Nutrition SPOTLight

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K-STATE Kansas State University Research and Extension

Mineral Basics – What is the Story?

We often hear about the nutrition pair – "vitamins and minerals." While much current nutrition research is focused on newly discovered roles that vitamins play in our health, exciting mineral research is being conducted worldwide, as well as here at Kansas State. As consumers, our growing knowledge of the many duties calcium performs in the body and the possible role selenium may play in cardiovascular disease are the result of just two of many examples of current mineral research. In light of so much emerging news, this issue of the *Nutrition Spotlight* focuses on minerals, mineral research and those who are researching the mineral story.

What is the real story? Minerals make up a small but vital part of the body's nutrition story. Fifteen minerals have been identified as essential to health and life. They are necessary to help chemical reactions and processes take place, and they also provide structure –in the form of bones and teeth. Minerals comprise only about four percent of body weight, but they are part of every tissue and organ. Major minerals, required in amounts of 250 milligrams or more a day include **calcium, chloride, magnesium, phosphorus, potassium** and **sodium.** Trace minerals are needed in amounts less than 20 milligrams a day and include **chromium, copper, fluoride, iodine, iron, manganese, molybdenum, selenium** and **zinc.**

Does the vital role that minerals play mean that we need to take a supplement? Not necessarily, but in some cases, mineral supplements are recommended when individual diets cannot meet the body's need. Depending upon age, gender and mineral levels supplied by diet, frequently recommended mineral supplements may include calcium or iron, for example. Ask your healthcare team if a mineral supplement is right for you or those you care about.

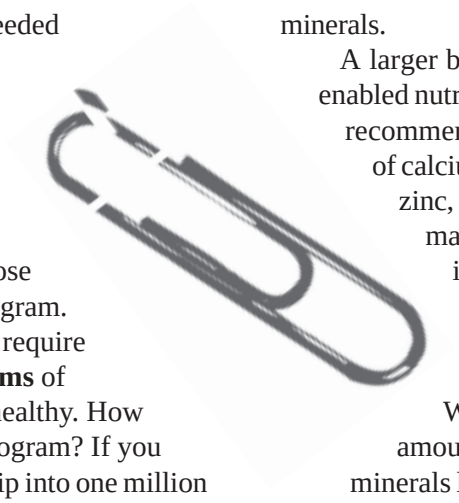
This issue of *Nutrition Spotlight* shares current information on mineral needs in the body and across populations. What minerals do we need for health? How do we get the ones we need? How much is enough — or too much? Arm yourself with mineral facts, review amounts required for health, and try a tasty, nutritious recipe – and know you've got the story!

Source: *The American Dietetic Association.* Vitamins, Minerals and Dietary Supplements. *Chronimed, 1999.*

In the Limelight

How Much of Each Mineral Do We Need?

Nutrients are needed in *very* small amounts. Carbohydrate, protein, and fat needs are expressed as **grams**. One paper clip weighs about one gram. Many vitamins and minerals are needed in **milligram** amounts. Imagine cutting a paper clip into 1000 pieces—each one of those pieces is a milligram. Some minerals require only **micrograms** of intake to stay healthy. How much is a microgram? If you cut the paper clip into one million pieces—one of those pieces is a microgram. Minerals are called *micronutrients* for a good reason: only very small amounts are needed, but these small amounts are essential to health.



Working with very small quantities challenges nutrition researchers because smaller amounts can be difficult to detect in foods and body tissues. Also, minerals may disguise themselves by combining with surrounding chemicals, making minerals even harder to detect. As new equipment and measurement techniques appear, scientists learn more about the body's mineral needs and regularly reassess dietary reference intakes (DRI), the amount we need in our diet to remain healthy. DRIs may include two levels: one that is needed to maintain health and another to note the upper margin of safety (taking more than this amount may be harmful to health). This safe upper level (UL) is the only intake level identified from research to date for boron, vanadium and nickel. ULs for these minerals are 20 mg (boron), 1.8 mg (vanadium) and 1 mg (nickel). Ongoing research will let nutrition scientists make firmer dietary recommendations for these minerals.

A larger body of research has enabled nutrition scientists to recommend specific amounts of calcium, phosphorus, iron, zinc, fluoride, manganese, magnesium, copper, iodine, chromium, molybdenum and selenium to maintain health. We need milligram amounts of the seven minerals listed first and microgram levels of the remaining five.

