

Cereal with Milk—An Effective Muscle Recovery Choice

Future performance of an athlete depends on how well the athlete restores muscle glycogen energy after a bout of physical exertion. New research suggests that a 100% whole wheat flake cereal plus non-fat milk is an effective option for rebuilding glycogen stores after extended physical activity.

Carbohydrates for Athletes

Carbohydrates are an essential part of any healthful diet, but are particularly important for athletes. Dietary carbohydrates consumed are converted to blood glucose to be used as fuel or stored. Muscle and liver cells change blood glucose to glycogen, the stored form of energy that can easily be converted back to glucose when needed during physical activity.

Restoring muscle glycogen is the top post-exercise nutritional goal to maximize future performance.¹ If muscle glycogen stores are not replenished, an athlete's performance will suffer during the next training session or competition due to a lack of readily available fuel.

Factors Affecting Glycogen Synthesis

• Carbohydrate

An athlete should eat a carbohydrate-rich diet daily to adequately restore muscle glycogen.² Typical American diets supply about 4 to 5 g carbohydrate/kg body weight. However, athletes who train daily, and individuals engaged in strenuous activity on the job should consume 6 to 13 g carbohydrate/kg body weight.³ Sports nutrition experts recommend consuming carbohydrate from nutrient-rich foods that provide essential components including fiber, iron, and B vitamins for energy metabolism.⁴

• Protein

There is less agreement regarding the role of protein with carbohydrates in promoting glycogen synthesis. Some experts suggest that combining protein and carbohydrate after exercise may be beneficial, especially when less carbohydrate is consumed.³ There is no doubt, however, about the role of protein in promoting tissue repair. Experts recommend consuming 1.4 to 1.8 g protein/kg body weight³ in recovery foods to enhance muscle tissue repair and for synthesis of new protein.^{2,5}

• Lactate

Exercising muscle can simultaneously produce and metabolize lactate. During strenuous physical activity more lactate is produced than is removed by muscles as glucose is used for energy. After physical activity, muscle cells remove lactate from the bloodstream and use it to make glycogen.⁶ Therefore, blood lactate levels can be used to suggest changes in glycogen synthesis when measured before and after physical activity.

Optimizing Muscle Recovery

Exercise duration and intensity can be limited by the amount of glycogen available in muscle; therefore, it is important to replenish glycogen stores to fuel subsequent exercise bouts.⁷ Following exercise, physiological changes occur in the muscle to promote glucose uptake, glycogen accumulation and protein synthesis.^{8,9} Providing post exercise food is critical to optimally replenish glycogen stores and minimize muscle protein degradation.^{10,11} The highest rates of muscle glycogen synthesis occur during the first hour after exercise due to² enhanced blood flow to muscles and increased muscle sensitivity to insulin promoting glucose uptake and glycogen formation.³

After exercise the primary dietary goals are to consume:³

- Carbohydrate to maximize glycogen synthesis
- Protein to promote muscle repair
- Fluid for rehydration

While high-carbohydrate sports drinks are ideal for rehydration after exercise, they may be less ideal for muscle recovery. Research suggests that eating protein along with carbohydrate can stimulate glycogen resynthesis and muscle recovery more than carbohydrate alone. Consuming readily available whole foods with the appropriate balance of macronutrients could be a viable option to support muscle recovery after extended physical activity.

New Research

A recent study of trained male and female cyclists examined the effects on muscle recovery of a 100% whole wheat flake cereal with non-fat milk (74 g carbohydrate + 18 g protein) 1 hour post exercise compared to a carbohydrate-based sports drink (70 g carbohydrate). Consumption of cereal plus milk lowered blood lactate levels while increasing muscle glycogen storage and protein synthesis activity—results effective to muscle recovery.¹²

Not only that, 100% whole wheat flake cereal plus milk has the benefit of providing carbohydrate as well as protein and other essential nutrients, including whole grains, fiber, B vitamins, sodium and calcium. Cereal plus milk is a tasty, convenient and affordable recovery option that enhances energy storage.

References:

1. Burke LM, Loucks AB, Broad N. Energy and carbohydrate for training and recovery. *J Sports Sci*, 2006; 24: 675-685.
2. Maughan R. The athlete's diet: nutritional goals and dietary strategies. *Proc Nutr Soc*, 2002; 61: 87-96.
3. Rosenbloom C. *Sports Nutrition: A Guide for the Professional Working with Active People*. The American Dietetic Association, 2000.
4. Position of the American Dietetic Association, Dietitians of Canada, and the American College of Sports Medicine: Nutrition and athletic performance. *J Am Diet Assoc*, 2000; 100:1543-1556.
5. Burke LM, Kiens B, Ivy JL. Carbohydrates and fat for training and recovery. *J Sports Sci*, 2004; 22:15-30.
6. Brooks GA. Current concepts in lactate exchange. *Med Sci Sports Exerc*, 1991; 23: 895-906.
7. Bergstrom, J., L. Hermansen, E. Hultman and B. Saltin. Diet, Muscle Glycogen and Physical Performance. *Acta Physiol. Scand.* 71: 140-150, 1967.
8. Bergstrom, J. and E. Hultman. Muscle Glycogen Synthesis after Exercise: an Enhancing Factor localized to the Muscle Cells in Man. *Nature* 210: 309-310, 1966.
9. Ivy, J. L. and C. H. Kuo. Regulation of GLUT4 protein and glycogen synthase during muscle glycogen synthesis after exercise. *Acta Physiol. Scand.* 162: 295-304, 1998.
10. Ivy, J. L. Muscle glycogen synthesis before and after exercise. *Sports Med.* 11: 6-19, 1991.
11. Biolo, G., K. D. Tipton, S. Klein and R. R. Wolfe. An abundant supply of amino acids enhances the metabolic effect of exercise on muscle protein. *Am. J. Physiol. Endocrinol. Metab.* 273: E122-129, 1997.
12. Kammer L, Ivy J. Effects of Cereal and Nonfat Milk vs. Traditional Sports Drink on Muscle Recovery Following Exercise. Abstract. American College of Sports Medicine meeting, 2007.

Health Professionals working with athletes can recommend 100% whole wheat flake cereal with non-fat milk as an effective option for post-exercise muscle recovery.

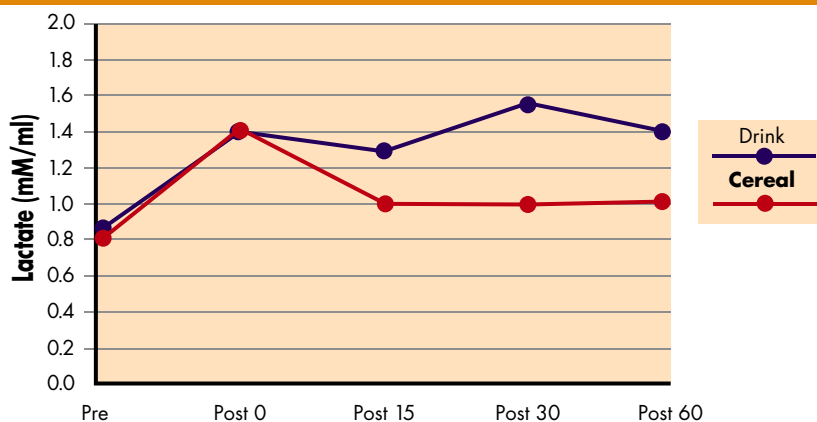


Figure 1 Lactate Changes by Treatment. Values are means \pm SE for 12 subjects.¹²

*Significant between Drink and Cereal at Post15 and Post30 ($p < .01$) and Cereal at Post60 ($p < .05$).