

PERFORMANCE NUTRITION HANDBOOK



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For more than a decade our discoveries have helped muscles work stronger, faster, longer

PacificHealth Laboratories, founded in 1996 by two prominent scientists, started with a unique mission – to develop innovative nutritional products based on cutting-edge research. PHLI developed a working collaboration with some of the world’s top nutritionists, biochemists and sports scientists. The discoveries that have resulted from this partnership have reshaped sports nutrition. Athletes at all levels incorporate PHLI’s discoveries and products into their daily training and race regimens.

PacificHealth Laboratories is a company driven by science. This *Performance Nutrition Handbook* authored by leading athletes, coaches and researchers is a practical guide, using the latest research to help triathletes and other endurance athletes perform at their best. It also includes easy-to-use calculators to help you design the most effective nutrition plan for your level of training and level of competition.

...and we’re just getting started.

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Dave Scott, six-time winner of the Hawaii Ironman, is considered one of the greatest triathletes of all time. He is a coach and lecturer.

Certain key features of an endurance athlete's diet should stay the same year-round. Whether you're taking a break between races, in heavy training for your next race, or resting up for an event that's only days away, your diet should consist of a healthy balance and variety of natural foods. But other features of your diet need to change depending on where you are in the training cycle. This cycle can be divided into three phases: off season, peak training, and taper. Your nutrition habits should be slightly different in each phase.

Off Season

Most endurance athletes reduce their training during the winter, when their last race of the past season is behind them and their first race of the next season is far ahead of them. Obviously, when your training volume decreases, the number of calories you burn daily decreases. To avoid gaining too much weight during the off season you need to eat less.

Most of the calories you cut from your diet should be carbohydrate calories. Unlike fats and protein, carbs are used only as fuel by the body. The less fuel you burn in training, the less carbohydrate you should have in your diet. It's especially important to cut out the refined carbohydrates that you may be able to "get away with" eating during peak training. This does not include sports drinks, energy gels, and recovery drinks you may use immediately before, during, and immediately after workouts, however.

It's OK to gain a little weight during the off season, but it should be kept to no more than 2 percent. So if your ideal racing weight is 150 pounds, your off-season weight limit is 153 pounds.

Peak Training

When you are in heavy training for your next race, your nutrition needs are somewhat different than they are during the off season. Preventing weight gain is a smaller concern. Fueling and recovering from your workouts are bigger concerns.

In the peak training period you should consume 4 to 8 grams of carbohydrate per kilogram of body weight (1 lb = 2.2 kg) daily to fuel your workouts. The lower end of this range is enough for most athletes. Only serious athletes with very heavy workloads need to aim for the high end. To ensure that you get enough carbohydrate, it's easiest to think in terms of carbohydrate calories (there are 4 calories in 1 gram of carbohydrate) and to spread your carb intake fairly evenly throughout the day.

The Three Phases of Endurance Nutrition

For example, if you weigh 150 lbs (68 kg), you probably need around 275 grams or 1,100 calories of carbohydrate daily. Here's an example of how to distribute those carbs throughout the day:

MEAL	CARBOHYDRATE CALORIES
Breakfast	300
Mid-Morning Snack	100
Lunch	300
Mid-Afternoon Snack	100
Dinner	300

Never eat carbs alone, however. You should include protein with your carbs in each meal to help meet your muscle recovery needs. Maintaining an anti-inflammatory diet during peak training is also important for recovery. This means keeping pro-inflammatory processed grains out of your diet as much as possible and getting plenty of omega-3 fats. Good dietary sources of omega-3's include wild salmon, flaxseeds, and walnuts.

Taper

It's important to reduce your training for a week or two before you race to ensure you're well rested for your event. That means your calorie intake needs to decrease too. The last thing you want to do in the final weeks before a race is gain a few pounds! Reduce your calorie intake by 300-700 calories per hour of training reduction during the taper period to avoid that issue.

Your carbohydrate intake should change little, however, because you want to store glycogen in your muscles and liver for the race. Many endurance athletes increase their carb intake before a race, a practice known as carbo-loading, but this is not necessary. Because you're training less and burning fewer carbs, you will be able to store extra glycogen without eating more carbs.

Endurance athletes often develop upper respiratory tract infections before races, because the hard training they've just completed taxes the immune system. So nutritional immune support is also critical at this time. I'd like to be able to say that endurance athletes can get all the nutrition they need for maximum immune function from food, but this is one area where supplementation may be necessary. The most important nutrients for immune function are glutathione, vitamins C and E, and zinc.

The Last 10 Percent

If you have a balanced and healthy diet, you're getting 90 percent of the benefit that nutrition can offer your endurance performance. The last 10 percent comes from making small adjustments to your diet depending on the phase you're in.



Matt Fitzgerald is a certified sports nutritionist and the author of numerous books for endurance athletes, including “Racing Weight: How to Get Lean for Peak Performance”.

Have you ever bonked in a workout or race while feeling great? Of course not. And there’s a reason for that. Exercise scientists used to believe that “perceived effort”, or how hard exercise feels, was a peripheral phenomenon that had nothing to do with performance and fatigue. More recently, however, researchers have learned that perceived effort is actually a major cause of fatigue during exercise. Simply put, when the level of suffering required to sustain a certain pace becomes unbearable, we slow down.

Training, motivation, and other factors increase performance in part by making exercise at any given intensity feel easier. Nutrition can do the same. The “big three” nutrients affecting perceived effort are carbohydrate, protein, and caffeine.

Carbohydrate

Studies have shown that endurance performance is increased when athletes merely rinse their mouths with a sports drink periodically during exercise instead of swallowing it. It appears the carbs in the sports drink activate carbohydrate receptors in the tongue, which communicate with a part of the brain that regulates perceived exertion. As a result, exercise feels easier and performance increases.

Rinsing your mouth with a sports drink is not a complete substitute for actually swallowing it, as drinking rehydrates in addition to supplying energy. But in situations where it’s difficult to drink a lot, such as during high-intensity running, rinsing your mouth with a sports drink may be a good complement to ingesting it.

Protein

A series of studies led by Michael Saunders at James Madison University has shown that a sports drink containing carbs and protein in a 4:1 ratio (Accelerade®) increases endurance more than a conventional sports drink containing carbs and no protein. These studies have also shown that the beneficial effect of consuming protein with carbs during exercise is linked to a reduction in perceived exertion.

How does protein make exercise feel easier? One possibility is that ingesting protein with carbs during exercise increases amino acid levels in the blood. There is evidence that elevated blood amino acids delay brain fatigue during exercise. Another possibility is that protein reduces perceived exertion by reducing muscle damage. Carb-protein Accelerade is in fact proven to reduce muscle damage during exercise compared to carb-only sports drinks.

