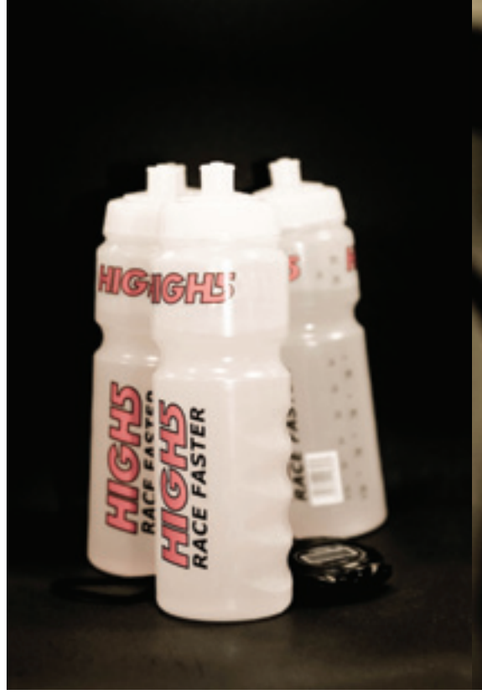
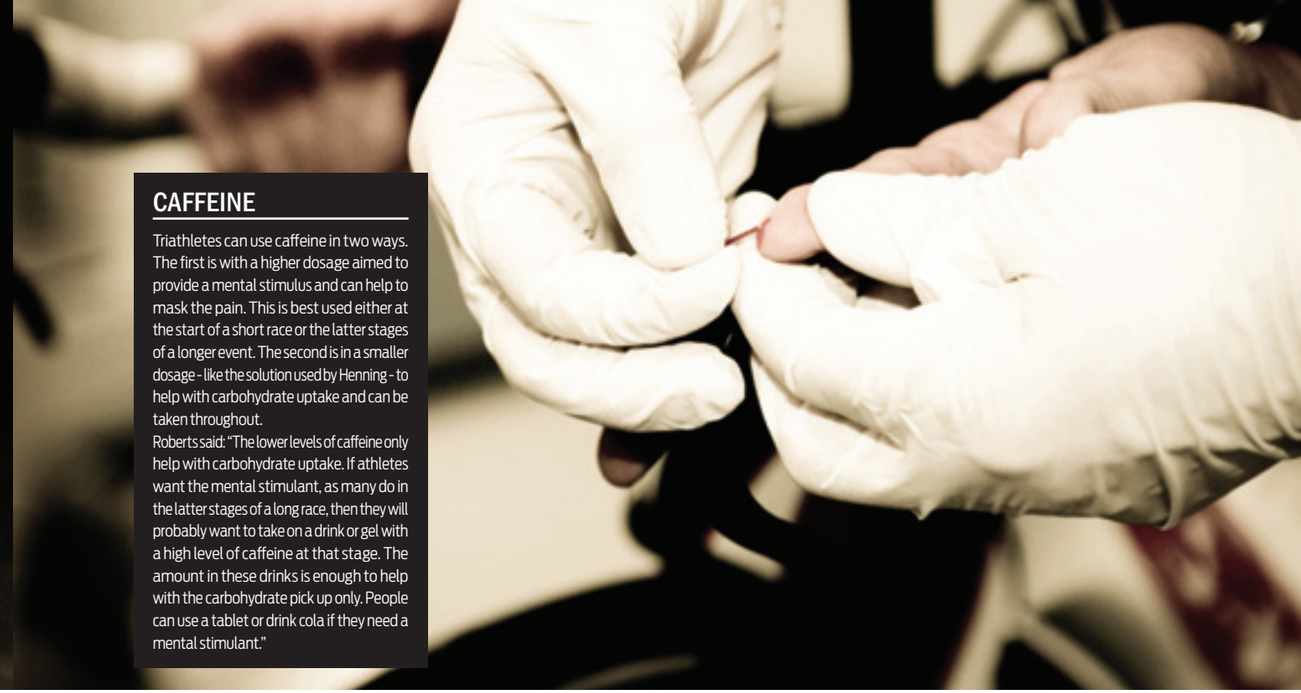
LAB RAT:

Pushing The Carbs To A Better Performance

As sweat oozes from every pore in his body, Rasmus Henning is heating up. Beads roll down his forehead and on to his nose before falling towards the bars of his bike below. The 2010 Challenge Roth winner doesn't bat an eyelid. He just keeps churning away and turning the pedals at Ironman race pace – a pace most of us would be happy to hold for 40K let alone 180. His large frame looks menacing aboard his Specialized Shiv and the noise of the power he is putting through the cranks resonates around the room, but there's a softness and friendly look to his face. Henning looks controlled and content, which is a good thing because he needs to hold this pace for three hours before hopping onto a treadmill and running for two hours at race pace – that's 15kph. This might sound a little sadistic when the weather outside is perfect for training but this is all in the name of research.

