

Role of Dairy Foods in Sports Nutrition*



Gopi Hariharan
Professor
Kebri Dehar University
Ethiopia

Introduction

Sports Nutrition is the basis for optimizing sport and exercise performance. A proper diet schedule enhances the performance of athletes. It is always felt that diet containing excessive amounts of meat will improve performance. Body builders and those pursuing similar type of sport tend to consume various supplements, many of which are very high in protein. The Sports Nutrition comprises of consumption of macro and micro nutrients.

Macronutrients

Macronutrients consist of carbohydrates, proteins and fats. Carbohydrates are most important energy source for the human body. Simple carbohydrates include sugars naturally occurring in foods like fruits, vegetables and milk. Complex carbohydrates are whole grains, bread, potatoes, most vegetables and oats. Carbohydrates are broken down into glucose which gives energy to body. They consist 45 to 65 percent of the total food intake depending physical demand.

Proteins are known as the building blocks of the body which are made up of amino acid chains. Proteins are essential for muscle growth and recovery. There are two types of proteins; Complete and Incomplete proteins. Complete proteins consist of all amino acids and are found in animal sources like meat, fish, poultry and milk. Incomplete proteins are plant based and lack some of the amino acids.

Fats play a vital role in human body by maintaining energy balance, regulating hormones and restoring muscle tissue. Fats can be saturated, which are found in animal products like red meat and high fat dairy products. Unsaturated fats are healthy and derived from plant sources like olive oil and nuts. Omega 3 and omega 6 are essential fatty acids that are important for sports nutrition.

Micronutrients

Micronutrients are required for exercise stresses and other important body functions. Most common deficiency is Iron deficiency, which can impair muscle function and respiration because of hemoglobin deficiency. Vitamin D and Calcium deficiency, results in weakness of bones, impaired regulation of muscle contraction and reduced nerve conduction. Vitamin A deficiency leads to impaired vision. Requirement of the nutrients depend on the physical, mental and emotional strains of competition. The energy required depends on the duration and the intensity of the exercise involved in a given sports.

Other Basics of Sports Nutrition

Eating Disorders

Many athletes require to maintain lean bodies and low body weight and exhibit muscular development. Chronic

* This paper was published in the Souvenir of 50th Dairy Industry Conference held during March 4-6, 2024 in Telangana.

competitive pressure can create psychological and physical stress leading to erratic eating habits which eventually lead to adverse health effects. The above individuals require the nutrition needed to achieve and maintain good health rather than athletic performance. Research findings indicate that the right food type, calorie intake, nutrition timing, fluids and supplementation are essential and specific to each individual.

States of Training and Sports which Benefit from Sports Nutrition:

Athletic Performance

A balanced nutrition plan should include sufficient calories and healthy macronutrients to optimize athletic performance. Carbohydrates or fats can be used as main energy source depending on intensity and duration of exercise. Intense training will require significantly more nutrients to support energy demands.

Endurance

Endurance sports and activities are sub-maximal activities that are performed for more prolonged periods of time. These activities are also characterized by continuous exercise/activity. These sports are highly dependent on oxidative metabolism as a source of energy and usually involve large muscle groups. It includes moderate to high intensity exercise and high amount of carbohydrates for high energy is needed. Fat is secondary source. There is risk of dehydration, thereby increasing the demand of fluids and electrolytes. Resistance training can benefit from the use of dairy proteins during muscle recovery. Endurance training can also be enhanced by these nutrients. A big part of this is the slow speed at which casein proteins are digested and absorbed. This helps to provide a steady supply of amino acids to muscles over a longer period of time. This is especially important for endurance athletes because they often exercise for long periods of time and need a constant supply of energy.

Strength

Resistance training programs are designed to gradually build the strength of skeletal muscles. It requires sufficient amount of all macronutrients for muscle development. Protein intake is also vital to increase and maintain lean body mass. Resistance exercise and resistance sports are characterized by repeated high intensity contractions of varying muscle groups that leads to well characterized adaptations in muscles. Resistance exercise alone results in both an increase in protein synthesis and protein breakdown. The increase in synthesis is greater than the increase in breakdown, resulting in a less negative net balance. Protein-related metabolic response following resistance exercise can be influenced through the nutritional intake of the main macronutrient constituents. The increase in protein net balance and

muscle protein synthesis is pronounced with the consumption of 500 mL of fat-free milk. Consumption of the fat-free milk results in greatest increase in muscle hypertrophy, greater increase in both type I and type II muscle fiber areas and also gaining the lean body mass and declining the fat mass. Greater increase in muscle fiber hypertrophy and lean body mass was due to of milk consumption influencing protein metabolism. Greater decline in fat mass is due to greater calcium intake associated with the milk consumption. Dairy proteins effectively build lean body mass when combined with resistance training. They contain a high concentration of leucine, which has been shown to play an important role in muscle growth. They are more rapidly digested and absorbed than other types of protein, which means they can get to work repairing muscles more quickly

Competition

Athletic goals will determine the best sports nutrition strategy. Pre and post workout meal planning are unique for each athlete and essential for optimal performance. Adequate hydration and electrolytes are required for athletic health and athletic performance. Rehydration with water and sports drinks containing sodium are often consumed depending on athlete and sporting event.

