Subject: Spirit Nutrition--Milk for Recovery
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Parents,
I'm forwarding an article Karen found on the use of milk as a sports recovery drink. Its rather long though informative. Bottom line is milk is an adequate recovery drink for both strength and endurance training. The details and references are included for those interested in the science behind it.

Dennis

Milk and Muscle Mass

By Amanda Carlson MS, RD and Bob Calvin MS, RD

Nutrition and recovery go hand in hand. The nourishment that we provide to the body in the post-workout period provides the raw materials necessary to rebuild and refuel the body. The sports nutrition world is filled with high-tech products designed make this recovery as quick and as efficient as possible, New research on milk suggests that it could be a cheaper and equally effective alternative…

At A Glance

- The main nutritional requirements of post-exercise recovery are identified;
- Recent research on the benefits of consuming milk as part of a post-exercise recovery strategy is presented;
- Practical advice is given on using milk-based drinks as an inexpensive alternative to proprietary recovery formulations is given.

The words milk and muscle seem to naturally go together. Many of us as children were told by our parents, "drink your milk, so you can grow up to be big and strong!" Then as we grew up, the media bombarded us with messages extolling the virtues of milk, with athletes and other celebrities endorsing its benefits. But does the consumption of milk after a training session really promote muscle growth? Can milk give us what we need to be a high performer on the field or in the game of life day in and day out?

Recovery Revisited

First, let's investigate the efficacy and importance of a recovery drink when paired with training. There is a host of research to support the benefits of consuming a carbohydrate/protein recovery drink immediately following a training session. When we think about what an ideal recovery

drink would look like or be made up of, we have to take a step back and think about what the body goes through during a workout.

After a workout your body is in a state of stress and it needs nourishment. More often than not, your body will be dehydrated, your blood **insulin** levels will be low, **cortisol** and other 'breakdown' hormones will be high, your **glycogen** (fuel stores) will be low or depleted, and your muscles will be in a state of breakdown. Your recovery nutrition strategy, in simple terms, should reverse all those things and restore your body to a hydrated, fueled, recovered, and muscle building state (1).

Recovery Nutrition: Putting the body back into balance (John Ivy, PhD.)

Post exercise environment	*Converting post-exercise environment from a catabolic state to an anabolic state*
• Dehydrated	• Rehydrate
• Blood insulin is low	• Increase blood insulin levels
• Cortisol and other catabolic hormones are elevated	• Lower blood cortisol levels and other catabolic hormones
• Immune system suppressed	• Strengthen the immune system
• Muscle and liver glycogen reduced or depleted	• Restore muscle and liver glycogen
• Muscle is in a catabolic state with increased proteolysis	• Stimulate muscle protein synthesis and tissue repair

The Main Components of Recovery

Refueling Muscles
When the science of sports started to come into its own, fuel (glycogen) restoration using carbohydrate was the name of the game. Studies have proven that taking in carbohydrate will indeed replenish fuel stores, and that the glycemic index (GI) of these carbohydrates is important for enhancing glycogen recovery, with higher GI carbohydrates (carbohydrates that are broken down rapidly) producing more glycogen restoration in the post-workout period when compared with their low GI counter parts. In terms of how much carbohydrate is needed in the post workout period, it is generally accepted that anywhere from 1.0-1.2g/kg body weight is ideal in the post workout period (2). This research leads to our first rule of recovery nutrition:

For optimal glycogen restoration recovery, use a high glycemic index carbohydrate source (Ivy et al.)

Rebuilding Muscles
There's more to recovery than just refueling muscles and scientists soon began to wonder how best to rebuild muscles and promote quick and efficient adaptations to training. The quest to find

the perfect post-workout cocktail was now the hot research topic –which protein was best, how much was needed and could you just use amino acids? As an example, US scientists found that as little as 6g of essential amino acids combined with 35g of carbohydrate resulted in muscle building (3).

A study in 2004 at University of Texas looked at the effect of two other types of protein on muscle building (4). The point of this study was to compare the response of muscle protein synthesis after exercise to casein and whey proteins. Casein protein is digested and emptied from the stomach at a slower rate compared to whey protein; whey protein is therefore deemed the 'fast protein' and casein protein is considered to be its 'slow brother'.

The amino acids from slow protein like casein appear in the blood more slowly, but the response lasts longer when compared with fast proteins. In this study the researchers consumed either 20g of casein, 20g of whey, or a placebo one hour after a resistance-training bout. They found that despite the different blood amino acid response, both proteins resulted in net protein balance – ie muscle gain.

