

# The Bottom Line...Soy and Health

## INTRODUCTION

Portion controlled meals are committed to maximizing the health and wellness through its provision of soy-based meal replacement weight control programs. In light of recent controversy, including books, slanting soy, these portion controlled meal producers feel it's their duty to provide the latest evidence-based recommendations regarding the use of dietary soy for healthcare providers.

The following document provides a comprehensive summary of the latest scientific information regarding soy and its relationship with all-cause mortality, cardiovascular disease, metabolic syndrome, cancer, menopause, bone health, and kidney function, as well as addresses any safety concerns regarding soy.

**IMPORTANCE OF (SOY) PROTEIN DURING DIETING** These soy-based meal replacements are a healthy way of achieving the optimal amount of dietary protein crucial for weight loss while still preserving lean muscle mass. In addition to preserving calorie-burning lean muscle tissue, dietary protein stimulates thermogenesis to a greater degree (~20%) than do carbohydrates (6-8%) and fats (1-2%), and it also ranks as the most satiating macronutrient. Further, soy protein is a healthy alternative to animal-based proteins that tend to be high in fat and saturated fat. Finally, both human and animal studies have demonstrated a favorable effect of soy protein on body weight and fat distribution. In a 12-week study comparing soy protein meal replacements to milk-based protein meal replacements as part of a low energy diet, the soy MRs were associated with greater (although not statistically significantly) weight loss (Anderson & Hoie, 2005).

Yet, perhaps even more important is that soy protein has been shown to yield numerous health-related benefits for conditions that overweight individuals are more likely to suffer from. The health benefits soy has been shown to confer occur independent of the weight loss itself, and range from cardiovascular disease to cancer and to reductions in overall mortality.

## NOT ALL SOY PROTEIN IS CREATED EQUAL

Medifast's soy-based meal replacements are made from isolated soy protein (Solae Brand™), with its naturally-occurring isoflavones (genistein, daidzein, and glycitein) working together to yield health benefits, like lower blood cholesterol. An innovative water-based technique is used to separate carbohydrate and fat from the soy protein while still maintaining the healthy isoflavones. Other processing methods, like the alcohol-extraction method, remove a substantial amount of the isoflavones and thus its anti-atherogenic properties (Clair & Anthony, 2005).

As far as protein quality is concerned, soy protein is the only plant-based protein whose quality meets that of meat, milk, and eggs. Using the FDA-recommended method of qualifying a protein, ***Protein Efficiency Digestibility-Corrected Amino Acid Score (PDCAAS)***, Medifast's soy protein (Solae Brand™), has the highest obtainable score (1.0). In addition to high digestibility, it contains all essential amino acids, including methionine and arginine, when compared to the FAO/WHO reference range.

**BOTTOM LINE:** Medifast meal replacements are made from the highest quality soy protein with the highest levels of naturally-occurring isoflavones.

## HEALTH BENEFITS

### All-Cause Mortality

Japan has the highest life expectancy in the world (Health and Welfare Statistics Association, 1999). Soy is a staple in the Japanese diet. The Takayama Study prospectively examined the relationship between soy intake and mortality among over 13,000 Japanese men and 15,000 Japanese women residents over a 7 year period. Using a food frequency questionnaire, they determined that the average total intake of soy per day for men was 102.3g (44.6mg isoflavones) and for women 93.3g (41.4mg isoflavones).

#### FINDINGS:

- A significant inverse association between soy intake (and isoflavone intake) with all-cause mortality for men and women after controlling for age and total energy intake.
- After adjusting for nondietary factors, a decreased hazard ratio was observed among men (0.83, 95%CI 0.68 to 1.01) and women (0.83, 95%CI 0.68 to 1.02) with the highest compared with the lowest quintile of total soy product intake.

