First International Symposium on the Role of Soy in Preventing and Treating Disease

Modern Applications for an Ancient Bean: Soybeans and the Prevention and Treatment of Chronic Disease[1]

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ABSTRACT Soybeans have played an integral part in Asian culture, both as a food and as a medicine, for many centuries. In the West, soybeans are best known for their protein content but increasingly, soyfoods are being recognized as having potential roles in the prevention and treatment of chronic diseases, most notably cancer and heart disease. There are also potential roles for soyfoods with respect to osteoporosis and kidney disease. Although more research is needed, the existing database on the health effects of soyfood intake is quite extensive and clearly warrants greater recognition by the research and clinical communities. Given the ease with which soyfoods can be incorporated into the diet, be it via the traditional soyfoods such as tofu and soymilk, or the more modern soy protein products, such as soy isolates, concentrates and flours, soyfoods may be able to have a significant beneficial impact on public health. J. Nutr. 125: 567S–569S, 1995.

INDEXING KEY WORDS:

• *isoflavones* • *soyfoods* • *cancer* • *heart disease* • *osteoporosis* • *kidney disease* • *protein* • *chronic disease* • *soybeans*

In China the word for soybean is *ta-tou*, which means "greater bean" (Simoons 1991). This is not surprising given the importance soybeans have played in Asian culture, both as a food and as a medicine. In the West, soybeans are still best known for their protein content. In comparison to most other legumes, soybeans are much higher in protein (~35% of energy). However, it is not only the amount of protein in soybeans that is notable, but also the amino acid pattern of soy protein. Despite recognition of soybeans as an excellent source of protein, the quality of soy protein has actually been undervalued until recently.

The conventional assay for evaluating protein quality, the protein efficiency ratio (PER), is based on the growth of laboratory rats. Growing rats not only have a much higher total protein requirement than do infants, but also a much higher need for certain amino acids than humans (Steinke 1979). In particular, the rat requirement for methionine is ~50% higher (Sarwar et al. 1985); consequently, the value of soy protein has been undervalued because the limiting amino acid in soy protein is methionine.

In recognition of the inadequacy of the PER and the expense and time required to conduct these tests, both the World Health Organization and the United States Food and Drug Administration adopted the protein digestibility corrected amino acid score (PDCAAS) as the official assay for evaluating protein quality. The PDCAAS represents the amino acid score (using amino acid requirements for 2–5-year-old children) after correcting for digestibility. Proteins that, after correcting for digestibility, provide amino acids equal to or in excess of requirements, receive a PDCAAS of 1.0. Soy protein has a PDCAAS of 1.0, indicating it is able to meet the protein needs of adults when consumed as the sole source of protein at the recommended level of protein intake (0.6 g/kg body wt) (Young 1991).

It is somewhat ironic that as the high quality of soy protein gains greater recognition, nutritional emphasis on meeting protein requirements has diminished. During the 1950s, considerable effort was expended toward eliminating what was referred to as the world protein gap. By the 1970s, however, it was recognized that the world protein gap was not so much a protein gap, but rather a food gap. This undue emphasis on protein was partially a result of an inflated estimate

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of protein requirements, particularly for infants. From 1948 to 1974, estimates of infant protein requirements decreased by two-thirds (Carpenter 1986). There was also an unwarranted emphasis on the need for animal foods to meet protein requirements. As long ago as 1946, however, Hegsted correctly stated that as long as caloric needs are adequately met, it is difficult not to also meet protein requirements; this is particularly true for adults (Hegsted et al. 1946).

This is not to say that the protein fraction of soybeans is unimportant; it is, not only for meeting amino acid and nitrogen requirements, but also for other reasons. Soy protein is very efficiently produced; approximately 25, 10 and 5 times more protein is produced when an acre of land is devoted to growing soybeans as compared with beef, milk and wheat production, respectively (Christiansen 1948). Although this is not a nutritional issue per se, it is nonetheless noteworthy, because there are increasing concerns about the efficient use of land and water resources. The soybean also represents an inexpensive source of high-quality protein, which may be particularly important for developing countries.

From a nutritional perspective, soy protein may hold many advantages over animal proteins above and beyond the fact that soybeans are low in saturated fat and, of course, cholesterol-free. Of utmost importance is the hypocholesterolemic effect of soy protein as discussed by several authors in this volume. As little as 25 g of soy protein is all that is needed to lower cholesterol in hypercholesterolemic subjects (Bakhit et al. 1994), thus soy protein represents a safe, viable and practical nonpharmacologic approach to lowering cholesterol.

Soy protein may also help to promote bone health. Factors affecting urinary calcium excretion play critical roles in determining calcium balance and bone mineral density. The hypercalciuric effect of protein has been proposed as one factor contributing to the high rates of osteoporosis in Western countries (Abelow et al. 1992), where protein intake greatly exceeds requirements. Studies indicate, however, that not all proteins are similar in this respect, and that in comparison with animal proteins, soy protein causes much less calcium to be excreted in the urine (Breslau et al. 1988). This is likely a result of the somewhat lower sulfur amino acid content of soy protein. Parenthetically, the isoflavones in soybeans may also directly inhibit bone resorption (Brandi 1992; Anderson et al. 1995); thus soybeans may work in several important ways to aid in bone health.

Soy protein may also have a role in the prevention and treatment of kidney disease, because soy protein, in comparison with some animal proteins, has been found not to adversely affect kidney function (Kontessis et al. 1990). For this reason, Kontessis et al. suggested that kidney disease patients would benefit as much by substituting soy protein for animal protein as by restricting overall protein intake. Furthermore, the hypocholesterolemic effects of soy protein may be of particular benefit to patients with chronic renal insufficiency, because elevated levels of cholesterol can exacerbate disease progression (Groñe et al. 1994). The oxidation of low-density lipoprotein (LDL) cholesterol may play a critical role in this regard; consequently, the suppression of LDL-cholesterol oxidation by soy protein may be still another benefit of soy protein not only to kidney disease patients, but also to the general public (Kanazawa 1994).

Research on the potential health benefits of soyfoods is particularly intriguing with respect to cancer prevention and treatment. As discussed in this volume and elsewhere, epidemiologic data suggest the consumption of as little as one serving of soyfoods (i.e., one cup soymilk, ½ cup tofu) per day lowers risk for a wide range of cancers (Messina et al. 1994). Although certainly speculative, this is the area where soyfoods may have their greatest impact on public health. If the hypothesized anticancer effects are due to the isoflavones, this places particular emphasis on soy, because the isoflavones have a very limited distribution in nature.

When one considers the many nutritional attributes of soyfoods, from the very basic (high-quality protein, lactose free and cholesterol free, good source of omega-3 fatty acids) to the most exciting (the prevention and or treatment of heart disease and cancer), it is clear that the nutrition community should welcome the incorporation of soyfoods into the American diet. Fortunately, the multitude of food products made from soybeans, from the traditional Eastern ones, such as tofu and soymilk, to the more modern ones, such as soy hot dogs and burgers, makes increasing soyfood consumption an achievable goal.

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