidence that supplemental intakes of 2,000 mg did not produce adverse effects. The amount of available information is much smaller than desirable, but with the absence of adverse effects with daily intakes as high as 10 g, and systematic clinical experience with oral intakes of up to 1,000 mg per day (Komar 1991), 1,000 mg per day is selected as the CRN supplemental UL value.” Therefore, no specific NOAEL is identified for the current update to serve as the basis for conducting CRN’s standard risk assessment calculations (see CRN Methodology chapter).

Quantitative Summary for Pantothenic Acid for Adults

CRN (2026) HOI, supplemental intake	1,000 mg/day ^a
IOM (1998) UL, total intake	Not determined
EFSA (2006) UL, total intake	Not determined
EVM (2003), guidance level	200 mg/day supplemental; 210 mg/day total intake
CNS (2023)	Not determined
ICMR-NIN (2020)	Not evaluated
KNS (2020)	Not determined

^a As D-pantothenate (and its calcium and sodium salts); includes D-panthenol as a source of pantothenic acid

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