Nutrition for 100K and Beyond

What to Eat for a Successful and Enjoyable Ride

By John Hughes

Paris-Brest-Paris ’79, ’87, ’91, ’95, ’99, Boston-Montreal-Boston ’92,
Rocky Mountain 1200 ’04, Race Across AMerica ’94, ’96

One banana and one baguette are good; 100 are not! That’s the lesson I learned on the 1200 km (750-mile) Paris-Brest-Paris (PBP) ’99. I was one of the stronger California double century (325 km) riders. How hard could PBP be? Ride 200 miles (325 km), sleep, ride 200, sleep, ride another 200, sleep, and then just 150 miles (225 km) to finish. My double century nutrition should work fine: a few bananas in my jersey pocket and a baguette and cheese sandwich whenever I could get one. By day two that was unappetizing, and by day three I quit eating, so my body cannibalized my muscles for glycogen and burned stored body fat to keep me going.

I finished and swore off long-distance cycling. I took up touring in the California mountains, carrying all my camping gear and eating whatever I could find. A week or two of 8- to 10-hour days required a lot of training. To prepare, I rode self-supported centuries and developed a simple rule of thumb. I needed to drink a bottle of sports drink and eat one thing *every* hour. I chose mostly carbs to eat: a banana, a few fruit newtons, a granola bar, part of a bagel and jam, whatever I could carry from home or buy at a mini-mart. I later figured out that I was eating (at least) 300 calories *every hour.*

I also experimented. One year I went on a juice fast for a week and tried to ride the Davis Double Century. I finished, but my time was slow because of all the bathroom breaks. Another year I supplemented my regular diet with smoothies with lots of protein powder, which didn’t seem to make any difference but ran up my grocery bill. During ultra races I used calorie rich drinks such as Ensure and Sustained Energy. Out of all of this I learned that I prefer real food to sports nutrition products, and I ride better if I nibble a steady stream of carbs every hour.

In this eArticle I lay out the principles of sports nutrition as applied to endurance cycling; however, we are each an experiment of one. Take the principles and suggestions and test them to see what works for you. Bon appétit!

Estimating Your Caloric Requirements

Learning to eat *every* hour was the first step in my exploration of sports nutrition, and it worked pretty well for rides from 100 km to 100 miles. However, as the rides got longer I seemed to run out of gas. I figured out I wasn’t eating enough calories.

Susan Barr, Ph.D., and I have written an article on estimating and meeting your personal caloric requirements *How Many Granola Bars*. Barr is a Professor of Nutrition at the University of British Columbia and an accomplished endurance cyclist. She has completed many brevets, the Rocky Mountain and PBP 1200s, and multi-day tours. In the

article we recommend "eating a minimum of 300 calories every hour on the bike, primarily from carbohydrate. This is the minimum for most riders to keep from bonking … The rest of your hourly energy needs can be made up at rest stops." (Barr, n.d.)

What are *your* hourly energy needs? That depends on a number of factors, including how much you weigh, the terrain, wind resistance and whether you are drafting or using aero bars. If you go into an exercise physiology lab, they can determine for different exercise intensities how many calories you are burning per minute and the proportion of energy from carbohydrate and fat. However, lab tests cost several hundred dollars, and we don't all have access to a lab. This table provides a *guesstimate* assuming you are riding a road bike without a lot of extra gear on a flat road with no wind and not drafting.

Approximate Calorie Needs While Riding

Average Speed (MPH)	Calories / Lb / Hr	Average Speed (Km/h)	Calories / Kg/Hr
12	2.5	19.3	5.6
13	2.8	20.9	6.2
14	3.1	22.5	6.8
15	3.4	24.1	7.4
16	3.7	25.7	8.1
17	4.0	27.4	8.9
18	4.5	29.0	9.8
19	4.9	30.6	10.7
20	5.4	32.2	11.8

Example. If you weigh 150 lbs and ride at 15 mph you burn about 150 x 3.4 = 510 calories / hour. If you weigh 70 kg and ride at 24 km/h you use about 70 x 7.4 = 518 cal / hr. (Barr, n.d.). These are *guesstimates* – rounding, you burn about 500 calories / hour. In the hills you'll burn more going uphill and fewer spinning downhill. On my website you can download a Calorie Estimator spreadsheet to estimate total calories for a ride based on the length of ride, total climbing, riding speed and your weight.

Bottom line. Figure out how many calories an hour you use at your typical riding speed, and for important events estimate the total you burn during the event.

Which Kinds of Fuel?

Now that you know about how many calories you are burning, which kinds of calories do you need? That depends on how hard you are riding and which muscle fibers are firing. Food is composed of three macronutrients: fat, carbohydrate and protein. Here's how they are used when riding.

