FAT 411: Why you can't live without it

In the many nutrition talks I have done in the past, I have received numerous questions surrounding the somewhat misunderstood macronutrient of fat. Question range from "What is the optimal fat burning zone?", "Is margarine better to eat than butter?", "Do omega-3 fatty acids help prevent cancer?" and "How can I spot reduce the fat around my stomach?" Hopefully over the next three-article series on fat you will learn the answers to these questions along with acquiring some common knowledge about fat in these three basic areas: 1) vital functions and roles fat plays in your body 2) dietary fats- the good, the bad and the ugly, and 3) how to try and achieve your unique ideal body composition (not weight), by trying to reduce percent body fat while maintaining lean muscle mass. But before getting to body composition issues, we need to examine what vital roles fat can play in the normal everyday functioning of your body and the incredibly energy dense fuel it can provide to us runners.

Do we even need fat in our diet?

Without a doubt, the answer to the question above is YES! It just depends on the type and amount of fat one consumes (more on this in the next article). Fat is widely distributed throughout the body and serves to conserve heat and protect major organs, such as the heart and kidneys[1]. As well, fat serves a vital role in the absorption of fat-soluble vitamins of A, D, E and K. However, likely the most important function that fat fulfills is that it is an incredible source of high-density energy.

FAT- An Endurance Athlete's Best Friend

To fully appreciate and comprehend the next three articles, an initial discussion on how much fat we store, how much fat we burn during different exercise intensities and what endurance training does to alter you body's use of fat, will be important for your understanding. Once you grasp these basics, you will likely agree that burning fat as an energy source, or fuel, is an endurance athlete's best option.

As figure 1 shows fat is by far the largest energy store in the human body, comprising up to 90% of the total stored energy, even in a lean athlete[1]. Fat is stored either as adipose throughout the body or subcutaneous (below the skin) or in the form of intramuscular triglycerides (IMTG). This refers to fat stored within the working muscles, while carbohydrate (CHO) is stored as glycogen. Also as a brief review, it is important to realize exercise intensity dictates what type of fuel (fat vs. carbohydrate) you body will be burning or using during exercise (as illustrated in Figure 2). So, in general, the more intense the exercise (or greater VO_{2max} percentage) the more CHO you burn. In contrast, the less intense the exercise, the more fat you burn[1].

Another major point shown in figure 1 is the fact that the storage of CHO, in the form of glycogen, is very small. Therefore, the ability to perform high intensity exercise for long periods of time is also limited. You also now realize that even lean endurance athletes have tons of fat stores, and that fat is a very energy dense molecule. As well, studies have shown that any adaptation that leads to an increased use of fat, and sparing of the precious stores of glycogen, generally leads to increases in performance[2]. So, what is the single best thing we can do to optimize our use of fat stores as a fuel during exercise? The answer is endurance training[2]!

Over time, endurance training results in physiological and structural changes within the exercising muscles to use more fat as a fuel, which is readily available. Some of the changes within the muscles include increased capillaries and blood vessels, increased number of mitochondria (or 'powerhouses' within each cell that produces energy), increased enzymes that break down fat and an increased ability to uptake fat into the working muscles for use[2]. Therefore several months of endurance training results in an increase in total fat burned at a given running pace. In a practical sense, this means that before endurance training while running 10-minute miles you might have been burning 50% fat and 50% CHO to provide you with the energy needed to sustain the pace. Since you only have a limited

source of CHO, you might have been able to run 90 minutes before fatiguing and "hitting the wall" (running out of stored glycogen). After several months of endurance training, you would have shifted and adapted your body to using more stored fat and now when running 10-minute miles you would be burning 60% fat and 40% CHO. In this situation, you would be able to run for at least 30 minutes longer, or at a faster pace over the 90-minute duration.

"Fat Burning Zone" - Myth or Reality?

Another notion surrounding fat metabolism that causes confusion is the concept of having an exercise that optimizes the fat burning zone. In reality, no single specific exercise will necessarily increase fat burning per se. Instead one needs to choose an exercise that utilizes major muscle groups to maximize the amount of calories burned per hour and one needs to make sure that the exercise is at the correct intensity. Exercise intensity is the key to maximizing fat burning over time.

Exercise intensity to optimize fat burning

As I outlined above, one needs to remember that lower exercise intensities elicit a greater overall relative *percentage* of fuel burned as fat and increased exercise intensities elicit a greater relative *percentage* of fuel burned as carbs. However, one also needs to remember that lower exercise intensities burn a lot less overall calories (kcals) per hour. For example, if you sit on the couch for an hour, the overall "intensity" of that is extremely low and therefore you might be burning approximately 80% fat and 20% carbohydrate. If you weighed 100 kgs (~220 pounds) you would only burn about 100 calories in that hour on the couch, of which ~80 of those would be from fat.

