EFS Research Packet

Rev. 2.0, Feb 2006

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Corporate Philosophy

Our Mission

Integrate our passion for racing, knowledge of sports nutrition, integrity, and values to provide endurance athletes with the ultimate, scientifically validated, high-performance racing formulations.

Research Philosophy

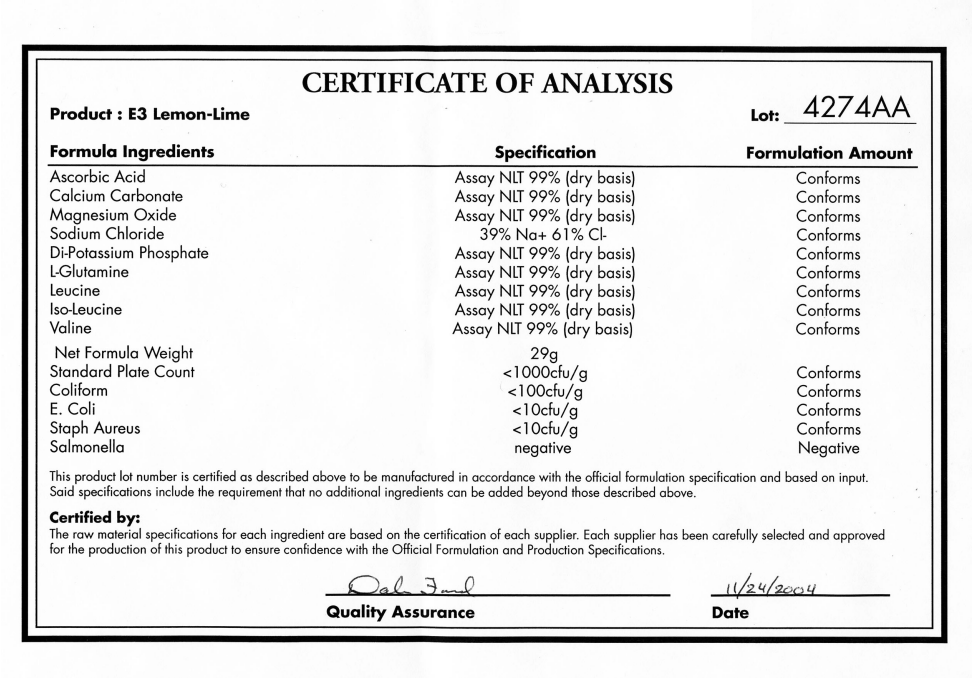
Research is the most important value at First Endurance. We are driven by a desire to ensure our products are proven to enhance endurance performance and have scientific validation. At First Endurance, we refuse to reduce costs by using "pixie dust" amounts of ingredients just to dress up the label. Our formulations utilize the same levels (sometimes more) of the active ingredients that were used in the actual human scientific research. We assure effective products by using the same ingredients used in the human clinical studies. We are meticulous about research and go out of our way to make sure we have addressed each of our stringent requirements. All products that First Endurance develops are based on human scientific research.

Commitment to Quality

First Endurance uses only the finest ingredients and follows stringent quality control. Supplements can be easily ruined. Even if you buy the right ingredients, they can degrade quickly and lose their efficacy if they aren't handled under the most stringent controls. We are determined to ensure nothing goes wrong with any step of the way. EFS is manufactured under the highest manufacturing guidelines assuring potency and strict quality control. Not only do our manufacturing facilities not allow banned substances, we take additional steps to assure complete cleanliness.

Certificate of Analysis

A Certificate of Analysis (C of A) is a document which states every active and inactive substance used to manufacture a product. A C of A also shows that there are no additional ingredients added to the EFS formulation.



CERTIFICATE OF ANALYSIS

Product : E3 Lemon-Lime **Lot:** 4274AA

Formula Ingredients	Specification	Formulation Amount
Ascorbic Acid	Assay NLT 99% (dry basis)	Conforms
Calcium Carbonate	Assay NLT 99% (dry basis)	Conforms
Magnesium Oxide	Assay NLT 99% (dry basis)	Conforms
Sodium Chloride	39% Na+ 61% Cl-	Conforms
Di-Potassium Phosphate	Assay NLT 99% (dry basis)	Conforms
L-Glutamine	Assay NLT 99% (dry basis)	Conforms
Leucine	Assay NLT 99% (dry basis)	Conforms
Iso-Leucine	Assay NLT 99% (dry basis)	Conforms
Valine	Assay NLT 99% (dry basis)	Conforms
Net Formula Weight	29g	
Standard Plate Count	<1000cfu/g	Conforms
Coliform	<100cfu/g	Conforms
E. Coli	<10cfu/g	Conforms
Staph Aureus	<10cfu/g	Conforms
Salmonella	negative	Negative

This product lot number is certified as described above to be manufactured in accordance with the official formulation specification and based on input. Said specifications include the requirement that no additional ingredients can be added beyond those described above.

