Training Log 03: Building Endurance

We've dissected the physical and technical requirements of the ride and also gone through the basics of bike fitting. The next step now is to understand the basics of how to build up our endurance, which will be the key over the coming months in order to handle the ride to Austin. To do this, we will go through the different ways by which your body converts food energy into pedaling energy.

The Metabolic Pathways

The food you eat forms the store of energy that your body taps into when you begin to exercise. This process converts the chemical energy of the food into mechanical energy to power your muscles and propel you forward on the bike. The three main nutrients your body uses are carbohydrates (glycogen, glucose), fats, and proteins.

However, the body, like any engine, is really wildly inefficient. Of your stored energy, maybe 20-25% gets converted to mechanical energy, with the rest converted to heat that must be dissipated. In turn, this is accomplished through your skin blood vessels exchanging heat from the warm blood to the environment, or else your sweat glands producing sweat that draws heat away from your body via evaporation. When it's cold, this internal heat generation can become very important for maintaining your body temperature too. As we will see, that is one important reason to make sure you eat properly when you're exercising in the cold.

The basic unit of currency for energy in the body is the ATP (adenosine tri-phosphate) molecule, which is used by every single cell in your body, from the brain to the muscles. How this is generated from food is quite different, though. Here are the three major pathways for generating ATP:

1. The ATP stores already in your muscles. No oxygen is required. The body keeps a tiny amount of ATP stored in your muscles, ready for instant use by your muscles. The amount is really tiny, only enough for a world-class sprinter to run about 60 m of the 100 m dash. That's because the ATP molecule is relatively heavy, so it's not an efficient storage form. When you're exercising at really high workloads like a sprint, your body can briefly regenerate ATP by using energy from creatine phosphate (commonly abbreviated as PCr), and in total this might last a sprinter enough energy for 10-15 s of all-out sprinting. This is also the reason why creatine is a popular supplement used by power athletes like football players, powerlifters, and track & field athletes. Theoretically, consuming creatine will increase the store of PCr in your muscles.
2. Anaerobic glycolysis. This pathway uses only glucose or muscle glycogen, in other words carbohydrates. It does not use fats or proteins at all. This pathway is not as rapid as the ATP-PCr system, but it's still very fast and also does not require oxygen. The carbohydrates are converted rapidly to ATP, but it is highly inefficient and only generates a very few (2-3) ATP molecules for each molecule of carbohydrate. Worse, one of the major byproducts is lactic acid, which you have all heard of as the stuff that makes your muscles burn with agony during hard exercise. Produce more lactic acid than what you can get rid of, and your body will start to accumulate the stuff (physiologists call this the **lactate threshold**

3. Aerobic metabolism. This is the big power generator in your body. It uses oxygen to extract a lot more ATP (36) molecules from each carbohydrate molecule. Better yet, this is the pathway that can utilize fats and proteins for energy too, and it does all this without generating lactic acid. So for endurance athletes, this is the critical energy pathway that you want to optimize to the hilt! For example, when you hear the term VO2max, what it means is the maximal amount of oxygen that your body can utilize. The higher the VO2max, theoretically the higher your aerobic capacity and the less your reliance on anaerobic metabolism and the less lactic acid you will produce. World-class cyclists like Lance Armstrong have had VO2max tests in the mid- to high-80s.

So two things to draw from the above in terms of physical numbers:

- VO2max can be considered to be your genetic ceiling. It will change rapidly with you training systematically for the first time, but will be fairly stable afterwards. The workload at your VO2max is really high and most riders can handle it for only 5-10 min, so it's not always the most useful index of endurance fitness.
- The more useful measure is your power at the point of your lactate threshold, the point where your reliance on anaerobic metabolism is too high. This workload is closer to what you can sustain for a long time, such as an hour or more. Therefore, this is a more realistic workload for prolonged endurance riding. The higher the power you can sustain before building up too much lactic acid, the faster and fitter you are.

Rubber on the Road
The above is all important for you to keep in mind as you're training, but how does it actually affect what we do on and off the bike?

1. Your aim as an endurance cyclist is to really, really emphasize training your aerobic metabolism. As I wrote in the very first Training Log, the fundamental basis of training for the ride will be building a large base of aerobic fitness. So many of our rides will be at a moderate pace of steady effort. This builds your aerobic engine inside each muscle cell and also your heart and lungs. While we will be adding harder interval workouts, this will remain the foundation. **DO NOT GLOSS OVER YOUR ENDURANCE!**
2. On a simplistic basis, you can think of fat as your long-term, endurance fuel, and carbohydrates as your high-octane turbo fuel. Neither are bad nutrients, and both are essential parts of your diets. You will notice that I've said nothing really about proteins, and that's because it's your body's fuel of last resource. The main storage form of proteins in your body is muscle, and you don't want to be burning your house down to keep warm! So a moderate diet of 55-65% carbohydrates, 30% fats, and 15% proteins remains the best for health and for endurance exercise, and I generally advise against any diet that deviates greatly from this.
3. Even in the depths of late winter, you can be building your endurance and aerobic base on and off the bike. If you can't get outside, go to spin classes, run, play basketball, anything that keeps you moving for a long period of time is great.

Keep active and keep the faith!
Stephen