Comments on Physiology

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The use of the term "carbohydrate loading" has created some considerable confusion among endurance athletes over the past few years, mainly because this one term is so often used to describe two completely different procedures. For some people, carbohydrate loading simply means increasing the amount of carbohydrate in the diet for several days before a big race. To others it means a more involved procedure, in which the athlete first avoids dietary carbohydrates for a period of time, while working out normally, and then uses a high carbohydrate diet up to the day of the race.

The former procedure, which we shall call "simple loading," can be useful for those athletes who prefer not to follow a high-carbohydrate diet as a regular daily routine. However, I consider its usefulness to be limited and I believe that overall performance is best served by following an ongoing high-carbohydrate diet. My specific recommendations in this regard have been outlined in some detail in earlier columns.

The latter technique, which we shall call "depletion-loading," can enhance endurance when it is done properly, but it has some severe medical and practical limitations and is highly questionable ethically. Because of the wide misunderstanding concerning the use of this procedure, its benefits and limitations, I would like to make it the main topic of this discussion.

In 1966, two Swedish physiologists published the results of an interesting study in which they had used themselves as the experimental subjects. Their purpose was to determine to what extent the replacement of glycogen in the muscle can be influenced by the amount of carbohydrate in the diet and by prior depletion of the glycogen through exercise. Each of the investigators exercised one leg repeatedly to exhaustion until the leg could do no further work. The other leg remained inactive throughout the experiment. To determine muscle glycogen content, the scientists took biopsy samples from the muscles of both legs; before the exercise, immediately following the exercise and for several days thereafter.

Their results showed that, before the exercise began, the muscles of each leg contained roughly the same glycogen concentration and that this concentration was about average for well rested muscles. Immediately after the exhaustive exercise, the muscles of the exercised leg were almost completely depleted of glycogen, while the inactive leg still contained the pre-exercise glycogen concentration.

For several days following the exercise, the investigators used a diet that was very high in carbohydrates. This dietary regimen had little effect on the muscle glycogen content of the non-exercised leg. However, the effect on the glycogen-depleted muscles was dramatic. Over a period of several days, the glycogen content of these muscles recovered much more than their original concentration and actually overshot this level by a large amount. With this observation, the "depletion-loading" technique was born.

The specific application of this technique to physical endurance was established several years later by co-workers of the scientists who did the original work. In these experiments, athletes were caused to deplete their muscles of glycogen by repeated days of hard exercise, while following a diet which was very low in carbohydrates. Then, they were given a high-carbohydrate diet during several days of reduced physical activity. At the end of these manipulations, the athletes were tested for endurance and these results were compared to their performance at the same task when no special dietary program was used. In all cases, the

"depletion-loading" procedure gave the athletes higher than normal muscle glycogen levels and significantly improved endurance.

The "depletion-loading" procedure works. The question is: at what cost? During the depletion phase, the athlete is essentially starving himself for carbohydrates. Typically, this causes some starvation of the brain for the fuel it needs to function normally. So, if it is done properly, the depletion phase is often accompanied by such unpleasant side effects as insomnia[1] nervous tension, irritability and inability to concentrate. In addition, complete glycogen depletion is difficult to achieve It can only be accomplished by repeatedly working oneself to exhaustion and fighting constantly against a feeling of muscular weakness.

Then, when you have depleted properly, and start the loading phase, you can begin to worry about “glycogen deposition disease." Glycogen occurs in the muscles as tiny granules, like little grains of sand. If you overload the muscles with these granules, they can actually begin to disrupt the working muscle cells, causing painful muscle injuries.

Even if you do endure the difficulties of depletion, and accomplish significant glycogen loading without injury, you will have attained only the possibility for one shot at success. And, then, you'll be spending your time doing physiological penance for having tried to fool Mother Nature. How much tine? I don't think anyone knows for sure, but I've heard reports that it can take anywhere from several weeks to several months to restore the body's normal glycogen deposition capability. During this period, performance can be expected to remain sub-normal.

With all these disadvantages, the most serious charge to be made against "depletion-loading" is that it is unethical, It is the physiological equivalent of doping. Like doping, it is intended to provide an extraordinary, one-time physiological advantage; a capability beyond that which the athlete could expect to attain in the same time by normal progressive training. And, like doping, there is a significant "hangover" effect.

As I have explained in past discussions, such practices as this are not necessary to improve endurance through better fuel economy. All you have to do is learn how to make your regular diet work to your best advantage.