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Ensuring Adequate Zinc Status in Vegans and Vegetarians

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Abstract

Zinc is an essential mineral that is naturally present in some foods, added to others, and available as a dietary supplement. It is involved in numerous aspects of cellular metabolism, and also supports normal growth and development. Frequent intake of zinc is required to maintain a steady state because the body has no specialized zinc storage system. Zinc is available from many plant foods. Protein increases zinc absorption. Because of this, foods high in protein and zinc, such as legumes and nuts, are good choices. Zinc deficiency is characterized by growth retardation, loss of appetite, and impaired immune function.

Zinc nutritional status is difficult to measure adequately using laboratory tests. Clinical effects of zinc deficiency can be present in the absence of abnormal laboratory indices. Adverse health effects have not been commonly demonstrated with varied, plant-based diets consumed in developed countries. Supplements are an option for those with potential deficiencies. Both zinc gluconate and zinc citrate are well-absorbed. However, zinc supplements have the potential to interact with several types of medications.

Keywords: Nutritional status; Zinc; Zinc gluconate; Zinc citrate; Medications; Plant foods; Cellular metabolism; Immune function; Protein synthesis; Lactic dehydrogenase; Protein; Growth retardation; Loss of appetite; Impaired immune function

Introduction

Zinc is an essential mineral that is naturally present in some foods, added to others, and available as a dietary supplement. Zinc is involved in numerous aspects of cellular metabolism. It is required for the catalytic activity of approximately 100 enzymes [1,2] and it plays a role in immune function [3,4], protein synthesis [4], wound healing [5], DNA synthesis [2,4], and cell division [4].

Zinc also supports normal growth and development during pregnancy, childhood, and adolescence [6-9] and is required for proper sense of taste and smell [9]. Importantly, Zinc is an integral part of carbonic anhydrase and lactic dehydrogenase [10].

A frequent intake of zinc is required to maintain a steady state because the body has no specialized zinc storage system [11] (Table 1).

Table 1: Recommended dietary allowances (RDAs) for Zinc [2].

Age	Male	Female	Pregnancy	Lactation
0–6 months	2 mg*	2 mg*		
7–12 months	3 mg	3 mg		
1–3 years	3 mg	3 mg		
4–8 years	5 mg	5 mg		
9–13 years	8 mg	8 mg		
14–18 years	11 mg	9 mg	12 mg	13 mg
19+ years	11 mg	8 mg	11 mg	12 mg

Zinc food sources

(Table 2) Protein increases zinc absorption. Because of this, foods high in protein and zinc, such as legumes and nuts, are good choices [12]. If a food doesn't have much protein, it can still be accompanied by one that does in order to enhance absorption.

Table 2: A list of representative plant-based foods.

Food	Serving Size	Amount of Zinc
Wheat Germ	1 ounce	3.4 mg
Baked beans, canned, plain or vegetarian	½ cup	2.9 mg
Pumpkin seeds, dried	1 ounce	2.2 mg
Tofu	½ cup	2.0 mg
Cashews, dry roasted	1 ounce	1.6 mg
Chickpeas, cooked	½ cup	1.3 mg
Oatmeal, instant, plain, prepared with water	1 packet	1.1 mg

Zinc deficiency

Zinc deficiency is characterized by growth retardation, loss of appetite, and impaired immune function. In more severe cases, zinc deficiency causes hair loss, diarrhea, delayed sexual maturation, impotence, hypogonadism in males, and eye and skin lesions [2,8,13,14].Weight loss, delayed healing of wounds, taste abnormalities, and mental lethargy can also occur [8,5,15-19]. Many of these symptoms are non-specific and often associated with other health conditions; therefore, a medical examination is necessary to ascertain whether a zinc deficiency is present.

Diagnosis

Zinc nutritional status is difficult to measure adequately using laboratory tests [2,20,21] due to its distribution throughout the body as a component of various proteins and nucleic acids [22] Plasma or serum zinc levels are the most commonly used indices for evaluating zinc deficiency, but these levels do not necessarily reflect cellular zinc status due to tight homeostatic control mechanisms [8]. Clinical effects of zinc deficiency can be present in the absence of abnormal laboratory indices [8].