Certified by:

The raw material specifications for each ingredient are based on the certification of each supplier. Each supplier has been carefully selected and approved for the production of this product to ensure confidence with the Official Formulation and Production Specifications.

Quality Assurance — Date 11/24/2004

Safe and Legal

First Endurance is committed to developing the most advanced endurance supplements on the market. First Endurance has taken additional measures to assure that our products are safe legal and stimulant free. First Endurance supplements are legal to use in any sporting event governed by the World Anti-Doping Association (WADA), the US Anti-Doping Association (USADA) and by the UCI (Union Cycliste International). One or more of the aforementioned governing bodies govern all US Cycling, International Cycling, US Triathlon and International Triathlon and USTF.

Some commonalties among these governing bodies include banned substances which fall into one or more of the following categories as listed in Section I A-E of the UCI Prohibited Classes of substance and Prohibited Methods document. A) Stimulants B) Narcotics C) Anabolic agents D) Diuretics and E) Peptide hormones, mimetics and analogues. This document goes on to list banned substances within each of these classes. Regulations also ban 'Compounds chemically or pharmacologically related to the products mentioned'.

First Endurance products contain NO ingredients which are explicitly listed under the banned substance list, and none of the ingredients are related chemically or pharmacologically. First Endurance has also contacted the USADA and received verbal confirmation that our ingredients are not banned based on their regulations. Note: USADA, WADA and UCI do not offer any certification or written confirmation.

First Endurance manufactures its formulations to the highest GMP (Good Manufacturing Practice) standards available. In addition, a proprietary manufacturing method is used for added safety and assurance.

All ingredients used in First Endurance formulations come from audited suppliers who do not carry, broker or supply any banned substances. In addition our manufacturing facility does not allow banned substances in any products manufactured.

Part XIV Article 7 of the Anti-doping Examination Regulations contains the following warning:
riders must refrain from using any substance, foodstuff or drink of which they do not know the composition. It must be emphasized that the composition indicated on a product is not always complete. The product may contain prohibited substances not listed in the composition.

For a complete list of regulations and banned substances please use one of the following links:

UCI Banned Substance List
WADA
USADA

Use Directions: Mix one scoop (29g) with 12oz cold water. Take one serving every 30 minutes, during long or exhaustive exercise. A small water bottle is generally 18oz (1 ½ servings)

Supplement Facts
Serving Size: 1 scoop (29g)
Servings per Container: 25

Supplement Facts

Serving size 1 scoop (29g): makes 12 fluid ounces

	Amount Per Serving	%DV*
Calories	96	
Calories from fat	0	
Total fat	0 g	0%
Cholesterol	0 g	0%
Total Carbohydrate (Complex carbohydrates, Sucrose, Dextrose)	24 g	9%
Sugars	16g	**
Vitamin C (as ascorbic acid)	120mg	200%
Calcium (as calcium carbonate)	100mg	10%
Magnesium (as magnesium oxide)	150mg	38%
Chloride (as sodium chloride)	380mg	4%
Sodium (from sodium chloride)	250mg	12%
Potassium (as di-potassium phosphate)	160mg	5%
Amino Acid Blend (L-Glutamine, Leucine, Iso-Leucine, Valine)	2000mg	*

*Daily Value Not Established
**Percent Daily Values are based on a 2,000 calorie diet.

About EFS-*Energizing Sports Drink*

EFS is an energy drink at the forefront of endurance nutrition that combines the latest clinical research with input from elite endurance athletes. Containing an ideal blend of simple and complex carbohydrates, amino acids, antioxidants and electrolytes, EFS provides endurance athletes the nutrients they need to fuel working muscles and increase endurance during exercise.

Energy = Carbohydrates

Consuming carbohydrates during prolonged exercise enhances performance by supplying energy for muscles to use when glycogen stores begin to drop. EFS was specifically formulated to deliver the ideal blend of complex carbohydrates, glucose (dextrose) and sucrose for energy. Clinical research shows a combination of carbohydrates is better than a single source for the absorption and utilization of blood glucose (Guezennec, C.Y, et.al.). EFS also provides three different high-glycemic sources of carbohydrates for immediate energy and easy digestion during long and intense workouts. The low osmolality of the EFS energy drink and ideal 7% carbohydrate solution provides superior fluid absorption. Clinical research shows that energy drinks mixed between 6-8% offer the optimal absorption of *both* carbohydrates and fluid for endurance racing and training (Shi, K et al.). The biochemical structure of the carbohydrate, the absorption process, the size of the food particle, the degree of processing, the contents and timing of the previous meal, and the co-ingestion of fat, fiber, or protein affect a carbohydrates absorption and glycemic index. (Guezennec, 1995).