Levels needed to maintain health may be set from two pools of information. The RDA (or recommended dietary allowance) stems from research identifying level of need with a safety margin. Scientific evidence is not sufficient to establish manganese and fluoride needs. Requirements for these minerals are based on current levels of intake known to be adequate (AI). Mineral needs of infants are also based on adequate intake. With the exception of iron and zinc, the level for each mineral is based on the quantity of that mineral found in breast milk. Infants between 7 and 12 months of age need more iron and zinc than is found in human milk, hence supplementation is recommended.

Minerals from plants are less available than those from animal foods, thus vegetarian needs are greater (50 percent more than the RDA for zinc and double the RDA for iron). Research-based upper levels of safety have been set for all minerals, except chromium. These should be heeded by mineral supplement users because mineral toxicity can be serious, even deadly. Lack of adverse effects from chromium in foods and little data on high levels of chromium from supplements hinder setting a UL. *This does not mean that high doses of chromium supplements are safe; what is meant is that lack of safety hasn't been shown.*

To find the RDAs, AIs, or ULs for each mineral consult the reference listed below or the USDA Nutrient Data Lab at http://www.nal.usda.gov/fnic/foodcomp

Check out the Nutrient Analysis Tool at http://www.ag.uiuc.edu/~food-lab/net.

For example, what does this website say about the iron level of a snack of 4 wheat crackers, 1 tablespoon chunky peanut butter and 4 ounces fruit yogurt? Which food has the lowest level of iron?

Russell, RM. Nutrition Today *36(3):163-171; 2001.*

Spotlight on K-State's Human Nutrition (HN) faculty: An interview with Dr. Denis Medeiros, Professor

Dr. Denis Medeiros, Head of the Department of Human Nutrition, began his professional career in public health and epidemiology, conducting human zinc supplementation studies and researching behavioral aspects of fruit and vegetable consumption. Now, however, his research interests are in basic science.

Medeiros joined the K-State faculty in Fall, 1999. He has been instrumental in garnering support for a campus-wide professional program, a Master's degree in Public Health. Students in this program will be able to choose between an emphasis in nutrition, physical activity, food safety or veterinary medicine. He hopes to gain final approval for the program soon, and anticipates students will be able to enroll one year from now.

Medeiros is pleased with the department's undergraduate programs, including those for majors and for the athletic training program. He reports that "many students majoring in nutritional sciences plan to go to medical school, interest in the public health nutrition has increased (partly because of the anthrax scare), and our nutrition and exercise science major continues to be the largest program of its kind in the nation." He is also pleased that the HN graduate program is flourishing. This is in part due to the range of research options available to them—from basic science to nutrition education—and also because of financial support provided by teaching and research assistantships. Medeiros is proud that the Sensory Analysis Center continues to be internationally acclaimed. "And," he continued, "the department's endowment broke the $1 million mark this past year, soaring from $800,000 to 1.2 million in one year."

In addition to his duties as department head, Medeiros conducts research that focuses on trace element nutrition. One of his current projects investigates why copper deficiency leads to an enlarged heart. Using animal models, Medeiros and his students are examining the problem at physiological, biochemical and molecular levels. Additionally, he and his team are studying the role of iron deficiency in bone development. Lack of dietary iron leads to decreased bone strength, which leads to increased risk for fractures and for osteoporosis.

Another area of interest for Medeiros is functional foods. There is a change occurring in the field of nutritional sciences, he stated. The emphasis is shifting to bioactive components of foods rather than vitamins or minerals per se. The HN department is collaborating with the Food Sciences Institute on campus to attract more support for this new area of research. In addition, KSU's Department of Human Nutrition and Mid-America Commercialization Center started a company called Nutri-Joy, which is funded by a gift received from Procter and Gamble. Product development is conducted in the department. Medeiros, with Nutri-Joy, is developing a fruit-flavored beverage fortified with vitamin C and calcium citrate malate, a well-absorbed form of calcium. Their goal is to deliver nutrient-rich foods that are also enjoyable to consume.

Medeiros teaches the department's graduate student seminar course. He is also developing a course focusing on molecular aspects of nutrition function.

He currently advises a postdoctoral research associate, one graduate student, and one undergraduate student. He has published more than 100 research papers in peer-reviewed journals, one book, and several book chapters.

Medeiros grew up in Connecticut. His late father was Spanish-speaking, while his mother is French-speaking. He has one younger brother. In high school, he enjoyed playing lead guitar and trumpet in a rock band. He went to college in his home state, then studied in Illinois and South Carolina, before accepting positions in Mississippi, Wyoming and Ohio. His daughter is a freshman at The Ohio State University.