Slow- and fast-twitch muscles. Your leg muscles are composed of a combination of slow- and fast-twitch muscle fibers. Slow- and fast-twitch refer to how fast the muscle fibers are firing, *not* how fast your legs are moving. The mix of fiber types is determined genetically. On endurance rides you primarily use your slow-twitch muscles. When you pick up the pace or increase the intensity to climb a hill your slow-twitch fibers keep working, and you also recruit your fast-twitch fibers. Fast-twitch fibers can produce much more power than slow-twitch fibers but don't have the same endurance.

- **Fat fuels slow-twitch.** Slow-twitch muscles metabolize primarily fat for energy, which requires lots of oxygen. These fibers have a rich supply of blood to deliver the oxygen, and so slow twitch muscles are dark. A chicken can walk around all day, and thus the legs are dark meat.

- **Glycogen fuels fast-twitch.** Fast-twitch fibers metabolize glycogen from carbohydrate for energy. If the pace is such that enough oxygen is delivered to the legs, then the fast-twitch fibers can burn glycogen *aerobically*. Fast-twitch fibers use less oxygen to burn glycogen than slow-twitch muscles use to burn fat. Muscles composed primarily of fast-twitch fibers are light in color because of the lower blood supply. The chicken can flap its wings hard enough for take-off – a high intensity activity – but can't fly very long, so the chicken breast is white meat.

- **Glycogen also fuels fast-twitch without oxygen.** When you ride even harder and your muscles aren't getting enough oxygen, then you've reached your lactate threshold (LT) and you metabolize more glycogen *anaerobically*, which produces lactic acid and that familiar burning sensation in the legs. Aerobic metabolism of both fat and glycogen continue, and the anaerobic metabolic process kicks in. Lactic acid isn't bad; it's just a byproduct of this metabolism.

Thus, your muscles use two sources of fuel: fat and carbohydrate. The proportion of the two depends on how hard you are riding. Riding at moderate intensity on a 100 km or longer ride, about half your energy comes from fat and half from carbohydrate. As you ride harder and approach LT more energy comes from carbohydrate and, above LT, carbohydrate provides most of the energy.

Glycogen stores are limited. Even if we are lean we have enough stored body fat to fuel days of riding; however, our glycogen stores are limited. An active 150-pound man can store about 1,800 calories of glycogen as follows:

- Muscle glycogen 1,400 calories
- Liver glycogen 320
- Blood glucose 80

Fortunately, training improves the capacity of muscles to store glycogen by 20 to 50%! (Clark, 1990).

Even if you are in good shape, you only have enough glycogen for several hours of moderately hard riding. Because your glycogen stores are limited, you want to start a ride with a full tank and to keep replenishing them during the ride. If you run out of glycogen three things may happen:

- **You bonk.** Your brain cells can only burn glucose from glycogen in the liver for energy. Without any fuel your brain feels fuzzy and your mood sours.

- **You hit the wall.** Your muscles run out of glycogen and your legs feel dead. Fat burns in the flame of carbohydrate so when metabolizing fat for fuel, you also use some glycogen from carbohydrate. Even riding at a moderate to slow pace, you need some glycogen to keep going.

- **You quit.** You're depressed, your legs can't produce much power and the ride seems endless, so you become tempted to bag it.

Note that protein is not a source of fuel for the working muscles, although it is important for rebuilding muscle damage after a ride. If you run out of glycogen your body can produce glucose from protein by a process known as gluconeogenesis, which is inefficient, i.e., the metabolic conversion requires more energy than just converting glycogen to glucose. By day 3 of P-B-P '79, my body started burning my muscles for fuel – it was ugly!

Bottom line. By consuming enough carbohydrate regularly during the ride, you'll have more fun, ride better and be much more likely to have a successful ride!

Training Implications

Before talking specifically about what to eat, let's look at the training implications of how your body metabolizes fat and carbohydrate for energy. Each of these ways of getting energy uses a different metabolic pathway with different enzymes in different parts of the muscle cell. Thus, you need to train at *different intensities* to train the different metabolisms.

- **Endurance training.** By training at low to moderate intensity, you improve your ability to metabolize fat. Endurance training is the classic long slow distance riding at an easy conversational pace. Burning fat takes place in mitochondria, the tiniest of vessels that suffuse the muscles with blood. Riding slowly increases the number of mitochondria in your slow-twitch muscles as well as the enzymes used to metabolize fat. As your fat-burning metabolism becomes more efficient, you train your body to ride a little faster – still relying primarily on fat for energy. Thus, you spare the precious glycogen.

