Let's Excel Together
CANADIAN ACADEMY OF SPORTS NUTRITION

Lecture 60:

Minerals

Part 3

Copyright Protection:

Minerals To Be Discussed:

- Potassium
- Selenium
- Sodium
- Vanadium

Potassium:

- **Potassium is one of the most important electrolytes in the body.**
- **Electrolytes are the minerals that ionize when dissolved in water and can conduct an electric current.**

- **Potassium is the major cation (positive ion) within the cells (intracellular).**

It has a key role in:

- **regulating blood pressure**
- **controlling water and acid – base balance**
- **conducting nerve impulses**
- **controlling muscle contraction**
- **maintaining normal heart function**

Food Sources and Absorption of Potassium:

- **The total amount of potassium in the body is 50 mEq (milliequivalent) per one kilogram of body weight.**

- **Therefore, a person with body weight of 70 kg has about 3500 mEq (120 grams) of potassium in the body, of which 98% is inside the cells and 2% is outside the cells.**

- **Dietary potassium is absorbed efficiently (90%) from the small intestine, and the kidneys are the main regulators of potassium.**

- **In a healthy person, the entire daily intake of potassium is excreted, approximately 90% in the urine, 10% in the stools, and a very small amount in the sweat.**

- **Potassium is easily lost in cooking, processing or canning foods, and even in freezing fruits and vegetables.**

Foods Rich in Potassium:

Foods	Serving Size	Potassium (mg)
Tomato paste	1 cup	2600
Beet greens, cooked	1 cup	1300
Dates	1 cup	1170
Raisins	1 cup	1080
Soybeans, cooked	1 cup	970
Lima beans, cooked	1 cup	945
Fish, halibut	5 oz	900
Fish, tuna	5 oz	900
Plantain, raw	One, medium	895
Spinach, cooked	1 cup	840
Papaya	One, medium	780
Lentils, cooked	1 cup	730
Kidney beans, cooked	1 cup	710
Navy, cooked	1 cup	705
Sweet potato, cooked	One, medium	700

Artichoke, raw	1 cup	640
Baking potato, cooked	One, medium	620
Black beans, cooked	1 cup	610
Fish, haddock	5 oz	600
Fish, salmon	5 oz	580
Yogurt	1 cup	580
Parsnip, cooked	1 cup	570
Pumpkin, cooked	1 cup	560
Mushroom, cooked	1 cup	555
Brussels sprouts, cooked	1 cup	495
Broccoli, cooked	1 cup	460
Cantaloupe	1 cup	430
Banana	One, medium	425
Apricots	10 halves	410

The normal range of potassium in the blood is 3.5 - 5.5 mEq/L.

Potassium depletion may cause:

- muscle weakness and cramps
- paralytic episodes
- irregular heartbeats (cardiac arrhythmias)
- rhabdomyolysis
- impaired glucose tolerance
- polydipsia (excessive thirst)
- polyuria (excessive urination)

Athletic Benefits of Potassium:

- **The heart, skeletal muscles, and intestinal smooth muscles are very sensitive to the fluctuations of potassium in the blood.**