LAB RAT





CAFFEINE

Triathletes can use caffeine in two ways. The first is with a higher dosage aimed to provide a mental stimulus and can help to mask the pain. This is best used either at the start of a short race or the latter stages of a longer event. The second is in a smaller dosage - like the solution used by Henning - to help with carbohydrate uptake and can be taken throughout.

Roberts said: "The lower levels of caffeine only help with carbohydrate uptake. If athletes want the mental stimulant, as many do in the latter stages of a long race, then they will probably want to take on a drink or gel with a high level of caffeine at that stage. The amount in these drinks is enough to help with the carbohydrate pick up only. People can use a tablet or drink cola if they need a mental stimulant."

High5, who sponsor Henning and Ironman world record holder Marino Vanhoenacker, has been conducting research into carbohydrate uptake in their two world-class athletes. The nutrition company employed the services of Dr Justin Roberts, a senior lecturer and researcher at Hertfordshire University, to look into increasing the percentage of carbohydrates in their drink and seeing the effects. Potentially they could increase fuel intake, which in the latter stages of the race could mean the difference between winning and second place, or it could result in stomach upsets and vomit.

Roberts explained: "What we're trying to establish is the effect of using a higher ratio of carbohydrates than these world class athletes are used to. We want to establish whether firstly they can tolerate the high numbers of carbohydrates per hour and secondly how much they're oxidising.

"What I mean by oxidising is how much of the carbohydrate — the sugar — in the drink they are actually using. We can measure their total oxidisation and can also assess how much of the sports drink they're oxidising. Ideally we're trying to push the boundaries here."

For this experiment, Roberts, who's no stranger to endurance events himself (see box), looked into what Henning was using pre-testing, which was about 80-90g of carbohydrate per hour. Based on this, Roberts upped his intake by 25 per cent to 120g per hour. For the test, the drink was based on a 10 per cent solution, so Henning was drinking 1.2 litres per hour. Water was also available if Henning felt thirsty and needed further hydration or because he wanted to dilute what was sitting in his stomach.

Roberts said: "The drink we are using is commercially available High5 Energy-Source Plus. This uses a maltodextrin which is a glucose polymer — essentially lots of sugar — which is absorbed through the gut wall via different mechanisms to glucose, therefore he should be able to absorb and use more. We also know small doses of caffeine can help with the uptake of carbohydrate too. This is not the big hit that some might use at the latter stages of a race. It's not about a mental stimulus."

Traditionally, most energy drinks used maltodextrin as the main source of carbohydrate, so based on High5's theory you were limited as to the number of grammes you could digest per hour. This was thought to be around 60g per hour. High5 found the addition of fructose which is absorbed in a different way allows for an additional 30g of carbohydrate per hour. Naturally this will vary from person to person and how their body works.

This all sounds simple enough but it wasn't quite that simple for human guinea pig Henning. He was told to cut out all energy products in the days leading up to the lab test and was told to avoid foods high in C4 carbohydrate — mainly sugar and plant based foods. Henning also had to perform a depletion training session a couple of days before testing. This involved a two to three hour intense training session at 80-90 per cent of maximum heart rate. The aim of this session is to be glycogen depleting, to empty any glycogen stores.

> "HENNING HAD THE PLEASURE OF PEDALLING FOR THREE HOURS AT RACE PACE."

If this wasn't enough Henning was told to fast after his evening meal the night beforehand, which meant no breakfast. It might not sound that tough but these world class Ironman athletes eat a lot. We have seen Henning eat and know he would have been feeling wobbly before he even kicked his leg over the bike.

The testing itself started with a standardised health screen, checking of body composition and looking at related resting measurements. After a further 10 minutes of rest a baseline respiratory, heart rate and blood lactate were taken. This was followed by a 10 minute warm up on the Computrainer Prolab bike ergometer rig. From here Henning had the pleasure of pedalling for three hours at race pace.

During the first two hours measurements were taken at 30-minute intervals. These tests included collection of expired air using a gold standard Douglas bag method. From here samples of expired air were taken into the tube to be sent for analysis which will then be used in the calculation of carbohydration use (referred to as exogenous carbohydrate oxidation rates in grammes per minute).

The expired air from the bag was also assessed for other respiratory parameters including minute ventilation, oxygen and carbon dioxide utilisation. These were then used for assessment of total carbohydrate and fat oxidation rates. Blood lactate tests continued throughout too. After two hours of pedalling, measurements were taken at 20 minute intervals for the final hour of the bike.

During the bike Henning looked consistently strong and unfazed riding indoors despite having various tubes put into his mouth and blood pricked from his fingers every half an hour. During those three hours he consumed only 1.2 litres of the 10 per cent High5 EnergySource Plus per hour without the need for additional water.

