# Comments on Physiology

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Earlier this year, I read an article intended for runners, in which the author offered a series of menus for what he considered to be a “high carbohydrate" diet. The menus were suggested for use during the three days prior to running a marathon. A close look at these menus, however, showed them to be actually below average in carbohydrate content and quite unsuitable for building muscle fuel reserves in that critical three-day pre-race period. That article points out the problems that runners face when they try to determine what kind of diet will provide the best support for their running programs. It's hard to know who or what to believe. To help you make decisions about what's best for you, here are some simple guidelines to use in selecting a diet, and some examples to show how they can be applied.

Last month we looked at my reasons for recommending that the regular diet of a long-distance runner provide at least 60% of the calories as carbohydrates and that the majority of these carbohydrates be of the structurally complex type. Our guidelines, then, will deal with how to determine the carbohydrate content of the foods we eat and how to judge the value of the carbohydrates in these foods. They will also consider how these carbohydrate-containing foods can be fit into a total dietary program.

Most of us are aware that the most common sources of dietary carbohydrates are the cereal grains and grain products, starchy vegetables, fruits and sweets. What we need to know is how to select foods from within these categories on the basis of their carbohydrate content and quality (structural complexity), what effect food preparation will have on carbohydrate quality and what overall changes have to be made in the diet in order to permit us to include a high level of carbohydrates.

Selecting foods for high carbohydrate content is not at all difficult. Grain products, such as breads, rolls, cereals and pastas, provide between 75% and 90% of their calories as carbohydrate. The carbohydrate content of most vegetables is in the same range. In most fruits, over 90% of the calories come from carbohydrates. Desserts and sweets can vary from 30% to 100%.

The more difficult decisions come in assessing the carbohydrate quality of a food. Recall from our previous discussion that the best dietary carbohydrates are those which are the most slowly digested and assimilated into blood sugar. Thus, in general, the less refined carbohydrates will have the highest quality for building the body's fuel reserves. Whole grain breads, for example, have a higher carbohydrate quality than breads made with refined flour. And, the more coarsely ground the flour is, the higher the quality, because the digestive system will require a longer time to release the starch from the whole-grain structure and convert the starch into blood sugar. At the other extreme, common table sugar (sucrose) is one of the most rapidly assimilated carbohydrates known. Foods which contain lots of sucrose, such as candy, soda pop and most dessert items, have very low carbohydrate quality.

Anything that is done to a food in the process of preparation, which tends to disrupt its natural structure, will lower the quality of its carbohydrate. Perhaps the most graphic example of this is what happens when you blend a carrot into carrot juice. The carrot contains the highest level of sucrose of any common vegetable—almost half of its total solids. When we eat a raw carrot, most of the sugar remains in the fragments that results from chewing, and will only be released in the intestine after considerable digestive effort. A juiced carrot, on the other hand, is little more than yellow-colored sugar water. The sugar in it will be assimilated immediately. In

carbohydrate quality, it's no better than soda pop.

In many respects, the cooking of carbohydrate foods has the same kind of effect as blending; it tends to make the carbohydrate more digestible and thus of lower quality. For example, a potato loses virtually all of its natural carbohydrate quality when it is baked. For this reason, I always recommend that vegetables be cooked as lightly as possible.

Fruits tend to complicate the decision-making process. Most of their carbohydrates are simple sugars, so you might expect that they would be low in carbohydrate quality. Indeed, for some fruits this is quite true. Pineapples, peaches and tangerines have very high sucrose content and are very juicy, which makes the sugar easily available for assimilation. Their quality is very low. Fruits canned in syrup are also very low in carbohydrate quality. Some fruits, such as bananas and dates, contain a lot of sucrose but have a higher carbohydrate quality simply because of their lower moisture content. Other fruits contain a high percentage of fructose, or fruit sugar, which does not stimulate the body to release insulin. These fruits, notably apples and pears, have much higher carbohydrate quality. As with vegetables, juicing fruits tends to decrease their carbohydrate quality.

To design a diet in which more than 60% of the calories come from carbohydrates, we have to be very aware of other sources of calories in the diet. Fat is the largest contributor of calories to the average American diet. Meat, which is our main source of protein, is also our major source of fat. Protein intake for the average American is presently a reasonable percentage of total calories. Thus, those who want to follow a high carbohydrate diet will have to limit their intake of high-fat meats (beef and pork) and obtain more of their protein from low-fat and high-carbohydrate sources, such as cereal grains and vegetables. Many desserts are not only high in the useless carbohydrate, sucrose, they are also very high in fat. Ice cream and Danish pastry, for example, each provides about half of its calories as fat. Without question, undertaking an effective high-carbohydrate diet means limiting or eliminating some of our favorite things.

In recommending high-carbohydrate diets for runners, I try to establish some balance between what I consider ideal and what I can reasonably expect a person to follow. I can't reasonably expect the elimination of all sugar, and fat is such an important factor in palatability that severe restriction is also unreasonable. The following is typical of my recommendations.

A.R., a fictitious 154-pound male runner of average activity, runs 6 miles a day at an efficiency of 93 calories per mile, and has a total daily energy requirement of about 3,290 calories. His 68% carbohydrate diet is limited to 7½ four-ounce servings of meat or fish and 4 eggs per week, yet his protein intake is still more than double what he needs. He eats an average of 4 slices of bread, 5 servings of fruit and2 servings of dairy products every day (not including snacks). He consumes 10 servings of cereal, 4 servings of pancakes and 6 servings of pasta per week. The remainder of his diet is mainly vegetables, including some representatives of all the common vegetable groups. In addition, his average intake from snacks (mostly fresh and dried fruit, raw vegetables and grain products) is about 450 calories per day. Because his diet is nutritionally balanced, he takes no vitamin supplements. He consumes no alcohol because alcohol is very high in calories yet contributes nothing to the buildup of fuel reserves in the muscles. I remain unconvinced by the theories that have generated the current beer-drinking craze among long-distance runners.

Making a diet high in carbohydrates certainly places some restrictions on what you can eat, but it doesn't have to take the joy out of mealtime. With a little creativity, your diet can be both a strong support for your running program and a pleasure to consume.