

# MAXIMIZING YOUR MITOCHONDRIA

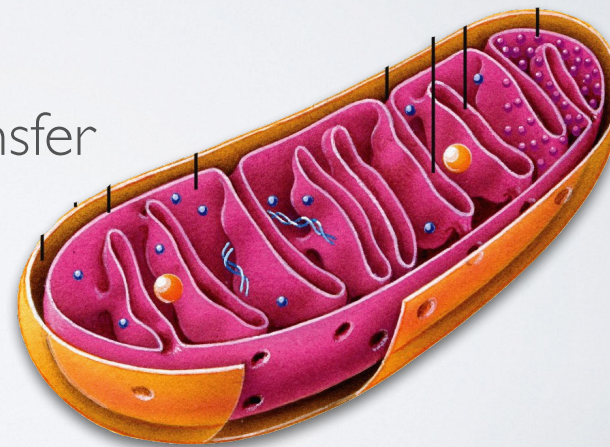
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# LEARNING OBJECTIVES

- Discuss the significance of mitochondria
- Discuss ways to increase the efficiency and amount of mitochondria
- Define a nitrate
- Discuss the effects of nitrate uptake
- Discuss what foods contain nitrate

# SIGNIFICANCE OF MITOCHONDRIA

- Powerhouse/Battery of Cell
- Krebs Cycle
- ETC
  - couples electron transfer with  $H^+$  ions across membranes
- ATP Factories



## The Significance of Mitochondria

So why exactly is mitochondria so significant in the body? It's so important because it's where a cell gets its power from. As we've learned throughout this quarter, the Krebs Cycle, which takes place in the matrix of the mitochondria goes through a series of chemical reactions to generate energy through the oxidation of acetate from the food we eat. From that food, ATP, which is energy, is produced.

As well we've learned the Electron Transport Chain assists in the process of producing more ATP for the mitochondria by using coupled electron transfer with  $H^+$  ions across the cell membrane.

Knowing this, we can see why the Mitochondria can be seen as an ATP Factory.

# OPTIMAL FUNCTION

- Exercise/Stress

- Nutrition



So how do we get our Mitochondria working at optimal functions? We can either increase the number of mitochondria in our cells or increase the efficiency of our mitochondria.

To increase the number of or mitochondria exercising is the overall best way, however before we increase the number of mitochondria we must increase the efficiency of the already existing mitochondria. To increase efficiency we must look at the food we are putting into our bodies. Because like the saying goes "you are what you eat".

# NUTRITION: NITRATES

- Dietary nitrates have profound effects on mitochondrial function
- Nitrates: Inorganic anion  $\text{NO}_3^-$  converted in the body to usable nitric oxide.

note: nitrates has been well established in various physiological roles in our body, such as in our vascular and immune functions

note: former belief= nitrates are harmful but now many studies are finding that nitrates are actually beneficial. ie. the study that we are going to tell you about



# STUDY

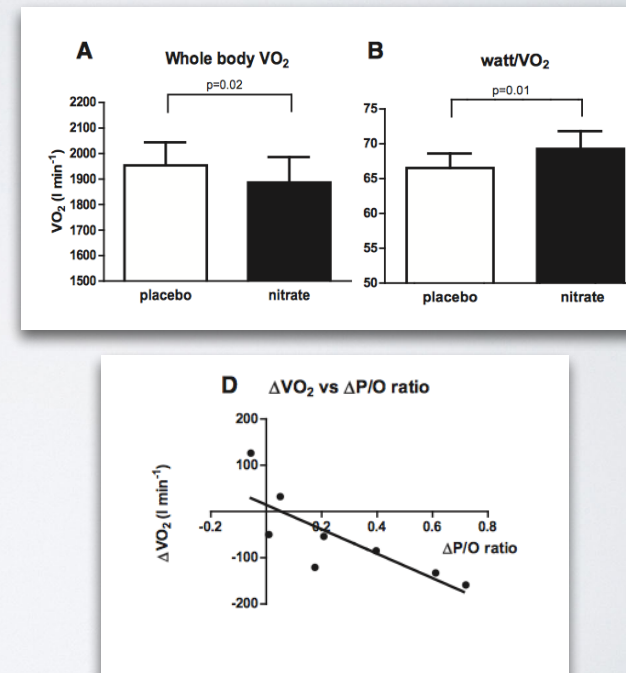
- Subjects supplemented with dietary nitrates or placebo
- Exercise: 10 mins cycling at various fitness levels
- Measured: O<sub>2</sub> uptake, CO<sub>2</sub> expired

Performed max exercise test to determine VO<sub>2</sub> (**oxygen uptake**) peak, then workload was determined with respect to fitness level

Subjects told to avoid nitrate rich foods during study

# RESULTS

- O<sub>2</sub> intake **decreased**
- Work Output/O<sub>2</sub> use increased  
\***mechanical efficiency**\*
- Subjects utilized **less** O<sub>2</sub> and **increased** their oxidative phosphorylation  
\***ATP production**\*
- **19% increase** in P/O ratio after nitrate supplementation!



note: efficiency of mitochondria performing oxidative phosphorylation is measured via P/O ratio (amount oxygen consumed per ATP produced )

# INCREASED MITOCHONDRIAL EFFICIENCY!

## After nitrate uptake:

- **increased** rate of ATP production
  - more efficient conversion of oxygen to yield ATP
- more efficient mitochondrial function
- improved exercise efficiency

## How?

- nitrates **reduce proton leak** at the mitochondrial level
  - normally 25% leakage



# HOW DO I GET MORE NITRATES?



**leafy green vegetables**



**cured meats**

Nitrate rich foods include **lettuce, beets, carrots, green beans, spinach, parsley, cabbage, radishes, celery and collard greens**

# QUESTIONS

When supplemented with nitrates, subjects showed a significant \_\_\_\_\_ in mitochondrial efficiency.

- A. Decrease
- ☒ B. Increase
- C. No Change

What does not occur after nitrate uptake?

- A. ~~decreased~~ rate of ATP production **Increased ↑**
- B. more efficient conversion of oxygen to yield ATP
- C. more efficient mitochondrial function
- D. improved exercise efficiency

# WORKS CITED

- Larsen, Filip J., Tomas A. Schiffer, Sara Borniquel, Kent Sahlin, Bjorn Ekblom, Jon O. Lundberg, Eddie Weitzberg, "Dietary inorganic nitrate improves mitochondrial efficiency in humans." *Cell Metabolism* 13.2 (2011): 149-159.
- K. Sreekumaran Nair, Brian A. Irving, Ian R. Lanza, "Can dietary nitrates enhance the efficiency of mitochondria?" *Cell Metabolism* 13.2 (2011): 117-118.