Now if you ran 10-minute miles for that hour, with increased intensity, with % CHO contribution to the total energy has also increased. In this situation, you would be burning around 50% fats and 50% CHO. But the total number of calories burned that hour goes up as well, to over 1000 calories! Thus, your percentage of calories burned as fat has dropped to 50%, but since your burning 1000 total calories an hour, you are burning 50% of that as fat calories, or 500 calories of fat and 500 calories of CHO. Make sense?

So the key is to find an exercise intensity that is high enough that you burn ample calories per hour, but at a low enough intensity that the majority of those calories are provided from fat. Studies show that maximal fat burning (total calories per hour) occurs around 60% of VO_{2max}.[3] Interestingly enough, this intensity is lower than most people realize, as marathon pace for more people is between 70-80% VO_{2max}. To put 60% of VO_{2max} into relative terms, this is approximately the pace of an *easy* tempo run. This is a pace that is faster than just easy jogging, but not so hard that you feel like you might not finish your run. After a run, at this type of pace, you should feel tired from the length of the run, not the intensity of it. In terms of heart rate, the maximal fat burning intensity would correspond to about 130 to 135 beats per minute[3] for people around the age of 25. Heart rates drop as you age, therefore, as a general rule of thumb the fat burning zone for most people would be approximately 160 minus your current age.

Type of exercise to optimize fat burning

This same group of researchers also looked at whether cycling vs. running would increase the amount of fat-calories burned per hour. Not surprisingly, fat oxidation rates were higher during running compared to cycling over a wide range of intensities[3]. Why is this not surprising? As I alluded to above, running uses a larger muscle mass, since it is weight dependent, where cycling is not. The more muscles you activate in your exercise, the more calories per hour you will burn.

You should now have a good framework for how fat is stored and used by the body at different exercise intensities. So, now that you realize fat can be a good fuel for an endurance athlete, watch for

an article outlining the types and amounts of fat that you should be eating – or the good, the bad and the ugly, in the next edition of Running Room Magazine.

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3. Achten J., and Jeukendrup AE. Optimizing fat oxidation through exercise and diet. *Nutrition*. 20(7-8): 716-727, 2004.

Figure 1.