Caffeine

Fifteen years ago, before the role of the brain in exercise performance was much appreciated, scientists believed that caffeine enhanced endurance exercise performance by increasing fat burning. It is now known that caffeine enhances endurance performance by blocking adenosine receptors in the brain and thereby reducing perceived effort. By reducing the perception of effort associated with exercise at any given intensity, caffeine allows athletes to go faster before they feel they’re working as hard as they can.

Putting Science into Practice

Fueling your brain for endurance performance is as easy as using Accelerade and Accel Gel® before and during workouts and races. Both products contain carbs and protein in the ideal 4:1 ratio to reduce perceived effort. And for an extra brain boost, incorporate caffeinated chocolate and raspberry cream Accel Gel into your race nutrition plan.



Pip Taylor is a professional triathlete representing Australia and a certified sports nutritionist.

There are only two rules of race nutrition. Rule No. 1 is that you have to get your race nutrition right to have your best performance. You will finish faster and stronger if you take in the right stuff at the right times. Rule No. 2 is that the right race nutrition is different for individual athletes. You have to treat yourself as an experiment of one and go through some trial and error to discover what works best for you.

Race nutrition starts before the race itself. The most precious and limited energy source for exercise is glycogen, or carbohydrate stored in the muscles and liver. You can reduce your risk of depleting your glycogen stores during a race by increasing your carbohydrate intake for a day or two before the race while also reducing your training. It's not necessary to "carbo load" before shorter races lasting 90 minutes or less. I don't even do it before Olympic-distance triathlons, which take me about two hours to finish. But the day before an Ironman 70.3 triathlon I supplement my normal diet by drinking Accelerade® for extra carbs.

The Pre-Race Meal

Your pre-race meal is critical. That's your last chance to top off your glycogen and blood glucose stores before the start. Your pre-race meal should be high in carbs, low in everything else, easy to digest, and eaten long enough before the race so that your stomach does not feel full when you start. My typical pre-race meal is toast and jam with a bottle of Accelerade consumed two to two-and-a-half hours before the start. But this might not be the best pre-race meal for you. Some athletes like to have something more substantial, especially before long events. Others need to avoid solid foods. Try different things until you find what works best for you, and then stick with it.

Nutrition during the race is also affected by individual factors, but there are some general guidelines to follow. First, water is not enough. Water replaces only the fluid you lose through sweating; it does not replace the salt and electrolyte minerals you lose and it does not supply extra carbohydrate energy to fuel your muscles. To get

everything your body needs nutritionally for maximum performance you need to use a good sports drink, or use energy gels with water. It's also important to take in fluids and energy frequently (every 10 minutes or so), but in amounts that are comfortable. Drinking or eating too much is no better than taking in too little.

Fast Fuel

Many endurance athletes, especially beginners, are concerned about the sugar in sports drinks and energy gels. That's understandable, since we're all taught that sugar is unhealthy. And it is bad for us—except during exercise. The rules change during exercise because our muscles run on a mixture of sugar (glycogen and glucose) and fat. Consuming sugar while you exercise is like refilling your car's gas tank while you drive.

The faster you can deliver extra energy from sports drinks and energy gels to your muscles, the better you will perform. So be sure to use products containing fast-acting sugars like sucrose, fructose and maltodextrin and avoid using products that boast of containing "complex carbohydrates" and "long-lasting" carbohydrates. These ingredients will just sit around in your stomach and liver doing your muscles no good. It's also important to choose products that combine multiple types of sugar. That's because your intestine absorbs different types of sugar through different pathways. Therefore a sports drink that contains (for example) 2% sucrose, 2% fructose, and 2% maltodextrin will deliver energy to your muscles faster than a sports drink that contains 6% glucose.

The same rule applies to the protein in sports drinks and energy gels. Most sports drinks don't contain protein at all. The fastest-acting protein is whey protein. Soy is absorbed and metabolized more slowly. So be sure your sports nutrition products use whey protein instead of soy.

Individual athletes differ in terms of the nutrition sources they find most palatable, digestible, and effective in races. They also differ in terms of how much they can comfortably consume. In Olympic-distance triathlons I drink one bottle of Accelerade and use one Accel Gel® on the bike and take nothing on the run. In Ironman 70.3's I drink two bottles of Accelerade and take three Accel Gels with water on the bike and drink a sports drink and/or cola according to my thirst on the run.

This routine is the result of lots of practice in training and past races. To develop your optimal race nutrition routine, you'll need to do the same.



Dr. Robert Portman, a leading researcher on how nutrition can improve recovery and athletic performance, is co-author of Nutrient Timing and Hardwired for Fitness

In the late 80's, sports scientists began to focus on the importance of nutritional intervention immediately after exercise. Although consuming nutrition after a workout made sense, there was little understanding on the best type of nutrition and the physiological implications. The first hint that recovery nutrition operated under a different set of metabolic rules was the discovery that the timing of nutrition was critical. I termed this interval the "metabolic window of opportunity".

Although food consumption at any time turns on metabolic pathways involved in replenishing and rebuilding, the metabolic window after exercise was very different in terms of the magnitude of response. We have since learned that key metabolic pathways are activated immediately after exercise. Providing the right combination of nutrients during this time can produce enormous changes in terms of glycogen and protein synthesis.

The launch of Endurox R⁴® began an intense focus on the importance of the recovery window. Studies from top investigators at many exercise science labs showed that Endurox R⁴ could greatly stimulate protein synthesis and replenish depleted muscle glycogen stores. Even more interesting, the studies showed that "if you wait, you lose". Consumption of nutrition after the metabolic window is closed produced almost no benefit in terms of muscle recovery. And, in fact, investigators noted that the key metabolic pathways 3-5 hours after exercise actually shut down.

Most serious endurance athletes make recovery nutrition an integral part of their training regimen. However, there are two very practical aspects that are often overlooked yet have a significant effect in terms of improving athletic performance. These are muscle damage and performance in a subsequent exercise bout.

Muscle Damage and Performance

Historically, muscle damage was looked upon as a point of pride – no pain, no gain. The problem, as we now know, is that too much pain leads to no gain. When muscles are moderately damaged through exercise they activate pathways that stimulate the remodeling of muscle fibers and the repair of damaged ones. That is why exercise

produces stronger muscles. However, when the muscle damage is too great it places too much of a burden on the repair systems and they may not have sufficient time to complete their work before the next workout. The result is decreased muscle performance in the subsequent workout. If this occurs chronically, which can happen when athletes overtrain, they reach a plateau or muscle performance declines. That's why the recovery interval between workouts is so critical and why a recovery drink with the right nutritional profile can raise the training level.

