TECHNICAL MANUAL

TYR
ENDURANCE SPORT
Athletic Beverage Powered by EMIQ

Endurance athletics subject the human body to a significant amount of biological pressure including inflammation, infection and oxidative stress-induced muscle damage. Stresses from strenuous exercise can result in various short and long-term health consequences.

TYR Endurance Sport

Is a high caliber hydration system that combines endurance, performance and recovery ingredients to enable athletes to maximize and sustain their full potential for prolonged periods of time.

Full Spectrum Formula

Utilizes a Full-Spectrum Formula that incorporates 3 pillars:

Enzymatically Modified Isoquercitrin (EMIQ)

Improves Endurance and Recovery

Carbohydrate Complex

Enhances Performance, Absorption and Digestion

Epigallocatechin Gallate (EGCG)

Supports Metabolism

Jeukendrup, Asker E. (2011). Nutrition for Endurance Sports: Marathon, Triathlon, and Road Cycling. Journal of Sports Sciences, 29(S1), S91-S99.

- This study finds that if an athlete feels fatigued after a half hour or more of endurance exercise, it is very possible that their body is dehydrated and/or depleted of carbohydrates. Therefore, if an athlete wants to prevent the onset of fatigue, they should avoid dehydrating their body. Specifically, they should minimize body mass loss via sweating to 2-3%. Fatigue isn't the only factor that can cause an athlete's endurance exercise abilities to suffer. Gastrointestinal issues, which are common to endurance athletes, can zap your performance and cause serious health threats. You may be more prone to GI problems due to genetics, which you obviously cannot help. However, GI issues can also be caused by consuming certain things including fiber, protein, fat and very concentrated carbohydrate solutions.

Nieman, David C. (2009). Immune Function Responses to Ultramarathon Race Competition. Medicina Sportiva, 13(4), 189-196.

- Half a decade of research was conducted on 350 athletes participating in the 160-km Western States Endurance Run (WSER). This article focuses on the findings of this extensive study. One finding was that people who partake in vigorous endurance exercise are likely to experience inflammation, muscle trauma and oxidative stress. A second finding is that in the two weeks after WSER, 24% of the endurance athletes suffered from upper respiratory tract infections. Finally, the study found that 70% of WSER competitors used Ibuprofen, but they experienced the same amount of muscle damage and soreness as athletes who did not use the medicine. Additionally, Ibuprofen users experienced a higher level of plasma cytokines, endotoxemia, inflammation and kidney dysfunction.

Jeukendrup, Asker E, Jentjens, Roy L P G, & Moseley, Luke (2005). Nutritional Considerations in Triathlon. Sports Medicine, 35(2), 163-181.

Asker E. Jeukendrup, Roy L P G Jentjens, and Luke Moseley reported the following findings.

- When athletes participate in any length triathlon, one of the biggest contributors to fatigue is dehydration. If you are competing in a hot environment or experiencing excessive sweating for any reason, you will become dehydrated - and thus fatigued - quickly. Even a miniscule amount of water loss can zap your performance by decreasing your blood circulation, as well as your stroke and plasma volume. Studies estimate that reductions in body mass due to sweating of just 1-2% can result in a 44% performance reduction. To combat dehydration and fatigue, as well as all associated negative side effects, endurance athletes should place great importance on consuming the necessary amount of fluids. It is helpful to note that the cycling portion of a race is the ideal time to drink beverages. If you are racing in the heat, it is good to be hyperhydrated; this will boost thermoregulation and performance.

- Another major cause of fatigue in endurance athletes is the depletion of carbohydrates. There are a few ways to combat this problem. First, athletes can consume carbohydrates before they compete. This act will ensure that there is plenty of glycogen in the athlete's muscles, liver and stomach, which can be released into the bloodstream when it is needed. Athletes can also avoid depleting their carbohydrate supply by drinking smart while they are exercising. Make sure your drink has a 5-8% concentration of carbohydrate. This percentage will ensure that your body remains hydrated, while the working muscle receives carbohydrates. Ideally, you should be consuming 60-70 g of carbohyrdates per hour. In order to achieve the best possible absorption rate, the beverage should also have 30-50 mmol/L sodium.