- **Tempo training.** Riding at a brisk pace but with enough oxygen, you are burning more glycogen than fat. Riding tempo is like riding into a headwind or up a sustained climb – you can still talk but don't have enough breath to whistle. By training at this pace, over time your body will be able to store more glycogen!

- **Intensity Training.** When you train near your LT, you increase your body's ability to clear the lactic acid produced when you ride at this level, i.e., significant lactic acid doesn't accumulate as quickly. You can ride harder *aerobically*, which uses glycogen more efficiently for energy than riding *anaerobically,* again sparing glycogen.

For more on training at different intensities see my eArticle *Intensity: How to Plan & Gauge Your Most Beneficial Training Efforts*.

Bottom line. Training at a conversational pace will increase your muscles' ability to metabolize fat as a fuel, thus sparing glycogen. Training a little harder will increase your muscles ability to store glycogen.

Let's Eat!

Now that you know about how many calories you are burning per hour and the metabolic sources of fuel, what should you eat for optimal performance?

- **American College of Sports Medicine.** The ACSM recommends consuming 25 to 60 grams (1 to 2 ounces or 100 to 240 calories) per hour after the first hour of exercise. This is sufficient for several hours of exercise.

- **Recent Research.** Research shows that eating a combination of types of carbohydrate can increase our ability to digest carbohydrate. We can digest 60 to 90 grams per hour (2 to 3 oz. or 240 to 360 calories). Test subjects who consumed a mix of glucose and fructose could digest more every hour than subjects who just consumed glucose. They digested more per hour because the different types of carbohydrate used different intestinal transponders. Consuming a mix of carbohydrate reduces fatigue, increases endurance and may result in reduced gastric distress. (Jeukendrup 2010).

- **Athletes' Experience.** Competitors in the Race Across AMerica (RAAM) regularly eat 500 calories an hour to stay fueled. Neal Henderson coaches world-class competitors in the Ironman and recommends a range of calories per hour from 250 for a small woman to 600 for a man competing in an Ironman. Henderson is the Director of Sports Science at the Boulder Center for Sports Medicine and was USA Cycling's Coach of the Year in 2009. (Henderson, 2010).

Based on all of the above, for rides of 100 km and longer I recommend consuming one-half of your hourly caloric utilization *every hour*. You should eat a mix of different carbohydrates totaling 60 to 90 grams (2 to 3 oz. or 240 to 360 calories) every hour, plus a little protein and fat. As noted above, protein is not a direct source of fuel for the muscles, and you have enough stored body fat for the ride (unless you are doing RAAM!); however, a little protein and fat make the food tastier. Protein, fat and also fiber slow digestion, so remember to eat just a little.

Complex vs. Simple Carbohydrate. We used to think that it was important to eat complex carbohydrate composed of starches rather than simple carbohydrate composed

of sugars. Both are converted to glucose by the body, but complex carbohydrate tends to be digested more slowly than simple carbohydrate. What to eat is a bit more complicated. Some nutritionists now use the glycemic index (GI), which measures the rate at which your blood sugar rises after eating something. White bread and pure glucose have GIs of 100. A GI of 70 or more is high, a GI of 56 to 69 is medium, and a GI under 56 is low. A mashed potato, which is a starch, has a high GI of 70 to 95. It contains many essential minerals, and the skin is an excellent source of fiber. (Carew, 2010). Should we avoid it? No. If you have a chance, try boiled potatoes at a rest stop on a ride!

In terms of cycling, for breakfast you want foods with low to moderate GIs. If you bonk or face a long climb, eat something with a high GI. To recover after the ride consume carbohydrate with a moderate to high GI. Since food with a high GI causes your blood sugar to rise rapidly, eat a mix of foods with different GIs so that your blood sugar doesn't then crash.

For more information on the glycemic index of specific products here are two sources:

- The Glycemic Index website
- Mendosa.com GI List

Real vs. Sports Food. Lab tests have shown no performance difference among carbohydrate ingested in liquid, gel or solid form, assuming that each substance has the same caloric value. Further, sports products have no performance advantage over regular food. One of my clients was a nurse, and after consultation with the doctor for whom she worked, she raced RAAM on pancake syrup instead of spending money on sports gel! Sports drinks and gels are easier to consume than solid food; however, you can ride just as well on food from the local grocery. The key is to read the labels so that what you are buying and consuming is composed primarily of carbohydrate. The label on a food product lists the total calories and amounts of carbohydrate, protein and fat in grams. To figure out the contribution of each macro ingredient to the total calories, use these conversion factors:

- Carbohydrate, 1 gram = 4 calories
- Protein, 1 gram = 4 calories
- Fat, 1 gram = 9 calories