Why Recovery Drinks are Essential

Confirmation of the essential relationship between muscle damage and improved performance came from a series of studies by researchers at James Madison University. Their results vividly show the relationship between muscle damage and decreased in muscle performance. They compared a carb-protein drink with the 4:1 ratio to a carb-only drink. They measured two markers of muscle damage, myoglobin, a specific indicator of muscle fiber breakdown that usually peaks immediately after exercise, and creatine kinase (CK), a non-specific indicator of muscle damage that can peak 24-30 hours later. They correlated increases in these two markers of muscle damage with effects on endurance performance and muscle function 16-24 hours later. They found that:

Compared to a carb-only drink, Endurox R⁴:

- Reduced short-term muscle fiber damage by 42% as measured by myoglobin
- Reduced longer term muscle damage by 47% as measured by CK
- Increased endurance performance by 40% 16 hours later as measured by duration of ride
- Increased muscle function by 14% 24 hours later as measured by number of consecutive leg extensions that could be performed

These studies clearly demonstrate the critical role post-workout nutrition plays in determining ultimate improvement in athletic performance.



JOHN IVY, Ph D

Dr. John Ivy is a world-renowned expert on the role of exercise nutrition on performance; Professor and Head of Kinesiology at the University of Texas

Nearly a decade ago, with the help of two colleagues, I conducted the first study comparing the effects of a conventional carbohydrate sports drink and a carbohydrate sports drink with added protein on endurance performance. We brought nine trained cyclists into the lab and had them cycle at varying intensities on stationary bikes for three hours. They then rode at a fixed high intensity until exhausted.

The test was repeated on three separate occasions. In random order, the cyclists drank flavored water, a conventional carbohydrate sports drink, and a carbohydrate-protein sports drink. On average, it took the cyclists 12.7 minutes to reach exhaustion in the last segment of the test with flavored water, 19.7 minutes with the carbohydrate sports drink, and 26.9 minutes with the carbohydrate-protein sports drink. We concluded that the addition of protein to a carbohydrate sports drink increased endurance performance by 36 percent in trained cyclists.

Effect of Protein on Post-exercise Muscle Damage

Subsequent studies performed by other researchers yielded similar results. In 2004, Michael Saunders and colleagues at James Madison University published a study demonstrating that a carbohydrate-protein sports drink increased time to exhaustion by 29 percent compared to a carbohydrate sports drink. This study also looked at post-exercise muscle damage and discovered that biomarkers of muscle damage were 83 percent lower after exercise when the carbohydrate-protein sports drink was consumed during exercise. This reduction in muscle damage was associated with better performance in a second workout performed the next day.

The list of benefits associated with the addition of protein to a carbohydrate sports drink grew further when John Seifert and colleagues at St. Cloud State University discovered that a carbohydrate-protein sports drink maintained blood volume better than a carbohydrate sports drink. Maintaining blood volume during exercise is an important aspect of rehydration that aids in thermoregulation and reduces cardiovascular strain.

Why Your Sports Drink Should Contain Protein

Early studies showing benefits of carbohydrate-protein sports drinks compared to carbohydrate sports were criticized on various grounds. Some scientists argued that the benefits had nothing to do with protein per se but were merely an effect of the greater calorie content of the carbohydrate-protein sports drinks. But in studies that compared a carbohydrate sports drink against a carbohydrate-protein sports drink of equal calories, the carbohydrate-protein sports drink was still found to be superior.

Some researchers have noted that when carbohydrate is consumed in high amounts during exercise (more than 60 grams per hour), the benefits of adding protein are diminished. But it is often impossible to consume carbohydrates in such large amounts during exercise, and in any case, a carbohydrate-protein sports drink allows athletes to maximize the performance benefit of energy intake during exercise with fewer total calories, which has a couple of advantages.

Less Can Be More

Recently our lab conducted a study showing that a carbohydrate-protein sports drink with less than 4 percent carbohydrate concentration increased endurance performance as much as a 6 percent carbohydrate sports drink. This is a noteworthy finding for athletes who are concerned about managing their body weight. With a carbohydrate-protein sports drink they can consume far fewer total calories during exercise without sacrificing performance. It is also a noteworthy finding for competitive athletes concerned about avoiding nutrition tolerance issues during races. With a carbohydrate-protein sports drink they can maximize their performance with significantly lower total calorie intake, hence reduced risk of gastrointestinal issues.

Some studies have found no performance benefit associated with the addition of protein to a carbohydrate sports drink. However, these results can be attributed to the design of these particular studies. For example, some have involved very high exercise intensities above the lactate threshold. But fatigue has different causes at such high intensities that are not affected by protein or carbohydrate intake.

To my knowledge, no study has ever shown superior performance from a carbohydrate sports drink compared to a carbohydrate-protein sports drink. The balance of the large body of scientific evidence that now exists supports the superiority of carbohydrate-protein sports drinks in terms of increased endurance, reduced muscle damage, faster recovery, better hydration, and the advantages of maximizing performance with less energy intake.



Dr. John Seifert an associate professor at Montana State University and is a leading researcher on the science of rehydration.

We have come a long way since coaches withheld water from their athletes to engender toughness. The relationship between dehydration and performance has been well documented. As the body becomes dehydrated, heart rate increases, muscle blood flow decreases, body temperature increases, and even the ability to concentrate and focus decreases. The result? Fatigue ensues and performance drops. As little as a 2% drop in body weight, as sweat loss, causes a significant decrease in performance. That is why rehydration is critical during exercise.

The science of rehydration has evolved significantly over the last 30 years. A better understanding of how fluid is absorbed in the gut has led to improved sports drinks that offer significant rehydration advantages and should be an integral part of both training and competition.

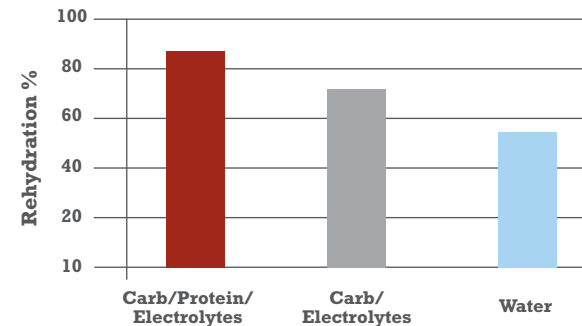
Water is still the most popular sports drink, which is surprising since the body's ability to retain water when it is dehydrated is quite poor. Years ago I was involved in some of the studies demonstrating the benefits of isotonic sports drinks. We found that when electrolytes were added to a sports drink, rehydration improved significantly. This wasn't surprising. As sodium moves across the intestinal membrane, water molecules follow due to osmosis. What was surprising, however, was the effect of adding carbohydrate to a sports drink. Our research team and others showed that when the sports drink contained both carbohydrate and sodium there was a significant improvement in rehydration. In other words, sodium and carbohydrates work together to activate a transport system to allow more water to be absorbed into the body.

Effect of Protein on Rehydration

The identification of the carbohydrate-sodium transporter system raised questions in our mind as to whether there were additional transporter systems and whether these could be recruited to improve rehydration further. In the early 90s researchers at the University of Texas and James Madison University showed that a protein-containing sports drink caused a significant improvement in endurance performance compared to a

conventional carb-only sports drink. In the clinical setting protein beverages are often used to treat dehydration. With this backdrop we conducted a series of trials comparing a sports drink containing carbohydrate and protein in a 4:1 ratio to a conventional carb-only sports drink and water.