- Athletes should be proactive in helping their body fully recover after a long race. Usually they won't have an appetite right after vigorous exercise, so consuming a beverage is an ideal choice to jump start recovery and rehydrate your body. The drink you consume after the race should have a sodium content of more than 60 mmol/L. Drink this fluid in a volume equal to 150% of the body mass you lost while exercising. The drink should also have a moderate to high glycaemic index for increased muscle glycogen synthesis, which is naturally restricted in the days following intense exercise. It is always important to consume fluids after a long race, but it is even more important if you raced in hot temperatures.

- It has been widely reported that water is not the most effective fluid to rehydrate an athlete's body. An isotonic beverage containing a 6% concentration of carbohydrates (similar to the levels that occur naturally in the human body) results in more effective fluid delivery than a beverage consisting of 100% H20 because the former offers optimized fluid transport harmonized with the human body. Also, having a beverage that an athlete wants to voluntarily and consistently drink is important, which means that having it taste good and flavorful is vital because the athlete is more likely to consume a flavored beverage than plain water.

ENZYMATICALLY MODIFIED ISOQUERCITRIN (EMIQ)

a superior form of Quercetin, is 100% water soluble and has been shown in pre-clinical studies to be absorbed by the body at higher rates than other forms of Quercetin.

Nieman, DC., Stear SJ., Castell, LM., Burke, LM (2010). A-Z of Nutritional Supplements: Dietary Supplements, Sports Nutrition Foods and Ergogenic Aids for Health & Performance: Part 15. British Journal of Sports Medicine, Vol. 44, 1202-1205.

- In vitro, purified flavonoids prove to be useful in decreasing inflammation and stress oxidation. In humans, flavonoids vary widely in bioavailability and most are poorly absorbed, which can alter their bioactive capacities.

Makino, T., Shimizu, R., Kanemaru, M., Suzuki, Y., Moriwaki, M., & Mizukami, H. (2009). Enzymatically Modified Isoquercitrin, a-Oligoglucosyl Quercetin 3-OGlucoside, Is Absorbed More Easily than Other Quercetin Glycosides or Aglycone after Oral Administration in Rats. Biological & Pharmaceutical Bulletin, 32(12), 2034-2040.

- Bioavailability is the degree and rate at which a substance is absorbed into a living system or is made available at the site of physiological activity. Quercetin has a low bioavailability because it is insoluble in water, which has limited its usage as a food additive or dietary supplement. In stark contrast, EMIQ - a superior form of Quercetin - exhibits the highest bioavailability among the glycosides examined in this study. Specifically, the bioavailability of EMIQ relative to Quercetin was 17.5X.

Akiyama, T., Washino, T., Yamada, T., Koda, T., & Maitani, T (2000). Constituents of Enzymatically Modified Isoquercitrin and Enzymatically Modified Rutin (Extract). Japan Food Hygiene Association, 41(1), 54-60.

- This report examined isoquercitrin and rutin (extract) that were enzymatically modified in order to study their structures. The conclusion was that enzymatically modified isoquercitrin consists of, not surprisingly, isoquercitrin, but also its a-glucosylated derivatives with 1-7 additional glucose moieties. Another conclusion was that enzymatically modified rutin (extract) was shown to consist of rutin.

QUERCETIN

is an anti-oxidant that promotes the body's natural ability to manage inflammation both during and after exertion for more stamina and faster recovery.

Nieman, DC., Stear SJ., Castell, LM., Burke, LM (2010). A-Z of Nutritional Supplements: Dietary Supplements, Sports Nutrition Foods and Ergogenic Aids for Health & Performance: Part 15. British Journal of Sports Medicine, Vol. 44, 1202-1205.

- This article focused on flavonoids, specifically their bioactive effects and effectiveness as performance and recovery aids. Flavonoids can be found naturally in certain fruits and vegetables. The average flavonoid intake for an American is 210 mg/day.

- Studies conclude that when an athlete consumes extracts full of flavonoids just before strenuous exercise or chronically in the days/weeks prior to exertion, oxidative stress, delayed onset of muscle soreness and immune dysfunction are reduced. In order to decrease exercise-induced oxidative damage, athletes must consume more antioxidants than non-athletes.

- When there is a perceived need to supplement dietary intake, athletes should select a mixture of many antioxidants/flavonoids in moderate amounts as opposed to consuming large doses of just one nutrient.

Nieman, David C. (2010) Quercetin's Bioactive Effects in Human Athletes. Current Topics in Nutraceutical Research, 8(1), 1-11.