Supplements in Sports Nutrition

Sports supplements and foods are unregulated products marketed to enhance athletic performance. The Australian institute of sport has provided a general guideline ranking sports performance supplements and foods according to significance of scientific evidence. Sports foods like sports drinks, bars, and gels, electrolyte supplements, protein supplements and liquid meal supplements, medical supplements like iron, calcium, vitamin D, multivitamin/multimineral, and omega 3 fatty acids and performance supplements like creatinine, caffeine, sodium bicarbonate, beta alanine and nitrate are included in the list for following the guidelines.

Specified Nutrition

Sports nutrition covers a wide spectrum of the need for athletes as per specific population and environment. Vegetarian athlete diet contains high intake of plant proteins, fruits, vegetables, whole grains and nuts. High altitude sports require iron rich foods more in diet as more oxygen is required by the cells. Foods high in antioxidants and protein are essential for high altitude sports person. Fluid and electrolyte balance is crucial for those sports performed in hot environment. Hot environment trainings require more of the hydration therapy. Cold environments athletes require adequate hydration and body temperature. Leaner athletes are at higher risk of hypothermia. Appropriate foods and fluids that withstand cold temperatures will promote optimal athletic performance.

Role of Dairy Foods in Sports Nutrition

Dairy includes milk and products derived from milk (e.g. yoghurt, cheese, custard and dairy desserts). Dairy is the richest source of calcium. It also provides 9 other essential nutrients including protein, vitamin A, Vitamin B12, zinc and magnesium. Dairy products are practical, cost-effective and enjoyable, and their nutrient profile can lend itself to meeting many sports nutrition goals. Milk naturally has high concentrations of electrolytes (133 mg Na⁺ and 431 mg K⁺ in a 250 mL serving) which aid in fluid retention when consumed. Ability of milk to be an effective post-exercise rehydration beverage is the rate at which it empties from the stomach. Energy dense fluids empty from the stomach much more slowly, leading to a slower absorption into the circulation. This slower absorption attenuates the large fluctuations in plasma osmolality that can occur with consumption of large volumes of water or sports drinks. Subsequently, the large fluctuations in osmolality (decreased osmolality) would result in increased clearance rates by the kidneys. Milk shows great promise as an alternative endurance exercise recovery beverage.

Milk is also a very effective beverage at promoting fluid recovery following dehydrating exercise in the heat. Fluid loss of as little as 2% can cause early fatigue, impair performance, increase cardiac stress and increase risk of heat illness. Proper hydration happens before, during & after training. Milk contains high quality proteins. Casein is a slow-to-digest and slow-release protein which has been shown to reduce muscle breakdown. Milk may be an ideal recovery beverage for resistance and endurance training because milk is a whole food source of whey, slowly digested casein proteins, and carbohydrates that provide fuel for growing muscles. Milk contains both proteins and carbohydrates, the combination of which is believed to play a role in increasing the repair of muscle protein structures and decreasing protein degradation within muscle tissue. Milk's combination of rapidly digested whey proteins, slowly digested casein proteins, and carbohydrates (lactose) work together to improve muscle recovery and future performance. Whey is a fast acting and quick absorbing protein. Whey has a high concentration of the branched chain amino acid leucine. Leucine has been shown to specifically stimulate the building of new muscle tissue. Chocolate milk may be as effective as more commonly used sports drinks at promoting glycogen resynthesis. Low-fat milk is an effective beverage for promoting rehydration following exercise induced dehydration and has lower total urine output during recovery.

Role of Dairy Foods in different aspects of sports

Short-term goals:

1. Before exercise

2. During exercise

3. Recovery post exercise (Rehydrate, Refuel and Repair)

Long-term goals:

1. Health
2. Body composition

Before exercise

Prior to exercise, nutritional goals are to ensure that the athlete is well fueled and that any nutritional intake will not interfere with the normal physiological responses to the activity. The goal of the pre-exercise meal or snack is to provide carbohydrate (at least 1g/kg body mass). Optimizes hydration status, particularly in hot conditions. Minimises the risk of gastrointestinal (GI) upset. Dairy products (milk, flavoured milk, yoghurt, dairy desserts and liquid meal supplements) provide carbohydrate and fluid to meet fuelling and hydration goals. Most are low in fibre making these products suitable for pre-exercise, and low-fat varieties (compared with standard products) are available and recommended for better absorption. Lactose-free varieties are available for those with GI issues, and liquid-meal supplements provide an alternative for athletes who do not tolerate solids before exercise. Low glycaemic index of dairy products are useful to those athletes who are susceptible to rebound hypoglycaemia, particularly when opportunities to consume carbohydrate during exercise are limited.