Our experimental protocol called for subjects to cycle until they lost 2.5% of their body weight and then they rehydrated using either water, a 6% carb sports drink or a carb-protein sports drink. As shown in the figure below, the carb-protein sports drink was 15% better than the carb-only sports drink and 40% better than water. These results suggest that there is a third transport system specific for protein. Thus, the superior rehydrating properties of the carb-protein sports drink can be explained by the fact that it activates all of the transporter systems.



It is quite common when exercising in warm conditions to lose more than 2% of your body weight in one hour. These studies have very practical implications for endurance athletes. They show conclusively that when dehydration is a concern, water is not your best choice. The sports drink that is most efficient in minimizing dehydration and its effects is a carb-protein sports drink. This formulation should be consumed at regular intervals during moderate to intense exercise. Be aware also that cold beverages are absorbed more quickly than warm beverages and that it is better to consume smaller amounts of fluid more frequently than to drink large amounts less often. Finally, recognize that the ability to tolerate fluid consumption during exercise increases with practice, so drinking should be a part of every workout.

Every endurance athlete has an ideal racing weight—a body-weight “sweet spot” that maximizes performance. Individual racing weights are influenced by so many factors that it’s impossible to calculate or predict them with perfect accuracy. But it is possible to make an estimate that’s good enough to serve as a goal.

Ideal racing weight is determined primarily by body fat percentage. That’s because body fat is the primary source of excess body weight, and loss of excess body fat is the primary cause of the weight change that results from progressive training and improved diet. The following table presents ideal body fat ranges for endurance performance for men and women of different ages:

MEN			
20-29	30-39	40-49	50+
3-10%	5-12%	6-15%	8-17%

WOMEN			
20-29	30-39	40-49	50+
10-16%	11-17%	13-20%	14-22%

Individual factors will affect how low you can get within your range. It’s a good idea to purchase a body fat scale and measure your body fat percentage every week or two to make sure you’re getting leaner as your next important race draws nearer.

Most endurance athletes are not at their ideal racing weight at most times. Why not? For the same reasons most non-athletes are overweight. The first problem is that our modern diet is filled with calorie-dense foods that circumvent the appetite control mechanism our bodies used to be able to rely on to avoid overeating. You can eat a 600-calorie cheeseburger in three minutes—much less time than it takes your gut to release the hormones that tell your brain that 400 calories would have been plenty!

A second problem is that food has never been cheaper and more plentiful, and we are bombarded constantly with temptations (in the form of food advertising and marketing) to eat. We might like to think that we are not so easily influenced by our environment, but research proves we are. For example, studies have shown that the more food people are served in restaurant portions, the more they eat, and average restaurant portion sizes have increased significantly in the past 30 years.

How can you overcome these barriers to attain your racing weight? There are five keys:

1. Improve your diet quality

Instead of trying to eat less, which won’t work because it will make you hungry, focus on improving the quality of your diet. High-quality foods contain more nutrients and fewer calories per unit volume than low-quality foods. We all know what high-quality foods are: fruits and vegetables, lean meats and fish, whole grains, low-fat dairy products, and healthy fat sources (such as nuts). And we all know what low-quality foods are: sweets, refined grains, fatty meats, high-fat dairy products, and high-calorie beverages.

2. Balance your energy sources

There are three major energy sources in the diet: carbohydrate, fat, and protein. Consuming these so-called macronutrients in the right balance will maximize your workout performance, and anything you do to increase your workout performance will make you leaner. Most endurance athletes get enough fat and protein, but most do not get enough carbohydrate. You need 4-10 grams of carbohydrate per kilogram of bodyweight daily to maximize your training. Four grams are enough for recreational endurance athletes. Elite athletes need 8 or more.

3. Time your nutrition

When you eat is almost as important as what you eat when you’re trying to get leaner. You need to consume the most calories when your body is most in need of energy. That means you need to eat a good breakfast early in the morning, have a good meal two or three hours before you train, consume a quality sports drink and/or energy gel during workouts, and consume recovery nutrition after training.

4. Manage your appetite

While you can’t ignore hunger, you can manage your appetite. That starts with basing your diet on high-quality foods that fill you up without a lot of calories. Eating breakfast and eating frequently will also keep your appetite in check. Finally, learn to tell the difference between real hunger and “head” hunger, and eat only when you’re truly hungry.

Q&A



Professional triathlete Leanda Cave truly is the queen of recovery. Born in England and now based on Tucson, AZ, Leanda likes to race often—and she likes to win. Thanks to her careful approach to recovery nutrition, she's able to do both. The two-time world champion gave the following interview shortly after completing her greatest feat of recovery yet.

You had a very busy and very successful 2010 season. Tell us how it ended.

Leanda Cave: In October I competed in the Hawaii Ironman and finished 10th. That was a bit of a disappointment. I wanted to finish my year on a high note, so three weeks after Hawaii I raced Ironman 70.3 Miami and won. Two weeks after that I took the silver medal at the Ironman 70.3 World Championship. And the very next weekend I got third place at Ironman Arizona.

That's incredible. How did you pull it off?

LC: It wasn't easy! And I'm not sure I would do it again. But I love to race, and that helps. And I know how to get my body prepared to give me what I need when I need it.

Tell us what you do to recover so quickly after races.

LC: Part of it is training. I'm not afraid to take it easy and get the rest I need to recover. Nutrition is also critical.

What is your recovery nutrition regimen?

LC: Getting protein after workouts is the key for me. It helps a lot with soreness and my performance the next day. I really notice a difference when I don't do it for whatever reason. I was using Endurox R⁴⁰ up to three times a day after my recent races. I know it sounds like a lot, but it works for me.

You say you notice a difference. How so?

LC: Well, I know the studies have shown that when you take Endurox R⁴⁰ after a workout you have less muscle damage and feel less sore the next day, and you perform better in your next workout. And that's exactly what I experience.

Research also shows that taking protein during workouts helps post-workout recovery. Is that something you do as well?

LC: I believe the research! And yes, I use Accelerade[®] and Accel Gel[®] in all of my longer rides and runs.

Well, we look forward to seeing what you do next.

LC: Thanks!

5 Biggest Sports Nutrition Myths



There's a lot of bad information out there. How many of these five sports nutrition myths have you heard before?

#1 *Complex carbohydrates refuel muscles better.*

Complex carbohydrates provide slow, steady energy. Simple sugars provide fast energy. In regular meals and snacks, complex carbs are better, because they keep glucose and insulin levels stable. Simple sugars are not so good because they cause insulin spikes and blood sugar crashes that lead to overeating and weight gain. But during exercise the rules change. Your muscles burn carbs faster than you can possibly take them in through sports drinks and gels. Therefore you want to consume the quickest energy sources you can get, which are simple sugars. Some sports nutrition products brag about containing complex carbs for “lasting energy”, but research has shown that these products are not as effective as those containing simple sugars because they don't provide energy quickly enough.

