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Soy Protein

DESCRIPTION

In October 1999, the Food and Drug Administration (FDA) approved a labeling health claim for dietary soy protein stating that it may reduce the risk of heart disease. The health claim that can be used on labels of products containing soy protein states: "Diets low in saturated fat and cholesterol that include 25 grams of soy protein a day may reduce the risk of heart disease." In order to carry the health claim, one serving of a product must contain at least 6.25 grams of soy protein and must also be low in total and saturated fat, cholesterol and sodium.

The substantive evidence underpinning the approval of the health claim came from a meta-analysis by James W. Anderson and his University of Kentucky colleagues, published in August 1995 in the *New England Journal of Medicine*. The article reported that regular consumption of soy protein lowered total cholesterol by 9.3%, LDL-cholesterol by 12.9%, triglycerides by 10.5% and raised HDL-cholesterol by 2.5%. The average daily soy protein intake by those included in the meta-analysis was 47 grams. Interestingly, those whose soy protein intake was 25 grams daily—the amount approved in the health claim—demonstrated only a 5% decrease in their LDL-cholesterol levels. Subsequent meta-analyses and clinical studies of the effects of soy protein intake on serum lipids reported LDL-cholesterol decreases ranging from 3 to 5.3%. One study found a 3% lowering of LDL-cholesterol at a soy protein intake of 36 grams daily. A review of 22 randomized clinical trials by the American Heart Association Nutrition Committee and published in 2005 reported that those consuming 50 grams daily of soy protein showed no higher than a 3% decrease in LDL-cholesterol and concluded that they could not support the use of soy protein to lower cholesterol. The FDA is reconsidering the soy protein health claim.

Soy protein isolates have become popular items in the nutritional supplement marketplace. Most of these supplements also contain the soy isoflavones genistin, daidzin and glycitin. (See Soy Isoflavones, Genistein, Daidzein and Glycitein.)

ACTIONS AND PHARMACOLOGY

ACTIONS

Soy protein has putative lipid-lowering, antiatherogenic, antioxidant, anticarcinogenic and antiosteoporotic activities.

MECHANISM OF ACTION

Diets rich in soy protein have been found to reduce serum levels of total cholesterol, LDL-cholesterol, triglycerides and apolipoprotein B (apo B). The mechanism of the possible lipid-lowering activity of soy protein is unclear. There are a few possible explanations. Soy protein is much richer in L-arginine than is animal protein, which is richer in L-lysine. Some animal studies indicate that dietary increases in L-arginine are accompanied by decreases in cholesterol levels. Further, some studies have demonstrated that, under certain conditions, e.g., hypercholesterolemia, high intakes of L-arginine could enhance endothelial-dependent vasodilation and nitric oxide or NO production (see L-Arginine). This could contribute to the possible antiatherogenic activity of soy protein.

The soy isoflavones may also contribute to the possible lipid-lowering activity of soy protein as well as its possible antiatherogenic activity. Most soy protein products contain the isoflavones genistin, daidzin and glycitin, which have weak estrogenic effects and also may have antiestrogenic activity (see Soy Isoflavones). Oral estrogens have been shown to decrease total cholesterol and LDL-cholesterol. The soy isoflavones may have similar actions.

Interestingly, a few studies have shown that when the isoflavones are removed from the soy protein, the protein itself has little hypocholesterolemic activity. Soy isoflavones themselves do not have the same hypocholesterolemic activity as the combination of soy protein and soy isoflavones. There are probably synergistic effects of these substances that are not understood at this time.

There are also other substances associated with soy protein, including saponins, trypsin inhibitor and bioactive peptides,

which may also contribute to the lipid-lowering activity of soy protein. The soy isoflavones are antioxidants, and their antioxidant activity may contribute to the possible anti-atherogenic effect of soy protein. Recently, peptides in soybean protein hydrolysate produced by certain proteases have been reported to have hypocholesterolemic activity. Among the mechanisms suggested—blockage of bile acid and/or cholesterol absorption, inhibition of cholesterol synthesis and stimulation of low- density-lipoprotein receptor (LDL-R) transcription—the peptides appeared to stimulate LDL-R transcription. Stimulation of LDL-R transcription in the human liver cell line appeared to reduce serum cholesterol levels. Further research on the identity of the peptides and their mechanism of action is needed and warranted.

The possible antioxidant, anticarcinogenic and antiosteoporotic activities of soy protein are probably due, in large part, to the soy isoflavones (see Soy Isoflavones). Soy protein has been found to reduce intestinal mucosa polyamine levels in rats, which may be another anticarcinogenic mechanism. Also, a bioactive peptide has recently been isolated from soybeans and has been found to have potent antimitotic activity.

PHARMACOKINETICS

The digestion, absorption, distribution and metabolism of soy protein occur by normal physiological processes. See Soy Isoflavones, Genistein, Daidzein and Glycitein for the pharmacokinetics of these substances.

