4 Jul

What Does It Mean to Be Fat-Adapted?

When describing someone that has successfully made the transition to the Primal way of eating I often refer to them as “fat-adapted” or as “fat-burning beasts”. But what exactly does it mean to be “fat-adapted”? How can you tell if you’re fat-adapted or still a “sugar-burner”? I get these and related questions fairly often, so I thought I’d take the time today to attempt to provide some definitions and bring some clarification to all of this. I’ll try to keep today’s post short and sweet, and not too complicated. Hopefully, med students and well-meaning but inquisitive lay family members alike will be able to take something from it.

As I’ve mentioned before, fat-adaptation is the normal, preferred metabolic state of the human animal. It’s nothing special; it’s just how we’re meant to be. That’s actually why we have all this fat on our bodies – turns out it’s a pretty reliable source of energy! To understand what it means to be normal, it’s useful examine what it means to be abnormal. And by that I mean, to understand what being a sugar-dependent person feels like.

A sugar-burner can’t effectively access stored fat for energy. What that means is an inability for skeletal muscle to oxidize fat. Ha, not so bad, right? I mean, you could always just burn glucose for energy. Yeah, as long as you’re walking around with an IV-glucose drip hooked up to your veins. What happens when a sugar-burner goes two, three, four hours without food, or – dare I say it – skips a whole entire meal (without that mythical IV sugar drip)? They get ravenously hungry. Heck, a sugar-burner’s adipose tissue even releases a bunch of fatty acids 4-6 hours after eating and during fasting, because as far as it’s concerned, your muscles should be able to oxidize them (PDF). After all, we evolved to rely on beta oxidation of fat for the bulk of our energy needs. But they can’t, so they don’t, and once the blood sugar is all used up (which happens really quickly), hunger sets in, and the hand reaches for yet another bag of chips.

A sugar-burner can’t even effectively access dietary fat for energy. As a result, more dietary fat is stored than burned. Unfortunately for them, they’re likely to end up gaining lots of body fat. As we know, a low ratio of fat to carbohydrate oxidation is a strong predictor of future weight gain.

A sugar-burner depends on a perpetually-fleeting source of energy. Glucose is nice to burn when you need it, but you can't really store very much of it on your person (unless you count snacks in pockets, or chipmunkesque cheek-stuffing). Even a 160 pound person who's visibly lean at 12% body fat still has 19.2 pounds of animal fat on hand for oxidation, while our ability to store glucose as muscle and liver glycogen are limited to about 500 grams (depending on the size of the liver and amount of muscle you're sporting). You require an exogenous source, and, if you're unable to effectively beta oxidize fat (as sugar-burners often are), you'd better have some candy on hand.

A sugar-burner will burn through glycogen fairly quickly during exercise. Depending on the nature of the physical activity, glycogen burning could be perfectly desirable and expected, but it's precious, valuable stuff. If you're able to power your efforts with fat for as long as possible, that gives you more glycogen – more rocket fuel for later, intenser efforts (like climbing a hill or grabbing that fourth quarter offensive rebound or running from a predator). Sugar-burners waste their glycogen on efforts that fat should be able to power.

Being fat-adapted, then, looks and feels a little bit like the opposite of all that:

A fat-burning beast can effectively burn stored fat for energy throughout the day. **If you can handle missing meals and are able to go hours without getting ravenous and cranky (or craving carbs), you're likely fat-adapted.**

A fat-burning beast is able to effectively oxidize dietary fat for energy. **If you're adapted, your post-prandial fat oxidation will be increased, and less dietary fat will be stored in adipose tissue.**

A fat-burning beast has plenty of accessible energy on hand, even if he or she is lean. **If you're adapted, the genes associated with lipid metabolism will be upregulated in your skeletal muscles.** You will essentially reprogram your body.

