J. Dairy Sci. 98:1–4
http://dx.doi.org/10.3168/jds.2015-9392

The effects of postexercise consumption of a kefir beverage on performance and recovery during intensive endurance training

K. V. O'Brien,*[1] L. K. Stewart,† L. A. Forney,‡ K. J. Aryana,* W. Prinyawiwatkul,§ and C. A. Boeneke*
*School of Animal Sciences, Louisiana Agricultural Experiment Station, Louisiana State University Agricultural Center, Baton Rouge 70803
†Rocky Mountain Cancer Rehabilitation Institute, School of Sport and Exercise Science, University of Northern Colorado, Greeley 80639
‡Laboratory of Nutrient Sensing and Adipocyte Signaling, Pennington Biomedical Research Center, Baton Rouge 70808
§School of Nutrition and Food Sciences, Louisiana State University, Baton Rouge 70803

ABSTRACT

This study was designed to determine whether kefir accentuates the positive health benefits assessed by measures in fitness, body composition, or both, as a measure of cardiovascular disease risk as well as the biomarker C-reactive protein (CRP). Sixty-seven adult males and females aged 18 to 24 yr were assigned to 1 of 4 groups: (1) endurance training + control beverage, (2) endurance training + kefir beverage, (3) active control + control beverage, or (4) active control + kefir beverage. The exercise groups completed 15 wk of structured endurance training while the active control groups maintained their usual exercise routine. Additionally, each group was assigned to either a kefir or a calorie/macronutrient matched placebo beverage that was consumed twice per week. No significant interactions were found among groups with respect to outcome variables with the exception of serum CRP. The endurance training was effective in improving 1.5-mile (2.41 km) times and kefir supplementation may have been a factor in attenuating the increase in CRP that was observed over the course of the intervention period. This preliminary study suggests that kefir may be involved in improving the risk profile for cardiovascular disease as defined by CRP.
Key words: kefir, probiotics, exercise, inflammation, C-reactive protein

INTRODUCTION

Endurance exercise has repeatedly demonstrated positive health benefits, such as improved cardiovascular functioning and helping to maintain a healthy BW. However, exercise can deplete the body's glucose stores (blood glucose, muscle, and liver glycogen) and can have catabolic effects on muscle proteins immediately following exercise. In several studies, milk, with the addition of an appropriate amount of carbohydrate, has been shown to be an ideal recovery beverage for athletes following bouts of endurance training as a way to attenuate some of the acute effects of strenuous activity (Karp et al., 2006; Roy, 2008; Thomas et al., 2009). The American College of Sports Medicine (**ACSM**) recommends the following: carbohydrate intake: 1.0 to 1.5 g/kg of BW (0.5–0.7 g/lb), and protein intake: 0.4 to 0.7 g/kg of BW (0.2–0.4 g/lb; ACSM and ADA Joint Position Statement, 2009). Other studies show a ratio of 4 to 1 carbohydrates to protein to have beneficial results in recovery if consumed within 2 h following exercise (Manninen, 2006; Thomas et al., 2009). Milk is also a good source of calcium, phosphorus, potassium, and vitamin D, which aid in developing strong bones and restoring proper electrolyte balance and hydration following exercise. Although can milk play an important role in sport nutrition, athletes with lactose sensitivities are unable to consume lactose-containing dairy products, such as unfermented milk, without some degree of gastrointestinal discomfort (Tomba et al., 2012). The production of lactase by mucosal cells in the intestinal epithelium decreases with age in most humans, particularly in individuals of East Asian and African descent (Suchy et al., 2010), and it is estimated that 65 to 85% of adults of these races lack sufficient lactase to digest the lactose that would accompany the 3 servings per day of low-fat dairy products recommended by the Dietary Guidelines for Americans (Rowlands et al., 2007).

Increased stress on the body, as occurs with exercise, can also cause acute and chronic disruption of immune functioning and increased inflammation (Oktedalen et al., 1992; Pals et al., 1997; Ji, 2002; de Oliveira et al., 2011). C-reactive protein (**CRP**) is a biomarker that is often used to assess both acute and chronic inflammation. Muscle damage during intensive exercise typically results in elevated CRP levels in the blood (Mackinnon, 2000). Because probiotics have demonstrated positive effects on reducing chronic inflammation in the body, they would likely have a similar effect on exercised-induced inflammation.