**BOTTOM LINE:** Soy is inversely associated with all-cause mortality.



### Cardiovascular Disease

Soy's isoflavones, genistein and diadzein, protect the heart by boosting the activity of LDL receptors that remove 'bad' cholesterol from the bloodstream and deliver it to the liver. Additional ways soy may protect the heart are through its antioxidant, anti-inflammatory, and potentially anti-thrombogenic properties (Clair & Anthony, 2005). Further, randomized controlled trials have also shown that soy decreases homocysteine levels in both men and women (generally post-menopausal) (Gehm et al., 1997; Kostelac, Rechkemmer, & Briviba, 2003).

**The Soy Health Claim** issued by the FDA in 1999 arose from 27 studies demonstrating soy protein's utility in lowering levels of total cholesterol and low-density lipoprotein (LDL, or "bad" cholesterol). To qualify for the claim foods must contain per serving:

- 6.25 grams of soy protein
- low fat (less than 3 grams)

- low saturated fat (less than 1 gram)
- low cholesterol (less than 20 milligrams)
- sodium value of less than 480 milligrams for individual foods, less than 720 milligrams if considered a main dish, and less than 960 milligrams if considered a meal.

### **Thirty-two of Medifast's meal replacements meet the criteria to carry this health claim.**

Seven years after soy's health claim was first issued by the FDA, tons more research has been done to substantiate the original claim. In 2006, Reynolds et al. performed a meta-analysis of 41 randomized controlled trials that evaluated the effect of soy protein supplementation, as the only intervention, on serum lipids. They found that soy protein supplementation was associated with:

- ♥ A significant decrease in mean **total cholesterol** of more than **5 mg/dl** (95% CI -7.14 to -3.38)
- ♥ A significant decrease in **low density lipoprotein (LDL) cholesterol** of more than **4 mg/dl** (95% CI -6.00 to -2.50)
- ♥ A significant decrease in **triglycerides** of more than **6 mg/dl** (95% CI -9.14 to -3.38)
- ♥ A significant increase in **high density lipoprotein (HDL) cholesterol** of **0.77 mg/dl** (95% CI 0.2 to 1.34).

While the results of other meta-analyses suggest that higher doses of soy protein are associated with greater LDL reduction among those with an elevated LDL at baseline (Balk et al., 2005), meta-regression analyses by Reynolds et al. (2006) showed a dose-response relationship between soy protein (and isoflavone) supplementation and net changes in serum lipids among adults with *or* without hypercholesterolemia.

**BOTTOM LINE: Soy protein protects against coronary risk factors and 32 of Medifast's meal replacements carry the Heart Healthy Claim.**

### **Metabolic Syndrome**

The metabolic syndrome is characterized by a clustering of cardiovascular risk factors, including abdominal obesity, dyslipidemia, increased blood pressure, insulin resistance, and a proinflammatory state (Borgman & McErlean, 2006). Metabolic syndrome is widespread among adults from developed nations and its prevalence continues to rise as rates of obesity do. While the etiology has yet to be fully elucidated, genetic, metabolic, and environmental factors, like diet, are thought to play a role.

Both animal and human studies have demonstrated that the inclusion of soy protein in the diet positively affects metabolic syndrome (Lukaczer et al., 2006; Davis et al., 2005; Azadbakht et al. 2007). Significant reductions in insulin, fasting plasma glucose, C-peptide have all been observed among postmenopausal women with metabolic syndrome on a diet incorporating 102 mg/d of soy isoflavones. Thus, it appears that soy foods

improve insulin sensitivity and modulate the metabolic abnormalities linked with insulin resistance (Jayagopal et al., 2002).

**BOTTOM LINE: Soy may improve the metabolic abnormalities of metabolic syndrome.**

## **Cancer**

After cardiovascular disease, cancer is the second leading cause of morbidity and mortality in the United States. Soy protein is associated with reduced risk of certain cancers. The evidence of a protective effect for soy is particularly strong in cancers of the prostate, breast, and gastro-intestinal (GI) tract.

