Molybdenum-HealthProfessional

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Molybdenum  
Fact Sheet for Health Professionals  
  
This is a fact sheet intended for health professionals. For a general overview, see our consumer fact sheet.  
  
Introduction  
Molybdenum is an essential trace element that is naturally present in many foods and is also available as a dietary supplement. Molybdenum is a structural constituent of molybdopterin, a cofactor synthesized by the body and required for the function of four enzymes: sulfite oxidase, xanthine oxidase, aldehyde oxidase, and mitochondrial amidoxime reducing component (mARC). These enzymes metabolize sulfur-containing amino acids and heterocyclic compounds including purines and pyrimidines [1,2]. Xanthine oxidase, aldehyde oxidase, and mARC are also involved in metabolizing drugs and toxins [3-6].  
  
Molybdenum appears to be absorbed via a passive nonmediated process, though where absorption occurs in the intestinal tract is not known [1]. Adults absorb 40% to 100% of dietary molybdenum [2,7-10]. Infants absorb almost all of the molybdenum in breast milk or formula [11,12].  
  
The kidneys are the main regulators of molybdenum levels in the body and are responsible for its excretion [1,2]. Molybdenum, in the form of molybdopterin, is stored in the liver, kidney, adrenal glands, and bone [2,7,13].  
  
Because molybdenum deficiency is rare [14], molybdenum status is not assessed in clinical settings. According to a small study of 30 healthy men and women, serum levels of molybdenum range from 0.28 ng/mL to 1.17 ng/mL, and their average is 0.58 ng/mL [15]. In another small study of four healthy young men, plasma levels of molybdenum reached 6.22 ng/mL with a molybdenum intake of 1,490 mcg per day for 24 days [10]. The average concentration of urinary molybdenum is 69 ng/mL, but urinary molybdenum does not reflect molybdenum status [1].  
  
Recommended Intakes  
Intake recommendations for molybdenum and other nutrients are provided in the Dietary Reference Intakes (DRIs) developed by the Food and Nutrition Board (FNB) at the National Academies of Sciences, Engineering, and Medicine [1]. DRI is the general term for a set of reference values used for planning and assessing nutrient intakes of healthy people. These values, which vary by age and sex, include the following:  
  
Recommended Dietary Allowance (RDA): Average daily level of intake sufficient to meet the nutrient requirements of nearly all (97% 98%) healthy individuals; often used to plan nutritionally adequate diets for individuals  
Adequate Intake (AI): Intake at this level is assumed to ensure nutritional adequacy; established when evidence is insufficient to develop an RDA  
Estimated Average Requirement (EAR): Average daily level of intake estimated to meet the requirements of 50% of healthy individuals; usually used to assess the nutrient intakes of groups of people and to plan nutritionally adequate diets for them; can also be used to assess the nutrient intakes of individuals  
Tolerable Upper Intake Level (UL): Maximum daily intake unlikely to cause adverse health effects  
The basis for the EAR for molybdenum consists of two carefully controlled balance studies in a total of eight young men. The EAR for children and adolescents is extrapolated from adult values. Table 1 lists the current RDAs for molybdenum [1].  
  
Table 1: Recommended Dietary Allowances (RDAs) for Molybdenum [1]  
Age Male Female Pregnancy Lactation  
Birth to 6 months 2 mcg\* 2 mcg\*  
7 12 months 3 mcg\* 3 mcg\*  
1 3 years 17 mcg 17 mcg  
4 8 years 22 mcg 22 mcg  
9 13 years 34 mcg 34 mcg  
14 18 years 43 mcg 43 mcg 50 mcg 50 mcg  
19+ years 45 mcg 45 mcg 50 mcg 50 mcg\*AI, based on mean molybdenum intakes of infants fed primarily human milk.  
  
Sources of Molybdenum  
Food  
Legumes are the richest sources of molybdenum [16]. Other foods high in molybdenum include whole grains, nuts, and beef liver [1,14,17,18].  
  
The top sources of molybdenum in U.S. diets are legumes, cereal grains, leafy vegetables, beef liver, and milk [17]. Milk and cheese products are the main sources of molybdenum for teens and children [19].  
  
The amount of molybdenum in food depends on the amount of molybdenum in the soil and in the water used for irrigation [1,2]. Drinking water generally contains only small amounts of molybdenum [17]. However, according to 2017 data from the U.S. Environmental Protection Agency, 0.8% of drinking water samples had molybdenum levels above 40 mcg/L [20]. The U.S. Department of Agriculture s (USDA s) FoodData Central [21] does not list the molybdenum content of foods or provide lists of foods containing molybdenum. Therefore, the amount of information on molybdenum levels in foods is quite limited.  
  