- According to this article, when Quercetin was tested in vitro, it was revealed that it has immune regulatory properties that help to fight stress oxidation and inflammation. As a result, Quercetin has many effects that support athletic endeavors, with studies in human athletes focusing on boosting endurance performance and assisting the body's natural ability to combat post-exercise inflammation, oxidative stress, and infection.

Davis, Mark J., Murphy, Angela E., & Carmichael, Martin D. (2009). Effects of the Dietary Flavonoid Quercetin Upon Performance and Health. Current Sports Medicine Reports, 8(4) 00-00.

- Preclinical studies suggest Quercetin has biological characteristics that may improve mental and physical performance, including endurance exercise capabilities. It may also assist the human immune system to reduce infection risk associated with prolonged exercise. The clinical studies are inconclusive which is not uncommon in the early stages of testing nutritional supplements in humans. However, the findings provide compelling evidence and definitely warrant further research to determine a clearer role of Quercetin in health, performance and nutrition.

Nieman, David C., Henson, Dru A., Gross, Sarah J., Jenkins, David P., Davis, Mark J., Murphy, Angela E., Carmichael, Martin D., Dumke, Charles L., Utter, Alan C., Mcanulty, Steven R., Mcnaulty, Lisa S., & Mayer, Eugene P. (2007). Quercetin Reduces Illness but Not Immune Perturbations after Intensive Exercise. Medicine & Science in Sports & Exercise, 39(9), 1561-1569.

- A three week study was conducted, during which some cyclists received 1000 mgxd-1 of pure Quercetin and some received a placebo. Throughout the two weeks after strenuous exercise, only 5% of athletes who took the Quercetin experienced illness, compared to 45% of the placebo-ingesting athletes. The study concludes that Quercetin may assist the immune system's natural ability to decrease the rates of illness in athletes following extreme exercise.

CARBOHYDRATE COMPLEX

utilizes multiple gastrointestinal transport mechanisms to deliver more performance without digestive side effects.

Jeukendrup, Asker E. (2010). Carbohydrate and Exercise Performance- The Role of Multiple Transportable Carbohydrates. Current Opinion in Clinical Nutrition and Metabolic Care, 13(4), 452-457.

- This study found that a saturation of carbohydrate transporters can limit carbohydrate oxidation. To boost carbohydrate delivery and oxidation, athletes should consume a carbohydrate mixture that utilizes various intestinal transporters for absorption instead of just one. In support of this argument, studies showed that carbohydrate oxidation rates for a glucose/fructose mixture was up to 65% higher than glucose alone. Additionally, the absolute maximum exogenous carbohydrate oxidation rate was previously believed to be 1 g/min, but new studies with multiple transportable carbohydrates show rates of 1.75 g/min. In addition to increased carbohydrate oxidation, drinking multiple transportable carbohydrates also reduces fatigue and boosts fluid delivery, oxidation efficiency and athletic performance. One of the most important results of consuming a drink with multiple transportable carbohydrates is that the risk of GI issues and discomfort is reduced; this is because higher oxidation rates result in less carbohydrates remaining in the GI tract which leads to less discomfort and bloating. These benefits make it extremely useful to athletes who exercise for three or more hours.

Jeukendrup, Asker E., Currell, K., Clarke, J., Cole, J., & Blannin, A. K. (2009). Effect of Beverage Glucose & Sodium Content on Fluid Delivery. Nutrition and Metabolism, 6(9), 1-7.

- The goal of sports drinks is to make fluid available for use within the body as quickly as possible. This goal is achieved with a mix of carbohydrates and electrolytes. When drinking these sports drinks, an athlete's body should ideally be able to utilize fluids right away.

- This article focuses on fluid delivery and how it is affected by glucose and sodium content. Fluid delivery is decreased when a person drinks a beverage containing more than 6% carbohydrate concentration unless multiple transportable carbohydrates such as glucose and fructose are used. Fructose is absorbed by GLUT5 in the intestines whereas glucose is absorbed by SGLT1. Therefore, fluid absorption is increased through the inclusion of multiple carbohydrates that can take advantage of these different transport mechanisms.

- Upping the sodium content (0-60 mmol/L) in a drink containing 6% glucose did not increase fluid delivery. However, sodium is still a good ingredient to include in sports drinks since it helps with fluid retention. It also improves the taste, resulting in more voluntary drinking and thus stabilized body temperature and performance.

