Let's Excel Together

CANADIAN ACADEMY OF SPORTS NUTRITION

Lecture 35:

Antioxidants

Part 1

Copyright Protection:

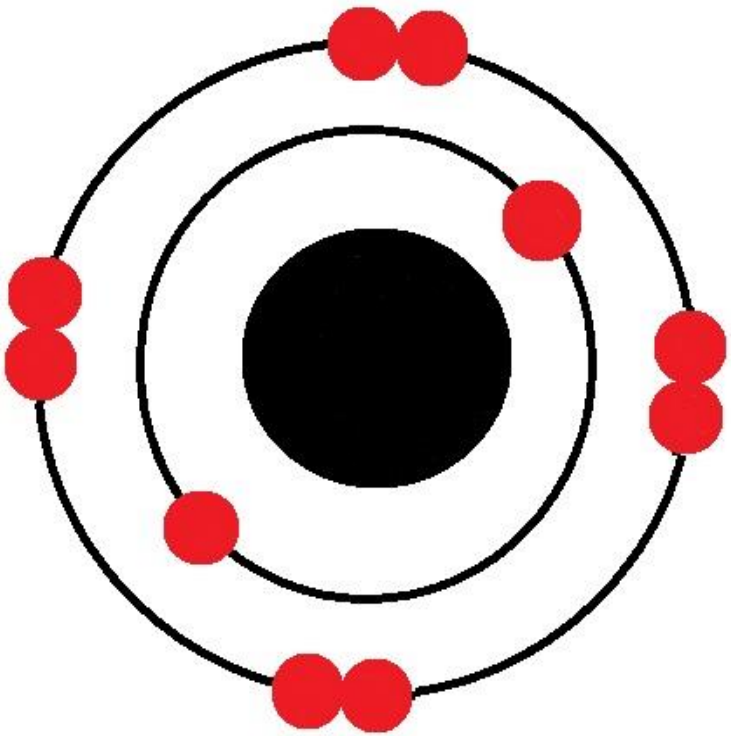
- **Antioxidant: it is a molecule that inhibits oxidation, or neutralizes free radicals.**

Image: Copyright©Depositphotos.com/Marco Guidi

- **Free Radical: is an atom or group of atoms with unpaired electrons, and they are highly reactive.**

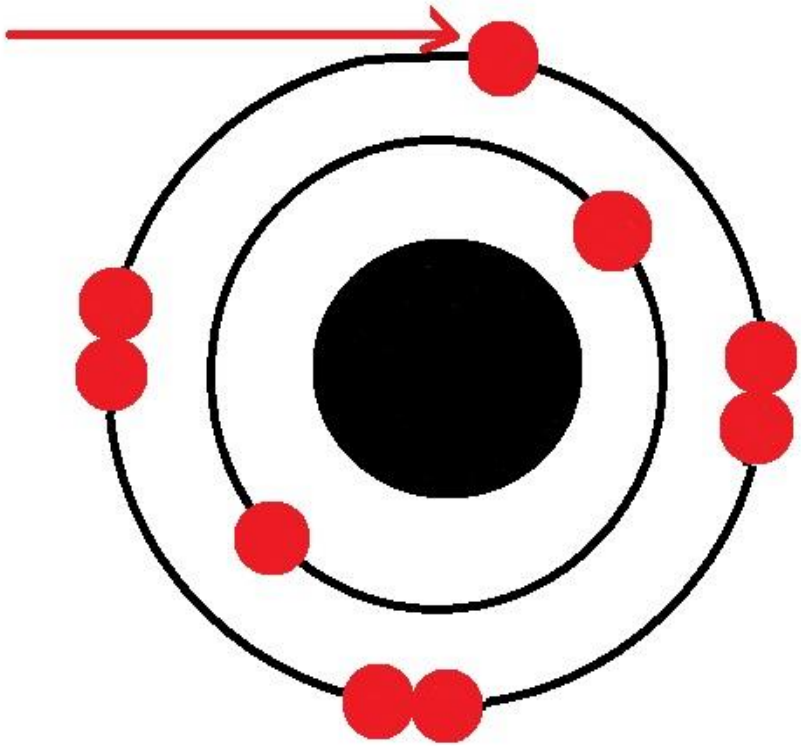
- **In other words, free radicals are unstable atoms at the outer layer of the cells looking for an electron to get paired and stabilized. This is why free radicals would attack any cells to get an electron to get stabilized.**

