

Common Dietary Supplements for Weight Loss

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Over-the-counter dietary supplements to treat obesity appeal to many patients who desire a “magic bullet” for weight loss. Asking overweight patients about their use of weight-loss supplements and understanding the evidence for the efficacy, safety, and quality of these supplements are critical when counseling patients regarding weight loss. A schema for whether physicians should recommend, caution, or discourage use of a particular weight-loss supplement is presented in this article. More than 50 individual dietary supplements and more than 125 commercial combination products are available for weight loss. Currently, no weight-loss supplements meet criteria for recommended use. Although evidence of modest weight loss secondary to ephedra-caffeine ingestion exists, potentially serious adverse effects have led the U.S. Food and Drug Administration to ban the sale of these products. Chromium is a popular weight-loss supplement, but its efficacy and long-term safety are uncertain. Guar gum and chitosan appear to be ineffective; therefore, use of these products should be discouraged. Because of insufficient or conflicting evidence regarding the efficacy of conjugated linoleic acid, ginseng, glucomannan, green tea, hydroxycitric acid, L-carnitine, psyllium, pyruvate, and St. John’s wort in weight loss, physicians should caution patients about the use of these supplements and closely monitor those who choose to use these products. (*Am Fam Physician* 2004;70:1731-38. Copyright© 2004 American Academy of Family Physicians.)

In 2000, an estimated 30.5 percent of adults were obese (i.e., had a body mass index [BMI] greater than 30 kg per m²)¹ and 15.5 percent of adolescents were overweight (BMI of 25 to 30 kg per m²).² Given the medical and psychosocial impact of being overweight, as well as the

difficulty in making sustained improvements in diet and physical activity, it is not surprising that patients often turn to over-the-counter (OTC) proprietary weight-loss products containing single or multiple dietary supplements (e.g., herbs, vitamins, minerals, amino acids).

A multi-state survey³ in 1998 found that 7 percent of adults used OTC weight-loss supplements, with the greatest use noted among young obese women (28 percent). Retail sales of weight-loss supplements were estimated to be more than \$1.3 billion in 2001.⁴ Metabolife 356, an ephedra-containing combination supplement, was the top-selling diet supplement with \$70 million in sales, representing a 127 percent increase from sales in 2000.⁴

Possible reasons that patients use dietary supplements for weight loss are summarized in *Table 1*. These supplements appeal to the desire for a “magic bullet” that is less demanding than special diets and increased physical activity. They are available without a prescription and often advertise remark-

TABLE 1

Why Overweight and Obese Patients Seek Dietary Supplements for Weight Loss

- Social stigma of obesity
- Health benefits of weight loss
- Desire for a “magic bullet” for weight loss
- Less demanding than accepted lifestyle changes, such as exercise and diet
- Frustration with previous attempts at dieting and/or exercise
- Easily available without a prescription
- More easily accessed than a professional consultation with a physician, nurse, or nutritionist
- Inflated advertising claims
- Appeal of a “natural” remedy
- Perception that natural equals safe

TABLE 2

Common Dietary Supplements Used for Weight Loss, Classified According to Purported Mechanism*†

Increase energy expenditure Ephedra (56) Bitter orange (49) Guarana (34) Caffeine (27) Country mallow (13) Yerba maté (9)	Increase satiety Guar gum (10) Glucomannan (7) Psyllium (6) Increase fat oxidation or reduce fat synthesis L-carnitine (49) Hydroxycitric acid (43) Green tea (42) Vitamin B ₅ (18) Licorice (17) Conjugated linoleic acid (7) Pyruvate (6)	Block dietary fat absorption Chitosan (16) Increase water elimination Dandelion (15) Cascara (5) Enhance mood St. John's wort (19) Miscellaneous or unspecified Laminaria (18) Spirulina [also known as blue-green algae] (13) Guggul (10) Apple cider vinegar (7)
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*—The Natural Medicines Comprehensive Database⁵ was searched for individual dietary supplements used or studied for weight loss. For each supplement identified, the number of commercial weight-loss products listed in the database which contained the supplement was determined. Commercial products in the database were deemed for weight loss if they contained any of the following words or syllables in their name: diet, thin, trim, fat, lean, weight, slim. Individual supplements found in at least five commercial products are listed. The number of commercial products containing the supplement is listed in parentheses.