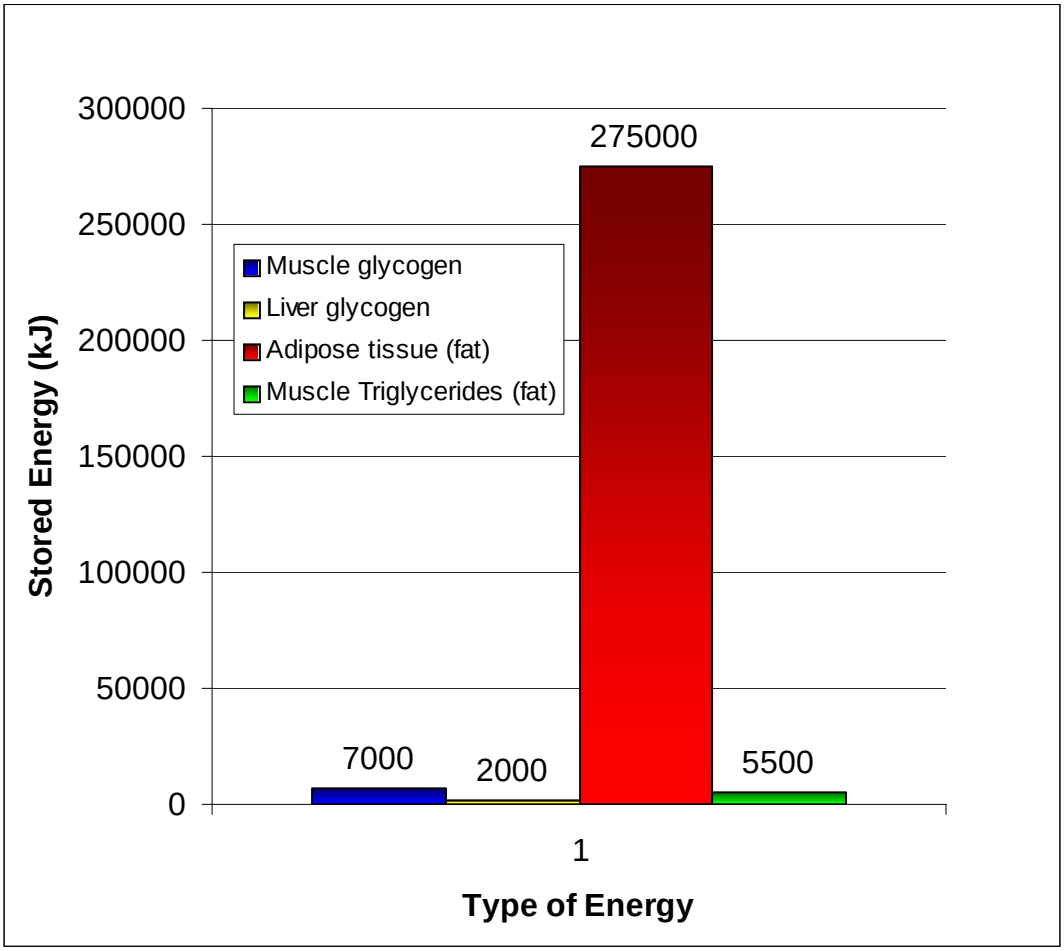
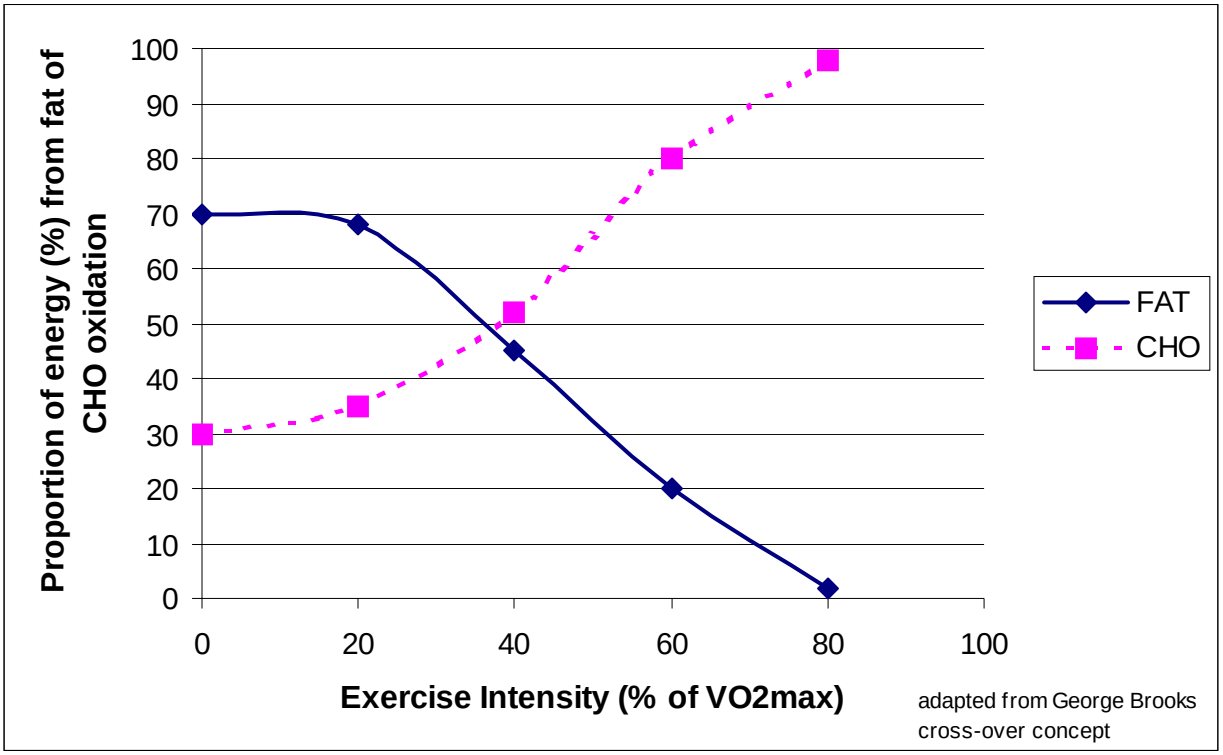

300000
250000
200000
150000
100000
50000
0
Stored Energy (kJ)
Muscle glycogen
Liver glycogen
Adipose tissue (fat)
Muscle Triglycerides (fat)
7000
2000
275000
5500
1
Type of Energy

Figure 2.


Proportion of energy (%) from fat of CHO oxidation
100
90
80
70
60
50
40
30
20
10
0
0
20
40
60
80
100
Exercise Intensity (% of VO2max)
FAT
CHO
adapted from George Brooks cross-over concept