Table 2: Molybdenum Content of Selected Foods [19]  
Food Micrograms  
(mcg) per  
serving Percent  
DV\*  
Black-eyed peas, boiled, cup 288 640  
Beef, liver, pan fried, 3 ounces 104 231  
Lima beans, boiled, cup 104 231  
Yogurt, plain, low-fat, 1 cup 26 58  
Milk, 2% milkfat, 1 cup 22 49  
Potato, baked, flesh and skin, 1 medium 16 36  
Cheerios cereal, cup 15 33  
Shredded wheat cereal, cup 15 33  
Banana, medium 15 33  
White rice, long grain, cooked, cup 13 29  
Bread, whole wheat, 1 slice 12 27  
Peanuts, dry roasted, 1 ounce 11 24  
Chicken, light meat, roasted, 3 ounces 9 20  
Egg, large, soft-boiled 9 20  
Spinach, boiled, cup 8 18  
Beef, ground, regular, pan fried, 3 ounces 8 18  
Pecans, dry roasted, 1 ounce 8 18  
Corn, sweet yellow, cooked, cup 6 13  
Cheese, cheddar, sharp,1 ounce 6 13  
Tuna, light, canned in oil, 3 ounces 5 11  
Potato, boiled without skin, cup 4 9  
Orange, medium 4 9  
Green beans, boiled, cup 3 7  
Carrots, raw, cup 2 4  
Asparagus, boiled, cup 2 4  
\*DV = Daily Value. The U.S. Food and Drug Administration (FDA) developed DVs to help consumers compare the nutrient contents of foods and dietary supplements within the context of a total diet. The DV for molybdenum is 45 mcg for adults and children age 4 years and older [22]. FDA does not require food labels to list molybdenum content unless molybdenum has been added to the food. Foods providing 20% or more of the DV are considered to be high sources of a nutrient, but foods providing lower percentages of the DV also contribute to a healthful diet.  
  
Dietary supplements  
Molybdenum is available in dietary supplements containing molybdenum only, in combination with other minerals, and in multivitamin/mineral products. Amounts range from about 50 mcg to 500 mcg. Forms of molybdenum in dietary supplements include molybdenum chloride, sodium molybdate, molybdenum glycinate, and molybdenum amino acid chelate [23]. No studies have compared the relative bioavailability of molybdenum from these different forms.  
  
Molybdenum Intakes and Status  
Most Americans appear to consume adequate amounts of molybdenum. Although national surveys no longer collect data about molybdenum intake, FDA s 1984 Total Diet Study estimated that average daily molybdenum intakes from foods were 109 mcg in men and 76 mcg in women [24]. According to the 1988 1994 National Health and Nutrition Examination Survey, molybdenum intakes from dietary supplements averaged 23 mcg/day for men and 24 mcg/day for women [25]. Intakes of molybdenum from drinking water collected from the 100 largest cities in the United States are estimated to be about 3 mcg/day based on intakes of 2 liters of water per day [26].  
  
Molybdenum Deficiency  
Molybdenum deficiency has not been reported, except in people with a genetic mutation that prevents the synthesis of molybdopterin and therefore of sulfite oxidase [14]. In this rare metabolic disorder, known as molybdenum cofactor deficiency, mutations in one of several genes prevent the biosynthesis of molybdopterin. The absence of molybdopterin impairs the function of enzymes that metabolize sulfite, leading to encephalopathy and seizures [1,14,27-29]; the neurological damage is severe and usually leads to death within days after birth [18,30].  
  
A single reported incident of acquired molybdenum deficiency occurred in 1981 in a patient receiving total parenteral nutrition that was devoid of molybdenum. The patient developed tachycardia, tachypnea, headache, night blindness, and coma. These effects resolved with molybdenum administration [1,31].  
  
Groups at Risk of Molybdenum Inadequacy  
No known groups of people are likely to have inadequate molybdenum intakes.  
  
Molybdenum and Health  
Molybdenum is not a standard treatment for any disease or disorder.  
  
Health Risks from Excessive Molybdenum  
Acute molybdenum toxicity is rare, but it can occur with industrial mining and metalworking exposure. In healthy people, consumption of a diet high in molybdenum usually does not pose a health risk because the molybdenum is rapidly excreted in urine [1,14,18]. One study assessed the effect of high dietary intakes of molybdenum (10 15 mg/day) in an area of Armenia where the soil contains very high levels of molybdenum. The affected individuals experienced achy joints, gout-like symptoms, and abnormally high blood levels of uric acid [14].  
  
Given the absence of human studies, the FNB established ULs for molybdenum for healthy individuals based on levels associated with impaired reproduction and fetal development in rats and mice [1].  
  
Table 3: Tolerable Upper Intake Levels (ULs) for Molybdenum [1]  
Age Male Female Pregnancy Lactation  
Birth to 6 months None established\* None established\*  
7 12 months None established\* None established\*  
1 3 years 300 mcg 300 mcg  
4 8 years 600 mcg 600 mcg  
9 13 years 1,100 mcg 1,100 mcg  
14 18 years 1,700 mcg 1,700 mcg 1,700 mcg 1,700 mcg  
19+ years 2,000 mcg 2,000 mcg 2,000 mcg 2,000 mcg  
\* Breast milk, formula, and food should be the only sources of molybdenum for infants.  
  
Interactions with Medications  
Molybdenum has no known, clinically relevant, interactions with medications.  
  
Molybdenum and Healthful Diets  
The federal government s 2020 2025 Dietary Guidelines for Americans notes that Because foods provide an array of nutrients and other components that have benefits for health, nutritional needs should be met primarily through foods. In some cases, fortified foods and dietary supplements are useful when it is not possible otherwise to meet needs for one or more nutrients (e.g., during specific life stages such as pregnancy).   
  
For more information about building a healthy dietary pattern, refer to the Dietary Guidelines for Americansexternal link disclaimer and the USDA s MyPlate.external link disclaimer  
  
The Dietary Guidelines for Americans describes a healthy dietary pattern as one that  
  
Includes a variety of vegetables; fruits; grains (at least half whole grains); fat-free and low-fat milk, yogurt, and cheese; and oils.  
Whole grains contain molybdenum.  
Includes a variety of protein foods such as lean meats; poultry; eggs; seafood; beans, peas, and lentils; nuts and seeds; and soy products.  
 Legumes and nuts contain molybdenum.  
Limits foods and beverages higher in added sugars, saturated fat, and sodium.  
Limits alcoholic beverages.  
Stays within your daily calorie needs.  
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