INDICATIONS AND USAGE

The FDA has allowed the following health claim for soy protein: "25 grams of soy protein a day, as part of a diet low in saturated fat and cholesterol, may reduce the risk of heart disease." The isoflavone constituents of soy protein may confer some additional benefits. The results of some recent reports, however, question the FDA-allowed health claim.

RESEARCH SUMMARY

The FDA-approved health claim—see Indications above—that soy protein, in adequate amounts, may help protect against heart disease is based upon numerous *in vitro*, animal, epidemiological and human studies. Evidence has accumulated over many decades showing that soy protein, but not animal protein, has significant cholesterol-lowering properties in animal studies. However, more recent results question some of the older evidence.

In a 1995 meta-analysis of clinical studies, most of them well-controlled, investigators concluded that soy protein significantly lowered serum concentrations of total cholesterol, LDL-cholesterol and triglycerides without significantly altering HDL-cholesterol concentrations.

Since the meta-analysis cited above was conducted, some, but not all, clinical research has continued to confirm the lipid-lowering ability of soy protein. One study demonstrated that administration for six weeks of as little as 20 grams of soy protein per day, in place of animal protein, achieved significant reductions of non-HDL-cholesterol and apolipoprotein (apo) B in moderately hypercholesterolemic men. However, the results of some more recent clinical studies and meta-analyses show much lower cholesterol-lowering activity of soy protein, and the FDA is reconsidering the allowed health claim for soy protein. However, even if the LDL-cholesterol-lowering activity of soy protein is much lower than what was originally thought, it may still be enough to confer some cardiovascular benefits. We know from prior studies that even a 1% reduction in LDL-cholesterol can result in a 2 to 4% percent reduced risk for heart disease and that could have enormous public health implications. Also, there may be other than LDL-cholesterol-lowering activities in soy protein that are also beneficial for cardiovascular health. Clearly, more high-quality clinical trials are needed and warranted to settle these important issues.

CONTRAINDICATIONS, PRECAUTIONS, ADVERSE REACTIONS

CONTRAINDICATIONS

Soy protein supplements are contraindicated in those who are hypersensitive to any component of a soy protein-containing product.

PRECAUTIONS

Pregnant women and nursing mothers should discuss the use of soy protein supplements with their physician before starting them.

Women with estrogen receptor-positive tumors should exercise caution in the use of soy protein supplements and should only use them if they are recommended and monitored by their physicians.

INTERACTIONS

NUTRITIONAL SUPPLEMENTS AND FOODS

Soy contains phytic acid, which may bind with certain minerals, such as calcium, magnesium, manganese, zinc, copper and iron, reducing their availability.

OVERDOSAGE

There are no reports of overdosage.

DOSAGE AND ADMINISTRATION

There are several soy protein supplements available. Typically the soy protein supplements contain soy isoflavones. Dosage is variable.

A total intake of 25 to 50 grams of soy protein and 50 milligrams of soy isoflavones daily may have cardiovascular

and other health benefits. This can come from nutritional intake, as well as supplemental intake.

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Spirulina

DESCRIPTION

In its commercial use, Spirulina refers mainly to the dried biomass of the cyanobacterium *Arthrospira platensis. Arthrospira platensis* (*Spirulina platensis*) is a genus of the phylum *Cyanobacteria. Cyanobacteria* are classified as either blue-green algae or as blue-green bacteria. Spirulina is a popular food supplement in Japan and is marketed as a nutritional supplement in the United States. Spirulina, wheat grass, barley grass and chlorella are sometimes referred to as "green foods." There are several cyanobacteria species; however, Spirulina usually refers to only two of them, *Arthrospira platensis* (*Spirulina platensis*) and *Arthrospira maxima* (*Spirulina maxima*). The term Spirulina is commonly used for both the dietary supplement and the genus *Arthrospira.*

Spirulina used for the production of nutritional supplements is either grown in outdoor tanks or harvested from lakes in such places as Mexico, Central and South America, and Africa.

Spirulina is a rich source of protein. It also contains chlorophyll, carotenoids, minerals, gamma-linolenic acid (GLA) and some unique pigments. The pigments give Spirulina its bluish tinge. Phycocyanin is a blue, light-harvesting pigment in cyanobacteria. It belongs to a group of light-harvesting proteins, called phycobiliproteins. All phycobiliproteins are multi-chain holoproteins, comprised of apoproteins with covalently bound phycobilins. Phycobilins are open-chain tetrapyrolle chromophores. The three common phycobiliproteins are phycoerythrin, with phycoerythrobilin chromophores, and phycocyanin and allophycocyanin, with phycocyanobilin chromophores. Phycocyanorubin, a reduced form of phycocyanobilin, is similar in structure to the bile pigment bilirubin.

ACTIONS AND PHARMACOLOGY

ACTIONS

Spirulina has putative antiviral, hypocholesterolemic, antioxidant, hepatoprotective, antiallergic and immune-modulatory activities.

MECHANISM OF ACTION

A sulfated polysaccharide called calcium spirulan isolated from *Arthrospira platensis* (*Spirulina platensis*) was found to inhibit a number of membraned viruses. The viruses inhibited by the polysaccharide included herpes simplex