Note

(−)-Hydroxycitrate Ingestion Increases Fat Oxidation during Moderate Intensity Exercise in Untrained Men

Kyoko TOMITA,† Yasuhide OKUHARA,† Norihiro SHIGEMATSU,† Heajung SUH,‡ and Kiwon LIM§

1Central Research Laboratory, Fancl Co., Yokohama, Japan  
2Institute of Elderly Health, Seoul, Korea  
3Department of Physical Education, Konkuk University, Seoul, Korea

Received February 21, 2003; Accepted May 7, 2003

We examined the effects of (−)-Hydroxycitrate (HCA) ingestion on fat oxidation during moderate intensity exercise in untrained men. Six subjects ingested 500 mg of HCA or a placebo for 5 days and did endurance exercise. Blood FFA concentrations were significantly increased and respiratory exchange ratio (RER) decreased by HCA ingestion. These results suggested short-term HCA ingestion increases fat oxidation in untrained men.

Key words: (−)-hydroxycitrate (HCA); fat oxidation; untrained; respiratory exchange ratio (RER); free fatty acid (FFA)

(−)-Hydroxycitrate (HCA), an active ingredient extracted from the rind of the fruit of Garcinia cambogia,1) is a potent competitive inhibitor of ATP-citrate lyase (EC 4.1.3.8).2) Recently, HCA has been used for anti-obesity treatment and the clinical relevance of HCA has often been proposed.3–5) There are also some reports examined the effects of HCA ingestion on endurance exercise performance in rats6) or human athletes.7) Thus, HCA supplementation with some exercise could be useful as an ergogenic aid increases fat oxidative capacity and is further expected to be a metabolic anti-obesity agent. However, energy utilization systems during exercise are different with or without a training state. In this study, we examined the effects of short-term HCA ingestion on fat oxidation during moderate intensity exercise in ordinary untrained men.

Six untrained males participated in the study. They did not take any regular exercise training for at least 6 months. They did not control their food consumption or private life style during the experimental periods. Their physical characteristics were as follows: 20.2 ± 1.5 years old, 177.0 ± 3.4 cm tall, 69.7 ± 7.2 kg weigh, and 16.5 ± 3.8% of body fat. This study was approved by Kyung Hee University in Korea, in accordance with the Helsinki Declaration of 1975. Subjects’ mean incremental maximum oxygen consumption (VO2max) measured on a bicycle ergometer was 43.0 ± 5.6 ml/kg·min⁻¹. We calculated their exact 40% and 60% of VO2max exercise bout based on their VO2max and divided them into two groups. They ingested HCA or placebo for 5 days in a double-blind and crossover manner. At least 2 days between the trials was established to minimize any possible effects of HCA. HCA was taken as 50 ml of drinks containing 500 mg of HCA. Placebo did not contain HCA but had the same amount of the energy and carbohydrate, protein, and fat was adjusted to the same as that of HCA. HCA used in this study was as soluble types and provided by Nippon Shinyaku (Kyoto, Japan).

The experimental design is shown in Fig. 1. On the 5th day, subjects reported and ingested 620 kcal of the meal and HCA or Placebo. Then, subjects started to warm up and exercise using a bicycle ergometer (Combi Aerobike, 75TXL-2, Japan) at a pedaling frequency of 50 rpm and an intensity of 40% of VO2max for 60 min, and then the intensity was elevated to 60% until they were exhausted. The two different exercise-intensity exercises protocol was selected to investigate endurance performance as reported by some researchers.7–9) Expired gas samples and blood samples were collected. Exercise time to exhaustion was measured when the cadence could no longer be maintained three times under 50 rpm. The experiments were done with a room temperature of 20°C and 50% humidity. Expired gas samples were analyzed on an auto-analyzer (Sensor Medic, Vmax 229, USA). Fat and carbohydrate oxidation during exercise was calculated as previously described.10) Blood glucose and lactate concentrations were analyzed using an auto-analysis system and plasma free fatty acid (FFA) concentrations were measured by an enzymatic method using a kit.7,8) The results are described as mean ± SE. To compare the data, a paired t-test was done between trials. Significant
The experimental results are as follows. Oxygen consumption (VO2) was not different between the HCA and placebo ingestion groups (Fig. 2A). On the other hand, the respiratory exchange ratio (RER) in the HCA ingestion group significantly decreased compared with the placebo group ($p < 0.05$) (Fig. 2B). Also, fat oxidation in HCA trials increased from 30 min of the exercise, significantly at 45 min of exercise ($p < 0.05$) while carbohydrate oxidation tended to decrease during the same period (data not shown). Endurance exercise training reduces the malonyl-CoA concentration and increases the mitochondrial contents, and also increases the mitochondrial uptake of long-chain fatty acids. That is why fat oxidation is increased. These results suggested that HCA ingestion increases the fat oxidation capacity and spares carbohydrate use during the same-intensity exercise even in untrained men. Blood FFA concentration during exercise time increased in the HCA ingestion group, significantly at 15 min and 60 min of the exercise ($p < 0.05$) (Fig. 3). This also suggested that HCA ingestion increased fatty acids use as an energy source during moderate intensity exercise. Increased FFA concentration might have a glycogen sparing effect and there are some reports that blood lactate levels during exercise were slightly decreased by HCA ingestion. However, glucose and lactate concentrations were not changed in this study (data not shown). It is considered that the effects of HCA on lactate levels may be affected by the subjects’ training state, but the details remain unclear. And also, exercise times to exhaustion at 60% VO2max after 40% VO2max for 1 h were slightly prolonged by HCA ingestion but the differences were not significant (data not shown). Thus, the effects of HCA ingestion on endurance exercise capacity were not clear.

Kriketos et al. failed to detect an effect of short-term HCA ingestion on lipid oxidation during moderate intensity exercise in men. The experimental design was very similar to this study, but the subjects ingested 3.0 g of insoluble HCA just for 3 days, and the endurance exercise time was shorter. There are also some reports that an acute administration of HCA did not affect energy substrate use. It can be predicted that some continuous ingestion term is needed to detect the effects of HCA on fat oxidation and the ingestion form of HCA or exercise time could be the important factor for these experiments.

In conclusion, it was seen that short-term ingestion of HCA increases fat oxidation during moderate intensity exercise also in untrained men.
The authors gratefully thank the students of Kyung-Hee University, Korea for their participation as the subjects, and Dr. Ho-Sung Nho, Dr. Sungkeun Choi, Dr. Taedong Kwon, and Dr. Sungpil Ryu for their technical assistance with the exercise program.

References