GI during exercise

Much research has focused on carbohydrate drinks and foods during exercise to slow the depletion of the body's carbohydrate stores and thus delay the onset of fatigue. While the availability of carbohydrate for use within the cells is extremely important, much of the regulation of glucose concentration rests not solely with the type of carbohydrates ingested, but in the hormonal regulation of glucose. Among the hormones that are especially important to glucose concentrations are insulin, glucagon, epinephrine, and cortisol. Exercise-induced elevation in epinephrine depresses the release of insulin from the pancreas. Thus, concerns about carbohydrate feedings increasing insulin and depressing fatty acid availability is less likely to occur when carbohydrate is fed during exercise. Exercise, in addition to carbohydrate type and timing of ingestion, also modulates the release of these hormones. Exercising at or above threshold can dramatically reduce your body's ability to properly digest foods (due to the pooling of blood to the exercising muscle). During these times it is best to consume carbohydrates and foods that are easily digested = High GI.

A recent research study has indicated that during a time trial effort, a carbohydrate drink mouth rinse (not consumption) actually improved performance during a 1-hour cycle TT. The authors feel that additional motivation that occurred when having a mouth rinse with a carbohydrate drink might have provided the benefit compared to a water only rinse (Carter, J.M. A.E.et al.).

Conversion

The ability to rapidly replenish carbohydrates after training, and the ability to consume and convert ingested carbohydrates into a usable form of carbohydrate, is important in allowing you to train and compete at your best. Ingestion of the wrong carbohydrates at the wrong time, or ingesting too little carbohydrate can impair performance both in the short term and long term. Consuming a slow**ly** digested carbohydrate during times where the body is at, or above threshold can lead to disaster. During times where you exercise or race at and above your threshold, your blood circulation is focused on the working muscles and away from the stomach. This makes digestion of foods difficult. In fact, consuming a slowly absorbed sugar during these times will slow gastric emptying (the emptying of fluids and foods from the stomach to the blood stream) and in essence block fluids from being absorbed. Thi**s** can actually cause dehydration.

How do sugars differ?
Conventional wisdom says that since all carbohydrates are eventually digested and absorbed as glucose, the original food source of the sugar, whether a bean or a candy bar, matters little. Sugar is sugar. Sucrose is sucrose. Not exactly!

Fructose
Fructose has a GI of 20±5 and is a simple sugar (monosaccharide) like glucose and galactose. Natural sources of fructose include honey and fruits. Fructose is 75% sweeter than glucose and is generally found in honey and fruits in addition to its many uses as a food-sweetening additive. It is absorbed more slowly into the bloodstream than straight glucose and sucrose and, therefore, has a less erratic effect on blood sugar levels (at rest). Diabetics or those that are very sensitive to changes in blood sugar find fructose to be advantageous. But, as a result of its slow absorption, beverages that contain fructose can cause gastric upset and slow gastric emptying. Research suggests that fructose is more tolerable when combined with sucrose and glucose. Avoid beverages that list "high fructose corn syrup" as primary ingredients as they will slow fluid uptake and not provide optimal sugars to support exercise energy requirements. As a pre-exercise meal, or between workouts, fructose is an excellent source of carbohydrates.

Galactose
Galactose is a simple sugar that has recently shown up in sports drinks. Lactose is the primary sugar in dairy products and is composed of one molecule of glucose and one of galactose. Because of its galactose content, it is more slowly absorbed into the bloodstream than pure glucose and is therefore more blood-sugar-friendly. *The GI of Galactose could not be found on any of the official GI lists, though G-Push (a popular sports drink) does claim that Galactose is absorbed quickly like glucose without a subsequent increase in insulin release. This is not confirmed with clinical studies.

Glucose
In terms of immediate use of carbohydrate within the body, glucose (a monosaccharide) with a GI of 99±3 is the most important. Glucose can be directly absorbed by the small intestine and directly transported to the cells to be metabolized. Glucose can also be stored as glycogen (chains of glucose) within muscles and the liver, and can also be converted to fats for energy storage. During exercise, consumption of glucose allows the body to maintain an adequate supply of carbohydrate for metabolism. Glucose is often called dextrose when it is added to foods. The body eventually breaks down all sugars and carbohydrates into glucose, which is the form in which sugar enters cells to be used for energy. During times of exercise at or above threshold, glucose can be easily digested.

Sucrose
With a GI of 68±5 (otherwise known as table sugar), Sucrose is composed of one molecule of glucose and one molecule of fructose. This is the white sugar that comes in many forms, such as powdered or granulated. It is usually made from refining extracts of sugar beets or sugar cane.

Maltodextrin aka Glucose polymers GI=99±3:
Lactose GI=46±2
Maltose GI=105±12
Honey GI=55±5
Gatorade® GI=78±13

Energy/Carbohydrate References

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Glycemic Index scores: http://diabetes.about.com/library/mendosagi/ngilists.htm

Electrolytes

Electrolytes, the mineral salts that conduct the electrical energy of the body, perform a cellular balancing act by allowing nutrients into the cell, while excreting waste products. Certain elements, sodium, chloride, magnesium, calcium and potassium, play a primary role in cellular respiration -- that of muscle contraction and nerve impulse transmission. It is at the cell membrane where these electrolytes conduct electrical currents similar to nerve impulses. Hydration is the medium which aids electrolyte transport and is crucial for both the health and performance of the cell. Your hydration state is mostly dependent upon water intake or loss thru sweat but is also heavily influenced by electrolyte status.

