

NUTRI NEWS



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WEIGHT LOSS

This issue of NutrineWS is a update of our March 2000 edition on weight loss. Since the March 2000 edition, there has been some fascinating new research on weight management that we believe will be of special interest, especially at this time of year when most people are attempting to lose weight gained during the winter months. Since that issue, we've also introduced two additional supplements, Conjugated Linoleic Acid (CLA) and Nopal Cactus, which are new to the marketplace and offer unique and substantial weight reduction attributes.

For many people, losing body weight is crucial for improving self-esteem. Dieting has become a national preoccupation, with a seemingly never-ending series of videos, books, and newspaper articles about diets and exercise regimens. The food industry has fed the trend with an ever expanding array of low calorie and low fat entrees, nutritionally complete beverages, food bars, and snack products intended to help in the quest to lose weight and improve body image. Excess weight loss is important not just for cosmetic reasons, but is also important for reducing the

risk of numerous diseases, including type 2 diabetes mellitus, cardiovascular disease, gall bladder disease, high blood pressure, and osteoarthritis. Ironically, while this desire to lose weight is pervasive in today's culture, the number of overweight and obese individuals has increased by 25% over the last 30 years and continues to increase among both adults and adolescents. Indeed, currently over half of all U.S. adults are considered overweight, a characteristic of an affluent society marked by sedentary lifestyles and overconsumption of high-fat foods.

The degree to which a person is overweight is defined by the body mass index (BMI), which is calculated by dividing weight in kilograms (kg) by height in meters square, (kg/m²). BMI is highly correlated with body fat content. For example, a woman who weighs 160 lb. and is 5 feet, 6 inches tall has a BMI of 25.9. Both the World Health Organization and the National Heart, Lung, and Blood Institute consider a BMI of 25.0 – 29.9 to be overweight or pre-obese.

Excess weight is typically caused by increased energy consumption coupled with decreased energy expenditure. One way to correct this imbalance is to limit high caloric, high fat intake and/or to increase exercise. Dietary supplements can also help. For example, Chitosan, a natural product produced from the chitin of crab shells, inhibits the absorption of dietary fat.

Additionally, numerous dietary supplements may directly affect fat metabolism. A new addition to the arsenal of weight reduction supplements, Conjugated Linoleic Acid (CLA), is a mixture of fatty acids that has demonstrated the ability to increase metabolic rates and reduce body fat while maintaining muscle mass. Inhibition of lipid synthesis by (-) hydroxycitric acid (HCA) derived from *Garcinia cambogia*, may inhibit fat formation and deposition. Herbal products containing ephedra may increase energy expenditure by stimulating the basal metabolic rate via the sympathetic nervous system and supplemental chromium may increase lean body mass and decrease body fat.

Conjugated Linoleic Acid (CLA)

CLA is a mixture of fatty acids that are derivatives of linoleic acid, and is mainly found in meat and dairy foods, but can also be found





in certain oils including safflower oil. Its presence in human tissue comes not only from dietary sources, but also from in vivo oxidation of linoleic acid. Although CLA's activity as a potent metabolic modulator was first recognized in studies of its anticarcinogenic properties in fried hamburger, research of its metabolic activity has now expanded to include its ability to modulate lipid and energy metabolism, particularly control of body fat and muscle, as well as atherosclerosis.

Research in several animal models has demonstrated that CLA reduces body fat accumulation. Some studies have shown that

the reduction in body fat occurs regardless of whether the diet is high or low in fat. It appears that increased energy expenditure is responsible for the decreased fat accumulation. Researchers have observed an increase in fat oxidation, but not a decrease in fat biosynthesis.

Mice fed a high fat diet with 1% CLA exhibited a 50% reduction in weights of adipose depots, but no significant effects on body weight or energy intake. Energy expenditure persistently increased almost 8% through the trial period. This chronic increase in metabolic rate is thought to be responsible for the reduction in body fat stores. Uncoupling protein gene expression in the mice's brown fat may be partially responsible for this increased metabolic rate. CLA's antiobesity effects have also been suggested to involve an inhibition and/or apoptosis of (pre)adipocytes.

Recently, supplementation in humans has demonstrated that CLA has the ability to reduce body fat of overweight or obese individuals. A double-blind, randomized, placebo controlled study confirms that CLA can improve body composition by reducing body fat and preserving muscle tissue in overweight individuals.

Garcinia cambogia

Garcinia cambogia, also known as Malabar tamarind or Brindall berry, is a native fruit of South India. This orange-sized yellowish fruit is used not only in the preparation of Indian curries, but also in Ayurvedic medicine to treat obesity. *Garcinia cambogia's* high content (20 - 30% in the dried fruit and rind) of the organic acid (-) hydroxycitric acid (HCA) is thought to be responsible for its effect in promoting weight loss.