A fat-burning beast can rely more on fat for energy during exercise, sparing glycogen for when he or she really needs it. As I've discussed before, being able to mobilize and oxidize stored fat during exercise can reduce an athlete's reliance on glycogen. This is the classic "train low, race high" phenomenon, and it can improve performance, save the glycogen for the truly intense segments of a session, and burn more body fat. **If you can handle exercising without having to carb-load, you're probably fat-adapted. If you can workout effectively in a fasted state, you're definitely fat-adapted.**

Furthermore, a fat-burning beast will be able to burn glucose when necessary and/or available, whereas the opposite cannot be said for a sugar-burner. Ultimately, fat-adaption means metabolic flexibility. It means that a fat-burning beast will be able to handle some carbs along with some fat. A fat-burning beast will be able to empty glycogen stores through intense exercise, refill those stores, burn whatever dietary fat isn't stored, and then easily access and oxidize the fat that is stored when it's needed. It's not that the fat-burning beast can't burn glucose – because glucose is toxic in the blood, we'll always preferentially burn it, store it, or otherwise "handle" it – it's that he doesn't depend on it. I'd even suggest that true fat-adaptation will allow someone to eat a higher carb meal or day without derailing the train. **Once the fat-burning machinery has been established and programmed, you should be able to effortlessly switch between fuel sources as needed**.

There's really no "fat-adaptation home test kit." I suppose you could test your respiratory quotient, which is the ratio of carbon dioxide you produce to oxygen you consume. An RQ of 1+ indicates full glucose-burning; an RQ of 0.7 indicates full fat-burning. Somewhere around 0.8 would probably mean you're fairly well fat-adapted, while something closer to 1 probably means you're closer to a sugar-burner. The obese have

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higher RQs. Diabetics have higher RQs. Nighttime eaters have higher RQs (and lower lipid oxidation). What do these groups all have in common? Lower satiety, insistent hunger, impaired beta-oxidation of fat, increased carb cravings and intake – all hallmarks of the sugar-burner.

It'd be great if you could monitor the efficiency of your mitochondria, including the waste products produced by their ATP manufacturing, perhaps with a really, really powerful microscope, but you'd have to know what you were looking for. And besides, although I like to think our "cellular power plants" resemble the power plant from the Simpsons, I'm pretty sure I'd be disappointed by reality.

No, there's no test to take, no simple thing to measure, no one number to track, no lab to order from your doctor. To find out if you're fat-adapted, the most effective way is to ask yourself a few basic questions:

- Can you go three hours without eating? Is skipping a meal an exercise in futility and misery?
- Do you enjoy steady, even energy throughout the day? Are midday naps pleasurable indulgences, rather than necessary staples?
- Can you exercise without carb-loading?
- Have the headaches and brain fuzziness passed?

Yes? Then you're probably fat-adapted. Welcome to normal human metabolism!

A quick note about ketosis:

Fat-adaption does not necessarily mean ketosis. Ketosis is ketosis. Fat-adaption describes the ability to burn both fat directly via beta-oxidation and glucose via glycolysis, while ketosis describes the use of fat-derived ketone bodies by tissues (like parts of the brain) that normally use glucose. A ketogenic diet "tells" your body that no or very little glucose is available in the environment. The result? "Impaired" glucose tolerance and "physiological" insulin resistance, which sound like negatives but are actually necessary to spare what little glucose exists for use in the brain. On the other hand, a well-constructed, lower-carb (but not full-blown ketogenic) Primal way of eating that leads to weight loss generally improves insulin sensitivity.

That's it for today, folks. Send along any questions or comments that you have. I'd love to hear from you guys.

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Posted By: Mark Sisson

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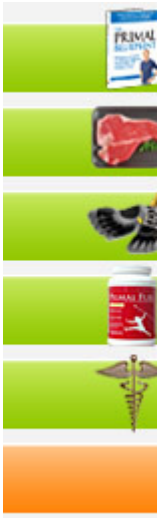

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What Does It Mean to Be Fat-Adapted? – Part 2: Q&A

As I figured it would, last week's post on fat-adaptation generated a lot of comments and questions. I couldn't answer all of them (maybe another time), so for today's post, I tried to collate the most burning questions to arrive at a representative sample. That way I hit the major ones without making this one of those super long posts. If you feel I've missed any major ones, feel free to let me know in the comment section.