Example. A chocolate PowerBar contains:

45 gms carbohydrate x 4 calories	180 calories	76%
10 gms protein x 4 calories	40 calories	17%
2 gms fat x 9 calories	18 calories	7%
Total	238 calories	100%

For more information on calories of specific items here are two sources:

- CalorieKing website
- LoseIt! free phone app

Examples of Bars, Cookies and Candies

Food	Serving	Total Calories	Carbo-hydrate gms	Pro-tein gms	Fat gms	Percent Carbo-hydrate	Gly-cemic Index
Peppermint Patty	1 (1.4 oz / 40 gm)	140	31	0.5	2.5	89%	n/a
Fig Newtons	2 (1.1 oz / 31 gm)	110	22	1	2	80%	n/a
Granola Bar, average	1 (1.0 oz / 28 gm)	114	22	2	2	79%	60
PowerBar, Chocolate	1 (2.3 oz / 65 gm)	240	45	10	2	76%	58
Pop-Tarts, Chocolate	1 (1.8 oz / 51 gm)	200	37	3	5	74%	70
Clif Bar, Chocolate Brownie	1 (2.4 oz / 68 gm)	240	44	10	5	73%	57
Luna Bar, Cookies 'n' Cream	1 (1.7 oz / 48 gm)	180	28	8	5	62%	n/a
Oatmeal Cookie, average	1 (0.6 oz / 17 gm)	81	12	1	3	61%	79
Snickers Bar	1 (2.1 oz / 60 gm)	280	35	4	14	50%	57
Hammer Bar Chocolate Chip	1 (1.8 oz / 51 gm)	220	26	9	9	47%	n/a

These examples give you the flavor of choices of sports bars and similar products. Note that the mix of ingredients varies within a product line. For example, 73% of the calories come from carbohydrate in a Chocolate Brownie Clif Bar vs. 44% of the calories from carbohydrate in a Cookies & Cream Clif Bar. Fruit is 100% carbohydrate and tends to have a low glycemic index in the 40s and 50s.

Sports drinks vary, with Allsport, Cytomax, Powerade and XLR8 having intermediate GIs in the 60s, while Gatorade and GatorLode have high GIs. By comparison, fruit juices also have low GIs, and Coca-Cola has a GI of 63.

Bottom Line. Eat what *you like,* tilting the mix toward carbohydrate. John Lee Ellis, who has ridden a dozen 1200 km brevets so far, follows a simple principle on what to eat: what goes down should stay down!

Hydration

If you run low on glycogen your body will keep chugging along on fat, although it won't be fun. If you get significantly dehydrated you may be in serious trouble. Thus, you were probably told to drink before you are thirsty and to eat before you are hungry. However, from studies of endurance athletes we have learned you can drink too much fluid, thus diluting your blood sodium. This condition is known as dilutional hyponatremia. You may start to retain fluid, and your limbs may start to get puffy. If you retain too much fluid, the brain starts to swell and press against the skull, a medical emergency. How much should you drink then?

- **American College of Sports Medicine.** The ACSM recommends drinking enough during exercise to prevent both excessive dehydration (>2% body weight) and excessive changes in electrolyte balance. Dehydration of more than 2% of your body weight affects aerobic performance, particularly in hot weather. Individual sweat rates vary considerably, so you should assess your sweat rate and develop your own personal plan. Women tend to have lower sweat rates and electrolyte losses than men, primarily because of their smaller body size and lower metabolic rate for a given workload.

  Hyponatremia in events under four hours is usually the result of drinking too much before, during and after the event. In longer events, even if you drink appropriately you may lose enough sodium to develop hyponatremia, so sodium supplementation is a good idea. (ACSM, 2007).

- **Calculate your sweat rate.** Make sure you are hydrated normally by drinking adequately, but not excessively, during the day of the test. Weigh yourself nude before and after a ride. Each pound lost equals about 2 cups (16 fl. oz.) of fluid. Each kilogram lost is 1 liter of fluid. Add in the amount of fluid that you drank during the ride and then divide the total fluid by the number of hours you rode. This is your hourly sweat rate. For greater accuracy repeat the test several days under similar conditions.

  Example: Suppose you ride for 3 hours and drink two 24-oz. bottles (6 cups) of fluid. You weigh yourself and you have lost 1.5 lbs (3 cups). Your sweat rate is 9 cups for 3 hours of cycling, or 3 cups per hour. If you rode for 3 hours, drank 2 liters and lost 1 kg, your sweat rate would be 1 liter per hour.

  If you ride in different conditions then you should test your sweat rate in those conditions as well.