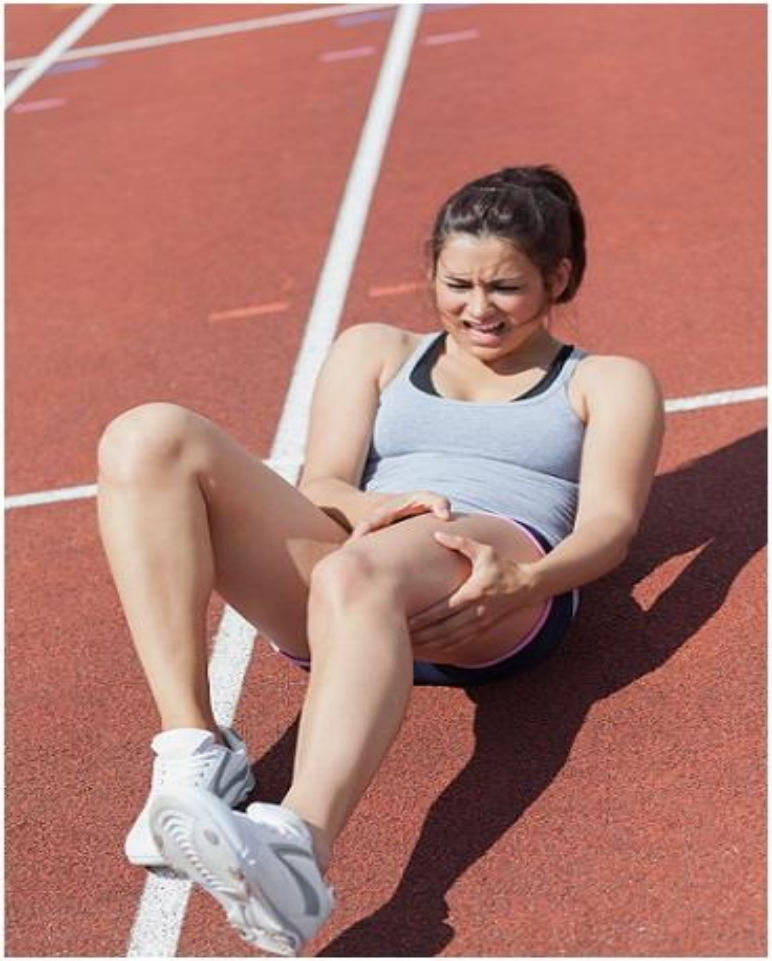
- **Therefore, small variations in potassium levels could affect the normal functions of the heart and skeletal muscles in athletes and physically active people.**

The potential benefits of potassium in athletes are:

- **a) May help prevent post – exercise exhaustion.**
- **b) Supports intense training sessions.**
- **c) Aids maintain normal levels of growth hormone (GH) and IGF – I, which are important for muscle growth and optimum athletic performance.**
- **d) May have a protective effect against post – exercise rhabdomyolysis.**

- **e) May help prevent cramps during and after intense exercise.**

- **f) Is important in replenishing glycogen stores by helping the conversion of glucose to glycogen.**



Electrolyte imbalances, especially decreased levels of potassium and magnesium, could cause cramps in the legs during exercise.
Image: Copyright©Depositphotos.com/Sean Prior

Non – Athletic Benefits of Potassium:

- a) High blood pressure.
- b) Kidney stones.
- c) Premenstrual syndrome (PMS).
- d) Chronic diarrhea.
- e) Infantile colic (as potassium chloride).
- f) Chronic fatigue syndrome.
- g) Dehydration.
- h) Weight management.
- i) Along with diuretics.

Dosage and Side Effects:

- **The daily requirement for potassium for non – athlete adults is 1500 – 2000 mg.**
- **The performance daily intake (PDI) for potassium for athletes and physically active adults is 2500 – 3500 mg.**
- **Potassium is available as potassium chloride, citrate, fumarate, and gluconate. Potassium pills may cause stomach upset and esophagitis (inflammation of the esophagus).**

Potassium supplementation should be avoided in the following conditions:

- a) Chronic kidney disease.
- b) Kidney failure.
- c) Congestive heart failure.
- d) Adrenal gland insufficiency.
- e) Addison`s disease.
- f) Post – exercise rhabdomyolysis.

Interactions:

The supplements and medications that may decrease potassium levels in the blood are:

- 1) Caffeine.
- 2) Vitamin B12.
- 3) Folic Acid.
- 4) Licorice.
- 5) Insulin.
- 6) Laxatives.

- **7) Diuretics.**
- **8) Corticosteroids.**
- **9) Catecholamines (epinephrine, dopamine, and albuterol).**
- **10) Theophylline.**
- **11) Penicillin derivatives (penicillin, nafcillin, ticarcillin, dicloxacillin, oxacilin, and carbenicillin).**

The supplements and medications that may increase potassium levels in the blood are:

- 1) Arginine.
- 2) Lysine.
- 3) Potassium – sparing diuretics (spironolactone, amiloride, and triamterene).
- 4) Angiotensin converting enzyme (ACE) inhibitors (captopril, enalapril, lisinopril, and ramipril).
- 5) Digoxin.