First up is the most basic of questions: how does one become fat-adapted? Some, probably most, of you have a good idea how to go about doing such a thing, but not everyone. And so, without further ado, let's get to the questions:

How do I become fat-adapted?

Ramp up your fat intake. This will spur your body to increase fat-digesting enzymes that have likely laid rather dormant. Rather than consuming any old fat you can get your hands on, I'd stick to high-nutrient fat – from pastured animals, pastured egg yolks, butter from truly grass-fed cows, red palm oil, extra virgin olive oil – and fat with interesting properties, like MCT and coconut oil (which will ramp up ketone production). It will also "train" your mitochondria to start burning fat for fuel.

Reduce your daily carb intake to about 50 grams if sedentary, 100-150 if you are highly active. Basically, you want to reduce your carb intake relative to your body's demands.

Avoid lean protein. Eat protein that has fat attached, as a focus on protein (rather than meat, which has both fat and protein) could lead to your body converting excess amino acids to glucose.

Reduce your workout intensity. Don't try to get fat-adapted while you try to make the CrossFit games, start P90X, do a triathlon, or engage in anything that demands a ton of glucose. It will end badly. Instead, walk a bunch and occasionally lift heavy things. Once you're fat-adapted, your desire to be active will likely spontaneously increase.

Be nutritionally replete. Make sure you're not missing out on any of the common nutrient deficiencies, as shown here and here.

Aren't ketones produced as a by-product of fat oxidation? Therefore, aren't blood ketone levels the best way of measuring how good you are at burning fat?

To the first question, yes. It's not an on-off switch. It's not either-or. As biological systems, we are fluid things existing on continuums, and so we're always using a mix of glucose, fatty acids, and ketone bodies.

Here's a quick and dirty picture of how it works. In the liver during beta-oxidation, fatty acids are broken down into acetyl-CoA. Acetyl-CoA is oxidized and its energy is shuttled toward the production of ATP, the body's energy currency. If "too much" acetyl-CoA is produced or insufficient amounts of a necessary precursor called oxaloacetate are present, however, the "excess" acetyl-CoA is converted into ketone bodies. So, as you can see, you could be beta-oxidizing fatty acids for ATP *and* producing ketones at the same time.

As to the second question, yes, I think that's a fair statement. However, higher blood ketones isn't necessarily "better." If you're under a medical professional's care, using deep ketosis as a therapeutic tool to treat a serious medical issue (epilepsy, brain cancer, neurodegeneration), then yeah, shoot for maximum fat and ketone burning. But if you're just a regular person who wants to maintain good body fat levels, be reasonably active, do some intense exercise now and then, and enjoy edible plant life, merely becoming fat-adapted is probably sufficient and ideal. Dr. Richard Veech, an expert on therapeutic ketosis, suggests that "mild ketosis" is plenty. Mild ketosis describes the basic fat-burning state, the type that we typically wake up in after a night of "fasting."

Once you are fat-adapted, how long does it take to become un-fat-adapted? If you go on vacation for a week and have a carbfest, do you have to start from square one?

Ideally, you'll get to a place where you can have those days where things go off the rails and bounce back without much of an issue – because the fat-burning machinery is in place, the mitochondrial biogenesis has already occurred, the digestive enzymes are upregulated and established. That's where I am nowadays. I can have some ice cream, some roasted potatoes with dinner, a heaping bowl of fruit (hey, hey, not all at once), and I don't miss a beat. But, if your 80/20 becomes more like 60/40 (and be honest, you know the difference), or you spend weeks or months with your old eating habits, that's when the work you've done begins to stall or really turn around.

Still, I'd imagine that if you stick to a Primal Blueprint eating plan and avoid refined carbs and junk, you can do carb refeeds after intense exercise and maintain stocked muscle glycogen stores without affecting your ability to burn fat.

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I'm confused…if you are a sugar-burning type, does that mean you won't lose the weight until you become a fat-adapted type?