Bone Health Requires Mineral Boost

Osteoporosis is becoming a significant public health problem as our nation "ages." Duane Alexander, MD, director of the National Institute of Child Health and Human Development describes osteoporosis as "a pediatric problem with geriatric consequences," arising in large part from the inadequacy of the American diet, which is often limited in mineral-rich foods important in bone health. Prevention must start during the important growth periods of childhood and adolescence. Alexander warns that health risks are not years away. Because youth often consume soft drinks in place of milk (an excellent source of calcium and vitamin D), it is likely that a recent increase in the number of bone fractures among children is linked to a lower intake of calcium. In addition, pediatricians are seeing an increase in rickets, a bone disease due to a deficiency in vitamin D.

As many children and teens are falling far short of obtaining adequate calcium in their diet, a research study is currently underway at the Children's Nutrition Research Center in Houston, Texas to assess the value of *inulin*, a carbohydrate that may prove valuable in increasing the absorption of calcium already present in common foods. Inulin naturally occurs in foods like bananas and wheat and is added to some commercial brands of yogurt.

Vitamin D is essential for the absorption of calcium and consequently, vital to bone health. Although milk isn't the only source of the vitamin, it is a reliable one. It is very important that children receive a reliable source either through fortified foods or supplementation. On the other end of the life span, optimal calcium absorption by older adults is often prevented by decreased availability of vitamin D through inadequate sunlight exposure (especially true for homebound individuals), estrogen deficiency in women and/or age related reduction in renal 1,25-dihydroxyvitamin D production. As a result, seniors have a higher requirement for the vitamin.

Although optimal levels of vitamin D are known, this is not the case with other bone-essential minerals such as boron. Dr Forrest Nielsen at the USDA ARS Human Research Center in Grand Forks, ND, has conducted studies which suggest that "boron influences hormones involved in bone mineral metabolism, and affects the matrix upon which calcification occurs....There's a growing body of evidence indicating that both nutritional and pharmacological amounts of boron have a beneficial effect on bone development, composition and strength characteristics." Foods that are rich natural sources of boron are fruit, leafy vegetables, nuts and legumes.

Another mineral, phosphorus, is being studied for its positive effect on calcium absorption in bone formation. A Creighton University study presented at the National Osteoporosis Foundation's Fifth International Symposium in March, 2002, showed that calcium is much more effective when taken with phosphorus. Since phosphate, which comes from phosphorus, makes up more than half the mass of bone mineral, researchers state that diets must contain adequate phosphorus if bone is to be built or rebuilt. Phosphorus inadequacy may be more prevalent than has been believed, due to changes in the diet such as strict vegetarianism and weight loss efforts.

Vitamin K is also important in bone health. The Nurses Health Study found those who consumed moderate amounts of vitamin K-rich foods had a 30% lower risk of hip fractures than those whose consumed minimum amounts. Vitamin K is easily obtained, as it is produced by "good" bacteria in our intestines and found in green vegetables. A word of caution – the vitamin K producing bacteria in our intestines can be destroyed by routine antibiotic treatments. Consequently, two to three servings a day of vegetables are a good insurance policy for vitamin K.

Bones are living tissue. Bone health is dependent on many factors: regular weight-bearing exercise such as walking and resistence exercise such as weight training or vigorous water exercise and a *variety* of nutrients- protein, calcium, vitamin D, phosphorus, magnesium, potassium, vitamin K and more. Eating the recommended servings from the Food Guide Pyramid (adjusted for age and sex) help assure bone health throughout the life span.

Sources: See:2001 Sept/Oct 1999.
Dr. Steven Abrams. Nutrition and Your Child .Children's Nutrition Research Center, Vol.# 3. 2001.p 1-2.
Forrest H. Nielson, Present Knowledge of Nutrition.*Chapt 36 (pp.384-400).2001.*
American College of Sports Medicine, Position Stand: Osteoporosis and Exercise. *1995.* Food Navigator, at *http://www.foodnavigator.com*

Copper Nutrition

Copper is a mineral that we need in our diets, but in such small amounts that it is called a trace element. It is an important antioxidant and is required for proper growth. Copper helps keep our bones, nerves, hearts, lungs and circulatory systems healthy. It is part of many essential body proteins and is needed by the body to make energy. Copper is also needed to absorb and use iron.

Many older adults have dietary copper intakes below the recommended intake. People who consume too much zinc or iron, including those who take supplements providing more than the Recommended Dietary Allowance (RDA), have decreased absorption of copper. This can lead to development of a copper deficiency. Excessive vitamin C intake also decreases copper absorption.

Low dietary copper intake rarely leads to severe copper deficiency. Our bodies store more than 50 times the amount of copper eaten in the average diet each day.

Medical problems may result from inadequate copper intake over many years, but scientists are not yet sure if these medical conditions are related to dietary copper or to other factors.

