Steve Lamm <steve@CEOH.COM>

01/25/2006 08:43 AM

To Tom Miller/DC/USEPA/US@EPA
Cc
Subject
FW: Arsenic essentiality literature

From: Steve Lamm
Sent: Tuesday, January 24, 2006 4:00 PM
To: 'Miller.Tom@epa.gov'
Subject: Arsenic essentiality literature

Tom,

Here is the Pubmed search on arsenic essentiality.

Steve

1: J Toxicol Environ Health B Crit Rev. 2006 Jan-Feb;9(1):63-85. Related Articles, Links

The speciation of metals in mammals influences their toxicokinetics and toxicodynamics and therefore human health risk assessment(1).

Yokel RA, **Lasley SM**, **Dorman DC**.

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Chemical form (i.e., species) can influence metal toxicokinetics and toxicodynamics and should be considered to improve human health risk assessment. Factors that influence metal speciation (and examples) include: (1) carrier-mediated processes for specific metal species (arsenic, chromium, lead and manganese), (2) valence state (arsenic, chromium, manganese and mercury), (3) particle size (lead and manganese), (4) the nature of metal binding ligands (aluminum, arsenic, chromium, lead, and manganese), (5) whether the metal is an organic versus inorganic species (arsenic, lead, and mercury), and (6) biotransformation of metal species (aluminum, arsenic, chromium, lead, manganese and mercury). The influence of speciation on metal toxicokinetics and toxicodynamics in mammals, and therefore the adverse effects of metals, is reviewed to illustrate how the physicochemical characteristics of metals and their handling in the body (toxicokinetics) can influence toxicity (toxicodynamics). Generalizing from mercury, arsenic, lead, aluminum, chromium,

and manganese, it is clear that metal speciation influences mammalian toxicity. Methods used in aquatic toxicology to predict the interaction among metal speciation, uptake, and toxicity are evaluated. A classification system is presented to show that the chemical nature of the metal can predict metal ion toxicokinetics and toxicodynamics. Essential metals, such as iron, are considered. These metals produce low oral toxicity under most exposure conditions but become toxic when biological processes that utilize or transport them are overwhelmed, or bypassed. Risk assessments for essential and nonessential metals should consider toxicokinetic and toxicodynamic factors in setting exposure standards. Because speciation can influence a metal's fate and toxicity, different exposure standards should be established for different metal species. Many examples are provided which consider metal essentiality and toxicity and that illustrate how consideration of metal speciation can improve the risk assessment process. More examples are available at a website established as a repository for summaries of the literature on how the speciation of metals affects their toxicokinetics.

PMID: 16393870 [PubMed - in process]

2: Environ Pollut. 2002;120(1):27-45. Related Articles, Links

The Biological System of the Elements (BSE)--a brief introduction into historical and applied aspects with special reference on "ecotoxicological identity cards" for different element species (e.g. As and Sn).

Franzle S, **Markert B**.

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There are different methods to estimate and predict effects of chemical elements and corresponding speciation forms in biochemistry and toxicology, including statements on essentiality and antagonisms. Two approaches are given here: (1) "identity cards" describing biologically fundamental aspects of element chemistry and (2) qualitative discussions which assume the existence of (indirect ways into) chemical autocatalysis to be essential for maintaining life and permitting reproduction. The latter method, developed by the present authors, draws upon Stoichiometric Network Analysis, a safe procedure for complexity reduction in feedback networks) and provides estimates of concentration regimes for different elements suitable for survival and reproduction. The biochemical hierarchy level considered here is that of (metallo-)proteins. Thermodynamic toxicity aspects are given in correlations with DMSO solvent affinities and thiocyanate bonding modes. Effects of antagonists and of ion substitution within metalloenzymes or of metabolic simplification can be dealt with, likewise increased sensitivities within symbiotic relationships and within carcinomas are explained which are relevant for environmental monitoring and tumour therapy, respectively.

Publication Types:
- Review

PMID: 12199465 [PubMed - indexed for MEDLINE]

3: J Nutr Health Aging. 2002;6(2):154-62. Related Articles, Links

Silicon, aluminium, arsenic and lithium: essentiality and human health implications.

Perez-Granados AM, **Vaquero MP**.

Instituto de Nutricion y Bromotologia (CSIC), Ciudad Universitaria, Madrid, Spain.

Ultratrace elements are currently being studied to determine their nutritional significance and impact on health, taking into account their possible toxic effects. Some elements are essential to one or more specific biological functions in humans while other are nonessential. Nevertheless, the latter may produce desirable pharmacological effects or, on the contrary, possess harmful properties which depend on the inherent toxic potential of the element, the amount ingested and the intrinsic characteristics of the individual. This review updates the information on the essentiality and toxicological aspects of silicon, aluminium, arsenic, and lithium and considers the involvement's in degenerative diseases, such as cardiovascular diseases, osteoporosis and Alzheimer's disease. Silicon and lithium are protective while aluminium and arsenic have toxic effects.