- Past studies revealed that a 6% carbohydrate electrolyte solution more efficiently delivers fluids than a 15% glucose solution. However, fluid delivery was the same for 6%, 8% and 10% glucose+fructose solutions.

Hulston, Carl J., Jeukendrup, Asker E. (2008). Substrate Metabolism and Exercise Performance with Caffeine and Carbohydrate Intake. Medicine & Science in Sports & Exercise, 40(12), 2096-2104.

- Several clinical studies have reported that caffeine enhances exercise performance. Recent studies show that caffeine, in addition to positive effects on exercise performance, may also increase the absorption and oxidation of carbohydrates during exercise. Combined ingestion of caffeine and carbohydrates led to a 4.6% increase in performance compared with carbohydrates alone and a 9% increase in performance compared with placebo.

- When athletes consume carbohydrates, it reduces their bodies' dependence on endogenous energy stores. However, the speed at which the body can absorb carbohydrates is limited by certain absorptive mechanisms in the intestines that can become saturated. Multiple carbohydrates rely on multiple absorptive mechanisms, reducing the chance that any one absorptive mechanism becomes saturated causing carbohydrate/fluid delivery to be compromised.

Currell, K., Jeukendrup, Asker E. (2008). Superior Endurance Performance with Ingestion of Multiple Transportable Carbohydrates. Medicine & Science in Sports & Exercise, 40(2), 275-281.

- When athletes consume carbohydrates during exercise, it boosts their performance. But for a while, it was thought that, even if an athlete eats/drinks quickly, exogenous carbohydrate oxidation rates could not exceed 1 g·min-1 due to the limitations of intestinal absorption mechanisms. However, new research reported in this article refutes this belief by demonstrating exogenous carbohydrate oxidation can be increased above 1 g·min-1 with the utilization of multiple transportable carbohydrate.

- A glucose/fructose mixture can enhance absorption due to reliance on diverse intestinal transporters. In fact, this study concludes that a carbohydrate drink consisting of glucose and fructose in a 2:1 ratio ingested at a rate of 1.8 g·min-1 caused an 8% improvement in performance compared with consumption of glucose alone at the same rate. This improvement is in addition to the 10% improvement in performance with glucose ingestion compared with water placebo.

EPIGALLOCATECHIN GALLATE (EGCG)

Is a catechin commonly found in Green Tea Extract that supports human metabolism, improving efficiency and increasing absorption of other ingredients.

Nieman, DC., Stear SJ., Castell, LM., Burke, LM (2010). A-Z of Nutritional Supplements: Dietary Supplements, Sports Nutrition Foods and Ergogenic Aids for Health & Performance: Part 15. British Journal of Sports Medicine, Vol. 44, 1202-1205.

- It is believed that the bioactive influences of several flavonoids mixed together (or flavonoids mixed with other nutrients) are more effective than a single flavonoid. An example of an effective mixture is the flavonol Quercetin combined with the flavanol EGCG. This study revealed that flavonoid-nutrient concoctions (such as quercetin with Green Tea Extract) and plant extracts that are full of different flavonoids help the immune system fight inflammation and exercise-induced oxidative stress. When there is a perceived need to supplement dietary intake, it makes sense to select a product that combines antioxidants, including flavonoids, at moderate levels instead of large amounts of just one nutrient.

Richards, Jennifer C., Lonac, Mark C., Johnson, Tyler K., Schweder, Melani M., & Bell, Christopher (2010). Epigallocatechin-3-gallate Increases Maximal Oxygen Uptake in Adult Humans. Medicine & Science in Sports & Exercise, 42(4), 739-744.

- Consumption of Green Tea Extract is purported by many studies to have extensive short and long term health benefits including weight loss and increased fat metabolism. Green Tea Extract contains 40% EGCG, a catechin shown to increase endurance in animals as well as fat oxidation during cycle ergometer exercise in humans. Another benefit of EGCG is increased VO2 max (the gold standard measure of endurance performance) which is the greatest rate at which a person can consume oxygen.

Nieman, David C. (2010) Quercetin's Bioactive Effects in Human Athletes. Current Topics in Nutraceutical Research, 8(1), 1-11.