Studies have also shown that products containing multiple sugars provide energy even faster than those containing one sugar. Endurox R⁴® and Accelerade® use a combination of simple sugars, which is one reason why they have been shown to extend endurance more than products that use complex carbohydrates or a single carbohydrate such as fructose.

#2 *Protein is the muscle building macronutrient.*

Most endurance athletes know they should consume carbohydrate after workouts to refuel their muscles. But many are not aware that getting protein after a workout is just as important. Bodybuilders are fanatical about consuming protein after workouts because it helps them build bigger muscles. As an endurance athlete, you're not trying to build new muscle, you're just trying to maintain the muscle you have. But to do that you need to consume protein after workouts too, because endurance exercise breaks down muscle tissue. Interestingly, research has shown that post-exercise muscle rebuilding is most effect when carbs and protein are consumed together. That's because protein provides the raw materials while carbohydrate helps deliver protein to the muscles indirectly.

The benefits of consuming carbohydrate and protein together were shown in a study in which investigators looked at three nutritional beverages: carbohydrate, protein, and carbohydrate-protein. They found that the carbohydrate-protein beverage increased protein synthesis 37% more than the protein drink. By consuming carbohydrate-protein products such as Endurox R⁴® after workouts you maximize both muscle refueling and muscle repair.

#3 *The best way to replenish your muscles is to eat healthy foods after each workout.*

Healthy foods are good for muscle recovery, but specially formulated muscle recovery products such as Endurox R⁴ are better. To maximize post-exercise recovery, you need to get the right nutrients into your body as soon as possible. Only specially formulated products such as Endurox R⁴ provide the fast-acting carbohydrates and proteins you need for muscle recovery, plus the fluid and electrolytes you need for rehydration and electrolytes to fight muscle damage—and nothing extra. No natural food provides everything your body needs and nothing it doesn't at this time. Endurox R⁴ is also easy to consume after exercise, when you may not feel like eating solid food, and easy to transport, so you don't have to wait to get your recovery nutrition when training away from home.

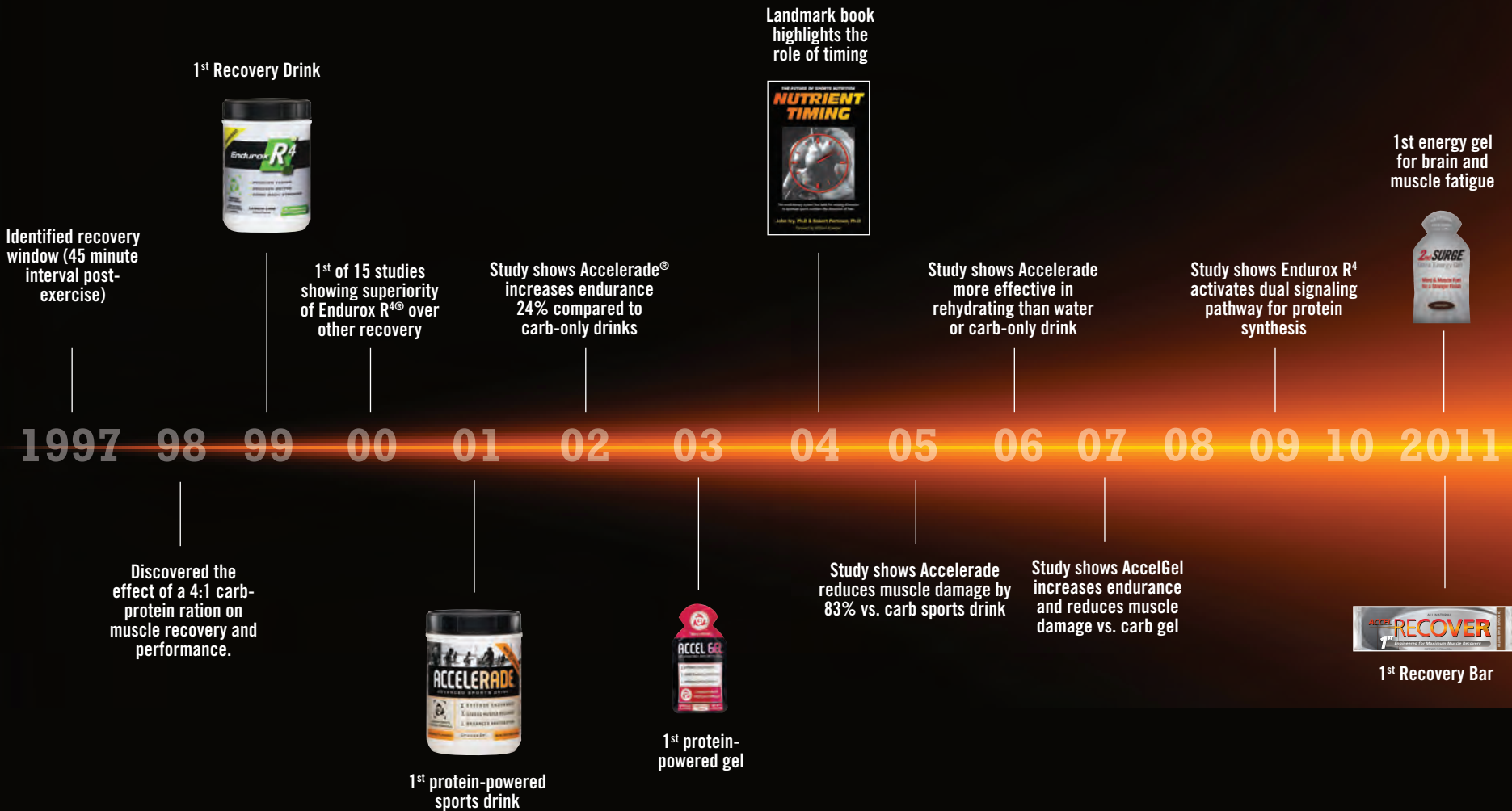
#4 *Protein in a sports drink reduces rehydration.*

Large amounts of protein inhibit rehydration by slowing the absorption of fluid into the blood stream. However, smaller amount of protein actually promote rehydration by aiding the transport of water into cells. What's the optimal amount of protein for rehydration during and after exercise. One study found that Accelerade, which contains carbs and protein in a 4:1 ratio, rehydrated athletes 15 percent better than Gatorade®, which contains no protein, and 40% better than water.

#5 *Sugar-free sports drinks are better for athletes trying to lose weight.*

Many athletes who are concerned about their weight use low-sugar or sugar-free sports drinks instead of regular sports drinks to avoid the calories in regular sports drinks. This is understandable, but it's a mistake for two reasons. First, low-sugar sports drinks do not enhance performance as much as sports drinks like Accelerade, which allows athletes to go faster, longer and thus burn more calories. Second, research has shown that when athletes take in fewer calories during workouts, they eat more afterward. It's better to get the calories when you really need them—during exercise and in the immediate 45 minute interval post exercise.