### ***Prostate Cancer***

Lung cancer is the biggest cancer killer among men. However, *overweight* men who fall into the *heaviest* weight category are also more likely to die from stomach or prostate cancer according to the American Obesity Association. When compared to Asian men, American men are far more likely to die from prostate cancer and have a death rate that is 18-fold higher than their Eastern counterparts (Jemal et al., 2002). Soy, a dietary staple, may confer the protective effect among Eastern Asian men as Asian men who have emigrated to the US and have adopted the Western diet have higher rates of prostate-related morbidity and mortality.

The mechanism of action may be an anti-androgen substance found in soy, equol, that is formed during digestion when the soy isoflavone, daidzein, is metabolized. Equol inhibits the male hormone dihydrotestosterone (DHT) which normally stimulates prostatic growth. It has been shown that mice fed high doses of soy isoflavones have less prostate cell growth so may prevent prostate cancer. A 2005 meta-analysis of epidemiological studies by Yan & Spitznagel, evaluating the consumption of soy protein (non-fermented), showed that consuming soy protein was associated with a significantly lower risk of prostate cancer in men [Overall risk estimate 0.70 (95% CI=0.59-0.83,  $p<0.001$ )].

**BOTTOM LINE: Men who consume soy may have lower rates of prostate cancer.**

### ***Breast Cancer***

While heart disease is the biggest killer of American women, breast cancer is the most frequently diagnosed cancer. Breast cancer rates among women in Asian countries are substantially lower than rates among women in Western nations (Parkin, Muir, & Whelan, 1992). Specifically, the risk of acquiring breast cancer risk for Asian women is 39 per 100,000 (Fukuda et al., 2002), whereas the risk for Western women is 133 per 100,000 (Weir et al., 2003). Yet, when Asian women emigrate to the US, their rates of breast cancer increase substantially (Ziegler et al., 1993). Based on a meta-analysis, summarizing results from 18 epidemiologic studies, Trock, Hilakivi-Clarke, & Clarke (2006) concluded that a high dietary soy intake was associated with reduced breast cancer

risk (odds ratio=0.86, 95%CI 0.75 to 0.99). This association was stronger among premenopausal women than post-menopausal women, and when evaluated in terms of grams per day of soy, a significant reduction was found only among premenopausal (Trock, Hilakivi-Clarke, Clarke, 2006).

**Position of the National Cancer Institute (NCI):** There have been several studies that suggest dietary soy may reduce breast cancer risk and improve survival. The controversy, however, is over the use of soy, by breast cancer patients, especially those with estrogen receptor–positive tumors. The NCI reports the following:

- Research suggests soy's isoflavone's, genistein and daidzein, may act preventatively by binding to estrogen receptors and decreasing plasma estrogen levels.
- A review of the literature found no convincing data to support the claim that soy is either protective against breast cancer or harmful for women with a history of, or at high risk for, breast cancer.
- The Shanghai Breast Cancer Study, a follow-up study using data collected from a large cohort of breast cancer patients, concluded that soyfoods do not have an adverse effect on breast cancer survival.
- While the use of soyfoods, as part of a healthy diet and in moderate amounts, are safe to consume according to researchers, there is not enough evidence to recommend that breast cancer patients begin to consume soy specifically to prevent the reoccurrence of breast cancer.

**Also according to the NCI:**

- Animal studies have found that genistein inhibited the efficacy of tamoxifen, a drug used to block the body's circulating estrogen.