In 2006, a study by US Scientists from Baylor University examined the effects of whey protein supplementation on body composition, muscular strength, muscular endurance, and anaerobic capacity during 10 weeks of resistance training (5). Thirty-six resistance-trained males followed a 4 days-per-week split body part resistance training program for 10 weeks. Three groups of supplements were randomly assigned, prior to the beginning of the exercise program, to all subjects:

1. 48g Carbohydrate placebo ;
2. 40g Whey protein + 8g Casein;
3. 40g of whey protein + 3g branched-chain amino acids + 5g of the amino acid L-glutamine.

The Whey/Casein group experienced the greatest increases in lean mass. Significant increases in one rep-max (1RM) bench press and leg press were observed in all groups after 10 weeks. In this study, the combination of whey and casein protein promoted the greatest increases in fat-free mass after 10 weeks of heavy resistance training. Athletes, coaches, and nutritionists can use these findings to increase fat-free mass and to improve body composition during resistance training. From this, we can formulate our second rule of recovery nutrition:

For the most complete muscular adaptation, make sure to have a combination of whey and casein protein in your post-workout cocktail.

Timing and Ratio

In 1988 John Ivy stirred up the world of sports nutrition with his ideas on muscle glycogen recovery and the importance of the timing of carbohydrate. The highest rates of muscle glycogen storage occur during the first hour after exercise due to activation of glycogen synthase (a glycogen building enzyme) (6). The activation of glycogen synthase is actually stimulated by the degree of glycogen depletion (7). Exercise-induced increases in insulin sensitivity and the

permeability of the muscle cell membrane to glucose also account for the physiological mechanisms behind post-workout carbohydrate timing (8).

Carbohydrate feeding immediately after exercise appears to take advantage of these effects, as shown by higher rates of glycogen storage during the first two hours of recovery, slowing thereafter to the more typical rates of storage. The most important finding of this study, however, is that failure to consume carbohydrate in the immediate phase of post exercise recovery leads to very low rates of glycogen restoration until feeding occurs (6). Therefore, the intake fo carbohydrate in the first two hours after exercise allows a somewhat faster rate of glycogen synthesis than normal. This is the period where you end to take in the recommended amount of carbohydrate, which ranges from approx. 1.0 – 1.5 g/kg body weight. Athletes should ingest sufficient carbohydrate as soon after exercise as is practical to start recovery as soon as possible and maximize the time for glycogen synthesis (9) (see figure 1).

If less carbohydrate is consumed, the addition of protein to equal the caloric content of a supplement between 1.2 and 1.5 g carbohydrate per kg of body weight can be ingested. It has been found that the isocaloric content of the combined protein and carbohydrate supplement promotes glycogen storage. The addition of protein to a carbohydrate supplement and its benefits to glycogen synthesis are not conclusive; you should therefore, make sure that carbohydrate is ingested at the level recommended above. However, a combination of carbohydrate and protein still promotes glycogen storage. The addition of protein additionally benefits muscle repair. (10)

The best sources of carbohydrate and protein, as well as the ideal carbohydrate to protein ratio will always be hotly debated. However, the consensus of research suggests that the ideal recovery drink should be liquid and comprised of an easily digested carbohydrate and a whey/casein mixture of protein, with the carbohydrate to protein ratio reflecting your individual weight goals as well as training demands. This ratio should increase with the intensity of your training, leaving it to fall anywhere between 2-4g of carbohydrate for every 1g of protein. As it happens, these guidelines remarkably resemble the components of low-fat milk! (1)

Recovery drinks have long been associated with supplements and therefore much of the research has been focused on the optimal supplements to use after training. However, over the past few years, researchers have investigated the potential of good old-fashioned low-fat milk as a recovery drink. The results may seem surprising, but when looked at objectively they make sense.

Milk Research

Several studies have compared the post-training (weight training) effects of milk, soy protein and carbohydrate alone. In each of these studies, the subjects given milk as a post-training recovery drink gained more lean muscle mass than their soy and/or carbohydrate counterparts (11-14).

In 2004, US scientists from Virginia Tech published one of the first studies comparing the effects a milk and a carbohydrate electrolyte beverage consumed in the immediate post workout period (11). In this study, 19 men consumed either a milk or carbohydrate electrolyte drink immediately following each workout, during a 10-week resistance training program. The authors concluded

that the milk group tended to increase muscle mass, but the magnitude of the gains weren't large enough to be considered statistically significant. They suggested that more prolonged training and supplementation period would expand the trend for greater muscle mass gains in a milk group.

Just this year, Canadian scientists evaluated the long-term consequences of milk or soy protein, or carbohydrate (as maltodextrin) on muscle mass gains after resistance training (12). Subjects trained five days a week for 12 weeks and were given isocaloric beverages consisting of either fat-free milk, fat-free soy protein, or maltodextrin within an hour after their training sessions.