More Than a Decade of Discovery



PacificHealth Laboratories

The uncompromising pursuit of science



Unleash the Power of Protein.

When introduced in 2003, Accelerade®, with the patented 4:1 ratio of carbs and protein, represented a dramatic departure from conventional carb-only sports drinks. Accelerade also demolished the conventional dogma regarding the importance of protein to help fuel muscle cells and improve rehydration, the two essential criteria for a sports drink.

To date more than 10 peer-reviewed studies have shown that, compared to a conventional sports drink, Accelerade:

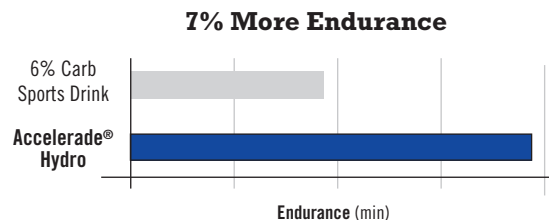
- **Increases endurance by 29%**
- **Decreases muscle damage by 83%**
- **Increases rehydration by 29%**
- **Increases endurance in a subsequent workout by 40%**

Only Accelerade meets the total hydration, energy and nutritional needs of working muscles.

ACCELERADE® HYDRO

More Performance with Less.

For less intense workouts, Accelerade Hydro may be ideal. Accelerade Hydro contains the same patented 4:1 ratio of carbs and protein as Accelerade but has 50% less sugar and 33% less calories. However, you don't compromise when selecting Accelerade Hydro. Researchers have shown that compared to a higher calorie carb-only sports drink, Accelerade increased endurance performance by 7%.



Work Harder, Easier.

Every endurance athlete knows that the better you feel, the better you race. The reason has to do with perceived exertion. It's no coincidence that perceived exertion is highest before you hit the wall, because high levels of perceived exertion actually produce fatigue. High levels of perceived exertion are caused by a drop in branched-chain amino acids (BCAAs) that trigger the release of fatigue signals in the brain.

Now, a study from James Madison University explains why athletes consuming Accelerade during exercise feel better even though they are exercising harder. The researchers found:

- **Accelerade lowered the levels of perceived exertion**
- **At the same level of intensity, athletes consuming Accelerade did not experience as much strain**

By maintaining BCAA levels, protein-powered Accelerade minimizes the release of fatigue signals from the brain.

The bottom line - Accelerade makes your hard work easier.



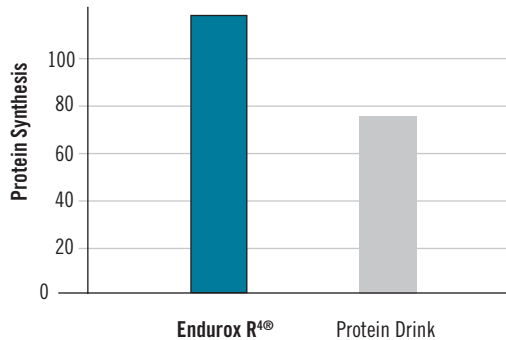


Uncompromisingly Effective.

Endurox R⁴® revolutionized the nutritional approach to muscle recovery. Over the last decade more than 15 peer-reviewed studies have demonstrated the superiority of Endurox R⁴ with the patented 4 to 1 carb-protein ratio. No other recovery drink has even one study behind it. These studies show that, compared to conventional recovery drinks, Endurox R⁴:

- **Increases glycogen replenishment by 200%**
- **Decreases muscle damage by 50%**
- **Increases protein synthesis by 400%**
- **Increases endurance by 55% in subsequent workout**

Endurox R⁴ is 38% more effective than a protein drink in stimulating muscle protein synthesis



Based on this research it is not surprising that Endurox R⁴ is the #1 recovery drink for serious athletes in all sports. If you're not already using Endurox R⁴, better hope your competition isn't either.

Less Pain, More Gain.

Post-exercise muscle damage is the primary barrier between your workout and your goals. Endurox R⁴ is the only recovery drink proven to reduce muscle damage and increase both muscle function and endurance in a subsequent workout.

Investigators for James Madison University conducted a series of studies measuring the impact of recovery beverages on muscle disruption and subsequent muscle performance. The researchers found that Endurox R⁴, compared to the carb-only drink:

- **Reduced short-term muscle fiber damage by 42%**
- **Reduced longer-term muscle damage by 47%**

And not surprisingly, these reductions in muscle damage translated into:

- **40% increase in endurance performance 16 hours later**
- **14% increase in muscle function 24 hours later**

Endurox R⁴. Recover faster. Recover better. Come back stronger.



*28 Servings
Fruit Punch, Tangy Orange,
Lemon Lime, Chocolate, Vanilla*

*14 Servings Fruit Punch, Tangy Orange,
Lemon Lime, Chocolate, Vanilla*

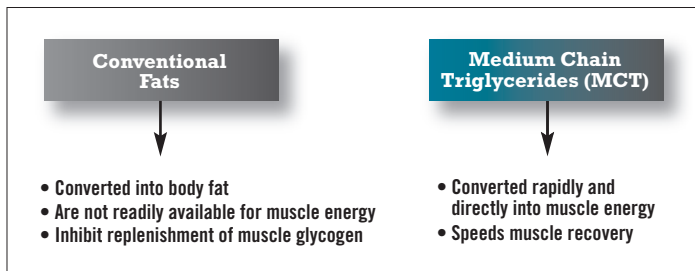
Fruit Punch, Tangy Orange



We Raised the Bar on Bars.

Accel RECOVER™ was developed by leading exercise physiologists whose cutting-edge research has defined the science of muscle recovery. The goal was to create a great-tasting bar in which every nutritional component contributed to muscle recovery. All natural Accel RECOVER is the most exciting advance in bar nutrition in 30 years, after 30 years, with a breakthrough formula that incorporates:

- **Unique blend of three carbohydrates to rapidly and completely replenish depleted muscle glycogen stores**
- **Proprietary combination of three proteins enriched with glutamine, arginine and leucine, the amino acids that drive the repair and rebuilding of muscle protein and the rapid transport of nutrients to muscles**
- **Medium-chain triglycerides, which rapidly convert into energy rather than fat. No other bar uses MCT's as the primary fat source.**
- **Antioxidants to protect your muscles from free radical damage.**



And we didn't forget about taste. Chocolate Peanut Butter Accel RECOVER may be the best-tasting bar you have ever eaten, and that could be the biggest breakthrough of all.

Accel RECOVER. Faster. Better. Stronger.

Engineered For Maximum Muscle Recovery.

No other bar mobilizes the breadth of metabolic activities for total muscle recovery.