†—Classification according to purported mechanism schema adapted from DeBusk RM. A critical review of the literature on weight loss supplements. *Integrative Medicine Consult* 2001;3:30-1.

Information from references 5 and 6.

able benefits. Patients also may be attracted to them because they are marketed as “natural,” which may be interpreted by some (albeit inaccurately) as an assurance of safety and efficacy.

To help identify patients using these supplements, physicians should ask their overweight and obese patients in a non-judgmental manner questions such as, “Have you tried, or considered trying, special diets, exercise programs, diet pills, herbs, or vitamins for weight loss?” If the ingredients of a patient’s weight-loss product are not evident, an Internet search can rapidly yield a product’s Web site and its labeled components.

To counsel patients appropriately, physicians must be knowledgeable about the efficacy, safety, and quality of common weight-loss supplements. Given that supplement users also may be taking prescription medications,³ the potential for drug/supplement

interactions should be considered. Because of the Dietary Supplement Health and Education Act of 1994, manufacturers are not required to provide the U.S. Food and Drug Administration (FDA) with proof of safety and efficacy before marketing supplements. Furthermore, adoption of good manufacturing practices by supplement makers is not currently mandatory. Therefore, product quality (e.g., absence of contamination, accuracy of labeling) is variable and uncertain.

More than 50 individual dietary supplements and 125 proprietary products are listed in the Natural Medicines Comprehensive Database as commonly being used for weight loss.⁵ Individual supplements found in at least five commercial products (Table 2^{5,6}) are discussed in this review, according to their purported mechanism of action. Of note, approximately one half of the most common individual supplements used in weight-loss products listed in Table 2 have not been studied in randomized controlled trials (RCTs) in humans.

Physicians should ask their overweight patients questions such as, “Have you tried, or considered trying, special diets, exercise programs, diet pills, herbs, or vitamins for weight loss?”

Supplements Purported to Increase Energy Expenditure

EPHEDRA ALKALOIDS AND CAFFEINE COMPOUNDS

Ephedra sinica (or *Ma huang* in Chinese) is a shrub native to China and Mongolia that contains sympathomimetic compounds referred to as ephedra alkaloids. Bitter orange and country mallow contain related chemicals. Ephedra alkaloids commonly are combined with caffeine or botanical sources of caffeine (e.g., guarana, yerba maté) for weight loss.⁷ A recent meta-analysis⁸ of RCTs showed a weight loss of 0.9 kg (2 lb) more per month for ephedra-containing supplements compared with placebo. However, no long-term data (i.e., greater than six months) on efficacy were available.

Using adverse event data from 50 trials of ephedra, a 2.2- to 3.6-fold increase in the odds of psychiatric, autonomic, cardiovascular, and gastrointestinal symptoms was estimated.⁸ Another review⁹ of adverse events possibly associated with ephedra use included 87 reports to the FDA MedWatch program between June 1997 and March 1999. These reports included episodes of hypertension, arrhythmias, myocardial infarction, stroke, and seizures. Ten events led to death and 13 yielded permanent disability. Of these 23 reports, nine occurred at recommended dosages of ephedra in persons without significant preexisting cardiovascular risk factors.⁹

Ephedra products comprised only 0.8 percent of all dietary supplement sales in 2001, yet they were responsible for 64 percent of all herb-related adverse events reported to U.S. Poison Control Centers during the same year.¹⁰ Although ephedra-caffeine combinations may be effective for modest weight loss, safety issues motivated the FDA to ban their sale in April 2004.¹¹

Supplements Purported to Modulate Carbohydrate Metabolism

CHROMIUM AND GINSENG

Chromium deficiency is associated with hyperglycemia, hyperinsulinemia, hypertriglyceridemia, and low levels of high-density lipoprotein cholesterol. Chromium is

thought to play a role in carbohydrate and lipid metabolism, potentially influencing weight and body composition.¹² However, data on healthy persons without diabetes do not support this theory, and data on patients with diabetes are inconclusive.¹³

Most weight-loss supplements use chromium picolinate in daily dosages of 200 to 400 mcg. The results of three RCTs¹⁴⁻¹⁶ that studied the role of chromium in obesity did not show any differences in weight loss between the treatment and placebo groups. However, drawing conclusions from these studies is difficult because of their small size (n = 15 to 36). Although short-term trials using chromium picolinate did not report significant adverse effects,¹⁷ there are theoretical concerns that this form of chromium could generate free-radical damage.¹⁸ Rhabdomyolysis and renal failure, possibly related to ingestion of more than 1,000 mcg daily of chromium picolinate, have been reported.^{19,20} Because of the lack of large, well-designed studies, the efficacy of chromium for weight loss and its long-term safety profile remain uncertain.

