Lactate and exercise performance: don’t buffer

The effect that lactate has on exercise performance is undoubtedly the most popular topic that athletes, coaches, sport scientists, as well as arm chair sports specialists, have an opinion about. For the most part of the 1900’s lactate had a bad “rap” and was blamed for every possible problem associated with exercise – including fatigue, muscle cramps, the stitch, post-exercise muscle soreness and ‘oxygen debt’. However, recent research has demonstrated that lactate is innocent on all these accounts and is one of the most important energy fuels in the body. Yet the misconceptions about lactate still exist. A few supplement companies continue to propagate the “myth” that lactate is “bad” by producing supplements that they claim buffer lactate, thereby enhancing recovery and performance. This article will attempt to clarify the issue of whether individuals or athletes need to spend money on such supplements to enhance their performance.

What is lactate?

Lactate is an end-product of one of the energy pathways in the body known as glycolysis. This pathway involves a series of chemical reactions that occur to break down carbohydrate (specifically glucose) to produce energy for muscle contraction. Lactate itself is a very important energy source for skeletal muscle as well as the heart. It is therefore both produced and used by the muscles and levels rise in the skeletal muscle and blood as exercise intensity increases, as we use more carbohydrate (glucose) than fat for energy during high intensity exercise. Importantly, research has shown that lactate is not the cause of exhaustion in any form of exercise. In fact, it has been demonstrated that even if infused directly into the bloodstream, there are no noticeable detrimental effects on performance. In a review of the research that examined the relationship between lactate and fatigue, it was concluded that most of the relationship is circumstantial at best (Booth, 2004). In addition to lactate being an important energy source, the following research findings provide further evidence for the argument, that lactate can’t possibly be the ‘scape goat’ for poor performance, fatigue or pain during or after exercise.

Firstly, during and after marathons, lactate levels are low and therefore cannot be blamed for the exhaustion or fatigue that individuals feel during or after such events. Secondly, lactate is rapidly removed from the muscle and blood between 20 and 60 minutes after exercise. Lactate has been blamed for the muscle soreness experienced 24 to 48 hours after exercise. However, this is not possible if lactate has already been cleared from the muscles. In addition, this muscle soreness has been shown after long races that are run at speeds below the lactate turn-point (the exercise intensity where lactate starts to increase). For these and numerous other reasons beyond the scope of this article, it was recently stated that “it should not be taken as fact that lactic acid is the devil that impairs exercise performance”. Importantly, although it was stated earlier that some supplement companies sell products purporting to buffer lactate, there are others that have now taken notice of the “up-dated” research regarding the importance of lactate as an energy source in the body. Specifically, one popular sports drink even contains organic and inorganic lactate salts as a major component.

So, if lactate does not have detrimental effects on performance or cause the pain experienced in the muscles during or after exercise, what does? For now, all I can tell you is that things are a lot more complicated than sport scientists initially thought. Whilst lactate was a relatively easy concept to grasp, as well as blame, for causing fatigue or pain, research has shown that there are numerous factors or mechanisms that may be responsible. For instance, studies have shown that excess acidic ions (hydrogen ions) released during the breakdown of carbohydrate for energy may interfere with muscle contraction during high-intensity exercise.

Lactate buffers

Do yourself a favour one day by spending some time examining the websites of some of the more popular performance enhancing supplement companies. Read the ingredients of the various products carefully and try and match the “ergogenic” claims of each of the ingredients with research published in accredited journals. You will be surprised with the result and will wonder at the power of marketing.
Ginseng is not the key for lasting performance

For instance, specifically related to the present article on lactate, I recently found a product containing Siberian Ginseng that amongst other “miracle effects” on performance, was also claimed to be a powerful lactate buffer. If my understanding of the recent research on the importance of lactate as an energy source is correct, by buffering lactate, the amount of energy available for muscle contraction will be reduced, possibly causing deterioration in performance. I subsequently searched for research articles in accredited journals to identify data suggesting that Siberian Ginseng actually buffered lactate and improved performance. To the detriment of the product, I found the following conclusions regarding the effect of Ginseng on human exercise and sports performance. Firstly, that there is “generally a lack of controlled research demonstrating the ability of Ginseng to improve or prolong performance in fatigued humans” and secondly, that there is “an absence of compelling evidence to suggest that ginseng either improves athletic performance or reduces fatigue”, with the “estimated magnitude of effect on performance being 0%”. Thirdly, in a more recent research article examining the effect of Ginseng on lactate levels in physically active men, it was concluded that Ginseng supplementation did not exert an ergogenic effect on aerobic fitness and did not alter lactate levels.

Sodium bicarbonate and citrate may improve performance but with consequences

I suggested earlier that increased carbohydrate breakdown in skeletal muscle results in an increased level of hydrogen ions. These hydrogen ions decrease the pH (increase the acidity) of skeletal muscle and the blood and interfere with muscle contraction and metabolic processes, possibly resulting in the fatigue experienced during high-intensity exercise lasting from 2-10 minutes. For this reason it has been suggested that the ingestion of chemical acid buffers such as sodium bicarbonate or sodium citrate, may enhance performance during high-intensity exercise. In fact, research has shown that bicarbonate ingestion may improve performance in high-intensity exercise of short-duration, such as running events of 800–1500 m and swimming events of 400 to 800 m (expected magnitude of effect on enhanced performance = 0-35%). A few studies have also suggested that there may be an improved response during prolonged exercise (30-60 minutes) of between 3 and 5%. However, it must be kept in mind that of the studies that have been completed, only 54% showed a beneficial effect. It has been argued that the response is likely to be highly individual, with some subjects, ~20%, showing a marked effect, a larger number (~40%), showing a much smaller effect and the remaining 40% showing no effect at all.

Research has shown that one needs to ingest about 0.3 g sodium bicarbonate or 0.5 g sodium citrate.kg⁻¹ body weight about 2 hours before exercise in order to enhance performance. These buffers elevate blood pH concentrations for about 5 hours after ingestion, with a peak effect occurring between 1 and 2 hours after ingestion. However, it is important to note the following negative consequence of “soda loading”. It is a pretty good laxative. Within approximately 1-3 hours after ingestion, about 50% of individuals develop severe gastrointestinal discomfort and diarrhoea. This typically offsets any possible benefits that one may obtain from the buffering of hydrogen ions.

In conclusion, it is important to reiterate that lactate is not the “enemy” and should not be held responsible for the exhaustion, fatigue or pain experienced by exercising individuals. Current research has shown that lactate is an important energy source for the body and any product that is marketed as a “lactate buffer” should be questioned. Finally, there are many complex mechanisms responsible for regulating performance and fatigue and although it would make our lives much easier to blame deteriorating performance on one factor, we know inherently, that exercise performance, like life, is not that simple.

References