*However, a 2007 study of soy's genistein and tamoxifen on prevention of estrogen-dependent breast cancer in mice showed a synergistic effect, especially at lower doses of tamoxifen, in delaying the growth of tumor cells via apoptosis and inhibition of tumor cell proliferation. They concluded that combination tamoxifen and genistein be investigated further for prevention and/or treatment of estrogen-dependent breast cancer (Mai, Blackburn, & Zhou, 2007).*

**BOTTOM LINE: Soy appears to have a protective effect against premenopausal breast cancer. The verdict is still out among postmenopausal females, or females with a past personal history or family history of breast cancer. The verdict is also still out regarding the use of soy and Tamoxifen. Medifast recommends that patients follow the NCI guidelines and the advice of their physician or breast cancer specialist.**

### ***GI Cancers***

Five epidemiologic studies evaluating soy and stomach/esophageal/colorectal cancer showed that soy consumption is significantly associated with lower rates of stomach and esophageal cancers (Ji et al., 1998; Lee et al., 1995; Nagata et al., 2002; Ngoan et al., 2002; You et al., 1988). Further, soy consumption has also been associated with lower rates of *Helicobacter pylori* (H. Pylori), a risk factor for stomach cancer. A cross-sectional study by Shinchi et al. (1997) showed that cases of seropositive H. Pylori occurred less frequently among those who frequently ate soy products (tofu) than those who consumed soy products less often.

Numerous studies have also found a protective effect of soy against adenomatous polyps (Witte et al., 1996) and colon cancer (Hoshiyama et al., 1993; Nishi et al., 1997). Results of an intervention study showed that an intake of 39 g/d of soy protein for one year significantly reduced colon mucosa cell proliferation vs. 39g/d of casein protein in “at-risk” patients with colon polyps or colon cancer (Bennink, 2001).

**BOTTOM LINE: Soy appears to protect against cancers of the GI tract and may help eradicate H. Pylori infections.**

### **Menopausal Symptoms**

Approximately 2/3 of women who reach menopause develop vasomotor menopausal symptoms, primarily in the form of hot flashes and night sweats. Of 21 trials examining the effects of soy and/or its isoflavones effects on hot flashes and night sweats in post-menopausal women, every trial found a decrease in hot flash frequencies compared to controls (Balk et al., 2005). Additionally, soy protein helps protect against some other menopause-associated features. A review by Geller & Studee (2006) suggest that soy isoflavones have a small but positive effect on lipids, bone mass, and cognitive function. A randomized, double-blind, crossover, placebo-controlled trial found that post-menopausal women who received 60mg/day of soy isoflavones had improved cognitive performance and mood (Casini et al., 2006).

**BOTTOM LINE: Soy helps with vasomotor symptoms of menopause and positively affects other menopause-related health conditions.**

### **Bone Health**

Post-menopausal women may experience rapid declines in bone mineral density (BMD) due to estrogen deficiency. Despite inconsistent results among randomized controlled trials evaluating soy and bone health, the results of numerous studies suggest that the isoflavones in soy have positive effects on bone formation biomarkers (Arjmandi et al., 2005), markers of bone resorption (Horiuchi et al., 2000), and markers of bone loss (Alekel et al., 2000; Horiuchi et al., 2000). Soy isoflavone extract (54 mg genistein) has been shown to increase lumbar spine and femoral neck BMD after 1-year in postmenopausal women (Morabito et al., 2002). Soy milk with isoflavones has yielded small but significant increases in lumbar spine BMD in comparison to the soy milk

without isoflavones (Lydeking-Olsen et al., 2004). Additionally, evidence from in vitro and in vivo, human observational, and dietary intervention studies suggest that diets rich in phytoestrogens have bone-sparing effects in the long term (Setchell & Lydeking-Olsen, 2003).

There are few long-term RCTs and a wide range of interventions used across studies making it difficult to draw overall conclusions about the effects of soy on bone outcomes. In addition to study design issues, the inconsistent results may be partly due to studies evaluating women in their post-menopausal years who would be less likely to hypothetically benefit from phytoestrogens because of age-related declines in estrogen receptors on bone (Reinwald & Weaver, 2006). To reap the benefits of soy when it comes to bone health, it may be better to consume soy protein in the peri-menopausal or early post-menopausal years when the more mild estrogenic effects of soy might be less opposed by endogenous estrogen, and before the age-related decline in estrogen receptor number occurs (Reinwald & Weaver, 2006).