In the study, they found no differences in strength development between the groups. However, the researchers did determine that type II muscle fiber increased in all groups; moreover, it increased the most in the milk group. Muscle mass gains were also significantly greater in the milk group when compared with both the soy and control groups. They concluded that the consistent consumption of milk after resistance training can promote greater hypertrophy when combined with resistance training.

Endurance and Hydration

The effects of milk have also been shown to aid recovery from endurance exercise. Scientists from Indiana University suggest that chocolate milk is an effective recovery aid between two exhausting bouts of exercise (15).

In their study nine endurance-trained cyclists performed an interval workout followed by 4 hours of recovery and then another endurance trial to exhaustion. After the first exercise bout, subjects consumed a post-ride recovery beverage consisting of either chocolate milk or carbohydrate and electrolytes. Time to exhaustion and total work were significantly greater for the chocolate milk compared to the carbohydrate electrolyte group. This suggests that in addition to promoting a greater hypertrophy adaptation in a strength training group, a milk recovery drink can also improve performance on a subsequent endurance bout. For athletes performing multiple training sessions a day, the potential of milk enhancing not only recovery and performance is very real.

Another study worth mentioning looked at the effects of chocolate milk, a fluid replacement drink and a carbohydrate replacement drink on recovery between two exhaustive bouts of cycling. Chocolate milk proved to be an effective recovery option between rides. It allowed riders to cycle for a longer period of time on their second ride than with the use of the carbohydrate or fluid replacement options alone (15).

Research has also shown milk to be an effective rehydration drink. Subjects consuming milk (with added sodium) post-training actually remained hydrated longer than when they consumed sports drinks or water (16). These hydration findings are consistent with the improved fluid retention shown with protein enhanced sports drinks (17).

Conclusion

Based on this compelling research, low-fat milk is an effective post-training recovery drink. When used in conjunction with resistance training, it produces gains in muscle mass, aids in hydration and speeds recovery. To some this is surprising news! How can something as simple as low-fat milk produce such results? The answer lies in the components of milk. They closely resemble the previously mentioned guidelines for an effective recovery drink. In fact the similarities are startling; milk is first and foremost a liquid, contains easily digested carbohydrate and a mixture of whey/casein protein. In addition, the carbohydrate to protein ratio of milk can easily be manipulated to meet your needs by adding something like syrup, a chocolate stir-in or a wholesome piece of fruit (see table 1).

Does this mean that specially engineered recovery supplements are useless? NO! But it will allow younger athletes and those who are on a tight budget to effectively recover and make lean body mass gains without breaking the bank.

Table 1: Examples of Milk-Based Recovery Drinks

When choosing a recovery beverage, consider the intensity of workouts. The more intense, the greater the carbohydrate demands to replenish fuel. Low to moderate intensity training recovery can be achieved with a 2:1 carbohydrate to protein ratio. Higher intensity sessions will need a carbohydrate to protein ratio of nearer 3 or 4:1.

For Low-Moderate Intensity Training	***For Moderate–High Intensity Training***
16oz Skim milk w/ 1Tbs Chocolate Syrup	*12oz Starbuck's chocolate milk*
223 calories 17g protein 36g carbohydrate 1g fat ~2:1 Carb:Pro	190 calories 13g protein 35g carbohydrate 1.5g fat ~3:1 Carb:Pro
24oz Skim milk w/ 1Tbs Chocolate Syrup	*16oz Ready to drink non-fat Nestle's Nesquik*
309 calories 25g protein 48g carbohydrate 1.3g fat ~2:1 Carb: Pro	320 calories 16g protein 64g carbohydrate 0g fat 4:1 Carb:Pro

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Glossary

Insulin: A hormone whose presence informs the body's cells that we are well fed, causing liver and muscle cells to take in glucose and store it in the form of glycogen. In addition it has several other anabolic effects throughout the body.

Glucose: A simple sugar that is an important carbohydrate because the cells uses it for their primary source of energy. The name comes from the Greek word glykys (γλυκύς), which means "sweet", plus the suffix "-ose" which denotes a carbohydrate.

Glycogen: Glucose molecules come together in the body and are stored as insoluble glycogen. Glycogen functions as the primary short-term energy storage and forms an energy reserve that can be quickly mobilized to meet a sudden need for glucose.

Cortisol: A catabolic hormone with physiological opposite effects to insulin. When cortisol is high, the body decreases the formation of glycogen and promotes the breakdown of glycogen, fats, and proteins.

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Additional Resources (Not cited but good reads):

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