- **Satisfy thirst.** Rather than drinking before you are thirsty, drink just enough to satisfy your thirst. That's the recommendation of current researchers on hydration and hyponatremia. (Hew-Butler 2008). Sports drinks provide some calories and may be a convenient and palatable way to replace some of the glycogen that you are burning. However, the electrolyte concentration in sports drinks is very low

relative to the concentration in your blood, so you can drink too much sports drink just as you can drink too much water. (Weschler n.d.).

Danger signs. If your urine is dark in color, you may be getting dehydrated, although your urine also turns yellow when you excrete supplements that your body doesn't need. If you stop urinating, then you may be developing dehydration or your body may be retaining fluid. If you feel or see puffiness at the top of your socks, shorts line or around a ring on a finger, you are retaining fluid. You may also develop a headache, which is made worse by riding on a bumpy road. If you develop these symptoms ***stop drinking*** until you urinate freely and the puffiness disappears. If you develop puffiness ***and become mentally confused***, your brain is swelling and it is a medical emergency. ***Call 911*** **or your local emergency number.**

Bottom line. Rather than drinking at every opportunity or following a pre-determined hydration plan, listen to your body. If you are thirsty, then drink whatever satisfies you. Otherwise, leave the bottle in the cage.

Electrolytes

Depending on body size, ambient temperature and level of exertion, the sweat rate varies from 16 fluid ounces (2 cups or 0.5 liter) per hour to close to 64 fl. oz (1/2 gallon or 2 l.) per hour. When you sweat you lose these minerals: sodium, chloride, potassium, calcium, and magnesium. Neither age nor gender affects the concentration of minerals in sweat; however, your genetics, diet and sweat rate all affect the concentration. Further, your sweat rate and the minerals lost decrease as you become acclimated to hot conditions. If you are eating a balanced diet and getting sufficient minerals, then during a ride up to about four hours you don't need to replace any minerals. (ACSM, 2007).

The experts don't agree on the value of replacing sodium during longer events. According to the ACSM, in events over four hours sodium losses can lead to hyponatremia even if you aren't drinking too much fluid. Thus, replacing some of the sodium is important. (ACSM, 2007). Studies with marathoners and triathletes indicate that sodium supplementation may not prevent hyponatremia if you over-hydrate. (Hew-Butler, 2008). The key is *not* to drink too much *and* to supplement with sodium on longer rides.

Sweat contains roughly 800 mg of sodium per liter; however, it varies from 200 to 1,600 mg. Sodium doesn't have to be from pills. During the Rocky Mountain 1200 I started to get puffy so I stopped at McDonald's, got some salt packets and dumped them into my water bottle. One-quarter teaspoon of salt contains 600 mg of sodium. V-8 and tomato juice, sliced turkey, dill pickles and most chips, pretzels and crackers are excellent sources! Check the label on the package.

If you aren't getting enough potassium, calcium or magnesium in your diet you may suffer from leg cramps. (Mayo, n.d.).

If you chose to use supplements during longer rides to replace minerals lost in sweat, then pay attention to what they contain and how that compares to sweat.

Servings to Approximately Replace Sodium in Sweat

	Sweat	Nuun	Succeed	Thermotabs	Endurolytes	Gatorade
Servings to equal sweat	1 liter	2 tablets	2 tablets	4 tablets	20 capsules	64 fl. oz.
Minerals per serving	1 liter	1 tablet	1 tablet	1 tablet	1 tablet	8 fl oz
Sodium	800 mg	360 mg	341 mg	184 mg	40 mg	110 mg
Potassium	115 mg	100 mg	21 mg	No	25 mg	30 mg
Calcium	23 mg	12.5 mg	No	No	50 mg	No
Magnesium	18 mg	25 mg	No	No	25 mg	No

Bottom Line. If exercising in hot conditions or on a ride lasting 4 hours or more, then taking in more sodium may be beneficial, provided you do *not drink too much.* Drink to satisfy thirst. If you notice puffiness around your sock tops, gloves bands and wrists, etc. then stop drinking until you have excreted the excess fluid and the puffiness goes away.

Test and Refine Your Nutrition

There is no one right way to eat during an event. One of my best cycling buddies, a veteran endurance rider, loves burritos from the minimart on his rides. Those wouldn't work for me! And he doesn't like the Gatorade spiked with maltodextrin and Frappuccinos that I've consumed on longer brevets!