Publication Types:
- Review

PMID: 12166372 [PubMed - indexed for MEDLINE]

4: J Nutr. 1996 Sep;126(9 Suppl):2377S-2385S. Related Articles, Links

How should dietary guidance be given for mineral elements with beneficial actions or suspected of being essential?

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The term ultratrace elements, often used to indicate elements with an established, estimated or suspected requirement generally indicated by microgram/, could be applied to at least 20 elements. The quality of experimental evidence for nutritional essentiality varies widely for the ultratrace elements. Thus, although differing dietary guidance is appropriate for these elements, most need increased attention in future editions of the Recommended Dietary Allowances (RDAs) for the following reasons: (1) Increased interest in these elements by the public has been stimulated by the mass media; thus, responsible information about the usefulness of the ultratrace elements for health and well being is needed. (2) Risk assessments and toxicological standards are influenced by the RDAs. Authorative advice is required to prevent standards that obstruct the achievement of beneficial intakes of ultratrace elements. (3) An emerging new paradigm is that the determination of nutritional requirements should include consideration of the total health effects of nutrients, not just their roles in preventing deficiency pathology; some of the ultratrace elements have identified health benefits. Six ultratrace elements, iodine, selenium, manganese, molybdenum, chromium and boron (and cobalt as vitamin B12), merit specific RDAs. The term "estimated safe and adequate daily dietary intakes (ESADDI)" should not be used for any of the other ultratrace elements because of the misleading words "adequate" and "safe". "Apparent beneficial intake (ABI)" seems more appropriate for the elements with beneficial, if not essential, actions that can be extrapolated from animals to humans; these elements include arsenic, fluoride, lithium, nickel, silicon and vanadium. The evidence is too limited or controversial for the remaining ultratrace elements to even provide an ambiguous ABI. The amount found in a healthful diet probably should be a value provided for an appropriate intake for aluminum, bromide, cadmium, germanium, lead, rubidium, and tin.

Publication Types:

- Review

PMID: 8811801 [PubMed - indexed for MEDLINE]

5: Regul Toxicol Pharmacol. 1995 Dec;22(3):206-12. Related Articles, Links

Approach to health risk determination for metals and their compounds under the Canadian Environmental Protection Act.

Meek ME, **Hughes K**.

Environmental Health Directorate, Health Canada, Ottawa, Ontario.

The Canadian Environmental Protection Act (CEPA) authorizes the Ministers of the Environment and of Health in Canada to investigate a wide variety of substances that may contaminate the environment and cause adverse effects on the environment and/or on human health. Under the Act, assessments have been completed for 44 environmental contaminants on the first Priority Substances List, including four metals and their compounds. The principles developed for the assessment of risk to human health for priority substances under CEPA are outlined, with specific emphasis on the metals.

These include general aspects such as estimation of total exposure from all media, the development of exposure potency indices for carcinogens in lieu of low-dose risk estimates, and incorporation of toxicokinetic and toxicodynamic data, where available, to modify traditionally adopted uncertainty factors for development of tolerable intakes, or concentrations, for nonneoplastic effects. Aspects of the approach to human health risk assessment more specific to the metals considered under CEPA (i.e., arsenic, cadmium, chromium, and nickel) and implications for the subsequent strategic options process are also addressed, including the extent to which various chemical forms could be assessed (i.e., speciation) and essentiality.

PMID: 8837844 [PubMed - indexed for MEDLINE]

6: Philos Trans R Soc Lond B Biol Sci. 1981 Aug 14;294(1071):171-84. Related Articles, Links

An appraisal of the newer trace elements.

Davies NT.

For an element to be considered essential it should satisfy three criteria: (1) it must be present in living matter; (2) it must be able to interact with living systems; (3) a dietary deficiency must consistently result in a reduction of a biological function, preventable or reversible by physiological amounts of the element. Ideally, essentiality should be established in more than one species and confirmed in more than one laboratory. Since 1970, vanadium, fluorine, silicon, nickel and arsenic have been shown to meet all the criteria listed above, and evidence from one laboratory has indicated that tin may have an essential biological role in the laboratory rat. A review is presented of the evidence on which the essentiality of these elements has been established and, when known, an indication of their biochemical functions. The possible significance of these 'newer' trace elements to the health of man and animals is discussed.

PMID: 6118894 [PubMed - indexed for MEDLINE]