Fluid Dynamics

From low cal to high sodium, today's sports drink market is more diverse than ever. Are you prepared to help athletes navigate the sea of options and find the best product for their individual needs?

By Michelle Rockwell

Michelle Rockwell, MS, RD, CSSD, is a Sports Dietitian based in Raleigh-Durham, N.C., and the former Coordinator of Sports Nutrition at the University of Florida. She offers sports nutrition consulting services in addition to educational products and workshops through RK Team Nutrition: http://www.rkteamnutrition.com/.

For several years, I have served as Team Sports Nutritionist for a competitive triathlon squad. Historically, each of the 16 athletes has been permitted to request their preferred sports hydration drink, and as recently as just a few years ago, all of the athletes chose one of two brands. The primary variation was simply which flavor they wanted.

However, in the last few years, the requests have changed dramatically. Most recently, the athletes asked for nine different brands and countless flavors. Our team administrator responsible for supplying these products officially went on strike! And I realized I needed to become even more well versed on the many new sports drinks on the market.

When I started my career, most athletes still drank the traditional lemon-lime Gatorade. Athletes can now find many different brands, flavors, nutritional components, and unique features in the sports drink world--and there is heightened competition among the various brands for loyal consumers.

Competition often works to everyone's benefit, but the vast number of options can be overwhelming to athletes. In today's market-driven world, your athletes need to be sports drink savvy to get the most out of their workouts.

POURING OUT OPTIONS

The household names like Gatorade and Powerade may still be the biggest players in the industry, with the largest percentage of market share overall, but several newer brands are also becoming well-known and gaining a devoted following. In addition, athletes are asking if popular beverages like Vitamin Water can serve as a sports drink.

Several organizations have come up with their own definition for sports drinks, and they don't always agree. But for those of us working with competitive athletes, sports drinks have a very specific need to fill. They must:
• Be designed for use during exercise as a way to rehydrate
• Contain electrolytes, which are typically lost via sweat
• Contain carbohydrates
• Be sold in ready-to-drink, powder, and/or liquid concentrate forms.

That means one of the first things we need to do is teach athletes what is not an appropriate sports drink. For instance, beverages like flavored waters, nutritionally enhanced beverages, and energy drinks are booming in popularity. There may be a place for these products in some athletes' diets, but they should not be used for the purpose of hydrating during intense exercise.

Here is how I categorize the expanding options in the sports beverage world:

**Sports drinks** contain carbohydrates, electrolytes, and sometimes other added nutrients. They are appropriate for use before, during, and after intense exercise.

**Flavored waters** usually contain very few calories (if any) and sometimes include artificial flavoring, vitamins, minerals, and/or herbs. Familiar names include Propel and Powerade Option. These can be used for general hydration in place of water, but not during long or intense exercise.

**Nutritionally enhanced beverages** may contain carbohydrates, artificial flavoring, added protein, vitamins, minerals, and/or herbs. This category includes Vitamin Water, Special K Protein Water, and SoBe Lifewater. Such products do not work well as sports drinks.

**Recovery drinks** frequently contain a combination of protein and carbohydrates along with other nutrients designed to support post-exercise energy replacement and muscle recovery. We know that consuming 10 to 20 grams of protein along with carbohydrates within 60 minutes of exercise completion is beneficial for athletes, and recovery drinks are often a convenient, appealing source. But they should not be confused with sports drinks.

Many athletes also ask me about energy drinks. I would not categorize these as sports beverages and rarely recommend them for any athlete in any situation. They usually include caffeine and/or other stimulants, carbohydrates, artificial flavoring, and sometimes ingredients such as amino acids, vitamins, minerals, or herbs. The level of caffeine and other ingredients in some energy drinks has raised concern among many health and sports professionals, and it's often difficult to determine exactly how much caffeine and other ingredients are in each drink. Energy drinks are definitely not appropriate as a hydration source.

There's further confusion over products that technically fit into multiple categories. For instance, is a traditional sports drink that contains caffeine an energy drink or a sports drink? I would not use it as a sports drink, because the caffeine can be detrimental to hydration.
How about flavored water with electrolytes? While this may be good for hydrating the casual athlete, the lack of carbohydrates makes it a poor choice for competitive athletes doing long or intense exercise. With so many choices in the pure sports drink category, there really is no reason to use products that may compromise the proven effects of sports drinks.

