



Liquid Assets

Sports drinks come in many guises and they make many claims. One recent development is the calorie-free option, which has attracted the interest, and the buying power, of a lot of people

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Sports drinks are a spectacular success story. Pioneered and still dominated worldwide by Gatorade in its various guises, the market is worth billions of dollars. With such vast profits being made, sports drinks companies are constantly searching for new ways to target their customers. The range of products is already bewildering and the research continues.

Among the newer kids on the block are calorie-free sports drinks. See that: they're calorie-free (or almost calorie-free) and they're sports drinks. But with so many drinks and so many variations already available, you might wonder about the thinking behind yet another option. Mere cynical marketing strategy? Genuine nutritional breakthrough? Something you didn't even know you needed but actually do? Or, simply, sensible science? Let's see.

CONTROL

One option is High5 Zero. According to the marketing the product "enhances fat-burning by 41 per cent", which may be particularly appealing if you're planning to lose some weight in time for race season. The science stems from a fairly simple equation: if you want to lose weight you have to expend more calories than you consume. If you simply want to hydrate without adding calories, products from Nuun and new Powerade Zero are designed to stimulate thirst and help your body retain fluid.

They are also designed to corner sections of a very lucrative market. When Gatorade released its low-calorie G2 drink it captured eight per cent of sports drinks sales in four months. So as athletes become more sophisticated and knowledgeable about their nutrition needs, drinks manufacturers come up with something new. Or, perhaps, it's the other way around.

BETTER OR JUST DIFFERENT

The obvious question to ask when deciding on rehydration is: are sports drinks (in this case the calorie-free variety) better than plain water? The main difference between the two is that calorie-free sports drinks replace electrolytes (sodium, potassium, magnesium and calcium) lost in sweat; water does not. Electrolyte loss varies from person to person and in different environments. One way to tell if your sweat is particularly high in sodium is to look for white marks on your clothing or salt crystals on your skin after exercise.

It is, of course, important to drink during training and competition to avoid

dehydration. According to the American College of Sports Medicine, a fluid loss of as little as two per cent of body mass can lead to a reduction in aerobic exercise performance. At the other end of the scale is hyponatraemia, which is caused by overhydrating with plain water. This is more often seen in longer races that take place in hotter climates. The sodium lost in sweat leads to a fall in the concentration of sodium in the blood. When this happens water levels rise as you overhydrate and your body cells swell – with potentially serious consequences. Some people also believe that muscle cramps are linked to dehydration and low electrolyte levels, though there is no scientific evidence to support the theory.

The American College of Sports Medicine recommends that sports drinks contain 0.5-0.7g/l of sodium and 0.1-0.2g/l of potassium. But during short sessions (under an hour) plain water is probably all

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you need, especially in the cold British climate. Most of us get plenty of sodium in our everyday diet and about 26 million adults in the UK eat too much salt, mostly because it's hidden in the food we buy.

Some people just don't like the taste, such as it is, of water. If this is you, calorie-free sports drinks can be a good way to encourage you to drink more, and their sodium content helps stimulate thirst.

WHAT ABOUT CARBS?

It has long been recommended that endurance athletes consume a diet rich in carbohydrate. Carbohydrate is stored in our muscles as glycogen, where it can easily be broken down to glucose, which we use as fuel. Most research continues to emphasise the importance of adequate carbohydrate intake before, during and after exercise. This is particularly important during high-intensity events, where glucose is the main fuel. In events or training sessions that last more than an hour, it is generally recommended that 30-60g of carbohydrate should be consumed per hour, in drinks, gels or food.

Drinking plain water, or a calorie-free drink, increases the proportion of fat burned during exercise because less glucose is available. When you take in a

standard sports drink, the glucose is rapidly delivered to your blood and provides an instant source of fuel. Without this, you must tap into your fat stores.

Research by the University of Glasgow, involving 22 recreationally active males, showed that, in a one-hour cycling test after an overnight fast, those who drank High5 Zero burned 41 per cent more fat than those who consumed a standard sports drink. It's important to note that total energy expenditure was similar in the two groups – 41 per cent may sound a lot but, when thinking about weight loss, it's the total amount of calories you burn that's important. However, those who drank the sports drink consumed around 250 extra calories, almost half what they expended. If weight loss is a goal, there's no need to take in this extra fuel during an hour of exercise. It's also worth mentioning that Zero is not intended to be a weight-loss product.

TRAIN LOW, RACE HIGH

According to High5, Zero can be used for 'train-low, race-high' strategies. 'Train low' means that some training is done without carbohydrate, to encourage the body to burn fat. As the bulk of modern sports nutrition research highlights the role of carbohydrate in enhancing performance under race conditions, the 'race high' part involves taking on standard sports drinks or gels during events.

The roots of this approach are in our evolutionary past. Our ancestors in the late-Paleolithic era didn't have the opportunity to fuel up with carbohydrate before they went off to forage and hunt – seeking food was the point. Cycles of feast and famine meant that the ability to perform extended periods of physical activity on an empty stomach was a survival advantage. It is thought that our genetic makeup hasn't changed much in the 10,000 or so years since then. So it makes sense, in theory, that humans are designed to exercise without taking on extra fuel.