On the other hand, too much dietary copper, which can occur when individuals drink water from corroding copper plumbing, is toxic and damages the liver. Excessive dietary copper may also cause an iron deficiency.

Recommended Intakes The estimated safe and adequate intake for copper is 900 micrograms per day for adult men and women. Pregnant and lactating women need more.

The maximum recommended intake of copper for adolescents and for pregnant women is 8 milligrams per day, and not more than 10 milligrams per day is advised for other adults.

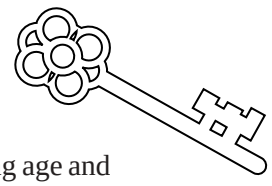
Adults in the U.S. generally consume the recommended intake for copper. The average diet provides about 1.0 to 1.6 milligrams copper per day from food, with an additional 0.1 to 0.9 milligrams copper from drinking water.

Dietary Sources Copper is found in many foods. The best sources are organ meats, seafood, nuts and seeds. Whole grain products and chocolate and cocoa products are also good sources. Other foods that are lower in copper but which contribute substantially to Americans' copper intake are tea, potatoes, milk and chicken.

Putting this Information to Work Choose to eat a variety of nutrient-rich foods each day, letting the Food Pyramid guide your choices. For instance, include 6 or more servings of grain foods, with at least 3 of these being whole grain foods. Also choose fruits, vegetables, dairy products, and protein foods such as meats, fish, poultry, nuts and legumes.

Beware of taking nutritional supplements that provide more than the Recommended Dietary Allowance (RDA), especially for iron, zinc or vitamin C.

Right Amount of Iron is Key



Iron is essential in the body for the delivery of oxygen to cells where it is used to produce energy. Iron also helps protect us from infection.

Iron is the only nutrient for which the requirement for adult women is greater than that for adult men. Iron needs are highest during periods of rapid growth: childhood, adolescence, child-bearing years for women and pregnancy. In older women, the recommended intake decreases because iron loss due to menstruation ceases.

Beef is an excellent dietary source of iron, in terms of both amount and bioavailability. Other excellent sources include clams, oysters, tofu and liver. Poultry, fish, pork, lamb and legumes are good sources. Whole-grain and enriched grain products are significant sources of iron because they are a major part of our diet. Good vegetable sources are leafy greens such as spinach and kale.

Although diet is the ideal way to meet iron needs, supplements are often recommended for groups at risk for deficiency, such as small children, women of childbearing age and pregnant women.

Iron is toxic in large amounts. Even a single dose can be life-threatening. Iron toxicity from supplements is one of the most common forms of poisoning among children under age six. Iron-containing supplements should be taken only as suggested on the label and stored out of the reach of children or others who could consume them in excess.

Potential Nutrition Problems in Hispanic Populations

Hispanic groups, especially children, living in Kansas may be deficient in vitamin A and zinc because of their dietary practices. The prevalence and extent of vitamin A or zinc malnutrition, or both, in the Hispanic population of Kansas are unknown. Other states, Mexico, and regions of South and Central America have from time to time reported these specific nutrient deficiencies among Hispanic populations. Severe outright deficiencies may not exist in the U.S., but mild forms, which still can have a negative effect on health, may be present. Early recognition of signs denoting inadequate intake of these nutrients, along with increasing awareness of related health problems, is imperative.

Zinc

Zinc deficiency can affect all age groups, and is not an all-or-none condition. Rather, responses vary according to how severe the deficiency is. The most significant problem with a mild zinc deficiency in children is low height for age[1]. In Denver, CO, teens who appeared healthy except for low height-for-age percentiles responded to a zinc supplement of just 5 mg per day. The response was greater for boys than girls, but was significant in each sex. Other mild deficiency symptoms include delayed sexual development, particularly in boys, and pregnancy complications, such as high blood pressure, premature and prolonged labor, and hemorrhage. Taste and appetite are also markedly decreased. Zinc intake of ten to 15 mg/day reverses most of these symptoms. Preventing, identifying and treating mild zinc deficiency are important because symptoms of severe zinc deficiency are quite harsh. These include dermatitis and skin lesions primarily on limbs and around orifices, decreased ability to fight off infections, and visual problems such as degeneration of the cornea, accompanied by night blindness and failure to adapt to light. Zinc-deficient children are often irritable, depressed and fatigued.

