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Molybdenum

Fact Sheet for Health Professionals

This is a fact sheet intended for health professionals. For a reader-friendly overview of Molybdenum, see our [consumer fact sheet on Molybdenum](#).

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:

- **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: Selected Food Sources of Molybdenum [19]

Food	Micrograms (mcg) per serving	Percent DV*
Black-eyed peas, boiled, ½ cup	288	640
Beef, liver, pan fried (3 ounces)	104	231
Lima beans, boiled, ½ 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, ½ cup	15	33
Shredded wheat cereal, ½ cup	15	33
Banana, medium	15	33
White rice, long grain, cooked, ½ 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, ½ cup	8	18
Beef, ground, regular, pan-fried, 3 ounces	8	18
Pecans, dry roasted, 1 ounce	8	18
Corn, sweet yellow, cooked, ½ cup	6	13
Cheese, cheddar, sharp, 1 ounce	6	13
Tuna, light, canned in oil, 3 ounces	5	11
Potato, boiled without skin, ½ cup	4	9
Orange, medium	4	9
Green beans, boiled, ½ cup	3	7
Carrots, raw, ½ cup	2	4
Asparagus, boiled, ½ 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 on the new Nutrition Facts and Supplement Facts labels and used for the values in Table 2 is 45 mcg for adults and children age 4 years and older [23]. FDA required manufacturers to use these new labels starting in January 2020, but companies with annual sales of less than \$10 million may continue to use the old labels that list a molybdenum DV of 75 mcg until January 2021 [22,24]. 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 [22].

Dietary supplements

Molybdenum is available in dietary supplements containing molybdenum only, in combination with other minerals, and in multivitamin/multimineral 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 [25]. 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, the FDA's 1984 Total Diet Study estimated that average daily molybdenum intakes from foods were 109 mcg in men and 76 mcg in women [26]. According to the 1988–1994 National Health and Nutrition Examination Survey (NHANES), molybdenum intakes from dietary supplements averaged 23 mcg/day for men and 24 mcg/day for women [27]. 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 [28].

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 [1,14,29-31]; the neurological damage is severe and usually leads to death within days after birth [18,32].

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 [1,33].

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 2015–2020 *Dietary Guidelines for Americans* notes that “Nutritional needs should be met primarily from foods. ... Foods in nutrient-dense forms contain essential vitamins and minerals and also dietary fiber and other naturally occurring substances that may have positive health effects. In some cases, fortified foods and dietary supplements may be useful in providing one or more nutrients that otherwise may be consumed in less-than-recommended amounts.”

For more information about building a healthy diet, refer to the [Dietary Guidelines for Americans](https://health.gov/dietaryguidelines/) (<https://health.gov/dietaryguidelines/>) and the U.S. Department of Agriculture's [MyPlate](https://www.choosemyplate.gov/). (<https://www.choosemyplate.gov/>)

The Dietary Guidelines for Americans describes a healthy eating pattern as one that:

- Includes a variety of vegetables, fruits, whole grains, fat-free or low-fat milk and milk products, and oils.

Whole grains contain molybdenum.

- Includes a variety of protein foods, including seafood, lean meats and poultry, eggs, legumes (beans and peas), nuts, seeds, and soy products.

Legumes and nuts contain molybdenum.

- Limits saturated and *trans* fats, added sugars, and sodium.
- Stays within your daily calorie needs.

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