Function	Combination of three proteins enriched with arginine, leucine and glutamine	Combination of three fast acting carbohydrates	Patented 4:1 ratio of carbohydrate to protein	Medium Chain Triglycerides (MCT)	Powerful anti-oxidants
Replenish glycogen		✓	✓	✓	
Stimulate protein synthesis	✓		✓		
Increase amino acid transport	✓		✓		
Support immune function	✓		✓		
Reduce muscle damage	✓		✓		✓
Blunt cortisol		✓	✓		
Prevent protein breakdown		✓	✓		
Increase nutrient delivery	✓	✓	✓		

NEW



Chocolate Peanut Butter

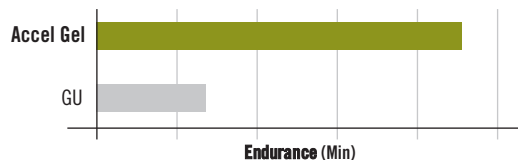
Keeps Working Ever After Your Workout Ends.

Accel Gel® is the first energy gel specifically designed to deliver rapid energy to working muscles. What makes Accel Gel unique is that it is the only gel that contains the patented 4:1 ratio of carb and protein and it uses a combination of three carbohydrates to maximize energy transport and uptake into muscle cells. This novel combination guarantees instant energy when you need it.

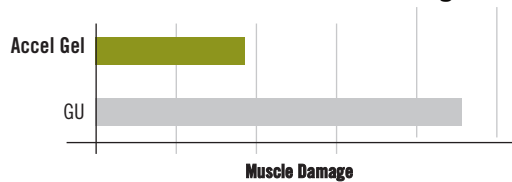


The superiority of Accel Gel was shown in a study published in the *Journal of Strength and Conditioning Research*. James Madison University researchers found that Accel Gel offers significant advantages compared to GU, a leading carbohydrate gel, both during and after exercise. Researchers found that cyclists using Accel Gel had:

13% More Endurance



50% Less Muscle Damage



Chocolate w/caffeine, Raspberry Cream w/caffeine, Vanilla, Key Lime, Strawberry Kiwi, Citrus Orange

The Finish Line Just Got Closer.

Bonking. Hitting the wall. Blowing up. What causes extreme fatigue? Researchers have identified two fatigue centers; one in the brain, the other in muscles.

2nd Surge™ is the first all-natural energy gel specifically formulated to delay the onset of both muscle and brain fatigue. The proprietary formula of rapidly acting carbohydrates, proteins, caffeine and antioxidants are proven to:

- Increase the delivery of cortical nutrients to brain and muscle cells
- Maintain metabolic energy needs
- Inhibit the release of fatigue signals in the brain
- Reduce muscle damage, an important trigger for release of fatigue signals
- Gives you added energy when you need it most

2nd Surge. Mind and Muscle Fuel for a Stronger Finish.



Double Espresso

Chocolate

Make Every Workout Count.

Adaptogens are Chinese herbs shown to have remarkable effects in bolstering the immune system and improving endurance. Used for over 1,700 years, ciwujia, the ingredient in Endurox Excel®, is considered the most effective of all adaptogens. Scientists at PacificHealth Laboratories became interested in ciwujia because of its use by Tibetan mountain climbers to improve endurance. Researchers at the University of North Texas conducted three studies to evaluate the effect of ciwujia during exercise. The studies found that Endurox Excel:

- Decreased lactic acid levels by 33%
- Increased fat utilization by 43.2%
- Lowered heart rate during moderate exercise

These results were confirmed in a study published in the official journal of the American College of Sports Medicine. The researchers found that in a 28-day trial with runners, ciwujia increased endurance, VO₂max and fat utilization. The bottom line - Endurox Excel works.

Compare Science of Endurox Excel vs. Expensive Hype of Optygen®

CLAIM	ENDUROX EXCEL	OPTYGEN
Increase in fat oxidation	Proven in published study	No published study
Decrease in lactic acid	Proven in published study	No published study
Increase in VO ₂ max	Proven in published study	No published study
Positive effect on immune system	Proven in published study	No published study
Suggested Price/30 day supply	\$17.99	\$50.00



Endurox Excel. More Performance for Less.

		Exercise Interval			Morning
		Before	During	After	
FUELING	ACCELERADE.	•	•	•	
	ACCELERADE HYDRO.	•	•	•	
RECOVERY	Endurox R4			•	
	ACCEL RECOVER		•	•	
ENERGY	ACCEL GEL.	•	•		
	2nd SURGE™	•	•		
SUPPLEMENT	Endurox EXCEL.				•

The typical training plan includes information about the distance, duration, and intensity of each workout. It does not include information about the types and amounts of nutrition to consume before, during, and after the workout. But it should. Nutrition really is an integral part of every workout. You need to fuel your body properly before and during workouts to maximize your performance, and you must get your nutrition right after the workout to maximize your recovery.

Following is an example of how to integrate workouts and PacificHealth Laboratories nutrition products into a triathlon training plan:

Day	Workout	Nutrition		
		Before	During	After
Mon	Rest	—	—	—
Tue	Swim 45 min	1 Accel Gel	Accelerade according to thirst	Endurox R4 9 oz
Wed	Bike 1 hour	1 Accel Gel	Accelerade according to thirst OR 1 Accel Gel at 30 minutes + water according to thirst	Endurox R4 9 oz
Thu	Run 45 min	1 Accel Gel	Accelerade according to thirst	Endurox R4 9 oz
Fri	Swim 45 min	1 Accel Gel	Accelerade according to thirst	Endurox R4 9 oz
Sat	Ride 1.5 hours	1 Accel Gel	Accelerade according to thirst OR 1 Accel Gel every 30-40 minutes (2 total) + water according to thirst	Endurox R4 9 oz
Sun	Run 1 hour	1 Accel Gel	Accelerade according to thirst OR 1 Accel Gel at 30 minutes + water according to thirst	Endurox R4 10 oz



Few topics are more confusing to endurance athletes than nutrition. Every endurance athlete recognizes that nutrition can play a major role in improving performance. The problem is how to design a nutrition plan that is right for you.

Every athlete is different and therefore has his or her unique nutritional requirements. In this section we will provide you with easy to use calculators and recommendations so that you can create your own nutrition action plan.

Nutrition for fueling and recovery is largely a function of energy expenditure. Energy expenditure is a function of four parameters:

1. **Total time of exercise**
2. **Intensity (i.e., pace)**
3. **Weight (heavier people burn more calories than lighter people doing the identical exercise for the identical time)**
4. **Exercise activity**

Although you do not have to be precise, it is always good to know your overall energy expenditure. It is easy to compute. Use the table below and plug it into the following equation:

$$\text{Total energy expenditure} = \text{energy expenditure value of activity} \times \text{duration of activity in minutes} \times \text{your body weight in pounds}$$

For example, suppose you weigh 150 lbs and you run at a pace of 7 minutes per mile for 30 minutes. The energy expenditure value of running at 7 minutes per mile is 0.10 cal/lb/min. Therefore, the total energy cost of the workout is $0.10 \times 150 \times 30 = 450$ calories.