Not exactly, but fat loss will become vastly easier once you're fat-adapted. The primary reason why diets fail is adherence. When you calorie restrict as a sugar-burner, you're often up against an immovable, unrelenting force of nature: hunger. The very thing that you're trying to overcome – your overconsumption of calories – is caused by the thing that thwarts you at every turn – your hunger. The hunger is the real problem, and it must be addressed, unless you like fighting regenerating hydra heads.

As I said last week, sugar is a fleeting source of energy. Aside from the most superhuman of athletes, we simply don't have a way to store large amounts of it in our bodies. Therefore, the sugar-burner needs to have a steady exogenous source on hand. Hunger is the body's way of requesting energy when internal stores are depleted or inaccessible. If you're constantly burning through glucose without ever really burning much fat, you're going to be hungry, and you're going to have trouble lowering the amount of energy you eat. If you're able to access body fat for energy, you won't get as insistent or frequent a hunger pang, because the required energy comes from within.

Since weight loss ultimately comes down to calories stored versus calories burned (more on this concept in a later post), and when you're a fat-burner you're both burning the stuff you want to get rid of (body fat) and taking in less energy and experiencing less hunger (because you're eating body fat), being fat-adapted just makes losing unwanted weight easier.

When I lower my carb load to 50g (veggies and nuts) to kick-start fat burning I develop severe insomnia within a week. I produce no ketones, either. How can I break through this barrier? I know I'm not alone in this.

There are a couple ways to kickstart ketone production, if that's what you're after. You can increase your intake of medium chain triglycerides, as found in coconut products. Since MCTs don't show up in cell membranes and never really appear in adipose tissue, they go directly to the liver to be converted into acetyl-CoA for energy. Remember how the acetyl-CoA-ATP pathway can be overwhelmed, thus spurring the creation of ketones? That's what eating MCTs can do – increase ketone production. Use more coconut oil and fewer long-chain saturated fats (which do go into cell membranes, can show up in adipose tissue, and are less likely to overwhelm the liver's ability to make ATP), like animals fats, while you get adjusted.

You could also incorporate ketogenic amino acids. Huh? Well, a bit like how certain amino acids are more likely to participate in glucogenesis, certain amino acids are more likely to participate in ketogenesis. Both lysine and leucine are readily converted into ketone bodies. As Paul Jaminet points out, high-leucine ketogenic diets have allowed researchers to treat epileptic patients without having to resort to the overly restrictive traditional ketogenic diets. Doing it this way gives you a little more leeway with your vegetable intake.

I would also make sure you're getting enough minerals, especially sodium, potassium, and magnesium. Magnesium in particular can help with sleep.

When you do eat your carbs, eat them closer to bedtime. A lot of people find that this helps with sleep, perhaps because a bolus of carbs can increase tryptophan, and subsequently serotonin, availability. Low-carb isn't no-carb.

Well, that's it for this time, folks. As I said earlier, send along any further questions you think I've overlooked and I'll do my best to address them. Thanks for reading!

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You want comments? We got comments:

Imagine you're George Clooney. Take a moment to admire your grooming and wit. Okay, now imagine someone walks up to you and asks, "What's your name?" You say, "I'm George Clooney." Or maybe you say, "I'm the Clooninator!" You don't say "I'm George of George Clooney Sells Movies Blog" and you certainly don't say, "I'm Clooney Weight Loss Plan". **So while spam is technically meat, it ain't anywhere near Primal. Please nickname yourself something your friends would call you.**

1. 

   Hi Mark and the community

   Maybe I missed this but as part of self experimentation, what is the best way to measure your current level of blood Ketones?

   Thanks for pointing out lean protein not great for you, I have tended to eat protein for protein sake (like chicken breasts), but will increase fat intake. Olive oil, steak with the fat on… anything else recommended to reduce amino acid to glucose conversion?

   Merci Mark!
   Patrice

   Patrice wrote on July 10th, 2012

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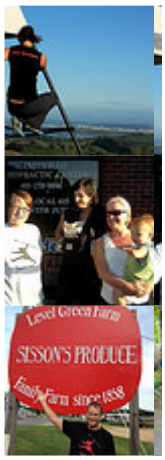

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