- **Experiment.** Following the general guidelines above, use your training rides to experiment with different foods and drinks to see what works for you. Only change one food at a time, e.g., try a sports bar instead of your favorite cookies. If you change several different foodstuffs and you feel great (or your stomach rebels) you won't know which one is responsible, or whether it's the combination. From these test rides develop a menu of different items you can eat and drink. Also use your training rides to experiment with quantities and rates of consumption. Start by consuming somewhat less than half of your hourly caloric requirement and increase the calories as the weeks go by.

- **Practice.** Develop the habit of getting enough calories *every hour.* If I start a ride at 9 a.m., then at 10 a.m. I check that I've had an appropriate amount of sports drink and eaten enough solid food. I do the same every hour. If you have trouble remembering, set your watch to beep every 15-20 minutes to remind you.

- **Events.** On your training rides you'll perfect your ride nutrition. Don't try *anything new* during an event! For an organized ride try to find out what will be available at the rest stops. If that meets your needs and tastes, great! If not, bring along your own.

What works in training or on a relatively short event may be great for the first part of a longer ride and then become unappetizing or even cause stomach upset. Start your event with your preferred nutrition, but if that isn't working then try something else from the menu of choices that you tested in training.

Bottom line. Test and refine your nutrition, try nothing new on an important ride and, if necessary, be flexible. As an example, see the article I wrote with Susan Barr on working through problems on a 400 km brevet: Experiment of One.

Before and After Events

Now you understand what to consume during events. Does this mean you can have a big steak the night before, scrambled eggs the morning of, and a few beers after a big ride? Not if you want to ride well. Nancy Clark's *Sports Nutrition Handbook* and Clark and Jenny Hegmann's *The Cyclist's Food Guide* both discuss at length day-to-day nutrition to support cycling. Food pyramids represent graphically what you should consume from each of the different food groups: grains, vegetables, fruits, lean meat and beans, milk, and oils. These provide excellent on-line resources:

- The Mediterranean diet summarizes 50 years of research on people who have a very low rate of chronic disease and high life expectancy.
- The Swiss pyramid is designed for people exercising 5 hours a week and includes information on how to increase nutrition if working out more.
- MyPyramid by the United States Department of Agriculture provides interactive tools to create a personal eating plan.

You can study these resources for detailed information. In general you consume:

- 55-65% of your total daily calories from carbohydrate
- 10-15% of your calories from protein
- 20-25% of your calories from fat

As a rule of thumb, your plate should be covered mostly with carbohydrate with a serving of protein about equal to a deck of cards. Choose dressings and side dishes that are low fat or fat free.

Pre-event. Before an event you want to be sure that your glycogen stores are topped off. If you have been dieting, two weeks before the event start meeting your full caloric needs. The last few days before the event increase the amount carbohydrate and decrease the fat and protein to:

- 70-75% of total calories from carbohydrate
- 15-20% of total calories from fat
- 10% of total calories from protein

When you increase the carbohydrate, be careful not to also increase hidden fat – for example, from pizza, some kinds of crackers and types of granola.

You also want to be fully hydrated, so drink plenty of water the last few days before an event. Alcoholic drinks are diuretics, so avoid them. You may gain a bit of weight, since your body stores the additional glycogen with water.

The morning of an event, eat a breakfast primarily of carbohydrate with a low to moderate glycemic index, as well as a bit of protein and fat. Try to eat at least 1 to 2 hours before the start to give the food time to digest. Some riders with sensitive stomachs prefer to eat a good dinner and a pre-bed snack and then a lighter breakfast.

Post-ride. The quality of tomorrow's workout depends on what you put in the fuel tanks after today's ride. During the last hour of your ride polish off whatever is in your bottles and pockets.

When you get off the bike start drinking fluid to satisfy your thirst. You can drink water, fruit juice, sports drink or even soda if you prefer. Juice, sports drinks and soda also help replace your glycogen. Beer is low in carbohydrate, and drinking enough to replace significant muscle glycogen probably won't leave you wanting to ride the next day! Over the next several hours continue to drink until you excrete a pale yellow stream of urine.

Also start eating. Until you have a real meal, every hour eat about 0.5 grams of carbohydrate per pound (1 gram per kilogram) of body weight. In this case, moderate to high glycemic carbohydrate is best. If you weigh 150 pounds, eat 75 grams of carbohydrate (300 calories) an hour while recovering. Note that you need to eat that many calories of carbohydrate – if you eat chips or a sports bar, read the label, since many of their total calories may come from protein or fat.

You probably will have lost some sodium during your ride, so choose salty snacks as you replenish your glycogen.

Some researchers suggest that consuming modest amounts of protein along with your carbohydrate may improve glycogen uptake by the muscles. Others think that as long as you eat enough carbohydrate, then eating protein won't help restore muscle glycogen but may help relieve muscle soreness. (Clark 2005).

