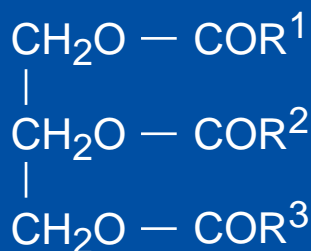


Medium Chain Triglycerides

R-groups = 8 to 12-carbon fatty acids

Medium Chain Triglycerides

Description

Medium chain triglycerides (MCTs) are a class of lipids in which three saturated fats are bound to a glycerol backbone. What distinguishes MCTs from other triglycerides is the fact that each fat molecule is between six and twelve carbons in length. MCTs are a component of many foods, with coconut and palm oils being the dietary sources with the highest concentration of MCTs. MCTs are also available as a dietary supplement.

Pharmacokinetics

MCTs have a different pattern of absorption and utilization than long-chain triglycerides (LCTs) that make up 97 percent of dietary fats. For absorption of LCTs to occur, the fatty acid chains must be separated from the glycerol backbone by the lipase enzyme. These fatty acids form micelles, are then absorbed and reattached to glycerol, and the resultant triglycerides travel through the lymphatics en route to the bloodstream. Up to 30 percent of MCTs are absorbed intact across the intestinal barrier and directly enter the portal vein. This allows for much quicker absorption and utilization of MCTs compared to LCTs. MCTs are transported into the mitochondria independent of the carnitine shuttle, which is necessary for LCT-mitochondrial absorption. Oxidation of MCTs provides 8.3 calories per gram. For more information on the absorption and utilization of MCTs, consult Ruppin and Middleton.¹

Clinical Indications

Malabsorption

The use of MCTs is clearly indicated in malabsorption states. Children with cystic fibrosis supplemented with up to 75 mL of MCTs per day experienced greater weight gain and reduced fecal fat compared to a trial period on a control diet.² When MCTs are given concurrently with a pancreatic enzyme preparation, absorption is improved.³ MCTs have been used in other malabsorption syndromes, including short-bowel syndrome, celiac disease, and hepatic disease.⁴

HIV/AIDS

MCTs may help with weight maintenance in AIDS patients. An enteral formula containing 85 percent of fat calories from MCTs (35% of total calories from fat) led to decreases in stool fat, number of bowel movements, and abdominal symptoms, as well as increased fat absorption compared to baseline.⁵ No improvement was seen in subjects taking a control LCT-containing formula. Another controlled trial confirmed these results.⁶ MCT-containing caloric supplements do not appear to cause weight gain in AIDS patients compared to a control diet.⁷

Cachexia

In chronically ill patients receiving total parenteral nutrition, preparations containing 50 percent of fat calories from MCTs led to a significantly lower production of tumor necrosis factor-alpha (TNF α) compared to a solution with 100 percent LCTs.⁸ TNF α is a cytokine thought to be responsible for at least some symptoms of cachexia.

MCTs have been used as part of a ketogenic diet to treat children with intractable seizures and cancer. The ketogenic diet varies, but generally contains 60 percent of calories from MCT oil, 20 percent from protein, 10 percent from carbohydrate, and 10 percent from other dietary fats. Although some preliminary data are available showing reduced sugar metabolism at tumor sites,⁹ use of ketogenic diets to treat active cancers remains unproven. A small study showed an enteral formula containing MCTs and hydrolyzed casein protein led to better weight maintenance during radiation therapy than an ad libitum diet.¹⁰

Weight Loss Programs

In a randomized, crossover trial, 12 non-obese women fed a diet providing 80 percent of fat calories as MCTs (40% of total calories from fat) exhibited a greater rate of oxidation of long-chain saturated fats for energy.¹¹ Another study demonstrated an increased metabolic rate in response to substitution of just 20 percent of fat calories with MCTs.¹² Obese women fed an 800 kcal/day diet with 24 percent of calories from MCTs had no more weight loss than women eating a similar diet without MCTs.¹³ While some authors have theorized a role for MCTs in weight control,¹⁴ this role has yet to be fully defined.

Exercise Nutrition

It has been theorized that MCTs improve energy utilization during exercise, but this has not been conclusively demonstrated in clinical trials. One study found similar exercise performance among subjects fed 400 kcal as MCTs, LCTs, or carbohydrates.¹⁵ Subjects used MCTs as an energy source more efficiently than LCTs, but less efficiently than carbohydrates. Another clinical trial found cyclists ingesting a five-percent MCT

solution actually had decreased exercise performance compared to those taking a carbohydrate solution or placebo.¹⁶ This decrease in exercise performance was thought to be due to gastrointestinal upset. When MCTs were given concurrently with carbohydrate, no negative effect on performance was noted.

Diabetes

In the inpatient setting, an experimental diet containing 78 percent of fat calories as MCTs (31% of total energy intake) increased glucose metabolism in patients with type 2 diabetes mellitus.¹⁷ In five outpatients with type 2 diabetes, an experimental diet containing 18 percent of calories from MCTs led to a slight reduction in postprandial blood sugar and no effect on fasting blood sugar.¹⁸ The role of MCTs in the management of diabetes remains to be decided.

Side Effects and Toxicity

Due to its unique absorption characteristics, MCTs tend to be well tolerated, even in individuals with severe malabsorption. While fat malabsorption symptoms are generally fewer with MCTs than with LCTs, some steatorrhea can occur.³ Mild gastrointestinal upset has been reported in trials using high doses of MCTs.¹⁶

MCTs significantly raised serum cholesterol in subjects with prior mild hypercholesterolemia.¹⁹ In another study, MCT administration led to an increase in serum lipids compared to corn oil, but a decrease in serum lipids when compared to butter.²⁰ MCTs significantly increased serum triglycerides and decreased HDL cholesterol compared to LCTs in one study,²¹ and significantly lowered plasma triglycerides versus LCTs in another study.²² In addition, MCT administration has been associated with a slight increase in serum insulin.²³

Dosage

Appropriate doses of MCTs vary with condition. Studies involving MCTs have typically used 15-30 mL of MCTs per day in children, and 50-100 mL per day in adults. Higher doses may be required in patients with severe cachexia.

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