Stable or Happy Atom
(No unpaired electrons)



Unstable or Unhappy Atom
(With unpaired electrons)

Free Radical

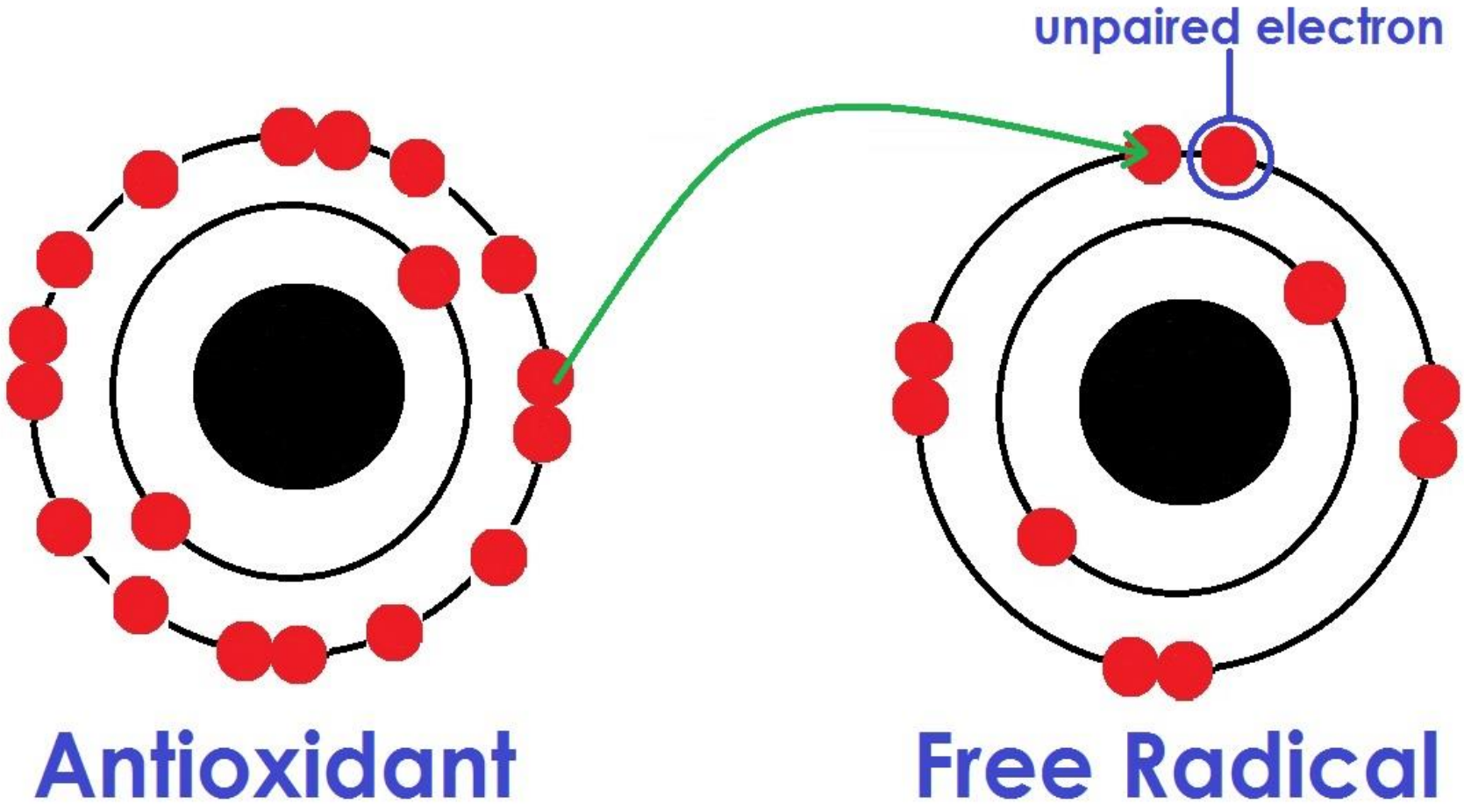


- **Free radicals are blamed for aging, cancers, inflammation, and many degenerative diseases.**

- **Antioxidants neutralize free radicals by donating electrons to make them become stable.**

- **Antioxidants are fire fighters within the cells and their jobs are to distinguish the fire set by toxic oxygen free radicals.**

Electron Donation



There are different types of free radicals:

- a) Superoxide radical.
- b) Hydrogen peroxide.
- c) Hydroxyl radical.
- d) Singlet Oxygen.
- e) Peroxyl radical.
- f) Peroxynitrate.
- g) Hydrochlorous acid.
- h) Nitric oxide.

Sources of Free Radicals:

- **Free radicals are continuously created by many chemical reactions and metabolic activities taken place in our bodies even when we are at rest.**

Accelerating factors to produce more free radicals are:

- **1) Smoking.**
- **2) Pollution.**
- **3) Herbicides.**
- **4) Pesticides.**
- **5) Food additives**
- **6) Heavy metals.**
- **7) Industrial chemicals.**

- 8) Medications: acetaminophen, nitrofurantoin, bleomycin, anthracylines, methotrexate, penicillamine, phenylbutazone and sulphasalazine.
- 9) Radiation (e.g. X-ray)
- 10) Stress.
- 11) Sleep deprivation.
- 12) High calories, poor nutrients diets.
- 13) Exercise without recovery.
- 14) Excessive exposure to sunlight.
- 15) Drinking chlorinated water.

Antioxidant Activity of Foods:

Antioxidant capacities of different foods were used to be measured by:

- **Trolox Equivalent Antioxidant Capacity (TEAC) assay.**