**MAKING CHOICES**

With a firm grasp of what constitutes a sports drink, an athlete’s choices are certainly narrowed down. But there are still many options available, so how do you know what is the best sports drink for a specific athlete?

As a sports dietitian, I base the practical strategies I provide to athletes on quality science. On the topics of hydration, electrolyte replacement, and carbohydrate consumption during exercise, we are fortunate to have a firm scientific platform from which to make recommendations. That science is the basis for all my advice to athletes.

However, the magic of individualized sports nutrition involves taking into account the fact that all athletes are different. Each one presents unique goals, taste preferences, belief systems, and rituals. Furthermore, physiology, digestion, gastric absorption rate, sweat rate, and sweat composition can differ dramatically among individuals. Thus, it is important to take all these personal factors into account.

I also believe in the value of experimentation with athletes and their nutrition choices. We start with science, discuss individual differences, and then use trial and error to arrive at the best results.

**THE SCIENCE**

Proper use of sports drinks during exercise can increase safety and enhance performance. When the temperature rises, the risk of heat illness goes up and mental and physical performance deteriorate. Dehydration increases body temperature. Sports drinks have been shown to enhance hydration status by stimulating thirst, replacing electrolytes, and promoting fluid retention. Carbohydrates in sports drinks can replace energy stores (blood glucose and liver and muscle glycogen) and supply fuel to maintain intense, high-level exercise for extended periods.

In general, sports drinks should be chosen over water for any exercise event lasting longer than one hour. I use the 3-H Rule as a guideline: It simply says to use sports drinks whenever exercise is Hard, Hot, or at least an Hour long.

What the drink contains is also part of the science of sports drinks. The two major ingredients to understand are electrolytes and carbohydrates. In addition, we need to be well versed on the pros and cons of other added ingredients.

**Electrolytes.** An effective sports drink should replace electrolytes lost in sweat—namely sodium, potassium, and chloride. Sodium is lost at the highest rate, with
an average of one gram lost per liter of sweat. Considering that many athletes lose a few liters of sweat during a hard, hot exercise session, sodium replacement is obviously critical to preventing heat-related problems.

The American College of Sports Medicine (ACSM) recommends that sports drinks contain 110 to 220 milligrams of sodium per eight ounces, and roughly 30 milligrams of potassium. There are no formal recommendations for chloride lost in sweat, as it is almost always paired with sodium in the form of sodium chloride. In other words, if you have enough sodium, you are also getting enough chloride.

However, it's important to recognize the extreme variations in individual sweat rates and the concentration of sodium and other electrolytes in each person's sweat. Some athletes are "salty sweaters," while others may not lose nearly as much sodium in their sweat, but tend to lose higher concentrations of other electrolytes.

How do you measure an individual athlete's electrolyte losses? Some companies have developed technology that can quantify sodium loss during exercise. A less scientific way is through trial and error.

You can tell that an athlete is a salty sweater if he or she frequently has a white film on his or her face or clothing after exercise. Another good indication is if an athlete has strong cravings for salty foods post-workout. Athletes who are clearly hydrating well--losing minimal weight during exercise sessions and producing pale yellow urine--but still struggling with muscle cramping or heat issues may also be salty sweaters.

For someone known to be a salty sweater, I encourage a high salt diet and drinking plenty of sports drinks throughout the day. I also tell them to start with an extra one-quarter to one-half teaspoon of salt in 20 ounces of sports drink about 30 minutes prior to exercise and continue with the same formula during exercise (one teaspoon of salt is roughly 2,400 milligrams). Another solution is to use specialty endurance sports drinks or electrolyte supplements.

While sodium is the electrolyte most critically in need of replenishment, magnesium, calcium, and other minerals are also lost in sweat. Should you look for sports drinks with these ingredients, too? In general, the answer is no. However, if I'm working with an athlete who is hydrating well and who I'm certain is consuming sufficient sodium, yet they're struggling with energy levels, I might recommend experimenting with increased consumption of these other minerals through diet (not sports drinks).