Specially formulated sports recovery drinks have no advantage over regular food. If eating doesn't appeal to you, mix up a smoothie of low-fat milk or yogurt, fruit and perhaps a bit of sugar or honey.

Chronic glycogen depletion. If you are training hard many hours a day or participating in a multi-day event such as a long brevet or tour, you could progressively deplete your glycogen stores if you don't eat enough carbohydrate. On the bike you are consuming at least half the calories of glycogen that you are burning. You need to replace the remainder at rest stops, during post-ride recovery and at meals.

Too little protein? Yes, that's possible if you over-emphasize carbohydrate. You need protein to rebuild those damaged muscles. While paying attention to carbohydrate in your diet, if it's covering most of your plate, rather than all of your plate, relax and enjoy the meal! The goal is 55-65% of your total calories from carbohydrate.

Bottom line. During a longer ride you are using precious glycogen and sweating out water and sodium. For a few days before you should consume a little more carbohydrate and fluid and do the same after you get off the bike, along with some salt.

24-Hour and Longer Events

As rides get longer your goal should be to consume as many calories as you are burning every 24 hours. Riding at a moderate endurance pace, about half your energy comes from carbohydrate and half from fat. "During very long rides (e.g., Paris-Brest-Paris), your body will use whatever you're feeding it. So if you're eating 70% carbohydrate, 20% fat and 10% protein, that's what you'll use, while if you're eating 50% carbohydrate, 40% fat, and 10% protein, that will be your fuel mix." (Barr, n.d.). Note that in both examples you are eating plenty of carbohydrate since metabolizing fat requires the presence of carbohydrate.

I plan my nutrition carefully on a spreadsheet that shows the calories I'll consume on the bike, at controls and before and after sleep breaks, as well as my estimated time for riding from control to control, my planned time off the bike at each control and my sleep breaks. A client of mine developed a much simpler system that works for him. As long as he spends at least $10 at each mini-mart control on food to eat and food to go he meets his caloric needs! I recommend the analytical approach. Here's how:

Total ride calories used. You have estimated about how many calories you burn when riding. Off the bike you're mainly eating or sleeping and use about .45 calorie/lb/hour (1 calorie/kg/hr). If you weigh 150 lbs (70 kg), ride at 12 mph (19 km/h) on a 600 km brevet and finish in 38 hours (6:45 off the bike), you use about this many calories:

Calories / hour on bike	2.5 cal x 150 / lb (5.6 cal x 70 kg)	510
Calories / hour off bike	.45 cal x 150 lb (1 cal x 70 kg)	68
Total riding calories	510 cal. x 31.25 hrs	16,000
Total non-riding calories	68 cal x 6.75 hrs	460
Total calories, approximate		16-17,000

Total ride calories eaten. How do you meet your energy needs? Apply what you've learned about eating before an event, on the bike, at rest stops and during post-ride recovery. Start by having breakfast before your ride and again after every sleep break. Eat a little more than your hourly burn rate every hour on the bike and eat about twice as much at each control. You don't have to eat a meal at a control – just drink a calorie-rich beverage and snack on fruit, cookies, crackers or bars. After each control, ride at digestion pace for a while. The only time for real recovery is your sleep break, so eat a more substantial meal before you go to sleep. If the ride organizers offer a drop bag service, then you could send ahead some liquid nutrition, e.g., Ensure to drink while getting ready for bed and more Ensure and a Frappuccino for breakfast. Or you could eat what the organizers provide or order a vegetarian pizza to eat while you shower.

Here's how you might meet most of your caloric needs over a 600 km brevet:

Serving of food	Calories / serving	Total calories
Breakfast before ride and after sleep break	2 breakfasts x 500 – 750 cal	1,000 – 1,500
On bike	31:15 hrs x 325 cal / hr	10,200
Controls	5 controls x 750 cal	3,750
Before sleep break	750-1000 cal	750 – 1,250
Total		15,500 – 16,500

Bottom line. Eat at every opportunity! We are each an experiment of one and you may not be able to replace all of the calories you are burning. If you run a slight caloric deficit you can make that up from your body fat as long as you are eating primarily carbohydrate.

Myths

Weight loss. Increasing your fat-burning ability will cause you to lose weight. No! A pro cyclist in Boulder, Colorado, once told me, "It's simple: ride more, eat less." Weight loss is a function of calories in vs. calories out, *not* training your fat-burning metabolism.

Only 300 calories per hour. Some assert that you can digest a maximum of 300 calories per hour while exercising. As explained above, top competitors regularly consume considerably more than this while racing. During training rides, try different products to see what sits well in your stomach. Practice nibbling small amounts throughout each hour. By finding the right foods and nibbling, you can train your body to digest more.