Although preliminary data suggest that ginseng (*Panax ginseng*) may improve glucose tolerance,²¹ no RCTs in humans have shown greater weight loss with ginseng compared with placebo.

Supplements Purported to Increase Satiety

GLUCOMANNAN, PSYLLIUM, AND GUAR GUM

Numerous weight-loss products contain sources of soluble fiber, which theoretically could absorb water within the gut, causing increased satiety and lower caloric intake. Fiber also may improve control of diabetes and hyperlipidemia, two common comorbidities in patients with obesity. Examples include guar gum (derived from the Indian cluster bean, *Cyamopsis tetragonolobus*), glucomannan (*Amorphophallus konjac*), and psyllium (derived from the seed husk of *Plantago psyllium*).

Although guar gum is relatively safe, a meta-analysis²² of 11 RCTs of guar gum versus placebo for weight loss showed no benefit. Three RCTs²³⁻²⁵ suggest that gluco-

mannan in dosages of 3 to 4 g per day may be well tolerated and yield modest weight loss. However, these trials were small (n = 20 to 50) and had methodologic limitations. Although psyllium improved glucose and lipid parameters significantly more than placebo in 125 overweight patients with type 2 diabetes, there were no differences in weight loss.²⁶

Supplements Purported to Increase Fat Oxidation or Reduce Fat Synthesis

HYDROXYCITRIC ACID

Hydroxycitric acid (HCA) is derived from the Malabar tamarind tropical fruit (*Garcinia cambogia*) native to India. HCA has been found to inhibit mitochondrial citrate lyase, leading to decreased acetyl coenzyme A production and decreased fatty acid synthesis.²⁷ A 12-week RCT²⁸ of mildly overweight women (n = 89; mean BMI of 28.6 kg per m²) reported a 1.3 kg (2 lb, 14 oz) greater weight loss in women who received 750 mg of HCA per day versus placebo. In contrast, an RCT²⁹ comparing a different formulation

of HCA at 1,500 mg per day and placebo in 135 men and women with a higher average BMI (31.2 kg per m²) showed no differences in BMI or adverse events. Although HCA appears to be well tolerated, the evidence for efficacy currently is contradictory.

CONJUGATED LINOLEIC ACID

Conjugated linoleic acid (CLA) refers to a family of trans-fatty acids that have been found to reduce fat deposition in obese mice, possibly through increased fat oxidation and decreased triglyceride uptake in adipose tissue.³⁰ A 12-week RCT³¹ of 60 patients using 3.4 to 6.8 g per day of CLA reported no change in BMI. Persons taking CLA reported mild to moderate gastrointestinal symptoms. Currently, no human data support the efficacy of CLA in weight-loss products.

GREEN TEA, LICORICE, PYRUVATE, VITAMIN B₅, AND L-CARNITINE

In one study,³² green tea increased fat oxidation and thermogenesis in 10 patients, but the study was not designed to assess weight loss. Licorice reduced body fat mass without changing BMI in 15 persons of normal weight.³³ However, licorice has been reported to cause pseudoaldosteronism, hypertension, and hypokalemia.³⁴ Six weeks of pyruvate, in a dosage of 6 g per day, was associated with a weight loss of 1.2 kg (2 lb, 10 oz), compared with placebo.³⁵ Although vitamin B₅ has been postulated to cause weight loss,³⁶ no human trials support this. Similarly, no trials demonstrate that L-carnitine is effective for weight loss.