Vitamin A

The visual problems noted for zinc deficiency resemble many symptoms of vitamin A deficiency. Permanent blindness called xerophthalmia is caused by vitamin A deficiency. A history of night blindness indicates insufficient vitamin A stores. Lesions on the conjunctiva and cornea of the eyes and the presence of Bitot's spots on the cornea of the eye are usually evidence of the severity of the case. In younger children, supplementation with vitamin A may reverse this, but in older children, the effect may be permanent. Another sign of vitamin A deficiency is a thick and scaly skin texture. Vitamin A deficiency can decrease immune function. Worldwide, many children who develop a weakened immune system become so susceptible to infection that they die.

Double troubled

Since Hispanic groups may have deficiencies of both zinc and vitamin A, they are at risk for vision, immune and skin problems. Screening for night blindness and height-for-age status in growing children of high-risk groups, such as Latino children, is a practical way to identify early problems. Signs that should send warning signals to health educators and practitioners are delayed healing and frequent infections, night blindness, scaly skin, loss of appetite and decreased growth in children. Further evaluation of these symptoms is indicated to determine if possible nutrient deficiencies exist. However, lack of these symptoms does not imply absence of nutrient deficiency.

Recommendations

A monitoring system of the Hispanic population in Kansas for zinc and vitamin A needs to be implemented. The monitoring program, even on a limited basis, would allow health care professionals to determine if overt or sub-clinical nutrition problems are present that can be addressed through education and intervention approaches.

Educators and health care providers are vital in raising awareness and teaching recognition of the symptoms of these nutrient deficiencies.

[1]***Reference**: Roche AF, Guo S, Baumgartner RN, Chumlea WC, Ryan AS, Kuczmarski RJ. 1990. Reference data for weight, stature, and weight/stature[2] in Mexican Americans from the Hispanic Health and Nutrition Examination Survey (HHANES 1982-1984). Amer J Clin Nutr. 51: 917S-24S.*

Dried Plums Keep Ground Beef Moist

Adding dried plums can increase the safety of ground beef and make it more tasty. This may sound unusual, but researchers at K-State have found this to be true.

Dried plum extract can prevent freezer burn in meat and also kill pathogenic bacteria. The cooked meat will remain moist and the beefy flavor will be enhanced.

School lunch programs may benefit from adding a prune mixture. Meat products that are prepared at central kitchens and reheated in satellite locations will remain moist and juicy.

Try "Plum Good Meatballs" in this Spotlight issue for a meat mixture with dried plums. The meatballs are moist and the dried plums add fiber and iron to the diet.

Plum Good Meatballs

48 small meatballs

1 pound extra lean ground beef
½ cup milk
1 cup wheat-flake cereal, crushed
1/4 cup ketchup
2 eggs, slightly beaten
1 tablespoon Worcestershire sauce
1 cup dried plums, finely chopped
2 teaspoons dried onion flakes
½ teaspoon ground pepper

1. Heat oven to 350 degrees. Lightly coat baking sheet with cooking spray.
2. In a large bowl, combine all ingredients, mixing lightly, but thoroughly.
3. Divide into 48 meatballs, about 1 ½ inches in size.
4. Place on baking sheet and bake for 20-25 minutes to medium (160 degrees) doneness.

Nutrition Facts

Serving Size 6 meatballs (118g)
Servings Per Container 8

Amount Per Serving	
Calories 160	Calories from Fat 30
	% Daily Value*
Total Fat 3.5g	**5%**
Saturated Fat 1g	**6%**
Cholesterol 75mg	**26%**
Sodium 190mg	**8%**
Total Carbohydrate 20g	**7%**
Dietary Fiber 2g	**8%**
Sugars 12g	
Protein 15g	

Vitamin A 15% • Vitamin C 8%
Calcium 4% • Iron 15%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Saturated Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Calories per gram:
Fat 9 • Carbohydrate 4 • Protein 4

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Contributors

Shelly Burklund
Spotlight Producer

Sandy Procter, MS, RD, LD
Spotlight Editor and
Coordinator, Expanded Food and Nutrition Education Program (EFNEP)

Barbara L. Knous, PhD, RD, LD
Extension Specialist, Nutrition

Mary L. Higgins, PhD, RD, LD
Extension Specialist, Nutrition Education

Denis Medeiros, PhD, RD, LD
Department Head, Human Nutrition

Karen Hudson, MEd, RD, LD
Coordinator, Family Nutrition Program (FNP)

Kathy Walsten
Nutrition Educator, FNP and EFNEP

Judy Speer
Graphic Design and Layout

Shannon Eastburn- Intern

Questions or concerns about this publication? Contact Shelly Burklund, 207 Justin Hall, Manhattan, KS 66506, Phone: (785) 532-1670, FAX: (785) 532-1678

Cooperative Extension Service
K-State Research and Extension
Department of Human Nutrition
207 Justin Hall
Manhattan, Kansas 66506-1422