- **6) Nonsteroidal anti- inflammatory drugs (NSAIDs) such as Advil.**
- **7) Beta – blockers.**
- **8) Cyclosporine.**
- **9) Heparin.**
- **10) Tacrolimus.**

Selenium:

- **Selenium is an essential trace mineral.**
- **In the form of selenocysteine, it is a component of the enzyme glutathione peroxidase, which serves to act as a potent antioxidant.**
- **Being the most famous trace mineral with anti – cancer activity, selenium has multiple functions in the body.**

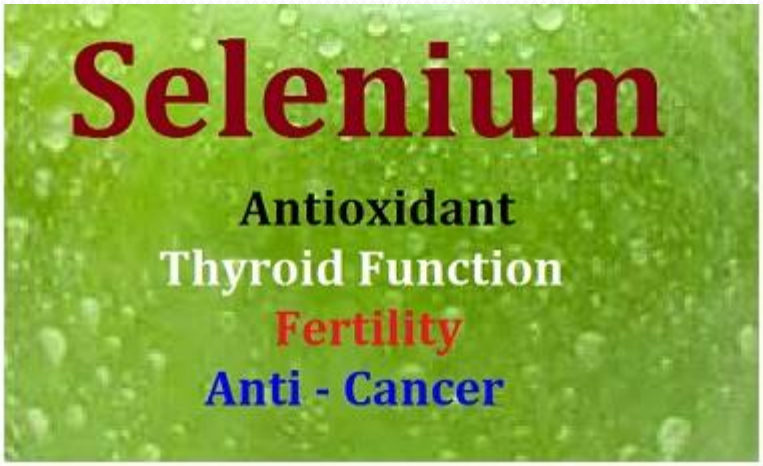
Functions of Selenium:

- **a) Acts as an antioxidant by being a part of glutathione peroxidase particularly when combined with vitamin E.**
- **b) Has anti – cancer activity especially prostate and colon cancers.**
- **c) Has a key role in production of thyroid hormones.**
- **d) Improves production and motility of sperms.**

- **e) Enhances immune system by stimulating the production of antibodies in response to vaccines.**

- **f) May help protein synthesis, growth and development.**

- **g) May have a cardioprotective effect.**



Food Sources and Absorption:

- **Foods high in selenium are brewer`s yeast, Brazilian nuts, wheat germ, liver, fish, seafood, cereals, and whole grain.**
- **Approximately 60% of dietary selenium is absorbed from the small intestine.**
- **Amino acids enhance the absorption of selenium to 85%.**

Selenium deficiency may manifest as:

- **heart diseases (such as cardiomyopathy and heart failure).**
- **degeneration of skeletal muscles characterized by decreased muscle bulk and strength .**
- **increased rates of cancers.**

Athletic Benefits of Selenium:

- **a) May speed up the healing process in sports injuries.**
- **b) May aid recover from overtraining syndrome.**
- **c) When combined with vitamins E and C, it may enhance recovery after intense strength training.**
- **d) Protects muscles against oxidative damage.**
- **e) May accelerate healing process in Osgood – Schlatter disease.**

Non – Athletic Benefits of Selenium:

- a) Male infertility.
- b) Asthma.
- c) Atherosclerosis.
- d) Hypothyroidism.
- e) Prostate cancer.
- f) Colon cancer.
- g) Keshan`s cardiomyopathy
- h) Compromised immune system.
- i) Liver cirrhosis.