**BOTTOM LINE:** There is evidence to suggest that soy confers a protective effect on bone. The benefits of soy on bone health may be most garnered more during peri-menopause or early post-menopause

## **SAFETY**

### ***Thyroid Function***

One concern has been that soy protein adversely affects thyroid function and may interfere with the absorption of synthetic thyroid hormone. In a review of 14 clinical trials by Messina & Redmond (2006), in which the effects of soy on at least one measure of thyroid function was assessed, they found that with only one exception, either no effects or only very modest changes were noted. Thus, they concluded that there is little evidence in euthyroid, iodine-replete individuals, that soy foods adversely affect thyroid function.

In contrast, some evidence suggests that soy foods, by inhibiting absorption, may increase the dose of thyroid hormone required by hypothyroid patients. Further, in some individuals who consume *marginal amounts of iodine*, soy foods may, at least theoretically, increase the risk of developing clinical hypothyroidism.

**BOTTOM LINE:** Soy has no adverse effects in euthyroid individuals. Individuals with hypothyroidism on synthetic thyroid hormones do not need to avoid soy in their diets. They simply need to pay closer attention by monitoring their lab work more frequently. Everyone should make sure they have an adequate source of iodine in their diet.

### ***Reproductive Function***

There is no evidence in animal (Fagi et al., 2004; Cardoso & Bao, 2007) or human studies that the phyto-estrogens in soy adversely affect child or adult growth, development, reproduction, or sexual behavior (Merritt & Jenks, 2004). Long-term feeding of high phyto-estrogen containing soy protein formulas in early life does not

produce estrogen-like hormonal effects in children (Giampietro et al., 2004). Five studies in adults, before and after soy consumption, found no significant decrease in testosterone or follicle-stimulating hormone (FSH) levels among men and women, respectively (Balk et al., 2005). Twelve studies in pre-menopausal females found no significant effect on estradiol levels at the follicular phase (Balk et al., 2005).

**NOTE:** The NCI considers high testosterone levels a risk factor for prostate cancer. A beneficial effect of soy on risk for prostate cancer is expected to decrease testosterone levels. The decreases in testosterone found in the above studies, while not significant, may be enough to confer a protective effect against prostate cancer without affecting male sterility.

**BOTTOM LINE: Soy does not alter sexual function, behavior, or affect sterility.**

### ***Kidney Stones***

Some soy foods have a relatively high concentration of oxalate. This raises a concern for individuals with kidney stones of the calcium oxalate type. The oxalate content of the soy Medifast uses (Solae™) provides relatively small amounts of oxalate per serving. For example, a meal replacement containing 10g of protein would contain 0.9mg of oxalate. The American Dietetic Association (ADA) recommends limiting dietary oxalate intake to 10mg per day for individuals who are stone-formers. Consuming 5 meal replacements per day would still fall significantly beneath the ADA's cut-off value. Further, soy protein also contains phytates. Studies suggest that phytate is a potential inhibitor of calcium kidney stone formation because of its antioxidant activity and ability to inhibit crystal formation (Al-Wahsh et al., 2005). The average phytate in Medifast's soy protein is 1.4%.

**BOTTOM LINE: The amount of oxalate in 5 Medifast meal replacements, as part of the 5 & 1 diet plan, is well beneath the ADA's daily cut-off for calcium oxalate stone-formers.**

### **CONCLUDING REMARKS**

For most people, the benefits of incorporating soy protein as part of a healthy diet plan far outweigh the potential (or hypothetical) risks. This is particularly true for overweight or obese individuals, who are more likely to suffer from a comorbidity that would be responsive to soy. Medifast is a pioneer in recognizing the double benefit that can be potentially gained by offering the highest quality soy protein, rich in isoflavones, as part of their clinically-tested weight control program.

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