Don’t blame lactic acid for sore muscles

People have believed for years that high levels of lactic acid in your muscles after a hard workout are the reason you feel tired and sore. Turns out this is just wrong.

Ask your average amateur athlete what causes stiff muscles after a hard workout and more likely than not you’ll hear “lactic acid” as the answer.

When you train hard or at high intensity, your body has to turn to a kind of spare engine to produce enough energy. This “engine” is called anaerobic metabolism. When your body produces energy this way, your muscles can continue to work hard, but not for very long. Eventually your legs begin to tire and stiffen, and you can’t run as fast as before.

The conventional wisdom has been to blame this on lactic acid, a by-product of anaerobic metabolism. And because the amount of lactic acid tends to increase while your legs are in the process of stiffening up, people concluded that lactic acid is what makes your legs stiff and sore.

But it turns out that this is almost certainly not true.

Lactic acid concentrations have no effect

“We are not one hundred per cent certain what causes muscles to become stiff during exercise,” says Jostein Hallén, a professor of physiology at the Norwegian School of Sport Sciences. “Our muscles may stiffen both at low concentrations of lactic acid and at high concentrations.”

Hallén can say, however, that there is little to suggest that lactic acid plays a role in muscle stiffness.

Instead, he says, it more likely is due to how your body creates energy, or how your body turns what you eat into muscle power.

Your body usually uses oxygen to turn the food you eat into a type of “fuel” for cells, called ATP (adenine triphosphate). But when you are running very fast, at some point your heart will not be able to pump enough oxygenated blood to your muscle cells.

That’s why cells have other ways to make energy.

Phosphate a prime suspect

Hallén explains that the body has two options when the heart can no longer keep up with the body’s oxygen demands.

The first approach has already been described: anaerobic metabolism, where lactic acid is produced. The second way for cells to make energy is to break down a substance called creatine phosphate, which is stored in the muscles.
“Creatine phosphate is split into creatine and phosphate, but phosphate can upset the chemical balance in the cell,” says Hallén.

This imbalance is one of the prime suspects for what makes your muscles become fatigued and stiff.

**Complex chemical reactions**

Running requires intricate chemical reactions inside your cells to allow you to put one foot in front of the other.

For example, when you decide to run faster, your brain sends a message to your muscles that it’s time to speed up. For muscle cells to receive and respond to signals from the brain, they need specific chemical substances to be in the right place at the right time.

When a signal comes from the brain to the muscle cell, calcium is released inside the muscle. As the concentration of calcium in your muscles increases, your muscle contractions get stronger, which makes you run faster.

But when you sprint, your body has to rely on other solutions to make energy. That's when things can start to get out of balance.

When the cells break down creatine phosphate into creatine and phosphate to make additional energy, phosphate accumulates in the cells and prevents calcium levels from increasing.

The combination of less calcium and more phosphate weakens your muscle contractions, meaning that pretty soon you simply can’t run as fast as you did before — and suggests this is the explanation for stiff, tired muscles after a tough workout.

**Extra energy**

And not only is it unlikely that lactic acid makes your muscles stiff—there’s fairly clear evidence that it can be used as extra energy for hard-working muscle cells.

“Lactic acid is nothing more than a glucose molecule split in two. Glucose is the most important energy source for muscles, and as such, lactic acid may also be a good source of energy for muscles,” says Hallén.

Hallén’s research has previously shown that when you go skiing, your legs will preferentially take up lactic acid from your blood rather than producing more lactic acid. And that's in spite the fact that the muscles in your legs are what work hardest when you ski.
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