- **Ferric ion Reducing Antioxidant Power (FRAP) assay.**
- **Oxygen Radical Absorption Capacity (ORAC) assay.**

- **According to USDA (the United States Department of Agriculture), ORAC is biologically invalid since 2012 for the following reasons:**

- **1) The data for antioxidant capacity of foods generated by in vitro (test-tube) methods cannot be applied to in vivo (human) effects and the clinical trials have produced mixed results.**

- **2) Antioxidant molecules in food have many functions that are unrelated to their ability to absorb free radicals.**

There are thousands of antioxidants in the body and nature. They include (but not limited to):

- **1) Alpha – Lipoic Acid (ALA).**
- **2) Astaxanthin.**
- **3) BHT (Butylated hydoxytoluene).**
- **4) Carnosine.**
- **5) Carotenoids (Lutein, Lycopene, and Zeaxanthin).**
- **6) Catalase.**
- **7) Co – Enzyme Q 10.**
- **8) Curcumin.**

- **9) Flavonoids (Quercetin, Hesperidin, and Rutin).**
- **10) Gamma oryzanol and Ferulic acid**
- **11) Glutathione.**
- **12) Melatonin.**
- **13) NAC (N – acetyl cysteine).**
- **14) NADH.**
- **15) Resveratrol.**
- **16) Selenium.**
- **17) Silymarin.**
- **18) Sulfur.**

- **19) Superoxide dismutase.**
- **20) Uric acid.**
- **21) Vitamin A.**
- **22) Vitamin C.**
- **23) Vitamin E.**
- **24) Zinc.**

Alpha – Lipoic Acid (ALA):

- **ALA is a sulfur-containing vitamin-like substance with a potent antioxidant activity.**
- **Since it is soluble in both water and fat, it sometimes referred to as the "universal antioxidant".**
- **The main free radicals neutralized by ALA are singlet oxygen and hydroxyl radicals.**