- **j) Diabetic retinopathy.**
- **k) Abnormal Pap smear.**
- **l) Dermatitis herpetiformis.**
- **m) Age – related macular degeneration.**
- **n) Periodontal disease.**
- **o) Acne.**
- **p) Cataract.**
- **q) Depression.**
- **r) Rheumatoid arthritis (RA).**

Dosage and Side Effects:

- **The RDA for selenium for adult is 55 mcg.**
- **However, a dose of 100 – 200 mcg a day is considered safe.**
- **The performance daily intake (PDI) for athletes and physically active adults is 200 – 300 mcg.**

- **Even though the tolerable upper limit for selenium for adult is 400 mcg a day, chronic ingestion of large amounts of selenium (more than 800 mcg a day) leads to selenium toxicity characterized by:**
- **nausea,**
- **vomiting,**
- **hair loss,**
- **brittle nails,**
- **garlic breath odor,**
- **skin rash, irritability, muscle weakness, lassitude, and tooth decay.**

Occupationally, chronic ingestion of high doses of selenium may increase risk of:

- **lung inflammation and cancer.**
- **liver damage.**
- **nasal cancer.**

Interactions:

- **a) Blood thinners (warfarin, clopidogrel, aspirin, and heparin): selenium may increase their effectiveness and risk of bleeding.**

- **b) Corticosteroids: they may decrease blood levels of selenium.**

- **c) Valproic acid: it may decrease blood levels of selenium.**

- **d) Clozapine: it may decrease blood levels of selenium.**

- **e) Cholesterol – lowering medications (such as simvastatin, atorvastatin, lovastatin and vitamin B3): selenium may reduce their effectiveness.**

Sodium:

- **Sodium is a very important electrolyte in the body with a key role in controlling fluid balance, regulating blood pressure, and transmitting never impulses.**

Image: Copyright©Depositphotos.com/Suzana Tomovska

- **Total body sodium is approximately 0.15% of the body weight with 60% outside the cells, 30% in the bones, and 10% inside the cells.**

Absorption, Functions, and Food Sources:

- About 100 % of the consumed sodium is absorbed from the stomach and upper part of the small intestine.

- The kidneys are the major regulators of sodium in the body, and aldosterone is the main hormone that controls sodium metabolism. It is released from the cortex part of the adrenal glands.

- **Being the main cation (positive ion) outside the cells (extracellular), sodium serves to regulate fluid balance and fluid volume in the blood and body.**

- **Along with potassium, it also functions to control blood pressure by adjusting osmotic pressure within the arteries.**

- **To control blood pressure, the ratio of sodium-to-potassium is more important than the amount of sodium alone.**

- **Many foods contain sodium in the form of sodium chloride.**
- **It is found in bacons, seafood, canned foods, processed foods, seaweed, and kelp. Vegetables contain small amounts of sodium.**
- **A common source of sodium is table salt, which is sodium chloride (40% sodium and 60% chloride).**
- **One teaspoon (5 grams) of table salt provides about 2 grams of sodium.**

Benefits and Dosage:

Sodium has a vital role in the following functions in the body:

- **a) Regulates fluid balance and volume in the body.**
- **b) Helps maintain pH balance.**
- **c) Is important in nerve impulse transmission.**
- **d) Is important in calcium metabolism.**

- **No RDA has been established for sodium. However, the daily requirement for sodium for adults is 1000 – 2500 mg.**
- **Exercisers especially endurance athletes may need more than that.**
- **The performance daily intake (PDI) for athletes and physically active adults is 2000 – 4500 mg.**
- **Most non-athlete people usually consume 8 – 12 grams of salt (3200 – 4800 mg of sodium) daily.**

Sodium Deficiency and Excess:

- **Normal level of sodium in the blood is 135 – 145 mEq/L.**

- **If the sodium level decreases to below 135 mEq/L, it is called "hyponatremia", and the sodium level above 145 mEq/L is defined as "hypernatremia".**

Hyponatremia:

- **It is a decrease in sodium level in the blood to below 135 mEq/L.**

- **Acute hyponatremia results in acute cerebral edema, which is characterized by headache, confusion, stupor, seizures and coma.**

- **Chronic hyponatremia may cause nausea, vomiting, confusion, seizures, cognitive defects, and subtle disorders in gait.**

Potential causes of hyponatremia are:

- a) Vomiting.
- b) Diarrhea.
- c) Burns.
- d) Hyperglycemia (increased levels of blood sugar).
- e) Pancreatitis (inflammation of the pancreas).
- f) Exercise – induced (especially endurance exercise).
- g) Heart failure.
- h) Rhabdomyolysis.
- i) Low function thyroid.