Sweat
Endurance performance is compromised greater by warmer temperatures than cooler temperatures. Here's why: to control an excessive rise in body temperature, the blood flow to the skin increases in order to dissipate heat to the environment. This shift of blood to the skin will result in a lesser proportion of blood, and hence oxygen, being delivered to the working muscle. In some individuals the circulatory adjustments may not be adequate and the body temperature will rise rapidly, leading to hyperthermia (excessive body heat). Individual sweat rates vary, but those that sweat early, heavily, and cake with salt tend to be more prone to muscle cramps during exercise (Burke, 2001). Evaporation of sweat in a hot environment can purge as much as 3 liters an hour. Alberto Salazar reportedly lost an average of 3.7 liters per hour of sweat during the hot and humid 1984 Olympic Marathon in LA (Armstrong et al. 1986). About 99% of sweat is water, with a number of major electrolytes found in varying amounts. Since sweat is derived from the extracellular fluid (fluid outside the cell) the major electrolytes found are sodium and chloride. The concentration of salt in sweat is variable, but averages about 2.6 grams per liter of sweat loss. Potassium, magnesium, calcium, iron, copper, zinc, amino acids and some of the water-soluble vitamins can also be found in sweat.

Too much water?
Hyponatremia is defined as a decrease in sodium concentration in the blood, which can have adverse effects on muscle contraction and performance. One study observed 27% of participants following a three-day cycling stage race competition were hyponatremic. Symptoms of hyponatremia include headache, nausea, muscle cramping, fatigue, and possibly death. Although there may be many causes of hyponatremia, the most common one for athletes is over-hydration. Athletes tend to super-hydrate in the days leading up to a race without an appropriate increase in electrolytes. In some cases, super-hydrating can produce hyponatremia prior to the race ever starting. However, drinking only water during a race can also causes hyponatremic conditions because the body requires electrolytes to effectively maintain hydration status. Hyponatremia, rare in events lasting less than 4 hours, has been shown in recent medical studies of slower marathon runners and ultra-distance triathletes to be at least as problematic and dangerous...if not more so...than dehydration.

Sodium and Chloride
Sodium is one of the principle positive ions in the body's fluid and is found primarily outside the cell (extracellular). Chloride, another extracellular electrolyte, is a negative ion and works closely with sodium in the regulation of body-water balance and electrical impulses across the cell membrane. Consuming adequate amounts of sodium and chloride, more commonly known as table salt, is crucial to maintaining the volume and balance of fluids outside your body's cells and in your blood. Sodium is especially important because it plays a key role in transporting nutrients into cells to be used for energy production, tissue growth, and repair. Sodium also assists in muscle contraction and nerve impulse transmissions. During exercise, your body loses fluids and sodium through sweating. This causes a decrease in your blood

volume, thereby increasing sodium and chloride concentrations in the blood. The increased concentration of electrolytes in the blood through decreased blood volume is what triggers the thirst mechanism. By the time you have become thirsty your electrolytes are already out of balance, so restoration of blood volume is critical for the prevention of dehydration. While water consumption is effective in increasing your blood volume, there is a consequential dilution of sodium in your blood due to the increased blood volume and excessive sodium losses in sweat so electrolyte replenishment is key. Drinking fluids with added electrolytes instead of just plain water is the best option, particularly when your exercise bout lasts longer than one hour and is in a hot or humid environment.

Potassium
Potassium is the main electrolyte found inside the body's cells (intracellular) and stored in muscle fibers along with glycogen. It plays a key role by helping transport glucose into the muscle cell. Potassium also interacts with both sodium and chloride to control fluid and electrolyte balance and assists in the conduction of nerve impulses. When glycogen breaks down to supply energy for your workouts, muscle cells are depleted of potassium. As a result, there is a greater concentration of potassium in your blood and greater quantities are lost in the urine. Symptoms of potassium depletion include nausea, slower reflexes, irregular heartbeat, drowsiness, and muscle fatigue and weakness. Although potassium deficiencies are rare, they may occur under certain conditions -- during fasting, diarrhea and when using diuretics. Replenishing lost potassium after exercise is important, but hyperkalemia (high serum potassium levels) can cause electrical impulse disturbance, irregular heart beat, and possibly death. Individuals should never take potassium supplements in large doses without the advice of a physician.