Practical dairy food ideas for fuelling

Dairy foods also make great fuelling snacks before training or competition. Ham and cheese sandwich, piece of fruit with a glass of milk, savoury muffins with grilled tomato and shredded mozzarella and some Italian herbs are good foods recommended. For a calcium boost, top fresh fruit or cereal and milk, with fruit flavoured yogurt, ricotta, honey and banana on toast. Dairy foods like flavoured milk, yoghurt and dairy desserts provide fluid, extra carbohydrate and are low in fibre, helping to maximise gut comfort. Milk and higher-fluid dairy foods, like smoothies, yoghurt and custard, provide the body with a great source of water and electrolytes.

During exercise

The goal of nutritional intake during exercise is to provide exogenous substrates in an attempt to delay the depletion of endogenous substrates, and to provide fluids to offset fluid losses due to sweating. Carbohydrate and fluid intake during exercise can delay the onset of fatigue and enhance exercise performance, especially in events longer than 60-90 minutes. Carbohydrate intake has several physiological benefits including stabilization of blood glucose. Providing a source of fuel and in some situations, sparing muscle glycogen in endurance events, and is likely to enhance the function of the central nervous system.

Recovery post exercise

Finally, the nutritional objectives of post-exercise nutrition are to promote muscle recovery and adaptations, fuel resynthesis in muscle, and fluid replenishment. The nutrition goals of recovery are to rehydrate, refuel muscle and liver glycogen stores, repair muscle tissue and encourage the adaptation process. The timeframe between sessions will determine how aggressive the athlete needs to be with each of these goals. If there is less than eight hours between sessions, a pro-active approach to nutrition recovery should be taken. Another common use of dairy proteins during muscle recovery is combining them with carbohydrates, which has been shown to further improve the rate of protein synthesis. This is likely due to the fact that carbohydrates help stimulate insulin release. Insulin has been shown to play an important role in amino acid uptake and muscle protein synthesis.

Rehydrate

Milk and semi-solid dairy products (yoghurt, smoothies, custard) provide both fluid and electrolytes (sodium and potassium) to assist with rehydration. The sodium concentration of milk is similar to conventional sports drinks and fluid retention is aided by other nutrients. The change in texture and flavour compared with sports drinks consumed during exercise may enhance voluntary consumption after exercise.

Refuel

Why are dairy foods great choices for refueling? They are easy to consume and widely available. Their energy content can be altered by making different choices to meet individual needs (e.g. choosing low-fat products). They contain essential vitamins and minerals that contribute to overall health, including calcium, iodine, vitamin B12 and potassium. They contribute to other aspects of recovery nutrition: rehydration and muscle repair. Dairy drinks, dairy desserts, and liquid meal supplements can provide a substantial contribution towards refueling targets either as stand-alone foods or as part of a meal/snack. Replacing muscle fuel (glycogen) after exercise is essential to an athlete's

recovery. Flavoured milk and yogurt contain the right mix of carbohydrates and protein to refuel muscles after a tough workout. Chocolate milk with its mix of carbohydrates and protein (compared to a carbohydrate-only sports drink) gives greater concentration of glycogen in muscles at 30 and 60 minutes post exercise

Repair

Optimizing the protein synthetic response to an exercise session requires the provision of essential amino acids. Dairy proteins, particularly the whey sub-fraction, have been shown to be superior to other protein sources in maximizing the response to resistance exercise. These findings can be translated to endurance exercise and synthesis of mitochondrial proteins, promoting adaptive responses to training. Many dairy products have good storage life (UHT), and are available in single serving sizes. In addition, liquid and semi-liquid forms can be quickly consumed in cases of appetite suppression, and sweetened dairy products are generally appetizing. Intense exercise leads to muscle tissue breakdown. Milk, cheese and yogurt contains high-quality proteins to help repair and rebuild muscles after strenuous exercise. Intake of 15-25g high quality protein (2 glasses of milk) in the first hour after exercise can help promote faster muscle repair (Table 1).