Carbohydrates. Athletes, and particularly parents of younger athletes, often ask me, "Do we really need all that sugar in sports drinks?" If exercise is hard enough and long enough, the answer is definitely yes. Research has shown that carbohydrate beverages consumed during exercise enhance performance. In fact, our bodies respond so well to carbohydrates during exercise that one study
found simply rinsing one’s mouth with a sport drink (and not swallowing it) enhanced performance in a cycling time trial.

The key to consider is the type and concentration of carbohydrates in a sports drink. Most contain at least one source of simple sugar, such as glucose or fructose. Others contain sucrose (table sugar), which is a combination of glucose and fructose. Some contain high fructose corn syrup, which is also a combination of glucose and fructose and is often referred to as "sucrose syrup" or "glucose-fructose syrup" on sports drink labels.

Research shows that a combination of sugars, as opposed to a single sugar, maximizes absorption during exercise. One reason for this is that each sugar utilizes different intestinal transporters. Having more than one sugar enables two transport systems to work at once and decreases the likelihood that one transport system becomes saturated.

Several newer sports drinks have incorporated some more complex carbohydrate sources, such as maltodextrin. The theory behind these is that slower absorption causes energy to be sustained longer during exercise, which would certainly appeal to endurance athletes. However, the slower absorption rate (especially when a more complex sugar is the sole carbohydrate source) may cause gastric upset.

Some sports drinks tout more natural sources of carbohydrates, such as cane juice or brown rice syrup solids. Many athletes whose lifestyles emphasize a natural or organic diet find these options appealing. There is little research on how these carbohydrates are absorbed during exercise, so interested athletes should experiment with them during training sessions and take note of the results.

In terms of carbohydrate concentration in sports drinks, professional organizations have slightly different recommendations. The ACSM and American Dietetic Association recommend six to eight percent carbohydrate. The NATA recommends four to eight percent carbohydrate. And the Institute of Medicine recommends five to 10 percent carbohydrate.

For many athletes, a carbohydrate concentration of greater than eight to 10 percent is likely to inhibit fluid absorption, so choosing a sports drink in the lower range and properly diluting powder or liquid concentrates is important. When an exercise event is very long or will require a lot of fluid consumption, a lower concentration can help prevent over-consumption of carbohydrates and gastric intolerance.

To determine the carbohydrate concentration of a sports drink, divide the amount of carbohydrates per serving (in grams) by the serving size (in milliliters) and multiply by 100. So, if the serving size is 240 milliliters (eight ounces) and total
carbs per serving is 11 grams, the sport drink contains about 4.5 percent carbohydrates.

To figure out which carbohydrate source and concentration is tolerated best by individual athletes, I again use trial and error. To avoid unwanted outcomes, athletes should try different sports drinks during training—not during competition.

Other Ingredients. Sports drinks containing protein have become more popular in recent years. Some researchers have shown that a small amount of added protein can improve exercise performance and speed muscle recovery, but other studies contradict those findings, and more research is still needed.

In practical terms, if an athlete is interested in using a sports drink containing protein, my advice is to try it during several different training sessions and evaluate how it feels. Some athletes find these beverages helpful and appealing. Others find the taste chalky or unpalatable, or they experience gastrointestinal symptoms (likely because protein empties from the stomach more slowly than other substances). In order for a sports drink to aid in hydration and performance, athletes must be able to consistently drink adequate amounts of it, so taste, appeal, and comfort are important factors.

Some sports drinks are also fortified with vitamins and minerals. There is little evidence that consuming a specific vitamin or mineral during exercise provides any immediate benefit. However, they may contribute to helping an athlete meet his or her overall needs for critical vitamins and minerals.

Sports drinks containing specific amino acids, various herbal ingredients, caffeine, and other additives are also readily available. In many cases, there is too little of these ingredients to have much impact.

HOW MUCH?
Once an athlete has decided on which sports drink to use, the final factor to consider is the amount they should consume. This depends on several factors, including sport, workout intensity, environmental conditions, hydration opportunities, sweat rate, age, general diet, and individual habits and preferences.

Starting exercise in a well-hydrated state is critical, because most athletes don't drink enough during exercise. Athletes can pre-hydrate with water, sports drinks, or other non-alcoholic beverages. Many foods, particularly fruits and vegetables, also have a high water content and contribute to overall hydration. As the start of exercise nears, athletes should use either water or sports drink to pre-hydrate.