HCA is a competitive inhibitor of the extra mitochondrial enzyme adenosine triphosphate (ATP)-citrate lyase. Inhibition of this enzyme effectively limits the amount of precursor, acetyl coenzyme A, available for fatty acid and cholesterol synthesis in the body. A significant amount of the acetyl-CoA used in fat synthesis comes from mitochondrial oxidation of pyruvate that originates from dietary carbohydrates. However, before fat synthesis can proceed, the precursor acetyl CoA must pass out of the mitochondria into the cytosol where it can be synthesized into fat. Citrate is the carrier that transports the acetyl unit across the mitochondrial membrane into the cytosol where ATP-citrate lyase cleaves it, producing acetyl-CoA for fat synthesis. Thus, inhibition of the enzyme that cleaves citric acid in this shuttle between the mitochondrion and the cytosol should effectively limit fat synthesis.

Although Ayurvedic medicine has been aware for centuries of *Garcinia cambogia's* potential to combat obesity, Western science has only in the past thirty years recognized the anti-lipogenic properties of HCA, *Garcinia cambogia's* active ingredient. Animal studies in the 1970s tested the hypothesis that metabolic regulation by HCA of the pivotal lipogenic enzyme, citrate lyase, might be useful in treating lipid disorders. These early studies showed that oral administration of HCA markedly reduced lipogenic rates and circulating triglycerides in genetically obese rats. Hypertriglyceridemia and increased hepatic lipogenesis, induced by dietary fructose, were also significantly reduced by orally administered HCA.

In vitro rat studies in the 1980s reaffirmed hydroxycitrate's depressive effect on fatty acid synthesis from glucose and indicated the prime role the citrate cleavage pathway plays in the conversion of carbohydrate to fat. Cellular work in the 1990s tested HCA in a hepatoma line and found a strong inhibition of citrate carbon flux into fatty acids.

However, researchers studying HCA have found that although obese rats that were orally administered HCA reduced their food intake and body weight, their body fat percentages did not change. These studies suggest that combating obesity has to be waged on several fronts, and not just in a campaign of metabolic regulation of lipogenesis. The obese body seems to be well adapted to defending its composition.





Chitosan

Dietary chitosan, a glucosamine polymer derived from crab shells, has been shown to be not only an effective binder of dietary fat, but also a potent hypocholesterolemic agent. Thus, chitosan could be a potent player in a weight control program by reducing the absorption of dietary fat.

Rat studies undertaken twenty years ago demonstrated that the addition of 2 to 5% chitosan to a hypercholesterolemic diet significantly

reduced plasma cholesterol 20 to 30%, without affecting food intake. Although higher dietary levels of chitosan further reduced plasma cholesterol, they had a depressive effect on growth. The chitosan in this study evidently reduced plasma cholesterol by binding intestinal lipids and increasing fecal excretion of both endogenous and exogenous cholesterol. Later investigation showed that chitosan binds both bile acids and phospholipids, reducing their absorption from the intestines.

Dietary chitosan (5%) has been shown to not only significantly lower plasma cholesterol, sometimes to 64% of control values, but also to significantly reduce the development of aortic atherosclerotic plaques (~46%) in rats.

The strong positive charge of the chitosan molecule is responsible for its binding to negatively charged lipid molecules. Despite chitosan's effective intestinal lipid binding capacity and its ability to lower both plasma and liver cholesterol levels in rats on a 7.5% chitosan diet (by 54% and 64% respectively), adequate cholesterol homeostasis was maintained, affirming the nontoxic nature of chitosan.

Recent studies with larger and more continuous intakes of chitosan in rats have reaffirmed its ability to significantly reduce fat digestion and absorption, but have also shown a decrease in mineral absorption and bone mineral content. Although the rat diet was supplemented with sodium ascorbate to prevent such a problem, it still had to be supplemented with twice normal levels of calcium. Furthermore, serum vitamin E levels dropped markedly and rapidly, presumably a reflection of lowered absorption of the fat soluble tocopherols. Although absorption of bone minerals was decreased with massive amounts of chitosan, another study showed

that a 5% chitosan diet did not significantly change zinc absorption. Significant interference with mineral absorption seems to be an effect of only large dietary levels of chitosan.

Not only does chitosan reduce fat absorption, but it is also acts as an anticarcinogen. Incidence of chemically induced precancerous colonic tissue was significantly reduced in rats fed diets containing 2% chitosan.

A recent randomized, placebo-controlled, double blind, human study of 30 overweight subjects fed four capsules of chitosan daily did not show any significant differences between the chitosan and placebo groups for BMI, serum cholesterol, or triglycerides. This study suggests that in order for dietary chitosan, to be effective, it should be supplemented at levels more comparable to those used in the animal trials. Additionally, there should also be serious dietary alterations to reduce caloric intake.

