

Sports Drinks: Don't Sweat the Small Stuff



By Tim Graham

Whatever your favorite sport—basketball, skateboarding, tennis, or mountain biking—if you do it hard, you sweat, and when you sweat, your body loses valuable substances that need to be replaced. This is where sports drinks like Gatorade, All Sport, Powerade, and many others enter the picture—to the tune of \$700 million in sales per year! The manufacturers of these drinks promise that their products can quickly replenish substances lost from extreme exercise, resulting in greater endurance and improved athletic performance for the consumer. Although these claims may seem quite reasonable, is there really evidence to support the assertions that sports drinks offer any benefit?

Exercise does a body good

Before considering the claims of sports drinks manufacturers, let's look at what happens inside your body during and after a hard workout. Your body stores car-

bohydrates in the muscles and liver in the form of a nonreducing, white, amorphous polysaccharide called *glycogen* (see Figure 1 on p 12). Glycogen is converted to a simple sugar called glucose and is released into the bloodstream to be used as fuel to maintain normal body processes. During moderate- to high-intensity exercise, glycogen reserves can be depleted within 60–90 min. Blood sugar levels drop as the glycogen reserves are used up, and lactic acid (see As a Matter of Fact, p 16) builds up in muscle tissue. Lactic acid lowers the pH of muscle cells—causing muscle fatigue, cramps, and pain. This certainly limits the body's ability to perform at peak levels.

Research has shown that if you plan on exercising for less than one hour, a sports drink is not beneficial. It takes an hour of steady exertion to begin depleting glycogen reserves. But if you are planning to play in a basketball or football game, a sports drink may be advantageous.

When carbohydrates are being depleted during exercise, muscles also generate a large amount of heat that must be dissipated for them to work properly. Water, in the form of sweat, which has a large heat of vaporization, is used to take heat away from these muscles. About 600 kcal (one dietician's Calorie, as listed on food labels, equals one kilocalorie) of heat is eliminated per liter of sweat. Sweating and evaporative cooling help your body to maintain a constant inner temperature, but the cost is huge!

Sweating away more than 2% of your body weight—1 L for every 45 kg—can stress the heart, increase

Sports drinks are also called isotonic beverages, which means they have the same osmotic pressure as fluids in cells. Experienced athletes drink them before they begin to play. These serious athletes believe that sports drinks help them perform better and longer.



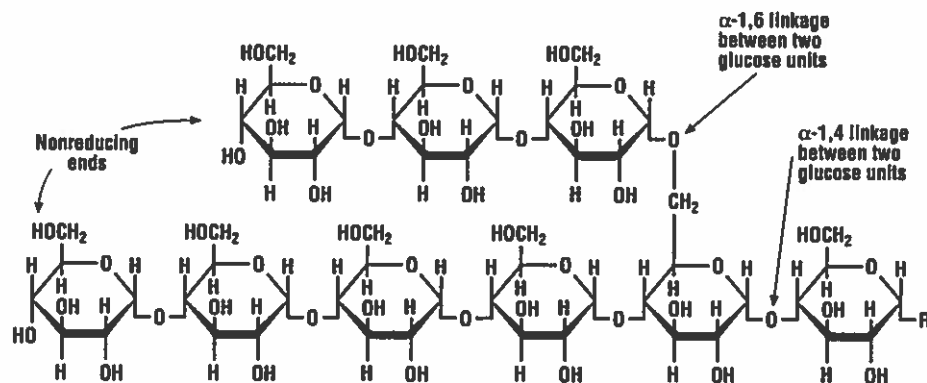


Figure 1. Glycogen is a storage form of glucose. It is a large, branched polymer of glucose residues. Glucose residues in glycogen are linked by α -glycosidic linkages that form open helical polymers. Glucose is used as fuel to maintain normal body processes.

body temperature, and decrease performance. During a high-intensity workout in hot weather, 1–3 L of water can be lost from sweating in as little as one hour.

Excessive sweating also results in the loss of potassium and sodium ions, which are very important positively charged particles that are present in the fluids inside and outside our cells. Positively charged ions are *cations*, and negatively charged ions are *anions*. Our bodies contain equal amounts of both kinds of charges, and these ions enable us to maintain normal body functions. Potassium cations (K^+) are responsible for activating certain enzymes, processing and storing carbohydrates, and helping to transmit nerve impulses to the heart and skeletal muscles. Sodium cations (Na^+) play a major role in exchanging nutrients and waste products between the cell and its extracellular fluid environment. It is very important for the body to maintain proper fluid balances. A loss of one to three liters of fluid from sweating can result in 1.5 to 8.0 g of lost mineral salts containing potassium and sodium ions. When concentrations of either or both of these ions are in lower than normal, fatigue and muscle weakness set in, and heat exhaustion or heat stroke is a real possibility.

The drink of champions

All the major sports drinks contain three main ingredients: carbohydrates in the form of simple sugars such as sucrose, glucose, and fructose; electrolytes, including potassium and sodium ions; and water. Because these are the three major sub-

stances lost through sweating, one might reasonably conclude that drinking sports drinks should improve performance. But is this really true?

Recent scientific studies have confirmed that athletes who consume sports drinks experience the same changes in core body temperature, heart rate, and sweat rate as those who consume H_2O —plain old water! Sports physiologists agree that the number one consideration for an athlete in maximizing performance is to stay hydrated, and water does the job as well as or better than any other drink. The lost carbohydrates and electrolytes can usually be replaced by eating a proper diet before and after exercise. Therefore, it would seem questionable whether sports drinks provide any benefit over drinking water.

