Nutrition Corner: Pre-race carbohydrates! Post-race carbohydrates! Why all the concern about carbohydrates?

Jack Daniels, the acclaimed exercise physiologist, Olympic silver medalist, and world-renowned running coach, has quantified the relationship between race duration and maximal aerobic capacity ("V-dot O_2-max"). Daniels has noted, for example, that a maximal five kilometer (5-k) race effort may be completed at between ninety (90) and one-hundred (100) percent (%) of maximal aerobic capacity (*Daniels' Running Formula, 1998, p. 61*)

With increasingly few exceptions, high school cross-country runners compete at the aforementioned 5-k distance. Thus, a maximal and, indeed, optimal competitive effort requires a sustained effort at 90 to 100% of an athlete's maximal aerobic capacity.

It is logical to suggest, moreover, that the macronutrient composition of an athlete's diet should reflect the substrates (carbohydrate and fat) that are required in order to sustain 90 to 100% of maximal aerobic capacity.

While a vast body of peer-reviewed exercise physiology literature has been devoted to the topic of substrate utilization during aerobic exercise, the timely combination of methodological advancements and increasingly sophisticated mathematical formulations during the last decade has refined our appreciation of substrate utilization during aerobic exercise. In particular, one pioneering study has precisely quantified the respective contributions of carbohydrate and fat to exercise performance at various percentages of maximal aerobic capacity.

Hans Romijn and colleagues published this exceptional study in 1993. This investigation quantified the contributions of both sources of carbohydrate (muscle glycogen and blood glucose) and both sources of fat (intramuscular triglyceride and blood-borne free fatty acids) to exercise performance at 25%, 65%, and 85% of maximal aerobic capacity.

Romijn et al. (1993) demonstrated, for example that carbohydrate contributed approximately 10% of fuel utilization and fat contributed approximately 90% of fuel utilization at the very modest exercise intensity of 25% of maximal aerobic capacity. By comparison, carbohydrate accounted for approximately 49% of fuel utilization while fat accounted for the remaining 51% of fuel utilization during so-called moderate aerobic exercise at 65% of maximal aerobic capacity. Finally, these investigators demonstrated that carbohydrate accounted for approximately 67% of fuel utilization and fat accounted for approximately 33% of fuel utilization during heavy aerobic exercise at 85% of maximal aerobic capacity.

In summary, carbohydrate accounted for 10%, 49%, and 67% of fuel utilization during exercise at 25%, 65%, and 85%, respectively, of maximal aerobic capacity.

The trend in fuel utilization is clear. The relative contribution of carbohydrate increases exponentially as exercise intensity rises within the aerobic scope. Furthermore, a reasonable extrapolation of this impressive data set leads to the inescapable conclusion that carbohydrate must make an even greater relative contribution to exercise performance at 90 – 100% of maximal aerobic capacity, or, equivalently, at the 5-k race distance.

Simply stated, a young cross-country runner must consistently ensure adequate muscle and liver carbohydrate availability if she/he seeks to optimize performance at the 5-k racing distance. In that context, I return to my general comments regarding dietary macronutrient composition from two previous newsletters. Young, competitive athletes should seek a diet that includes approximately 55-60% of calories from carbohydrate, approximately 15-20% of calories from protein, and the remaining 20-25% of calories from fat.

One nutrition article from a previous newsletter suggested that such a diet will optimize recovery from and adaptation to the consistently demanding training regimen of an elite cross-country runner. A subsequent article in the ensuing newsletter indicated that such a diet will similarly position an athlete to "top-off" liver and muscle carbohydrate levels prior to heavy training and competition.

Against that background, the fundamental premise of this article is that such a diet will optimally position an athlete to meet the very significant carbohydrate requirements of intense, 5-k cross-country running. Indeed, outstanding scientific data confirms both intuition and experience that carbohydrate is an important fuel for maximizing competitive performance.

A commitment to a high carbohydrate, moderate protein, and low fat diet is not only an important commitment to optimal training and recovery but also an essential commitment to optimal racing. It is a commitment to excellence.