Calcium
Calcium is an electrolyte that may be overlooked. The skeleton is the major reservoir of calcium in the human body. Besides building teeth and bones, calcium is needed by many other cells to perform different functions in the body: contraction and relaxation of muscle, nerve conduction, secretion of hormones, enzymatic reactions, and blood coagulation. Calcium plays a central role in both the synthesis and breakdown of muscle glycogen and liver glycogen. Blood calcium levels are tightly regulated by hormones at the expense of bones. Many do not realize that bones are constantly being broken down and rebuilt through the processes of resorption and formation. The National Academy of Sciences recommends the following calcium intake levels for different age groups: 500mg for 1-3year olds, 800mg for 4-8 year olds, 1,300mg for those aged 9-18, 1,000mg for ages 19-50 years, and 1,200mg for those over 50 years of age. Endurance athletes may require even greater levels. Dairy products like milk, cheese and yogurt are excellent sources of dietary calcium because they are also fortified with vitamin D which is necessary for optimal absorption of calcium into the body. Low serum levels of calcium can cause a number of problems, including muscular cramping due to an imbalance of calcium in the muscle and surrounding fluids. Muscular contraction and exercise performance in active individuals is also compromised with low serum calcium. In addition to calcium intake, athletes should be aware that weight-bearing exercise is beneficial the maintenance of a healthy skeleton. Non-weight bearing sports like bicycling and swimming have been associated with bone mass similar to or below that of normal sedentary people (Duncan, 2002; Heinonan, 1993; Warner, 2002; Taaffe, 1995 & 1999). So, remember to fit in some weight bearing exercise and consume varied sources on calcium in your diet!

Magnesium
Magnesium is an element found in every cell in your body, with the largest concentrations found in the bones, muscles, and soft tissues. Magnesium forms part of 300+ enzymes involved in nerve impulse transmission, muscle contraction, and ATP (or energy) production. Increased levels of exercise deplete your body's stores of magnesium so it is crucial to replenish what you have lost. Investigators suggest that prolonged exercise increases the loss of magnesium from the body via urine and sweat. Signs of magnesium depletion include dizziness, muscle weakness, fatigue, irritability, and depression.

Electrolyte Chart

	Extracellular (mmol/L)	Sweat (mmol/L)	Intracellular (mmol/L)
Sodium	137-144	20-80	10
Potassium	3.5-4.9	4.0-8.0	148
Calcium	4.4-5.2	3.0-4.0	0-2.0

Magnesium	1.5-2.1	1.0-4.0	30-40
Chloride	100-108	30-70	2

From Maughan and Shirreffs, 1998. Fluid and electrolyte loss and replacement in exercise. In Oxford textbook of sports medicine, 2nd Edition. Edited by Harris, Williams, Stanish, and Micheli. New York: Oxford University Press, pp. 97-113.

Endurance athletes have different fluid and electrolyte needs particularly during longer and higher intensity training sessions and competition. The composition of standard sport drinks may not provide an adequate amount of electrolytes during activity lasting longer then 2 hours. The increased loss of sweat translates into an increased loss of electrolytes. As previously mentioned sodium is one of the important electrolytes that needs to be replaced during exercise to prevent dehydration and hyernatraemia. Most standard sports drinks contain 50- 110 mg (200-460 mg/liter) of sodium per 8 oz. Because we are limited on the amount of fluid the body can absorb by the intestines, it may be important to consume a higher amount of sodium during exercise to minimize fluid loss. The body can tolerate a higher sodium intake (closer to the amount lost in sweat) and it does not appear to negatively affect carbohydrate absorption.

Comparison of the Electrolyte Content between Standard Sport Drinks and Endurance Specific Sport Drinks

Electrolyte	Sweat Loss mg/L	Standard Sport Drink mg/L	Endurance Specific Sport Drink mg/L
Sodium	900-2600	200-450	800-1110
Potassium	100-200	80-125	390-650
Magnesium	60-260	0	10-615
Chloride	900-1900	0	390-1550
Calcium	50-100	0	250-500

Electrolyte References

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Endurance: *Free Form Amino Acids*

Free Form Amino Acids vs Protein
New research done in 2003 and 2004 indicates that supplementing with protein during exercise improves time to exhaustion (Ivy, Saunders) and reduces post exercise muscle damage (Saunders).

> Ivy, J.L. et al. (2003). Effect of a carbohydrate-protein supplement on endurance performance during exercise of varying intensity. *International Journal of Sport Nutrition and Exercise Metabolism, 13,* 388-401.
>
> Saunders, MJ et al. (2004). Effects of a carbohydrate-protein beverage on cycling endurance and muscle damage. *Med. Sci. Sports Exerc.,* Vol. 36, No. 7, 2004.

In these two Protein studies, the Scientists were unable to explain why time to exhaustion increased but postulated that the reason was due to a greater sparing of muscle glycogen, which would provide a greater reserve during exercise, however, the insulin responses to the carbohydrate and carbohydrate/protein supplements were not different. In addition, carbohydrate oxidation was similar in both groups, which would suggest that the utilization of muscle glycogen was also similar. Scientist are left to hypothesize that another mechanism may be involved in producing enhanced performance.