Zinc deficiency risk in vegetarians and vegans

The zinc deficiencies commonly associated with plant-based diets in impoverished nations are not associated with vegetarian diets in wealthier countries [20]. Adverse health effects have not been demonstrated with varied, plant-based diets consumed in developed countries [23].

Well-planned vegetarian diets can provide adequate amounts of zinc from plant sources. Vegetarians appear to adapt to lower zinc intakes by increased absorption and retention of zinc. Studies show vegetarians have similar serum zinc concentrations to, and no greater risk of zinc deficiency than, non-vegetarians despite differences in zinc intake [24].

A meta study showed that zinc intake by vegetarians was only slightly lower than their omnivorous counterparts. It showed vegans to have only a slightly lower serum zinc level than non-vegetarians, a difference of 1.17 ± 0.45 µmol/l [25]. Average serum zinc levels are from 10 to 15 µmol/l [26]. Therefore the clinical relevance may be minimal. Existing data indicate no differences in serum zinc or growth between young vegetarian and omnivorous children [27].

Pregnant women are vulnerable to a low zinc status due to the additional zinc demands associated with pregnancy and fetal development. A meta study found the pregnant vegetarian women consume on average, about 1.4mg per day less than their omnivorous pregnant women [28]. Supplements may be necessary for pregnant women. Although vegans have lower zinc intake than omnivores, they do not differ from the nonvegetarians in functional immunocompetence as assessed by natural killer cell cytotoxic activity [29]. It appears that there may be facilitators of zinc absorption and compensatory mechanisms to help vegetarians adapt to a lower intake of zinc [30].

There has long been a theoretical concern about the larger intake of phytates in plant foods inhibiting mineral absorption of some minerals, such as zinc, in those following a vegetarian diet. However, there was little evidence of deficiency commonly occurring in practice. Part of the answer lies in the microbiota of the vegetarian. It turns out that their flora act to degrade phytate, thus allowing for good absorption of minerals. One recent study concludes that, "it was the vegetarians' microbiota that particularly degraded up to 100% phytate to myo-inositol phosphate products." A diet rich in phytate increases the potential of intestinal microbiota to degrade phytate. The co-operation of both aerobic and anaerobic bacteria is essential for the complete phytate degradation [31].

The vegetarian diet compared with a meat-based diets resulted in lower amounts of absorbed Zn due to a higher content of Zn in the meat diets, but no difference was observed in the fractional absorption of zinc despite a high intake of phytates [32]. The presence of garlic and onion very significantly increased the bioavailability of zinc from grains [33].

Zinc Supplements

Both zinc gluconate and zinc citrate are well-absorbed [34]. Zinc picolinate is also thought to well absorbed [35]. However, zinc oxide, which is used in many supplements because it's cheaper, may not be well absorbed by some people [34]. Note that in the case of zinc, the Supplement Facts panel on the supplement container is required to list the elemental zinc content, as opposed to the compound.

Interactions with Medications

Zinc supplements have the potential to interact with several types of medications

Antibiotics: Both quinolone antibiotics (such as Cipro®) and tetracycline antibiotics (such as Achromycin® and Sumycin®)

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interact with zinc in the gastrointestinal tract, inhibiting the absorption of both zinc and the antibiotic [36,37]. Taking the antibiotic at least 2 hours before or 4–6 hours after taking a zinc supplement minimizes this interaction [38].

Penicillamine: Zinc can reduce the absorption and action of penicillamine, a drug used to treat rheumatoid arthritis [39]. To minimize this interaction, individuals should take zinc supplements at least 2 hours before or after taking penicillamine [37].

Diuretics: Thiazide diuretics such as chlorthalidone (Hygroton®) and hydrochlorothiazide (Esidrix® and HydroDIURIL®) increase urinary zinc excretion by as much as 60% [40]. Prolonged use of thiazide diuretics could deplete zinc tissue levels, so clinicians should monitor zinc status in patients taking these medications.

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