



FACT SHEET

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Are vitamins and minerals safe for persons with G6PD deficiency?

Background

Persons with genetically inadequate activity of the enzyme G6PD are very susceptible to adverse effects after ingestion of specific oxidizing substances present in some food and drugs. In these individuals, the most common sign of toxicity is hemolytic anemia. Specific food and drug substances associated with these effects include fava beans, which contain the oxidants vicine and covicine, many antimalarials, sulfonamide antibiotics and several other drugs. No questions have been raised about the safety of most vitamin and minerals in supplements for G6PD deficient persons, but some texts claim that a few vitamins, notably vitamins C and perhaps K, should be avoided. This fact sheet reviews the scientific evidence behind those recommendations.

Q: What is G6PD?

A: Glucose-6-phosphate dehydrogenase is an enzyme that uses metabolic reactions to provide the reducing capacity to keep glutathione in its reduced form (GSH) and available for its metabolic roles that include regeneration of vitamins C and E after they are oxidized while performing their antioxidant functions.

Q: Why is G6PD activity important?

A: Reduced glutathione is essential for protecting red blood cell membranes, and other cell structures and components against oxidation. Without this protection by GSH, the red cells are easily ruptured (hemolyzed), resulting in hemolytic anemia.

Q: What is G6PD deficiency?

A: G6PD deficiency is the condition in which the activity of this enzyme is low enough that the person becomes unusually susceptible to adverse effects by substances that have strong oxidizing characteristics. These strong oxidants include fava beans (Italian broad beans) and several drugs, especially the quinine-based antimalarials.

Q: Who has G6PD deficiency?

A: It is a genetically determined condition. The incidence is not known because overt signs and symptoms generally occur only in persons subjected to high levels of oxidative stress. Moreover, a large number of genetic variations occur that may compromise G6PD activity to different degrees, so there are varying degrees of deficiency in this enzyme activity and corresponding differences in susceptibility to adverse effects by fava beans and oxidizing drugs.

Q: What are the practical consequences of G6PD deficiency?

A: Consumption of substances with strong oxidizing capacity by a person with low activity of G6PD can result in hemolytic anemia in adults. The primary consequence is the anemia, an insufficient capacity of the blood to bring oxygen to the tissues and carry away carbon dioxide. The plasma of a person with hemolytic anemia may be colored pink or red by the hemoglobin released by the rupture of red blood cells. Neonatal jaundice can occur in newborn infants with severe G6PD deficiency.

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Q: How is G6PD deficiency managed?

A: Persons known to be G6PD deficient are prohibited from taking certain drugs or eating fava beans. If a severe episode of hemolytic anemia occurs, treatment may include blood transfusion or nasal oxygen.

Q: Are vitamins and minerals safe for persons with G6PD deficiency?

A: Definitely yes, if their potency is within the safety guidelines for healthy persons. Some textbooks and websites include lists of substances that G6PD deficient persons should avoid. These often include not only oxidizing drugs but frequently include vitamin C and occasionally vitamin K. In contrast, vitamin E is listed as protective. There is no clinical or other evidence that ingestion of vitamin and mineral supplements, when used as directed, are associated with adverse effects in individuals with G6PD deficiency.

Vitamin C: The texts and websites that mention this possible effect often assert that vitamin C can cause problems for G6PD deficient persons when consumed “in high doses.” Search of the medical and scientific literature finds that vitamin C may cause red blood cell rupture (erythrocyte hemolysis) in G6PD deficient adults after massive intravenous infusions (40 to 100 grams within a few hours, or in extremely large oral doses. There are no reports of this hemolysis problem when oral intake by G6PD deficient persons is less than 6 grams per day in G6PD deficient adults or in healthy adults at any dose. There is a single report of hemolysis after a 1.5 gram intake by a 10 year old child who was G6PD deficient. By comparison, maximum daily supplement intake by adults that is without recognized side effects is 2 grams (2,000 mg) in healthy adults (www.crnusa.org/safety). For a 10 year old healthy child, the Food and Nutrition Board identifies the vitamin C Tolerable Upper Intake Level (UL) as 1,200 mg of total daily intake (<http://www.nap.edu/openbook/0309069351/html/index.html>), an amount expected to be without any side effects. Thus, there is no known risk from vitamin C supplementation for persons with G6PD deficiency if the intake is within the safety guidelines for healthy persons.

Vitamin K: Search of the medical and scientific literature reveals a problem for G6PD deficient adults only when given very large doses of vitamin K in a water-soluble form (vitamin K3, one of the menadione salts). Large doses of water-soluble vitamin K have been tried (ineffectively) in attempts to control the hemorrhage sometimes seen because of hemolysis in G6PD deficiency. In either healthy or G6PD deficient adults, there are no reports of hemolysis or other toxic effects from vitamin K as vitamin K₁ (phyloquinone/ phytonadione, the form in conventional foods and vitamin and mineral supplements) at any dose.

Vitamin E: In contrast to the exaggerated or unfounded concerns about possible adverse effects of vitamins C and K supplements in G6PD deficient persons, there are several convincing reports that vitamin E in oral doses of 400 to 800 IU reduces, but may not completely eliminate, the tendency of red cell to hemolyze in G6PD deficient persons. Thus, vitamin E is somewhat protective in this condition.

Summary: Vitamin and mineral supplements are safe for G6PD deficient persons.

- There is no substantiation for concerns about vitamin C in normal or high doses (within the general safety guidelines) for G6PD deficient persons.
- There is no known reason for concern about the usual supplemental forms of vitamin K for G6PD deficient persons.
- There is substantial evidence that vitamin E supplements of 400 to 800 IU may be somewhat helpful for those with G6PD deficiency.