Following the bike testing, Henning was allowed a couple of minutes rest but being a triathlete he wanted to hop straight onto the treadmill and get

running. Once running, Henning looked even more at ease than on the bike and despite running at 15.1kph was able to chat and joke as he went about his business. Tests were conducted in a similar way and like the final hour of the bike took place every 20 minutes.

During the test, Roberts told us: "What we have found during the test is just how efficient Henning and Vanhoenacker are. They can ride and run at world class pace while still talking quite happily and looking relaxed. Full results will be revealed post-test after full analysis, but what we have seen is these guys are using around three to four grammes of carbohydrate per minute and were getting about 1.3 -1.4 grammes in per minute. This leaves a large deficit."

It's this deficit the test is trying to change and by giving the athletes more carbohydrates the more efficient and longer they will be able to hold race pace. What also comes into the equation and can't be forgotten, especially for these guys who often race in hot and humid conditions — like in Kona, is the sweat rate.

During the test Rasmus was taking in 1.2 litres of liquid per hour but was losing around 1.3 litres per hour. It's only a small deficit but this, especially at the business end of a race, could be the difference between winning and losing. This means keeping an eye on sweat rate is extremely important. Conversely it's equally important not to over do the water because it can wash out all your electolytes which has a negative effect. In more extreme cases it can lead to hyponatraemia where people have died from over drinking, but this wouldn't be an issue for most pro athletes.

Roberts said: "Rasmus is constantly sweating and losing water regardless of how much we give him. Hydration deficit, especially at this level, can start to have an effect, especially if it's a close race and there's a sprint for the line. In extreme conditions this could be equally, if not more, detrimental than the amount of calories being consumed."

Spreadsheets were provided with raw and summary data for total carbohydrate and fat oxidation rates and calculated exogenous oxidation rates (ie: from the drink) — the ratio of exogenous to total carbohydrate oxidation provides an indication of efficiency and use by the athlete. In both cases (Vanhoenacker and Henning), the drinks were well tolerated, and oxidation rates were typically higher than previously observed. As sweat rates dictated high fluid needs, the recommendations to consume more on the bike stage became the obvious suggestion along with a higher solution concentration (pending environmental challenges).

Post test, a relieved Henning said: "The drinks were fine and apart from a short period early in the bike my stomach was fine. I think I could probably tolerate an even higher solution with more carbohydrates."

Roberts said: "Both Rasmus and Marino came in and performed at a high intensity and felt quite comfortable. While they may be using oxygen at different levels because they're maybe working in a different way overall they're oxidising very similar amounts and their heart rates are pretty similar.

"Interestingly enough if you put me on the treadmill I certainly wouldn't be able to keep up and more importantly wouldn't be able to tolerate the drink. Top end athletes have the ability to tolerate and oxidise at high levels and this is where sports supplements offer a bigger advantage in the latter stages of an event."

Since testing with High5 earlier in the year, Vanhoenacker has been training and racing with a high concentration of carbohydrates. The High5 sponsored athlete went on to win his sixth Ironman Austria title on July 3 while shattering the world record when he crossed the line in 7:45:58.

Tim Atkinson, High5 director, said: "After his result last year we did some testing on his race nutrition and this helped us make some important changes. We learnt that we could optimise his carbohydrate uptake using our new generation of 2:1 Fructose drinks with a moderate caffeine content. A higher energy supply means that he should be able to push harder on the bike and the run."

WHAT ABOUT AGE GROUPERS?

The testing carried out shows that professional athletes can tolerate higher levels of carbohydrates because their bodies are efficient at oxidising the energy they're taking in. But what about age groupers? Once again, like the pro athletes, it comes down to how well trained you are. The higher the concentration of carbohydrates in your stomach the slower it is to be absorbed. Taking on too much trying to fight the carbohydrate deficit is not as simple as just taking in more. You need to make sure you have enough water to help with this and practise nutrition strategies in training. It is important to carry out these personal tests at race pace and see how your body copes.

The race environment also needs to be added into the equation. If it's hotter or more humid conditions it's worth realising for most age groupers taking on more water will outweigh trying to take on additional carbohydrates. This is because dehydration will have a more detrimental affect on performance falling off than carbohydrates. It's a balancing act and consistency is key for nutrition and hydration.

DR JUSTIN ROBERTS

Dr Justin Roberts is senior lecturer and researcher at Hertfordshire University specialising in performance nutrition. He is an accredited nutritional therapist and a registered member of the British Association of Applied Nutrition and Nutritional Therapy (BANT) and the Complementary and Natural Healthcare Council (CNHC). Roberts is also a longstanding accredited sport and exercise physiologist who has worked with many world-class athletes.

When Roberts isn't testing athletes he is usually testing himself and is no stranger to endurance sports having completed several Ironman events in the past. This year he stepped things up when he completed the Marathon Des Sables before going on to finish Ironman France and Challenge Roth just two weeks later.