No magic bullets. Companies make billions of dollars selling nutritional supplements, which are only loosely regulated by the Food and Drug Administration. Further, the efficacy of these is usually not supported by scientific studies. If you are eating a healthy, well-balanced diet, then you usually won't benefit from pills. Clark (1990) and Clark and Hegmann (2005) both discuss supplements. Before you spend money on a supplement, research both the safety and the efficacy of the product. These are excellent resources on safety:

- Consumer Lab
- USP (United States Pharmacopeia) on the supplement label
- NSF certified

Protein. Eating more protein makes you stronger. No, only hard work in the gym increases your strength (capacity to move a weight) and only intensity on the bike increases your power (capacity to exert more force). These training activities result in micro-trauma in your muscles, and you need protein to repair the damage. Athletes in training need 0.6 to 0.9 grams of protein per pound of body weight (1.3 to 2 gms protein /

kg). If you weigh 150 lbs (70 kg) then you need 90 to 135 grams of protein. You can get this from a couple of cups of low-fat milk or yogurt and 4 to 6 oz. of protein-rich foods a day. (Clark, 1990).

Eat to Ride or Ride to Eat

Some of us want to beat our buddies in a longer club ride, or achieve a best time in the local century, or set a personal record riding farther than we've ever gone. We know that requires fuel – and we eat to ride. Others of us enjoy riding to breakfast with friends or enjoying the camaraderie at rest stops. We ride to eat. Whatever your motivation, you've got to eat. Is this a great sport or what?

Resources

American College of Sports Medicine. (2007). *Exercise and fluid replacement position stand.* Medicine and Science in Sports & Exercise, 39, 377–390.

Barr, Susan, Ph.D. and Hughes, J. (n.d.). *How Many Granola Bars.* Estimating caloric requirements and 24-hour nutrition.

Burke, Ed. (2002). *Serious Cycling (2nd ed.)*, Human Kinetics, Champaign, IL

Burke, Ed, Ph.D. and Hughes, J. (2001). Recovery for Endurance Cyclists

Carew, Lyn, PhD. (2010). *Musings of a Vermont Nutritionist.* Wind Ridge Publishing, Shelburne, VT

Calorie Estimator. Spreadsheet to estimate total calories for a ride based on the length of ride, total climbing, riding speed and rider weight.

CalorieKing. Website to look up calories

Clark, Nancy and Hegmann, J. (2005). *The Cyclist's Food Guide.* Sports Nutrition Publishers, West Newton, MA

Clark, Nancy. (1990). *Nancy Clark's Sports Nutrition Guidebook*. Leisure Press, Champaign, IL.

Food Pyramids:

- Mediterranean diet
- Swiss pyramid
- USDA MyPyramid

The Glycemic Index. Website to look up GI values.

Henderson, Neal. (2010). *Watts Up.* Lecture at Boulder Center for Sports Medicine.

Hew-Butler, Tamara, et al. (2008). Practical management of exercise-associated hyponatremic encephalopathy, *Clinical Journal of Sport Medicine*, *18*(4).

Hughes, John and Kehlenbach, D. (2011). *Distance Cycling*. Human Kinetics, Champaign, IL

Hughes, John and Barr, S. (n.d.). *Experiment of One.* Dealing with digestion issues during a long ride.

Hughes, John. (2010). *Intensity: How to Plan & Gauge Your Most Beneficial Training Efforts*. RoadBikeRider.com, Atlanta, GA.

Jeukendrup, AE (2010). *Carbohydrate and exercise performance: the role of multiple transportable carbohydrates*. *Current Opinion in Clinical Nutrition and Metabolic Care. 2010 Jul;13(4):452-7.*

LoseIt! Free phone app to look up calories.

Mayo Clinic. (n.d.). *Muscle Cramps.*

Mendosa.com GI List. Website to look up GI values

Supplements Safety:

- Consumer Lab
- USP (United States Pharmacopeia) on the supplement label
- NSF certified

Weschler, Louise. (n.d.). *Drinking too much.* Risk of hyponatremia.

John Hughes earned coaching certifications from USA Cycling and the National Strength and Conditioning Association. He enjoys coaching riders with a variety of goals and fitness backgrounds. For more information, visit www.coach-hughes.com.

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John's cycling career includes course records in the Boston-Montreal-Boston 1200 km randonnée and the Furnace Creek 508, a Race Across America qualifier. He has ridden solo RAAM twice and is a 5-time finisher of the 1200 km Paris-Brest-Paris. Much of this was accomplished during a 24-year career at Stanford University where he balanced a professional career, family and cycling.