- **ALA is also known as thioctic acid and pyruvate oxidation factor (POF).**

- **While being produced in the body, it is naturally found in the liver, kidney, heart, yeast, and broccoli.**

Athletic Benefits of ALA:

- **a) ALA helps recycle Co –Enzyme Q10, vitamin E, glutathione, and vitamin C.**

- **b) ALA helps the body build muscle glycogen by acting as an "insulin mimicker".**

- **c) ALA helps with the oxidation of pyruvate, BCAA (branched chain amino acids), and alpha-ketoglutarate (AKG).**

- **d) ALA may prevent from athletic overtraining syndrome by enhancing glutathione level within the muscles.**

- **e) ALA reduces oxidative damages caused by training or competitions.**

Non – Athletic Benefits of ALA:

ALA may be beneficial in the following conditions:

- **a) Diabetes type II.**
- **b) Diabetic neuropathy.**
- **c) Cataracts.**
- **d) Glaucoma.**
- **e) Hepatitis.**
- **f) HIV/AIDS. ALA has the ability to inhibit the replication of HIV by reducing the activity of reverse transcriptase.**

- **g) Heavy metal toxicity. ALA is a potent chelating agent that chelates mercury.**
- **h) Adjuvant therapy in MS (multiple sclerosis).**
- **i) Altering body composition (it shows better results when combined with exercise).**
- **j) Male infertility.**
- **k) Cardiovascular disease.**
- **l) Metabolic syndrome.**
- **m) Liver detoxification.**

Dosage :

- **It is usually between 200 to 800 mg a day.**

- **As an insulin mimetic, it should be taken 1000 mg immediately after exercise or training session during "*anabolic window*", not later than 30 minutes.**

Side Effects:

- **Possible side effects are numbness and tingling, skin rash, and hypoglycemia.**
- **Long-term consumption of ALA might interfere with the function of biotin.**
- **There are few studies indicating that ALA may exhibit pro-oxidant activity as well.**

Astaxanthin:

- **Astaxanthin is a carotenoid and one of the most potent antioxidants, being 500 times stronger than vitamin E and 6000 times stronger than vitamin C.**

- **Reddish color of salmon, crab, krill and lobster results from astaxanthin.**

- **Unlike many other carotenoids, astaxanthin cannot be converted into retinol (pro-vitamin A) in the body.**

Athletic Benefits of Astaxanthin:

- a) Protects muscles from oxidative damage caused by exercise.
- b) May improve blood flow to the muscles by increasing production of NO (nitric oxide).
- c) Promotes fatty acid utilization versus glucose metabolism for ATP production.
- d) Supports muscle recovery from strenuous exercises.
- e) May improve athletic endurance.

Non – Athletic Benefits of Astaxanthin:

- a) Antioxidant activity.
- b) Cardiovascular benefits:

  - lowers triglyceride.

  - increases HDL.

  - improves blood flow to and from the heart.

  - helps maintain normal blood pressure.

- c) Visual benefits:

  - helps reduce the occurrence of occasional eye fatigue especially when using visual electronics (computer eye strain syndrome).

- **d) Protective activity against diabetic nephropathy (kidney damage caused by diabetes).**

- **e) Neurologic benefits (It may help protect from neurodegenerative diseases such as Alzheimer's disease, multiple sclerosis (MS), amyotrophic lateral sclerosis (ALS) and many others by preventing oxidative stress in the nerves and nervous system.**

Dosage:

- For cardiovascular, visual and neurologic benefits, it is taken 5 – 10 mg a day.

- Athletes need higher doses of astaxanthin, 10 – 20 mg per day. It shows better results if combined with L – Carnitine and MCTs (Medium-Chain Triglycerides).

- For better absorption, it is better taken along with a meal.

Homework:

- **1) Describe the sources of free radicals and how they could affect the body.**

- **2) Describe how an athlete could benefit from supplementing with Alpha – Lipoic Acid.**