FUEL EFFICIENCY

At all times, our bodies burn both fat and carbohydrate for energy. While our storage capacity for carbohydrate is limited, most of us have more than enough fat stores to keep us going for a while if circumstances demand it. Aerobic training increases the proportion of fat to carbohydrate burned, making it easier to exercise for long periods. Just as the body adapts to any training stimulus by becoming stronger or fitter, the idea is that training with low glycogen levels »

stimulates the body to become more efficient at using stored fat for fuel.

Low-glycogen training is different from simply training after an overnight fast, when muscle glycogen levels are still relatively high. Studies investigating the 'train-low' approach deplete participants' glycogen stores by putting them through an hour or more of aerobic training. After an hour's rest, participants then complete up to an hour of high-intensity exercise, all with only water to drink.

SMART MUSCLES

A study published in *Medicine & Science in Sports & Exercise*, involving 14 well-trained cyclists, showed that three weeks of high-intensity training in this glycogen-depleted state was as effective in improving time-trial performance as was training with normal glycogen levels, even though their power output during training was lower. The low-glycogen training led to a greater increase in the rate of fat oxidation by increasing the levels of enzymes involved in the metabolism of fat. At the same time, it led to greater resting levels of muscle glycogen after training.

What this means is that, although training with low levels of glycogen

(carbohydrate) in the muscles reduced the intensity the cyclists were able to operate at in a session, their race performance still improved. This is probably because the cyclists' muscles responded to training with low fuel levels by storing more carbohydrate at rest and they became more efficient at burning their fat stores for fuel on the big day.

Athletes need to look at their training schedule and identify sessions that would benefit from a little extra stimulus

Most studies on low-glycogen training have been carried out on males. Energy metabolism during exercise varies between the genders. A study published in the *Journal of Science and Medicine in Sport* found a greater increase in fat-metabolising enzymes for women when they trained in the fed state, suggesting that the 'train low, race high' approach may be more appropriate for men than it is for women.

While there is no clear evidence that this approach will benefit performance, it may be something you want to experiment with, especially if fat loss is a goal. But training with low glycogen levels is unlikely to be beneficial for people who compete in short races, where the intensity is higher and carbohydrate is the main fuel. It's better suited to Olympic- and Ironman-distance triathlon than it is to sprint events.

SAVE IT FOR THE RACE

According to Dr Keith Baar from the University of California, a leading researcher in this field, "The idea of training should be to maximise the adaptation and not to perform the best. Athletes need to look at their training schedule and identify sessions that would benefit from a little extra stimulus. These sessions should include some high-intensity work so that they are using the muscle fibres that would benefit the most from additional fat-burning enzymes."

The glycogen-depletion sessions should be carried out at least two or three hours after eating. The adaptive sessions can be carried out immediately after the depletion session, or after an hour or so of rest. Both

Glycogen-depletion session	Adaptive session
60-90 min bike at 70% maximal workload	8 x 5 minutes at maximal workload with two minutes rest
60-90 min run on the track	30 min track session: 4-6 x 1200m at a 10K pace
Evening run followed by a low-carbohydrate dinner (eg grilled fish and vegetables)	Morning run or bike ride that includes 20 minutes at race pace
Morning bike ride of 3-4 hours (2-3 hours after normal breakfast)	30-60 min run, including 4-6 x 500m hill reps at maximal effort, with jog recovery

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sessions should be carried out without taking on any carbohydrate. See panel above for examples of both sessions

"After the session, drink water for the first hour and then take a recovery drink to replenish glycogen. This allows a longer stimulus for adaptation while still allowing full glycogen recovery for future training," says Baar. The main thing to consider when choosing between plain water and a calorie-free sports drink is that you like the taste, as this will encourage you to drink enough.

Bear in mind that training in a glycogen-depleted state has its risks as well as its possible benefits. They include

increased levels of stress hormones, muscle breakdown, fatigue and lowered immune response. If you decide to add some low-glycogen training to your schedule, it's probably best, initially, to limit it to once a week. Allow plenty of time for recovery, and monitor your response, stopping if you feel unwell or more fatigued than seems right.

Whether you choose to drink water or a sports drink, you must be able to gauge how much you should drink to be sure you're not taking in too little or too much liquid. A simple way to assess your hydration status is to weigh yourself before and after exercise. (See table below for tips on fluid replacement.)

USING CALORIE-FREE SPORTS DRINKS

Calorie-free sports drinks may be particularly useful for:

- People looking to lose weight – they hydrate without adding calories
- 'Train-low' or short, intense training sessions (less than one hour) – when extra carbohydrate is not needed but electrolytes lost in sweat ought to be replaced
- People who simply don't like the taste of plain water – the drinks can be used on their own or, in longer training sessions, alongside gels or 'real' food. ■



Fluid-replacement recommendations:

Before exercise	Slowly drink 250-500ml a few hours before training; more if your urine is dark in colour
During exercise	Aim to prevent body weight loss of more than 2% by drinking 400-800ml per hour
After exercise	Drink 1.5L for every kilogramme of body weight lost

SOURCE: AMERICAN COLLEGE OF SPORTS MEDICINE, 2007.