Supplements Purported to Block Dietary Fat Absorption

CHITOSAN

Chitosan, derived from chitin found in crustacean shells, is a positively charged polymer thought to prevent fat absorption by binding negatively charged fat molecules within the intestinal lumen. A meta-analysis³⁷ of five RCTs that evaluated chitosan and placebo for weight loss showed a greater mean weight reduction for chitosan (3.3 kg [7 lb, 4 oz])

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over placebo. All of the studies were conducted by the same team of investigators and several methodologic concerns were noted.

Subsequently, three other researchers reported well-designed RCTs³⁸⁻⁴⁰ that failed to show any differences in weight loss. Furthermore, healthy persons taking chitosan have not shown clinically significant increases in fecal fat excretion.⁴¹ Given the totality of the evidence, chitosan appears to be safe in short-term studies, but is likely ineffective for weight loss.

Supplements Purported to Increase Water Elimination

Dandelion (*Taraxacum officinale*) appears to have diuretic activity and cascara (*Rhamnus purshiana*) acts as a laxative.⁴² Neither of these herbs has been studied specifically for weight loss in humans. Regarding safety, long-term use of these supplements theoretically could cause adverse effects similar to those of conventional diuretics and laxatives (e.g., dehydration, electrolyte abnormalities).⁴³

Other Common Supplements Used for Weight Loss

Although botanical remedies for depression such as St. John's wort (*Hypericum perforatum*) often are found in weight-loss products, no data support their role in weight loss. Laminaria (kelp) has not been studied for weight loss. Spirulina (also known as blue-green algae) contains phenylalanine, which is purported to inhibit appetite. In 1981, the FDA declared spirulina ineffective for weight loss,⁴⁴ and no subsequent studies to the contrary have been published. Guggul (derived from the myrrh tree, *Commiphora mukul*) and apple cider vinegar, which contains various vitamins and minerals, have not been studied for weight loss.

Advising the Patient About Weight-Loss Supplements

Criteria adapted from a recent review⁴⁵ can be used to develop clinical recommendations for each supplement. If there is strong evidence for a product's quality, safety, and

efficacy, it may be reasonable to *recommend* that product and closely monitor the patient. No supplements discussed in this review meet these criteria, however.

In contrast, it would be appropriate to *discourage* use of products when there is strong evidence for lack of quality, safety, or efficacy. For example, use of products that contain ephedra should be actively discouraged because of serious safety concerns. Chitosan appears to be ineffective for weight loss and should also be discouraged. The use of guar gum for weight loss should be discouraged because of its lack of efficacy.

For products that do not fall into the categories to recommend or to discourage use because of insufficient or contradictory evidence, physicians should *caution* their patients about the risks and benefits of using the product given the uncertainty in safety, efficacy, and/or quality control. Chromium, CLA, ginseng, glucomannan, green tea, HCA, L-carnitine, psyllium, pyruvate, and St. John's wort fall into this category. If a patient chooses to use one of these supplements, the physician should monitor the patient closely for adverse effects as well as benefit. *Table 3*^{8,13-18,21-26,28,29,31-35,37-41,44,45} summarizes the evidence for quality, safety, and efficacy for each supplement discussed and provides a suggested clinical stance.

For weight-loss supplements not discussed here, several electronic and print resources containing evidence-based reviews of supplement quality, safety, and efficacy can help physicians obtain the relevant information necessary to counsel patients (*Table 4*).

Patients who use weight-loss supplements may be highly motivated to lose weight, and physicians can try to harness this motivation to encourage more proactive and established approaches to weight loss, such as changes in diet and exercise. Regarding the future use of dietary supplements for weight loss, well-designed RCTs with standardized quality products and increased regulation of the dietary supplement industry are necessary if any of these products are to be recommended as part of a responsible weight-loss program.