Practical recovery snack ideas (~10g protein):

- 200g tub yoghurt
- 40g Ricotta on 2 slices fruit toast
- 200g drinking yoghurt
- 250ml tetra pack flavoured milk

More substantial snacks with ~15-20g protein:

- 70g cereal with 200ml milk
- 600ml flavoured milk/smoothie

Chocolate Milk for Recovery

Chocolate milk is the ideal sports recovery beverage because it contains the golden ratio of carbs to protein - about 3-4 grams of carbs for every 1 gram of protein. This ratio helps rehydrate your body, repair your muscles, and replenish your energy after exercise. Chocolate milk

Table 1

Dairy Foods Providing Approximately 10g of Protein	Serving Size
Milk	250ml (a large glass)
Flavoured Milk	250ml (a large glass)
Evaporated milk	125ml
Flavoured yoghurt	250ml
Ricottacheese	100g
Cheddar cheese	40g –2 slices
Vanilla custard	250ml

Table 2: Nutrient Profile Per Serve of Commonly Available Dairy Products

Product	Energy	CHO	Protein	Fat(g)	Calcium(mg)
FC Milk* (250 ml)	680	12	8	10	285
RF Milk* (250 ml)	510	13	10	4	343
Skim Milk* (250 ml)	455	14	11	0	377
RF Chocolate Milk (250 ml)	635	21	8	5	285
RF fruit yoghurt (200g)	660	27	10	2	310
RF cheese (30g slice)	425	0	9	7	261
LF custard (200 ml)	680	29	8	2	265

LF= Low fat; RF=reduced fat; FC=Full cream

*Powerdered milk, when made to directions, has the same nutritional profile as liquid milk.

is considered even more beneficial than regular milk for those looking to improve their muscle recovery. In addition, chocolate milk contains cocoa flavanols, which have been shown to improve blood flow and reduce inflammation.

Whey Protein for Recovery

Consuming whey protein before or after a workout is beneficial as it is an easy-to-digest form of protein, making it ideal for building lean muscle. Whey proteins found in milk contain a high proportion of amino acids known to play a role in muscle tissue protein synthesis. Whey protein during resistance training programs show greater increases in lean body mass than those supplemented with either soy protein or carbohydrates. Whey proteins combined with carbohydrates have been demonstrated to improve recovery after workouts, including decreases in muscle functional capacity. Whey proteins are especially rich in branched chain amino acids (BCAA), including leucine. Protein synthesis begins in the nucleus when the DNA receives a chemical signal that it needs to manufacture proteins. Leucine and other BCAA found in whey are believed to act as this molecular signal to the many nuclei of muscle fibers. Leucine and whey protein activates muscle protein synthesis (an anabolic action) as well as prevents muscle protein breakdown (an anti-catabolic action).

Long Term Goals

Health

A diet adequate in energy, carbohydrate, protein, fluid and micronutrients can attenuate the acute and chronic immunosuppression seen with exercise. Dairy products have an advantage over other foods, as they provide a combination of nutrients, rather than one in isolation. Vitamin D-fortified dairy products may be useful in the prevention and treatment of injuries associated with sub-optimal intake of these nutrients.

Body Composition

The role of dairy products in manipulating body composition is an emerging area of research. Early evidence suggests that consumption of recommended

intakes of dairy products (or perhaps, more specifically, the whey sub-fraction) enhances gains in lean body mass and increases functional strength outcomes, as well as playing a part in reducing body fat levels.

The practical benefits of dairy products

The variety of dairy products (e.g. cheese, milk, yoghurt, etc.) as well as the range within each product (low fat, reduced fat, and full fat) allows the athlete to choose an appropriate option to meet their needs (Table 2). The energy content can be further increased by adding other components (e.g. fruit or flavoured topping to a smoothie or milkshake). Lactose-free dairy products are available for those who do not tolerate lactose. Flavoured milk and smoothies provide an alternative for athletes who dislike milk on its own. Long life milk products are portable, have a long shelf-life, and are well suited for sporting situations involving travel and when refrigeration is not available. Single serve portions are practical for the athlete or sports team, and provide known nutrient profiles of the product. Milk drinks can be served cold or warm to suit the environmental conditions. This can assist with temperature regulation and voluntary intake. Dairy products provide a cost-effective and enjoyable recovery option for athletes. Cheese has a high salt content, and may be added to post exercise meals and snacks to aid electrolyte replacement and the retention of fluid.

References

- Brian D Roy, 2008, Milk: the new sports drink? A Review, Journal of the International Society of Sports Nutrition 2008, 5:15
- Fact sheet, Dairy and sports performance, Sports Dietician Australia
- "Milk -Natures sports drink" presented Dairy and Sports Performance session in Nutrition Australia Seminar 2012
- Narinder Kaur, 2019, Role Of Nutrition In Sports, IJRAR, Vol.1:6
- Rishi Kumar and Tajamul Hussain Malik, 2014, Role of Nutrition in Sports, IJCRT, Vol. 2:2
- Sports Nutrition by Sharon Madigan Nutrition