Activity	Energy Expenditure Value (cal/min/lb)
Aerobic: high impact	0.07
Aerobic: low impact	0.04
Basketball	0.06
Cycling 10 mph	0.06
Cycling 15 mph	0.08
Cycling 17.5 mph	0.09
Cycling > 20 mph	0.12
Football	0.07
Golf (carrying clubs)	0.04
Gymnastics	0.03
Mountain bike	0.06
Running, cross-country	0.07
Running: 5.5 min/mile	0.13
Running: 6 min/mile	0.11

Activity	Energy Expenditure Value (cal/min/lb)
Running: 7 min/mile	0.10
Running: 8 min/mile	0.09
Running: 9 min/mile	0.09
Running: 11.5 min/mile	0.06
Skiing vigorous/racing	0.06
Soccer competitive	0.08
Strength Training: Circuit	0.06
Strength Training: Vigorous	0.05
Swimming back stroke	0.08
Swimming breast stroke	0.07
Swimming freestyle*	0.06
Swimming freestyle**	0.08
Tennis Match	0.08
Volleyball	0.02

The amount of fluid lost during exercise by sweating depends on a number of factors, principally exercise intensity, ambient temperature and individual sweat rates. The table below shows the amount of fluid lost per hour of exercise based on low, moderate and high sweat rates when exercising at different intensity in different ambient temperatures.

You can estimate your own standard rate of sweat loss by weighing yourself immediately before and immediately after exercising and calculating the difference. For example, if you lose two pounds (32 ounces) during a two-hour workout, you would be considered to have a moderate sweat rate.

One thing to keep in mind, as discussed in the next section, is you can easily exceed the maximum rate that your body can absorb fluid, which is about 34-36 ounces per hour. This means you cannot consume as much fluid as you are using, but that is not necessarily a problem.

Temp.	Sweat Rate (oz/hr)		
	Low	Moderate	High
40°F	12	17	31
55°F	15	22	35
70°F	22	27	47
90°F	31	37	75

How much should you drink during your workouts and races? The answer to this question has changed over the years. Sports nutrition experts used to advise athletes to “drink as much as possible” during exercise. But subsequent research showed that some athletes who followed this advice actually drank too much. Later, athletes were advised to drink enough to completely offset sweat losses during exercise. However, research has shown that this is not always possible—especially during running—or even necessary to prevent fatigue due to hydration.

Sports nutrition experts now advise athletes to drink according to their thirst during exercise. This means you should drink as soon as you are thirsty, as often as you are thirsty, and enough to satisfy your thirst throughout exercise. Studies have shown that drinking by thirst maintains performance and core body temperature as well as drinking to completely offset sweat losses while reducing the risk of gastrointestinal distress. Thirst naturally increases as exercise intensity and air temperature increase, so you will naturally drink more to meet your greater fluid needs on faster and hotter days if you obey your thirst.

Athletes typically consume enough fluid to replace roughly 70 percent of the fluid they lose through sweating when drinking by thirst. So be sure to always have at least enough fluid available to match 70 percent of anticipated sweat losses during every workout and race.

To determine your hourly rate of sweat loss, weigh yourself before and after a one-hour workout during which you do not drink. The difference in your weight (in ounces) is your hourly rate of sweat loss. Remember that your sweat rate will increase as your pace and the air temperature do, so try to match your anticipated pace and the expected air temperature of an upcoming event when doing this test.

Once you calculate the total caloric expenditure for your workout, you can use the table below to calculate your nutrient needs. Your refueling needs are a percentage of your total caloric expenditure. An excellent target is to consume carbohydrate and a small amount of protein equal to 30% of your total caloric expenditure. For example, if your total caloric expenditure was 500 calories, ideally you try and consume 150 calories, which translate into 30 grams of high-glycemic carbohydrate and 7.5 grams of protein.

Total Calorie Expenditure (cal)	Target Caloric Intake (cal)	Carb (g)	Protein (g)
200	60	12	3.0
250	75	15	3.8
300	90	18	4.5
350	105	21	5.3
400	120	24	6.0
450	135	27	6.8
500	150	30	7.5
550	165	33	8.3
600	180	36	9.0
650	195	39	9.8
700	210	42	10.5
750	225	45	11.3
800	240	48	12.0
850	255	51	12.8
900	270	54	13.5
1000	300	60	15.0
1200	360	72	18.0

RECOVERY CALCULATOR

When you complete a workout, your body needs carbohydrate to replenish muscle glycogen stores and protein to repair and rebuild muscle cells. But how much carbohydrate and protein do you need? It depends on how much energy you used (i.e. how many calories you burned) in the workout.

Your target goal for recovery nutrition should be to replace approximately 40% of the total calories burned during your workout. If you burned 500 calories, your target caloric intake should be 200 calories. This should be split between 40 grams of carbohydrate and 10 grams of protein. Whether you consume a sports drink or an energy dense recovery drink depends on your total caloric expenditure. A sports drink works well when your total caloric expenditure is 450 calories or less. Energy dense recovery nutrition, such as Endurox R4 or Accel Recover, works better when your workout burns 500 calories or more.

Drinking your recovery nutrition is often easier since appetite can be diminished after a workout. A beverage also helps you replace rehydrate. If you use a bar be sure to consume water. A superior combination is to drink a recovery beverage immediately after exercise and 30-60 minutes later consume a bar. This will actually extend the rebuilding process.

	Total Calorie Expenditure (cal)	Target Caloric Intake (cal)	Carb (g)	Protein (g)
Sports Drink (Accelerade/Accelerade HYDRO)	200	80	16	4
	250	100	20	5
	300	120	24	6
	350	140	28	7
	400	160	32	8
	450	180	36	9
Energy Dense Recovery Nutrition (Endurox R4/Accel RECOVER)	500	200	40	10
	550	220	44	11
	600	240	48	12
	650	260	52	13
	700	280	56	14
	750	300	60	15
	800	320	64	16
	850	340	68	17
	900	360	72	18
	1000	400	80	20
1200	480	96	24	

Daily carbohydrate requirements vary significantly based on how much exercise you do. The more you train, the more carbohydrate you need in order to adequately recover from your last workout and perform optimally in your next workout. Use this calculator to determine your daily carbohydrate needs.

Recommended Daily Carbohydrate Intake

Training Volume	Recommended Carb Intake g/lb
≤4 hours/week	2-2.75
5-6 hours/week	2.75-3.25
7-10 hours/week	3.25-3.75
11-14 hours/week	3.75-4
15-19 hours/week	4-4.5
20-24 hours/week	4.5-5
≥25	5-5.5

Recommended Daily Protein Intake

Lifestyle	Grams/Protein/lb Body Weight
Sedentary	0.4-0.5
Athlete	0.6-0.7
Rigorous Training	.09-1.2

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Visit us at www.pacifichealthlabs.com to obtain information on our latest products, cutting edge research in sports nutrition, and detailed guides to incorporate our products into your training program.





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The uncompromising pursuit of science

U.S. \$3.95/Can. \$4.95

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