

Maintain Peak Performance: How Tocotrienols Impact Exercise Endurance

During exercise, muscles contract to create movement and oxidative stress in muscle tissues increases. To counter the harmful effects of oxidative stress, the body produces antioxidative enzymes like superoxide dismutase.

Tocotrienols Enhance the Antioxidant Capacity of Muscle Tissues

Concentrations of superoxide dismutase (SOD) after maximal swimming exercise in muscle tissue

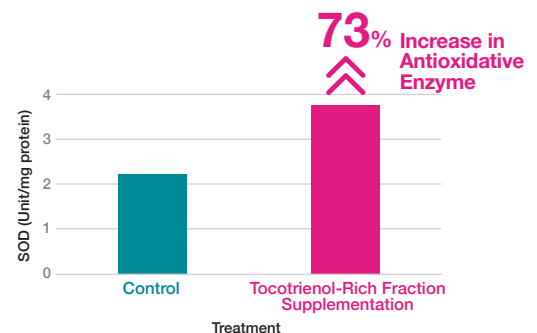


Figure 1: Concentrations of SOD in muscle tissue (Lee *et al.*, 2009).

Glycogen reserves reduce during exercise, causing insufficient energy supply or oxygen to the muscles. This induces muscle fatigue.

Tocotrienols Maintain Glycogen Levels in Muscle Tissue

Concentrations of glycogen after maximal swimming exercise in muscle tissue

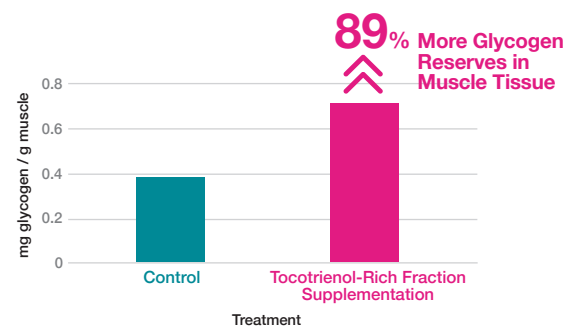


Figure 2: Concentrations of glycogen in muscle tissue (Lee *et al.*

Exercise also induces an increase in lactate in muscle tissues as a by-product of anaerobic respiration. High lactate levels increase the acidity of muscle tissue and slows its capacity for more work.

Tocotrienols Reduce The Amount of Lactate Produced After Exercise

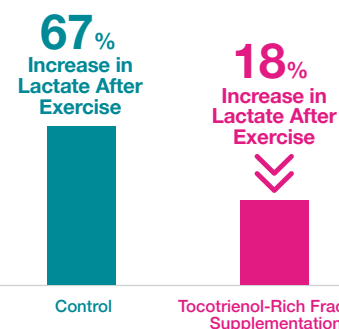


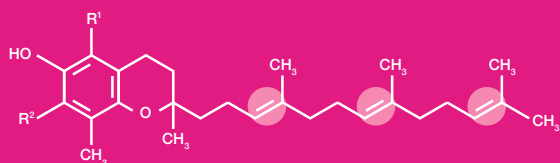
Figure 3: Concentrations of blood lactate in all groups after swimming exercise (Lee *et al.*, 2009).

Tocotrienols, The Extraordinary Vitamin E

Vitamin E is not just a single molecule, but a family of eight fat-soluble substances that are sub-divided into two classes of structurally-similar molecules. These two classes are tocopherol and tocotrienol, each of which have four structurally and chemically diverse molecules termed as alpha (α), beta (β), delta (δ), and gamma (γ) respectively.



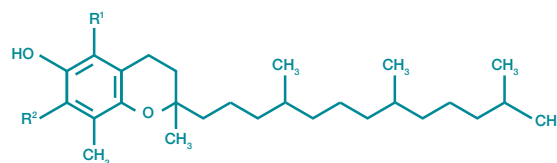
Tocotrienols have up to **60X** more antioxidative potency compared to α -Tocopherol, and have **unique anti-inflammatory properties** not seen in α -Tocopherol¹.



TOCOTRIENOLS

Tocotrienols have unsaturated isoprenoid side chains with three double bonds. This unique property gives it better flexibility with a higher efficiency of penetrating into the cell membrane. Tocotrienols are potent **ANTIOXIDANTS*** with unique **ANTI-INFLAMMATORY** properties.

α : $R' = CH_3$, $R'' = CH_3$
 β : $R' = CH_3$, $R'' = H$
 γ : $R' = H$, $R'' = CH_3$
 δ : $R' = H$, $R'' = H$



TOCOPHEROLS

Tocopherols, in contrast, have saturated side chains. They also function as antioxidants, but this chemical structure gives them a lower antioxidative capacity as compared to tocotrienols.

α : $R' = CH_3$, $R'' = CH_3$
 β : $R' = CH_3$, $R'' = H$
 γ : $R' = H$, $R'' = CH_3$
 δ : $R' = H$, $R'' = H$

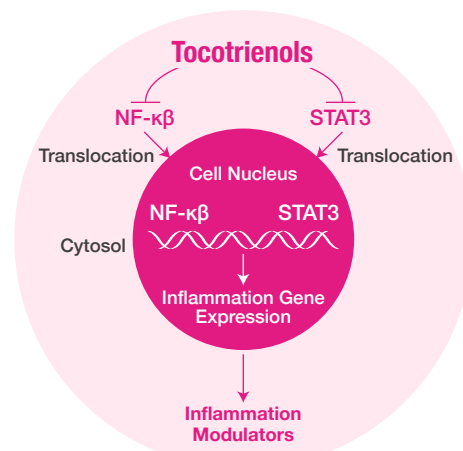
Tocotrienols have Unique Properties that Positively Impact Different Areas of the Body

Tocotrienols are naturally sourced from plant species like oil palm, rice and Annatto seed.

Each analogue of tocotrienol are functionally unique, with α -, β -, δ -, and γ -tocotrienol each exerting different beneficial effects on health and disease that are separate from the biological functions of α -tocopherol.



Potent Anti-Inflammatory Agent



Tocotrienols have pronounced and potent effects on NF- κ B (key master regulator of inflammation) and STAT3 (master inflammatory transcriptional factor) to reduce inflammation^{2,3,4}.

Reference:
 1. Serbinova, E., Kagan, V., Han, D., and Packer, L. (1991). Free radical recycling and intramembrane mobility in the antioxidant properties of alpha-tocopherol and alpha-tocotrienol. *Free Radical Biology and Medicine*, 10: 263 – 275.
 2. Guang et al. (2015). *Am J Transl Res*; 7(9): 1612-1620
 3. Ng et al. (2012). *Food Chemistry*; 134: 920-925
 4. Aggarwal et al. (2010). *Biochem Pharmacol.*; 80(11): 1613-1631.

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info@davoslife.com | www.klkoleo.com/DavosLife