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L-carnitine in petfood

Some dog and cat foods contain L-carnitine added as a chemically pure substance. It generally concerns light foods, but also certain senior foods. The food packaging declares L-carnitine in the ingredient list and often says that it helps to burn fat and supports lean muscle mass. Or rather, it favors fat loss and muscle deposition, thus promoting a healthier body weight (1, 2). Along with light foods, veterinary weight-reduction, heart and liver diets may have added L-carnitine.

L-carnitine is a vitamin-like compound that assists in delivering dietary and body fat to the energy-producing machinery of body cells. The L prefix refers to the active structure that is made in the body of dogs and cats, normally making carnitine supplementation unnecessary (3). Unsupplemented petfood provides L-carnitine through various ingredients, particularly those of animal origin. Supplemental L-carnitine is derived from bacterial or chemical synthesis, the latter process yielding 50% active and 50% inactive carnitine.

Evidence suggests that supplemental L-carnitine stimulates fat burning in dogs and cats, which theoretically sets metabolism toward less body fat and more muscle amount. However, studies showed no L-carnitine effect on body fat and non-fat amounts in cats and negligible effects in dogs. This holds for both weight-control and weight-reduction feeding regimens.

In addition to its meaningless impact on body composition, there is no convincing proof that supplemental L-carnitine further enhances the rate of body-weight loss during calorie-restricted feeding of dogs and cats. In free-feeding animals, L-carnitine did not reduce body weight. For weight maintenance and reduction, portion-controlled feeding of a nutritionally adequate food, with pet's body condition as compass, is still indicated.

L-carnitine

L-carnitine (4-tri-methylamino-3-hydroxybutyrate) and two carnitine palmitoyltransferases (CPTs) carry fatty acyl groups from the cytosol into the cellular mitochondria. The acyls are oxidized into acetyl-CoA that enters the tricarboxylic cycle and generates reducing equivalents for ATP synthesis.

Feeding extra L-carnitine, as beef or pure substance, raises plasma carnitine in dogs and cats (4-9). In foxes fed animal byproducts, apparent ileal absorption of L-carnitine was 78% (10), but oral supplements are much less available (11). Non-absorbed carnitine is degraded by colonic bacteria (11).

Regular dry and wet petfoods contain 5 to 39 and 23 to 1450 mg L-carnitine/kg dietary dry matter (ddm) (5, 6, 12-17). Supplementation typically equals 50 to 350 mg/kg ddm, but is greater for cardiac diets. An 11-kg dog consuming 200 g unsupplemented dry food/day may ingest 4 mg L-carnitine/day while its biosynthesis (from lysine) equals 14 mg/day (12, 14). L-carnitine is not catabolized by dogs (12, 18) so that urinary excretion reflects absorption plus synthesis. At constant L-carnitine intake, higher fat intake raised urinary loss in dogs (14).

Fatty acid oxidation

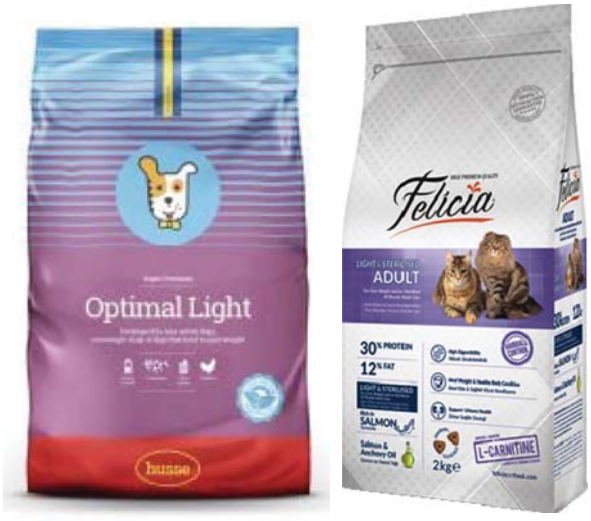
High-dose oral L-carnitine raised myocardial content in two carnitine-deficient dogs (4). L-carnitine stimulated fatty acid oxidation in isolated dog cardiac myocytes (19) and skeletal muscle homogenates (20). However, L-carnitine tissue concentrations and CPT-Km values (12, 21-23) indicate that supplemental dietary L-carnitine most likely stimulates hepatic fatty oxidation.

Adding L-carnitine to the diet lowered fasting plasma free fatty acids in cats (8) and dogs (9). In restricted-fed, overweight cats, supplemental L-carnitine (76 vs 32 mg/kg ddm) lowered the respiratory quotient, pointing at enhanced whole-body fatty acid oxidation (15), but corroboration is meager (16).

Theoretical considerations

Percentages of the fat and fat-free masses in the body add up to 100%. In adult, normal-weight cats and dogs, the distributions are about 30:70 and 20:80 (24). Can supplemental L-carnitine theoretically lower body fat and consequently raise muscle mass?

L-carnitine may increase hepatic oxidation of fasting plasma fatty acids originating from adipose tissue. Hepatic triacylglycerol secretion falls, but increased ATP production spares glucose, leading to less gluconeogenesis, which in turn depresses muscle protein catabolism. Body fat shrinks due to increased fatty acid release, but then stabilizes as more glucose is converted into fatty acids. Muscle mass grows due to decreased protein catabolism, but then stabilizes while reinstating its catabolic rate. At negative energy balance, L-carnitine may accelerate body-fat loss, thus conserving the fat-free mass.



Body composition

Restricted-fed, overweight cats received diets containing 32 to 176 mg L-carnitine/kg ddm, but baseline percentage body fat (%BF) was different for the low-dose group and not affected dose-dependently in the other three groups (15). In a similar trial, supplemental L-carnitine (220 mg/kg ddm) left %BF unchanged (25). In cats fed ad libitum, extra L-carnitine (500 mg/kg ddm) did not influence %BF (26).

In obese dogs with effective weight loss, L-carnitine lowered body fat, but effect size is unreported (27). In dogs fed ad libitum for 7 weeks, L-carnitine (81 or 140 vs 24 mg/kg ddm) reduced %BF by 1 unit (13, 28). During the following 12-weeks period of caloric restriction, L-carnitine-induced lowering was 2 %units (13, 29). In dogs fed to prevent weight gain, extra L-carnitine (300 mg/kg ddm) lowered fat percentage by 3.4 units (30). In growing dogs, L-carnitine hardly affected %BF (31).

Weight loss

In energy-restricted, obese cats, supplemental L-carnitine was associated with greater caloric deficit (7), promoted weight loss (25) or did not (15). In dogs, L-carnitine did not enhance weight loss when cutting their calories (13, 27).

Hepatic and cardiac diets

L-carnitine inconsistently protected against feline hepatic lipidosis (8, 25, 32). Therapeutically used L-carnitine doses are not met by commercial canine cardiac diets (33).

List of references is available on request from the author (beynen@freeler.nl)

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