TABLE 3

Evidence Summary and Clinical Stance for Individual Weight-Loss Supplements

Supplement	Evidence summary			
	Product quality	Product safety	Product efficacy	Clinical stance*
Apple cider vinegar	Uncertain	Uncertain	Uncertain†	Caution and monitor
Cascara	Present‡	Uncertain	Uncertain†	Caution and monitor
Chitosan ³⁷⁻⁴¹	Uncertain	Present	Absent	Discourage
Chromium ¹³⁻¹⁸	Present‡	Uncertain	Uncertain§	Caution and monitor
Conjugated linoleic acid ³¹	Uncertain	Uncertain	Uncertain§	Caution and monitor
Dandelion	Uncertain	Uncertain	Uncertain†	Caution and monitor
Ephedra alkaloid–caffeine combinations ⁸	Uncertain	Absent	Present	Discourage
Ginseng ²¹	Uncertain	Uncertain	Uncertain†	Caution and monitor
Glucosaminan ²³⁻²⁵	Uncertain	Present	Uncertain¶	Caution and monitor
Green tea ³²	Uncertain	Present**	Uncertain†	Caution and monitor
Guar gum ²²	Uncertain	Present	Absent	Discourage††
Guggul	Uncertain	Uncertain	Uncertain†	Caution and monitor
Hydroxycitric acid ²⁸⁻²⁹	Uncertain	Uncertain	Uncertain‡‡	Caution and monitor
Laminaria	Uncertain	Uncertain	Uncertain	Caution and monitor
L-carnitine	Present‡	Present	Uncertain†	Caution and monitor
Licorice ³³⁻³⁴	Uncertain	Uncertain	Uncertain†	Caution and monitor
Psyllium ²⁶	Present‡	Present	Uncertain†	Caution and monitor
Pyruvate ³⁵	Uncertain	Uncertain	Uncertain¶	Caution and monitor
Spirulina (also known as blue-green algae)	Uncertain	Uncertain	Absent§§	Discourage
St. John's wort	Uncertain	Uncertain	Uncertain†	Caution and monitor
Vitamin B ₅	Present‡	Present	Uncertain†	Caution and monitor

*—If there is strong evidence for the presence of quality, safety, and efficacy, then the suggested clinical stance is to recommend. If there is strong evidence for the absence of quality, safety, or efficacy, then the suggested clinical stance is to discourage. If the evidence does not meet the criteria for recommend or discourage (i.e., evidence for quality, safety, or efficacy is uncertain with no strong evidence for absence of quality, safety, or efficacy), then the suggested clinical stance is to provide caution and monitor. (Clinical stance schema adapted from Weiger, et al.⁴⁵).

†—No or few human weight-loss trials.

‡—Good manufacturing practice formulations are available.

§—Most or all trials do not show weight loss, but the small number of trials and subjects precludes definitive efficacy conclusions.

||—Also includes country mallow, bitter orange, guarana, yerba maté.

¶—Most or all trials demonstrate weight loss, but the small number of trials and subjects precludes definitive conclusions.

**—If taken in appropriate dosages (the equivalent of < 5 cups of green tea daily).

††—Discourage refers specifically to the use of guar gum as an antiobesity agent only. Guar gum and other fiber agents may have a role, however, in obese patients for the treatment of comorbidities such as diabetes, glucose intolerance, and/or hyperlipidemia.²⁶

‡‡—Efficacy data are contradictory.

§§—Based on the negative findings of the U.S. Food and Drug Administration⁴⁴ and no subsequent studies to the contrary.

Information from references 8, 13 through 18, 21 through 26, 28, 29, 31 through 35, 37 through 41, 44, and 45.

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TABLE 4
Evidence-based Resources on Dietary Supplements for Physicians

Natural Medicines Comprehensive Database (<http://www.naturaldatabase.com>)
 Natural Standard (<http://www.naturalstandard.com>)
 E-pocrates (<http://www.epocrates.com>)
 ConsumerLab.com (<http://www.consumerlabs.com>)
 Fugh-Berman A. The five-minute herb & dietary supplement consult. Philadelphia: Lippincott Williams & Wilkins, 2003.
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Strength of Recommendation

<i>Key clinical recommendations</i>	<i>Label</i>	<i>References</i>
Ephedra is somewhat effective for weight loss, but is unsafe; therefore, use of this supplement should be discouraged.	A	8-11
Chitosan and guar gum are ineffective for weight loss, and their use should be discouraged.	A	22, 38-40
Patients should be cautioned regarding the use of chromium, ginseng, glucomannan, green tea, hydroxycitric acid, L-carnitine, psyllium, pyruvate, St. John's wort, and conjugated linoleic acid because the evidence regarding their efficacy and safety for weight loss is unclear.	B	14-16, 19, 20, 23-36

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