1. Central fatigue hypothesis. During exercise, branched chain amino acids (BCAAs) decrease and tryptophan, a precursor to serotonin, competes with BCAAs. What this means is that tryptophan overpowers BCAAs and crosses the blood brain barrier rather than BCAAs, increases serotonin in the brain and lowers brain activity and possibly causes central body fatigue. Some studies show that the addition of BCAAs during exercise will improve endurance exercise performance while others do not and a definitive consensus has not been reached regarding this topic.

2. Maintain Krebs Cycle intermediates. This is a relatively new hypothesis in this area. The authors speculated that the addition of protein during exercise could provide precursors for the reactions required to maintain the Krebs Cycle (this is one of the metabolic cycles that is responsible making energy to supply the muscles during exercise). As exercise duration increases, the precursors, specifically 2-oxoglutarate and oxaloacetate, for the Krebs Cycle reactions decrease to critically low levels and therefore decrease energy production. Although carbohydrate supplementation is thought to assist this process somewhat, it may not be as efficient as once thought when the proper amino acids are provided.

While the claims for improved performance can be clearly supported, the generalization that Protein is the reason for the benefit may be misleading. Protein naturally contains Branched Chain Amino Acids and Glutamine. Clinical evidence supporting the use of Branched Chain Amino acids and Glutamine during exercise dates back to 1991. These clinical studies clearly indicate supplementing with as little as 1g Free Form Amino Acids improved performance, reduced post-exercise muscle damage, improved muscle glycogen re-synthesis, reduced central fatigue and improved rate of perceived exertion. These are the same claims made by the ‘NEW’ Protein study and clearly support a mechanism for improved performance.

Glutamine
Glutamine is the most abundant amino acid in the body, accounting for greater than 60% of the total intramuscular free amino acid pool. Virtually every cell in the body uses this non-essential amino acid. Glutamine is synthesized in both skeletal muscle and in adipose tissue in addition to the lungs, liver and brain. Because the body has the ability to produce glutamine it has long been considered a non-essential amino acid, which simply means the body has a mechanism to produce this powerful amino acid. However, there is evidence that, during times of stress, the body cannot produce enough glutamine to keep up with demand which in turn can reduce performance, immune function and mood. As a result, glutamine has recently been classified as a conditional non-essential amino acid. Glutamine offers a significant benefit to exercising individuals and those looking to increase lean muscle mass and decrease body fat. Supplemental glutamine can help promote cell volumization, the phenomenon of drawing of water INSIDE muscle cells which can help increase muscle "fullness", increase protein synthesis (the making of proteins), and decrease proteolysis (the breakdown of protein).

Glutamine and overtraining
Intense physical exercise drains Glutamine stores faster than the body can replenish them. When this occurs, the body breaks down muscles and becomes catabolic. Clinical evidence supports supplementation with glutamine for recovery, glycogen storage & transport, synthesis of other amino acids and to reduce the catabolic effects of overtraining. Its been proven that glutamine levels in the serum are dramatically reduced following exhaustive exercise. With reduced glutamine levels performance and recovery are also compromised.

Conditions of severe stress such as exposure to extreme altitude, massive trauma, and burns have been shown to decrease glutamine concentrations similar to the reductions noted in endurance athletes after training and competition. Supplementation with glutamine has been shown to improve recovery rates in these patients, and has also been linked to improve gut function. The evidence for maintenance of healthy immune function is one more great benefit to glutamine supplementation. A strict and strenuous training program, which does not allow for enough time to recover, may cause an athlete to experience overtraining syndrome (OTS). Researchers have effectively correlated OTS to amino acid imbalances. Decreased performance, decreased mood, and increased incidence of infections characterize these amino acid imbalances caused by OTS. Significantly decreased plasma glutamine concentrations have been observed after prolonged exercise in healthy athletes as well. Athletes who exercise extensively and are suffering from OTS may become immuno-suppressed leading to infection and increased upper respiratory tract infections (URTI). Supplementing with glutamine in order to maintain normal levels of intramuscular glutamine is critical in maintaining a strong immune system AND preventing the breakdown of skeletal muscle and catabolism (the breakdown of muscle).

Supplementation vs. Foods
Most naturally occurring food proteins contain only 4 to 8% of their amino acid as glutamine. Though glutamine is available in small quantities from a variety of foods, it is easily destroyed by cooking. Raw vegetables can be a good source of glutamine though evidence suggests that dietary glutamine is not easily absorbed through the intestine. On the contrary a stable form of glutamine from dietary supplements has a better absorption rate.