Nopal Cactus

Nopal, also called the prickly pear, is a perennial cactus that grows in semi-tropical areas throughout the world. The leaves of the Nopal cactus have the unique ability to bind and trap fat and certain sugars consumed during a meal and prevent their absorption into the body. Reducing the amount of fat and sugar absorbed during a meal may play a key role in cholesterol metabolism as well as weight reduction. Chitosan, referred to earlier, exhibits a similar action, but is derived from shellfish. Nopal cactus offers vegetarians and those allergic to shellfish an effective alternative to chitosan.

Nopal cactus, traditionally used to control glycemia in diabetics, has been shown in scientific studies to effectively attenuate postprandial hyperglycemia. Studies comparing the glycemic and insulin indices of foods commonly eaten in Mexico show that Nopal cactus has the lowest indices of all. Nopal's therapeutic effectiveness may depend chiefly upon its content of gums and mucilages. These hydrophilic polysaccharide molecules may bind not only water as they increase in volume, but also sugars and fats as they are caught within the voluminous matrix of mucilage and water. Nopal consumption has also been demonstrated to reduce plasma low density lipoprotein (LDL) cholesterol levels.



Treatment of obese patients on a low 800 Kcal, hypoglycemic diet, with mucilage such as found in Nopal Cactus, resulted in a weight loss greater than that obtained with diet alone. Investigators of this particular study suggested that the mucilage treatment reduced plasma cholesterol by limiting intestinal absorption of bile acids.

Another way that nopal may effectively lower body weight is by reducing appetite. The increased volume in the stomach afforded by the swollen mucilage and water matrix of ingested nopal may more quickly produce a feeling of satiety and thus limit caloric intake.

Chromium

Chromium is an essential nutrient that plays an integral role in the regulation of carbohydrate and fat metabolism. Its participation in carbohydrate, lipid, and protein metabolism, particularly in affecting insulin activity, has generated prime interest in its ability to positively regulate levels of lean body mass, and to assist in weight reduction.

Chromium's involvement in regulation of lean body mass is especially important for someone embarking on a weight reduction regimen. Losing weight often leads to a loss of lean body mass and, subsequently, metabolic rate. The drop in metabolic rate increases the difficulty in losing weight, necessitating an increased effort in dieting. Maintenance or increase in lean body mass during weight reduction efforts would stimulate caloric utilization making it that much easier to lose weight.

Although several recent human studies have shown chromium supplementation of 200 to 400 mcg/d to improve body composition (i.e. increased lean body mass and decreased body fat) others have shown minimal or no effect. Despite these equivocal results, human studies showing chromium's positive effect on body composition are supported by several animal studies.

An important issue to consider in chromium's potential to positively regulate body composition is its low levels in the typical Western diet. Individuals with low dietary intakes of chromium that intend to begin a weight reduction program may benefit from chromium supplementation for its ability to normalize insulin metabolism and expedite fat loss while maintaining lean body mass.



Ephedra

Ephedra has been used for thousands of years in Chinese and Indian herbal therapies to treat conditions such as bronchial asthma and the nasal congestion associated with colds and allergies. Its active ingredients, the alkaloids ephedrine and pseudoephedrine, act not only as decongestants and bronchodilators, but also as central nervous system stimulants that increase the body's basal metabolic rate. Scientific animal studies have shown that as a sympathetic stimulant, ephedrine increases metabolic thermogenesis and reduces body fat. Its effectiveness also involves reduction of food intake. Human studies have demonstrated that ephedrine can promote weight loss in obese women. However, since ephedra's alkaloid ingredients are potent sympathomimetics, care should be taken as side effects may include increased blood pressure, increased heart rate, insomnia, and anxiety.

Don't Forget Exercise

It is becoming increasingly apparent that the decreased level of physical activity associated with our Western lifestyle is a very important determinant of the "obesity epidemic" sweeping through the world today. Exercise may work on two fronts to battle this encroaching epidemic. First, increased physical activity will result in more calories being burned. As lean body mass expands, induced by muscular contraction, there is a concomitant increase in the daily thermogenesis of the metabolic rate. Highly active individuals may have a reduced appetite, and find energy dense foods less appealing.

Putting It All Together

In conclusion, dietary supplements can be a valuable part of a weight reduction program that combines lowered caloric intake with increased activity. In the effort to reduce energy intake, the first step is to wisely choose a less energy dense diet. Supplementation with Conjugated Linoleic Acid can reduce body fat through the increase in metabolic rate without diminishing muscle tissue. Chitosan operates to reduce absorption of consumed fat, the most calorically dense food component. Nopal Cactus offers similar fat-trapping action in a non-animal vegetarian formula. *Garcinia cam-*



bogia can reduce the synthesis of new fat in the body, while ephedra may help to increase energy expenditure, by increasing metabolic rate as well as reducing appetite. Finally, chromium works to normalize carbohydrate, protein, and fat metabolism toward preferential loss of fat rather than muscle protein.

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