- This study reports that there are many benefits to athletes ingesting a mixture of quercetin with additional plant foods, including Green Tea Extract. These benefits include decreased inflammation and exercise-induced oxidative stress as well as augmentation of innate immune function.

Nieman, David C., Henson, Dru A., Maxwell, Kendra R., Williams, Ashley S., Mcanulty, Steven R., Jin, F., Shanely, R. A., Lines, Thomas C. (2009). - Effects of Quercetin and EGCG on Mitochondrial Biogenesis & Immunity. Medicine & Science in Sports & Exercise, 41(7), 1467-1475.

- Flavonoids are superior antioxidants in vitro thanks to their low redox potential and ability to donate multiple electrons or hydrogen atoms. However, the antioxidant efficiency of flavonoids inside the body is compromised due to poor absorption, limited half-lives and first-pass metabolism. Nonetheless, Quercetin is a broadly active flavonoid that assists the immune system's natural ability to fight inflammation and stimulates muscle mitochondria. These benefits are especially useful to endurance athletes. A growing body of evidence supports the notion that Quercetin is more powerful and effective in fighting inflammation when mixed with certain other foods/nutrients/flavonoids, including EGCG, Isoquercetin, DHA and EPA.

Venables, Michelle C., Hulston, Carl J., Cox, Hannah R., Jeukendrup, Asker E. (2008). Green Tea Extract Ingestion, Fat Oxidation, and Glucose Tolerance in Healthy Humans. The American Journal of Clinical Nutrition, 87(3), 778-784.

- Green Tea contains catechins, which comprise Epicatechin Gallate, Gallocatechin Gallate and EGCG (the most pharmacologically active). Many studies have demonstrated that drinking Green Tea can enhance exercise abilities and boost fat oxidation. This particular study reports, while exercising at average levels, drinking Green Tea can boost fat oxidation and improve insulin sensitivity and glucose tolerance in young, healthy males. In fact, after consumption of Green Tea, average fat oxidation rates were 17% higher compared to people who consumed a placebo. Drinking green tea also increased the contribution of fat oxidation to the total energy expended by 17% compared to non-tea drinks. It is important to note that this report studied effects during exercise, not at rest. During exercise, there is an increase in fat oxidation and hydrolysis of fats into fatty acids and glycerol. Despite this increase, drinking Green Tea can boost fat metabolism during exercise.

Hill, A.M., Coates, A.M., Buckley, J.D., Ross, R., Thielecke, F., Howe, P.R.C. (2007). Can EGCG Reduce Abdominal Fat in Obese Subjects? Journal of the American College of Nutrition, 26(4), 396S-402S.

- Green Tea Extract (contains 40% EGCG and 15% caffeine) increases fat oxidation and energy expenditure particularly in the presence of a metabolic stimulant such as caffeine.

- There are metabolic and circulatory synergies to combining EGCG with caffeine. The benefits closely mirror the benefits associated with aerobic exercise. To reap the greatest possible benefits from consuming EGCG, one should partake in regular exercise.

- This study found that, when compared with a cellulose placebo, caffeine/EGCG doses resulted in an 8% boost in 24 hour energy expenditure. When compared with caffeine alone or a placebo, caffeine/EGCG doses resulted in a 4% increase in 24 hour energy expenditure. The caffeine/EGCG mixture showed exponential synergism in enhancing fat oxidation.

- This study concludes that overweight individuals who partake in regular exercise and drink a moderate amount of EGCG can decrease their heart rate and concentrations of plasma glucose, increasing their overall metabolic health. Drinking a larger amount of EGCG may help these individuals lose body fat.

Murase, T., Haramizu, S., Shimotoyodome, A., Nagasawa, A., Tokimitsu, I. (2004). Green Tea Extract Improves Endurance Capacity & Increases Muscle Lipid Oxidation in Mice. American Regulatory Journal of Physiology, 288, R708-R715.

- Green Tea Extract improves endurance capacity, depending on the amount consumed. This article questions how Green Tea Extract improves endurance capacity, observing that EGCG alone increases endurance but Green Tea Extract (including EGCG, caffeine, and other catechins) seems to lead to even greater improvements in endurance capacity. The exact mechanism by which Green Tea Extract improves athletes' endurance capacity remains unknown. Regardless of the lack of understanding, it is established in many research studies that Green Tea Extract improves endurance performance and stimulates fat metabolism.

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