According to the NATA, general pre-exercise guidelines are as follows:

• Two to three hours before exercise, drink 17 to 20 ounces of water or a sports drink.
• Ten to 20 minutes before exercise, drink seven to 10 ounces of water or sports drink.

During exercise, sports drink consumption should be based on each athlete’s unique sweat rate. Athletes should aim to lose less than two percent of their body weight via sweat during exercise. A loss greater than two percent has consistently been shown to jeopardize safety and performance.

If you don't know an athlete's sweat rate, a general guideline is to have them drink seven to 10 ounces of sports drink every 10 to 20 minutes of exercise, for a total of about 24 to 40 ounces (three to five cups) of sports drink every hour. This level of consumption is not only likely to meet an athlete's fluid needs, but their carbohydrate needs as well. Athletes typically utilize 30 to 60 grams of carbohydrate per hour of exercise, but sometimes can use 100 grams or more. Since most sports drinks contain about 15 grams of carbohydrate per cup, three to five cups would equal 45 to 75 total grams of carbohydrates per hour.

Note that if an individual requires more fluid to balance sweat loss, they may benefit from using a mix of sports drinks and water, or a sports drink with a lower carbohydrate concentration. This will help avoid gastric upset and over-consumption of sugar and calories.

To calculate an athlete's sweat rate, you can follow this procedure:

1. Obtain body weight in minimal clothing and without shoes prior to exercise.
2. Record the amount of fluid consumed during the exercise session.
3. Obtain body weight in minimal clothing and without shoes after exercise.
4. Subtract the athlete's post-exercise weight from pre-exercise weight. If the difference is less than two percent, they are consuming enough fluid. If it is greater than two percent, the athlete is not hydrating well enough during exercise. Assuming that one fluid ounce roughly equals one ounce of mass, the athlete should add 16 fluid ounces of sports drink to their hydrating plan for every pound of weight lost.

For example, if Sam's pre-practice weight is 175 pounds and his post-practice weight is 170 pounds after consuming two cups of sports drink during a two-hour practice, we know that he needs to up his intake. As a goal for the next practice, Sam must replace at least two more pounds of fluid, or about 32 fluid ounces. That should give him a fluid loss of just three pounds, which is less than two percent of his body weight.

Conversely, what if an athlete gains weight during exercise? That means they are drinking too much, which increases risk for hyponatremia, a potentially fatal condition in which sodium concentration in the blood becomes dangerously low. Athletes also want to avoid the sluggish feeling of carrying around excess fluid. The advice here is simple--drink less during the workout, but not so much less that dehydration comes into play.
I always tell athletes to drink early in their exercise sessions, prior to the onset of thirst. Drinking small amounts at very frequent intervals is helpful for achieving optimal hydration without impacting comfort level, and it also helps promote a consistent hydration level throughout a workout.

Today's athletes have a daunting array of sports drinks to choose from. If they understand the science and claims behind the various products on the shelf, and they're willing to engage in a bit of trial and error, they can find the one that best meets their hydration needs and suits their personal tastes and preferences. Once they've done that, achieving and maintaining optimal hydration is, well, no sweat.

Sidebar: BETTER THAN WATER
For the most part, athletes need to use sports drinks instead of water only for very intense workouts and exercise events lasting longer than one hour. But there are other situations when sports drinks may be helpful. For example:
• When an athlete is starting exercise on an empty stomach or hasn't ingested adequate carbohydrates.
• If an athlete is carbohydrate-loading—sports drinks consumed throughout the day can provide extra carbs to help boost stores leading up to an important competition.
• If an athlete seeks weight gain—the extra calories can help shift their calorie count upward.
• If an athlete has chronic dehydration or heat-related issues—to support pre-hydration and electrolyte intake before exercise.
• For training at altitude, which increases fluid loss.
• For training during very cold weather, when athletes tend to drink less and wear clothing with inadequate ventilation.
• When suffering from vomiting or diarrhea—to replace lost fluids and electrolytes.
• When water would be appropriate but the flavor, sodium content, and appeal of sports drinks is the only way an athlete will hydrate properly.

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