Branched Chain Amino Acids
Low levels of branched chain amino acids (BCAAs) may contribute to fatigue so BCAAs should be replaced within two hours or less following exercise. These include the essential amino acids leucine, isoleucine, and valine. They are very popular among athletes and there is some research validating their use. Numerous research studies have shown these three key amino acids are extremely important to consume, especially during dieting and exercising (and according to one study, BCAAs are even more important when exercising in the heat). During exercise, the body uses a mix of glucose, fats, and even protein as a fuel source. When diet and carbohydrate intake is lower than normal, the percentage of protein the body uses for fuel (specifically Leucine, Isoleucine, and Valine) dramatically increases. The body will pull those needed amino acids from the continuously circulating pool of amino acids in the bloodstream. And if not replenished from an outside source, i.e. specific amino acid ingestion in the form of BCAAs, the body will breakdown other areas of the body in order to supply this pool. Studies have shown that subjects who consume an effective dose of BCAAs while endurance training have greater levels of lean muscle

mass retention than control subjects who ingest a placebo (and typically *lose* muscle during the same dieting period). Additionally, BCAAs form antibodies that combat invading bacteria and viruses. The body cannot manufacture its own BCAAs, so they must be supplied through diet and supplementation. BCAAs have also been studied for their ability to improve exercise capacity in heat. In a 1998 study, subjects supplementing with BCAAs significantly improved moderate exercise performance in the heat.

BCAAs and Central Fatigue

Branched Chain Amino Acids are also associated with a syndrome termed *central fatigue*. Following exhaustive exercise, BCAAs are depleted from the working muscle and from the circulating pool of amino acids. This depleted state causes an imbalance of the BCAA to Tryptophan (another amino acid) ratio. . When BCAAs are low, Tryptophan (a precursor to serotonin) is more readily available and can cause increases in serotonin. Low levels of BCAAs cause an increase in serotonin, which causes a feeling of sleepiness and lethargy It is this imbalance that can cause an athlete to become lethargic and almost sleepy. Supplementing with higher levels of BCAAs will help stop the Tryptophan/serotonin mechanism. All whey protein supplements contain Tryptophan, however only some will actually disclose an amount on the label. An effective supplement should contain at least three grams of BCAAs and minimal levels of tryptophan.

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Antioxidants

Through training as athletes more oxidative stress is caused than in the average individual. In fact, studies have shown that endurance and strength training athletes produce more free radicals than sedentary individuals. This oxidative stress not only causes damage to cells and DNA, it may also limit aerobic capacity. Antioxidant supplementation helps maintain the integrity of cell membranes, allowing oxygen to be carried more efficiently and effectively to the working muscles. Damage to membranes may compromise the blood's oxygen carrying capacity, negatively affecting aerobic performance. Antioxidants like vitamin C also have powerful immune enhancing properties, beneficial because intense exercise may cause a suppressed immune system in athletes. For example, after an intense aerobic bout phlegm and coughing may last a few hours or a few days. Vitamin C may help combat this suppressed immune function allowing an athlete to train at a higher level day in and day out.

Because of the wide variety of reactions in which vitamin C plays a role, many structure/function claims can be made for supplements. Perhaps the most well known function of vitamin C is as one of the key nutritional antioxidants – where it protects the body from free radical damage. As a water-soluble vitamin, ascorbic acid performs its antioxidant functions within the aqueous compartments of the blood and inside cells and can help restore the antioxidant potential of vitamin E (a fat-soluble antioxidant).

Vitamin C is thought to strengthen the cell membrane, thereby preventing the viruses from entering the cell. In addition, vitamin C supports immune cell function, an effect which may help fight infections in their early stages. The combined effects of cellular strengthening, collagen synthesis and antioxidant protection are thought to account for the multi-faceted approach by which vitamin C helps to maintain health.

A number of smaller targeted studies, however, in subjects under heavy acute physical stress, show that vitamin C decreases common cold incidence by half. In other studies, healthy subjects consuming low levels of vitamin C (below 60 mg/day), have a cold incidence that is about one-third lower following vitamin C supplementation. Vitamin C, mainly known for its antioxidant properties and ability to fight infection, may also have some anti-cortisol effects.

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EFS Q & A

Q: What is EFS?
A: EFS is a new energy drink that provides endurance athletes with the nutrients they need to fuel working muscles and increase endurance during exercise. The EFS formula utilizes the latest clinical research on endurance nutrition and input from some of the best endurance athletes in the world.

Q: I've heard that there are benefits to having protein during exercise. Why doesn't EFS contain protein?
A: EFS contains 2g Free Form Amino Acids per serving which is the equivalent in BCAA and Glutamine profile to 9g Whey Protein. Protein naturally contains Branched Chain Amino Acids and Glutamine. Clinical evidence supporting the use of Branched Chain Amino acids and Glutamine during exercise dates back to 1991. These clinical studies clearly indicate supplementing with as little as 1g Free Form Amino Acids improved performance, reduced post-exercise muscle damage, improved muscle glycogen resynthesis, reduced central fatigue and improved rate of perceived exertion. These are the same claims made by the 'NEW' Protein study and clearly support a mechanism for improved performance.

The First Endurance Research Board sides with the abundance of clinical studies supporting improved endurance performance while supplementing with Amino Acids during exercise. In addition to the clinical support, other factors lead to a decision to use these Free Form Amino Acids over complete proteins.