- **j) Kidney disease.**
- **k) Mannitol.**
- **l) Excessive intake of water.**
- **m) Medications (diuretics, chlorpropamide, carbamazepine, clofibrate, vincristine, narcotics, cyclophosphamide, antidepressants, NSAIDs, oxytocin, desmopressin, and vasopressin).**
- **n) Severe increase in proteins and lipids in the blood (they cause pseudo-hyponatremia).**

Hypernatremia:

- **It is an increase in sodium level in the blood to above 145 mEq/L.**
- **As in hyponatremia, the symptoms of hypernatremia are mainly neurologic: confusion, lethargy, and coma.**
- **Thirst is a major symptom as well.**

Potential causes of hypernatremia are:

- a) Severe dehydration.
- b) Diminished water intake.
- c) Insensible losses of water: fever, exercise, heat exposure, severe burns, and mechanical ventilation.
- d) GI losses of water: vomiting and diarrhea.
- e) Hypercalcemia (increased blood levels of calcium).

- **f) Hypokalemia (decreased levels of potassium).**
- **g) Medications (lithium, alcohol, demeclocycline, amphotericin B, rifampin, foscarnet, aminoglycosides, and methoxyflurane).**

Vanadium:

- **Vanadium is an essential trace mineral with an anti – diabetic activity.**
- **It is a controversial mineral in sports nutrition and has been claimed to have a positive impact on athletic performance.**

- **Vanadium may improve sensitivity of the cells to insulin. This is why it is considered as "insulin mimetic". It may be important in bone health as well.**

Food Sources and Absorption:

- **Foods high in vanadium are cabbage, mushroom, parsley, dill, radish, spinach, black pepper, green beans, buckwheat, carrots and oysters.**
- **Approximately 5% of dietary vanadium is absorbed.**
- **Most of the vanadium intake through foods is eliminated via stools.**

- **An average person has totally 22 mg in the body with the highest concentration in the bones followed by liver, spleen, and adipose tissues.**

Image: Copyright©Depositphotos.com/Jean-Marie Guyon

Athletic Benefits of Vanadium:

- **a) May improve exercise recovery.**
- **b) Increases athletic endurance.**
- **c) May help increase muscle mass by enhancing the uptake of creatine by the muscles.**
- **d) May increase muscle strength by causing forceful muscle contractions.**

Non – Athletic Benefits of Vanadium:

The following conditions may benefit from vanadium:

- **a) Diabetes.**
- **b) Insulin resistance syndrome.**
- **c) Polycystic ovarian syndrome (PCOS).**
- **d) Osteoporosis.**
- **e) Weight management.**

Dosage and Side Effects:

- **No RDA has been established for vanadium. However, adults may need 8 – 10 mcg of vanadium per day.**
- **Western diets provide about 10 – 20 mcg of vanadium per day.**
- **The tolerable upper intake level for elemental vanadium in adults is 1.8 mg per day.**

- **Different products of vanadium supplements contain different amounts of elemental vanadium.**

- **To benefit athletic performance, up to 50 mg of vanadyl sulfate can be taken daily.**

- **Common side effects of high doses of vanadium include stomach upset, diarrhea, nausea, vomiting, bloating, greenish color of the tongue, and decreased energy level.**

Interactions and Contraindications:

Vanadium should be avoided in the following conditions:

- **a) Kidney diseases.**
- **b) Liver diseases.**
- **c) Anemia.**
- **d) Compromised immune system, such as HIV.**
- **e) High cholesterol level.**
- **f) Leukopenia (decreased white blood cells).**
- **g) Infections.**

The potential interactions are:

- **a) Insulin and anti – diabetic medications: vanadium may increase their effectiveness.**
- **b) Digoxin: vanadium may increase its effectiveness.**
- **c) Anticoagulants (blood thinners): vanadium may increase their effectiveness and risk of bleeding.**
- **d) MAO inhibitors: these anti – depressants antagonize the effects of vanadium.**
- **e) Magnesium: vanadium may increase the blood levels of magnesium.**

Homework:

- 1) Describe the athletic benefits of potassium.
- 2) Describe the athletic benefits of vanadium.