Pantothenic acid

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Importance of pantothenic acid for health

Pantothenic acid (vitamin B5) belongs to the B-vitamin complex and acts as a precursor for the synthesis of coenzyme A (CoA) and serves as an acyl carrier protein. CoA is essential to numerous metabolic pathways that sustain life (1-4):

- Synthesis of pantothenic acid cofactors (CoA, 4'-phosphopantetheine)
- Cofactor and co-substrate function (CoA, 4'-phosphopantetheinylation)
- Acyl-carrier protein
- 10-formyltetrahydrofolate dehydrogenase
- α-aminoadipate semialdehyde synthase

Pantothenic acid is derived from dietary CoA or phosphopantetheine, which are converted to pantothenic acid through a cascade of digestive enzymes in the intestinal lumen and intestinal cells before transport to the bloodstream. The red blood cells, and to a much lesser extend the plasma, are distributing the vitamin throughout the body (1, 2, 5). The majority of pantothenic acid in tissues is present as CoA but minor amounts are found as acyl carrier protein or free pantothenic acid (2).

Many food items are rich in pantothenic acid, including animal organs, fish, shellfish, milk products, eggs, avocados legumes, mushrooms, or sweet potatoes. Its bioavailability from foods has been estimated to 40-60%, but data is limited. Whole grains are also a good vitamin B5 source but when refined losses up to 75% can occur. Food processing such as canning and freezing may results in similar pantothenic acid losses (2, 3).

Nutrient Interactions

Very little information is available on nutrient-nutrient interactions of pantothenic acid. Thiamin, and possibly riboflavin, may affect pantothenic acid metabolism, but more research is needed for a better understanding. Pantothenic acid in high doses may also compete with biotin for intestinal and cellular uptake by the human sodium-dependent multivitamin transporter (hSMVT) (1, 3).

Risks of deficiency:

Naturally occurring deficiency is usually linked to cases of severe malnutrition and in combination with other nutrient deficiencies. Symptoms of deficiency include headache, fatigue, insomnia, intestinal disturbance, and numbness and tingling of hands and feet. At-risk population include individuals with pantothenate kinase-associated neurodegeneration 2 mutation (2, 3, 6).

Risks of excess:

Very high doses of pantothenic acid have been reported to cause diarrhoea, otherwise, this vitamin is generally not known to be toxic to humans. Given the lack of reports of adverse effects, there is no tolerable Upper Limit (UL) established (2, 3).

Interatcions with medications

Drug interactions have been reported for oral contraceptives, which may increase pantothenic acids needs. Also, pantethine use with cholesterol-lowering drugs (statins) or with nicotinic acid may result in additive effects on blood lipids (3).

Human biomarkers for measuring pantothenic acid intake and status

Pantothenic acid status can be assessed by different methods, as shown in the Table (1, 5).

Whole Blood (WB), erythrocytes (RBC), plasma

Enzymatic hydrolysis of bound pantothenate in WB and RBC is required for measurement of total vitamin B5 (7). WB measurements are usually higher than pantothenic acid analysed in plasma due to the CoA stores in the red blood cells.

Urinary excretion

Urinary excretion is highly associated with dietary intake (1) and has been used as status indicator for pantothenic acid. However, measurements in other bodily tissue or fluids are not necessarily correlated to urinary pantothenic acid, even though associations between intake and WB/RBC has been reported.

Table: Assessment methods for pantothenic acid intake (1, 5)

Biomarker	Analysis type	Sample	Benefits	Intricacies
WB B5	Direct analysis	WB	Status indicator	Relationships of B5 status among the different matrices are mostly non-existent
Plasma B5	Direct analysis	Plasma, serum	Does not reflect status	
RBC B5	Direct analysis	RBC	Status indicator	
Urinary B5	Direct analysis	urine	Reflects recent intake	

RBC: red blood cells, WB: whole blood

Methods

- Radioimmunoassay applicable to various matrices (7, 8)
- Enzyme Linked Immunosorbent Assay (ELISA) for plasma samples (9, 10)
- Chromatographic methods for various matrices (11, 12)

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Alternatively, please see the OpeN-Global page on laboratory accreditation: https://open-global.kcl.ac.uk/accreditation/

Technical assistance

For questions on methods of pantothenic acid assessment or for technical assistance, please contact the OpeN-Global team at https://open-global.kcl.ac.uk/contact/ or write to:

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Useful links

US National Academies Press IOM Dietary reference intakes for thiamine, riboflavin, niacin, vitamin B6, folate, vitamin B12, pantothenic acid, biotin, and choline, 2000: http://nationalacademies.org/hmd/reports/2000/dietary-reference-intakes-for-thiamin-riboflavin-niacin-vitamin-b6-folate-vitamin-b12-pantothenic-acid-biotin-and-choline.aspx

Linus Pauling Institute Micronutrient Information Center (Oregon State University): https://lpi.oregonstate.edu/mic/vitamins/pantothenic-acid

NIH Health Information https://ods.od.nih.gov/factsheets/PantothenicAcid-HealthProfessional/

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