- Proteins are more difficult to digest than Amino Acids during exercise
- Proteins don't taste very good during exercise
- Proteins can reduce the glycemic index of a drink, further reducing its ability to be quickly absorbed
- There is considerably more evidence supporting Free Form Amino acids than complete proteins

Q: What are the benefits of using EFS during exercise?
A: The benefits of EFS are:

- Supplying fast and sustained energy for muscles
- Improved fluid absorption
- Reduced cramping and dehydration
- Improved performance
- Easy to digest and absorb
- Improved glycogen resynthesis
- Delayed central (mental) fatigue
- Replenish electrolyte loss

Q: How does it taste?
A: EFS is a light, great-tasting energy drink that's sweetened and flavored with 100% natural ingredients. Because EFS is low in sweetness, there is no need to dilute the recommended serving allowing you to drink it full strength. Unlike energy drinks that contain complete proteins, EFS is not chalky and thick. The benefit is a potent, easy to digest energy drink which delivers all the nutrients like they were intended (full strength). EFS is available in two refreshing flavors: Lemon-Lime and Tangerine.

Q: How much EFS should I use during my training and racing?
A: Clinical research shows that a 6-8% solution delivering between 45-60g carbohydrates, >1000mg Amino Acids, 400-600mg sodium and equivalent balance in all electrolytes should be taken every hour during exercise. EFS is designed to maximize all these levels. Athletes should consume one serving for every 30 minutes of intense exercise. Adjustments should be made based on body weight, training state,

heat, individual sweat rates and preference. Use one serving for every 30 minutes as a starting point and adjust as necessary from there.

Q: What types of athletes should be taking EFS?

A: The following symptoms will all benefit from use of EFS

1) Athletes which experience cramping from strenuous exercise.
2) All athletes who demand rapid fluid absorption in order to stay hydrated.
3) Athletes who want all the benefits of protein without the heavy/chalky consistency of protein drinks.

Essentially any athlete exercising for one hour or more will benefit from the use of EFS in their training and racing.

Q: Should I use EFS even when it's cold, like during XC ski races?

A: Cold weather sports still put a considerable fluid and electrolyte demand on the athlete. EFS works just as well in the cold as is the heat. The high sodium content in EFS may even help reduce the drinks propensity to freeze. (this has not been tested).

Q: Should I use EFS in short races?

A: Short races generally don't put a heavy demand on your glycogen, carbohydrate stores, given that you are well nourished prior to the start of the race. During a short race athletes can be slowed significantly from cramping and electrolyte imbalance. A serving of EFS can be used 15-30 minutes prior to a short race to assure adequate carbohydrates and electrolytes are available for the intense effort. Short race is defined as one lasting less than one hour.

Q: Should I use EFS in long races?

A: During long races (3 hours+) considerable stress is put on an athlete's body. 1) Glycogen (energy) stores are depleted 2) cells experience damage from cellular oxidation 3) electrolytes are depleted and 4) amino acids are depleted.

1) EFS replenishes glycogen by using a mix of high glycemic carbohydrates including both simple and complex sugars. This easy to digest mix is rapidly absorbed and delivers fast and long term energy.
2) Formulated with 120mg (200% RDA) of Vitamin C per serving, EFS helps protect cells from oxidation keeping the immune system stronger for better training and faster racing. A depleted immune system can cause upper respiratory distress which generally accompanies long exhaustive exercise.
3) EFS provides the most potent electrolyte profile available. The combination of all five electrolytes deliver a potent 1040mg per serving, helping to prevent cramping. The 270mgs sodium per serving also aids in maximum fluid absorption so you stay hydrated throughout your training and racing. Supplementing with additional salt tabs, electrolyte tabs, or salty snacks is no longer needed when using EFS.
4) 2000mg of Amino Acids offers the same BCAA and Glutamine levels as 9g Whey Protein. These amino acids have clinically shown to improve performance, reduced post-exercise muscle damage, improve muscle glycogen resynthesis, reduced central fatigue and improved rate of perceived exertion.

Q: What's the carbohydrate source in EFS?

A: EFS replenishes glycogen by using a mix of high glycemic carbohydrates including both simple and complex sugars. This easy to digest mix is rapidly absorbed and delivers fast and long term energy.

Q: I am prone to cramping during longer training and racing. Will EFS help me with cramping problems?

A: Nutritionally cramping stem from electrolyte imbalance, electrolyte depletion and/or dehydration,. EFS provides the most potent electrolyte profile available. The combination of all five electrolytes deliver a potent 1040mg per serving, helping to prevent cramping. The 270mgs sodium per serving also aids in maximum fluid absorption so you stay hydrated throughout your training and racing. Supplementing with additional salt tabs, electrolyte tabs, or salty snacks is no longer needed when using EFS.

Q: How many servings are in a container of EFS?
A: There are 25 servings per container of EFS