Received January 28, 2015.
Accepted June 25, 2015.
[1]Corresponding author: kobrie9@lsu.edu

Kefir is a naturally fermented milk beverage containing a mixed microbial culture of lactic acid bacteria and yeasts. Characteristics include a smooth and creamy texture and an acidic, slightly alcoholic and yeasty taste with varying levels of effervescence (Muir et al., 1999). Health aspects attributed to the consumption of kefir, include, but are not limited to, improved lactose utilization, anti-carcinogenic activity, control of intestinal infections, and improved nutritional quality of milk (Vinderola et al., 2006; Medrano et al., 2011). Studies involving probiotics and athletes have demonstrated maintenance of gastrointestinal function and health, attenuation of immunosuppressive effects, reduced susceptibility to illness, enhanced resistance to upper-respiratory tract infections, and reduced gut permeability (Kekkonen et al., 2007; West et al., 2009; Cox et al., 2010; Gleeson et al., 2011; Lamprecht et al., 2012). However, the effects of probiotic supplementation following exercise have not been examined when using fermented milk as the delivery method for probiotics. The capacity for probiotics to modulate perturbations in immune function following exercise, along with the enhanced digestibility of fermented milk, would make a kefir-based recovery beverage a good source of nutrients required for muscle synthesis and regeneration following activity. The objective of this project was to design an all-natural, minimally processed postexercise kefir-based recovery beverage for athletes to meet 3 specific criteria: (1) follows the ACSM guidelines for endurance athlete nutrition following exercise, (2) has a significantly reduced lactose content to allow for consumption by lactose-sensitive athletes, and (3) contains live, active probiotic cultures at the time of consumption. A second objective was to determine the physiological responses to intensive exercise training and kefir supplementation by examining levels of established biological markers of inflammation and immune functioning.

MATERIALS AND METHODS

A kefir beverage was developed that meets the ACSM guidelines for recommended nutrition following endurance and resistance exercise manufactured at the Louisiana State University Creamery. Pasteurized, non-homogenized, full-fat cow milk was fermented in either gallon-sized lidded glass containers or 5-gallon lidded stainless-steel milk pails by inoculation with approximately 30 g of kefir grains (Cultures for Health, Sioux Falls, SD) per gallon of milk. During the fermentation process, the kefir grains were contained in unbleached cotton tea bags. The bags were sterilized in boiling water before addition of the kefir grains. The milk was allowed to ferment at 25°C for approximately 24 h, or until a pH of 4.6 was reached. The kefir was then placed in refrigerated storage until formulation and packaging of the beverage. Lactaid, an ultra-pasteurized homogenized lactose-free milk product, was used as the dairy portion of the control beverage.

A fruit base for the kefir and control beverage was processed separately and was subsequently blended with kefir or Lactaid several hours before consumption by the study participants. The fruit base included all of the beverage ingredients except the dairy portion; it was prepared using a VitaMix Commercial/Household Food Preparing Machine Model VM0100A (VitaMix Corp., Cleveland, OH). After combining the kefir and the fruit base, 16 ounces (454 g) of the product was portioned into clear plastic containers with snap-on lids with a tamper-evident seal. Each container was labeled with a number that corresponded to subject code; no other identifying information was on the container when presented to the participants. The containers were placed in refrigerated storage (6 ± 5°C) until consumption. The ingredients and macronutrient profiles for the kefir beverage and the control beverage were identical with the exception of the type of milk used (kefir or Lactaid; Table 1). Nutritional analysis for the products and ingredients was performed using The Food Processor Nutrition and Fitness Software (ESHA Research, Professional Nutritional and Analysis Software, Salem, OR). Macronutrient contents for each ingredient were generated by The Food Processor software, and the total macronutrient composition for each beverage was calculated from those values. Sensory questionnaires were administered during the intervention period to determine the likeability of the beverages by the participants and the intent to purchase before and after knowing about potential probiotic effects.

This study was approved for use of human subjects by the Louisiana State University Institutional Review Board (#3335). Subjects were recruited from the student population at Louisiana State University. Subjects

Table 1. Nutrient compositions of a kefir beverage and a control beverage given to endurance athletes and an active control during a 15-wk marathon training program

Item	Kefir beverage	Control beverage
Serving size (oz)	16	16
Calories (kcal)	220.16	220.16
Fat (g)	5.4	5.4
Sodium (mg)	71.68	71.68
Total carbohydrate (g)	66.56	66.56
Fiber (g)	2.8	2.8
Sugar (g)	30.72	30.72
Protein (g)	10.24	10.24
LAB[1] (cfu/serving)[2]	10^9–10^{10}	0
Yeasts (cfu/serving)	10^7–10^8	0

[1]Lactic acid bacteria.

[2]Colony forming units per 16-oz (454-g) serving.