Amount/serving	%DV*	Amount/serving	%DV*
Total Fat 0 g	0%	Total Carb. 20 g	7%
Sodium 55 mg	2%	Sugars 19 g	
Potassium 30 mg	1%	Protein 0 g	
Thiamine 10%		Fiber 10%	
Vitamin B ₆ 10%		Vitamin B ₁₂ 10%	
		Pantoic acid 10%	

* Percent Daily Values are based on a 2,000-Calorie diet.

Figure 2. Food labels list nutritional values in terms of quantity or percentage of *Daily Values*. The *Daily Values* are calculated based on a daily 2,000-Calorie intake. Caloric intake must be adjusted for the level of physical activity and energy demands. Good sports drinks should provide 14–20 g of carbohydrate and 50–100 mg of sodium per 240 mL of drink.

This is not to suggest that if you consume sports drinks you should stop. Drinking a sports drink does have one profound advantage over drinking water—for some

people it tastes better! And if a drink tastes better, it encourages a person to consume more, thus hydrating cells to a greater extent. This greater degree of hydration can certainly help improve performance. Further, it seems quite evident that athletes trust the claims of sports drinks' manufacturers—they are buying and consuming large quantities. Reinforcing this trend, science confirms that the more you drink, the less fatigue you experience.

Selecting the best

If you are considering using sports drinks or have already tried them, here are some guidelines to look for to achieve the best possible advantage that a sports drink has to offer. A good sports drink should provide 14–20 g of carbohydrates per 240 mL of drink (see Figure 2). Too much sugar slows down the absorption rate and increases the amount of time it takes for both the sugar and water to enter the bloodstream. Recent studies confirm that fluids containing this recommended concentration of carbohydrates (about 6–10%) enter the bloodstream just as quickly as water, and performance is definitely enhanced by the increased hydration.

A good sports drink should also provide at least 50–100 mg of sodium per 240 mL of drink. Sodium is added to help maintain fluid levels, but its most important role as a sports drink supplement is simply to encourage



Table 1. Nutritional Comparison of Beverages

Drink (serving size 240 mL)	Calories (C)	Sodium (mg)	Potassium (mg)	Carbohydrate (g)	
				Total	Sugars
Water	0	0	—	0 (0%)	0
Apple Juice	140	25 (1%)	—	34 (11%)	32
Iced tea	80	70 (3%)	—	22 (7%)	22
Regular soda	100	35 (1%)	—	27 (9%)	27
Diet soda	0	25 (1%)	—	0 (0%)	0
All Sport	70	55 (2%)	50 (1%)	20 (7%)	19
Gatorade	50	110 (5%)	30 (1%)	14 (5%)	14
Gatorade (concentrate)	50	110 (5%)	30 (1%)	15 (5%)	14

drinking. Just as eating salty potato chips causes you to be thirsty, the extra sodium in sports drinks encourages you to drink more! Drinking salt solutions greater than 3% salt tends to dehydrate living cells.


When the concentration of sodium and chloride ions is too high, the kidneys eliminate the excess by producing more urine. In the process, your body loses a lot of water and becomes dehydrated, limiting its ability to

perform at peak levels. Unlike salt water, however, the small amounts of sodium added to sports drinks tend to encourage drinking without causing the kidneys to work overtime to get rid of excess salt. Once again, your body is getting more of that valuable water from the sports drink, and increased hydration means increased performance!

Fluid retention

Sports exercise experts agree that thirst is a poor indicator to tell you when you need to replace fluids in your body. By the time you become thirsty, you already have depleted fluid levels to a point where athletic performance is going to be adversely affected. Probably the best indicator of the degree of hydration is urine. If you are hydrated adequately, urine should be clear and pale yellow, not dark yellow. For this reason, it is important to drink 300–480 mL of fluid before exercise and 150–360 mL every 15 min during exercise.

Avoid high-sugar drinks (most juices) and carbonated beverages, because they are harder for the body to absorb (see Table 1). If you are going to drink a sports drink rather than water, find one that tastes good, and drink lots of it! All of the leading sports drinks contain basically the same ingredients in similar concentrations; therefore, taste may be the single most important factor in choosing your drink. If you are not interested in any particular sports drink, just drink plenty of water. ▲



Bottled Sweat

“**G**atorade” got its name because the University of Florida’s football team—the Gators—was involved in testing this new sports drink formula in 1965. The recipe, containing a mixture of carbohydrates and electrolytes, was used to prevent dehydration caused by extreme workouts in the hot Florida climate. The Gators’ success that season was in part attributed to its use of the sports drink formula. In 1967, a modified form of this drink was marketed with the name “Gatorade”. To this day, Gatorade is the market leader in sales of sports drinks.



Tim Graham teaches chemistry at Roosevelt High School in Wyandotte, MI. His article “Colors Bursting in Air” appeared in the October 1998 issue of *ChemMatters*.

REFERENCES

- Applegate, L. Brave New Beverages. *Runner's World*, July 1998, pp 30–33.
 Applegate, L. Fluid News You Can Use. *Runner's World*, July 1996, pp 26–28.
 Bookspan, J. Are Sport Drinks Good for Divers? *Skin Diver*, June 1993, pp 62–66.
 McArdle, W. D.; Katch, F. I.; Katch, V. L. *Exercise Physiology: Energy, Nutrition, and Human Performance*, 4th ed.; Lea & Febiger: Philadelphia, PA, 1996.
 Selling Sweat. *Consumer Reports*, August 1993, pp 491–494.

RELATED ARTICLE

Alper, J. Survival at Sea. *ChemMatters* 1992, 10 (3), pp 4–7.