



## RD Resources for Professionals:

# Safety of Soyfoods

Many vegetarians value soy products for their nutrient content, taste and versatility. However, as soyfoods become more common in Western diets, concerns have been raised regarding the effects of soy isoflavones on health and about soy intake on nutrient status.

## Concerns Related to Soy Isoflavones

Soybeans are the only commonly consumed food that provides nutritionally relevant amounts of isoflavones. These are naturally occurring compounds which are classified as phytoestrogens because they bind to and activate estrogen receptors (ER). However, unlike the hormone estrogen, isoflavones preferentially bind to and activate ER- $\beta$  in comparison to ER- $\alpha$ , and for this reason, are classified as selective estrogen receptor modulators (SERMS).<sup>1</sup> SERMs have estrogenic effects in some tissues but anti-estrogen effects, or no effects, in others. For this reason, conclusions about the health effects of isoflavones cannot be made on the basis of how estrogen behaves in the body.

## Feminization in Men

In two case studies, each involving one man, soy intake was linked with feminizing effects.<sup>2,3</sup> However, estimates indicate that these men consumed as many as 14 to 20 servings of soyfoods per day. In contrast, evidence from randomized controlled studies indicates that neither isoflavones nor soyfoods decrease testosterone levels<sup>4</sup> or increase estrogen levels.<sup>5</sup> These include studies in which men consumed the isoflavone equivalent of up to six servings of soyfoods per day. Clinical studies also show isoflavone consumption does not affect sperm concentration, count or motility.<sup>6,7</sup>

## Breast Cancer

Hormone therapy has been shown to increase postmenopausal breast cancer risk and markers of breast cancer risk, such as breast cancer proliferation, breast tissue density and circulating estrogen levels. Neither soy nor isoflavones exert any of these effects.<sup>8</sup> Furthermore, in prospective epidemiologic studies, soyfood intake is associated with the improved prognosis of breast cancer patients, including reductions in risk of death and disease recurrence.<sup>9,10</sup> These studies have been conducted in both China and the United States. The totality of the clinical and epidemiologic evidence indicates that traditional soyfoods can be safely consumed by women with breast cancer.

## Thyroid function

Some in vitro and animal data suggest that isoflavones can adversely affect the thyroid.<sup>11</sup> Use of early formulations of soy infant formula were linked to cases of goiter. However this issue has not been a concern since commercial formulas were reformulated and fortified with iodine.<sup>11</sup>

Among healthy adults, clinical studies clearly show that soy consumption has no effect on thyroid function even though intakes in many of these studies were much higher than typical Asian intake.<sup>11</sup> In one three-year study, including instances where very sensitive measures of thyroid function were evaluated, isoflavones had no harmful effects.<sup>12</sup> However, in a pilot study of people with subclinical hypothyroidism, thyroid function worsened in 10 percent of the subjects in response to an isoflavone-containing soy protein.<sup>13</sup> It is notable that in the patients overall, there were marked improvements in risk factors for diabetes and cardiovascular disease. Nevertheless, those with

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subclinical hypothyroidism should be monitored if soyfoods are added to their diet or intake is increased. People who take synthetic thyroid hormone can safely consume soyfoods as long as intake is consistent on a daily basis. Changes in soy intake could require minor adjustments in medication dose.

### Cognitive Function

In the Honolulu Heart Study, tofu consumption was associated with impaired cognitive function in Japanese men and their spouses.<sup>14</sup> The study had several important limitations, however, including the small number of foods assessed and the inconsistent methodology used in quantifying tofu intake. In a cross-sectional study of older people in Indonesia, high tofu consumption was linked to poorer memory, whereas tempeh consumption was associated with better memory.<sup>15</sup> However, a follow up study did not find any problems associated with tofu consumption<sup>16</sup>, nor did a study of nearly 4,000 older men and women in Hong Kong.<sup>17</sup>

From the eight clinical trials that assessed cognition, results generally showed beneficial effects.<sup>18</sup> At the present time, the totality of the evidence does not support either a benefit or risk of soy intake on cognitive function.

### Growth and Development

Isoflavones consumed by pregnant women are transferred to the fetus. However, among Asian women, levels of isoflavones in the amniotic fluid are very low compared to the concentrations of estrogen that normally occur in pregnancy, suggesting that isoflavones would be unlikely to place an additional estrogenic burden of any significance on the developing fetus.<sup>19-22</sup>

A British study did find that soy consumption during pregnancy was linked with an increased risk of hypospadias, a birth defect of the penis.<sup>23</sup> Although isoflavones were thought to be responsible for this association, non-soybean legume consumption was associated with an even higher risk of hypospadias even though these foods contain only negligible amounts of isoflavones. Furthermore, in contrast to this study, a Dutch study found that soy intake during pregnancy was unrelated to risk of hypospadias.<sup>24</sup> Therefore, the limited available evidence has not established a link between soy intake and hypospadias.

While some data link high animal protein intake to early puberty, there is little research on the effects of soy or phytoestrogens on early development and puberty. Two intervention studies, one in teenage boys,<sup>25</sup> and the other in young children,<sup>26</sup> failed to find any hormone-related effects in response to isoflavone supplements or soyfoods. Additionally, although early puberty may be linked to increased breast cancer risk, extensive data suggest that soy intake in childhood and adolescence is associated with lower breast cancer risk later in life.<sup>27</sup>



### Concerns Regarding Nutrient Availability

Soybeans are high in phytate and oxalate, compounds that inhibit mineral absorption. In older studies, iron absorption from soyfoods was found to be poor, but improved methodology suggests that absorption from iron is much higher than previously believed.<sup>28,29</sup> Most of the iron in soy is in the form of ferritin which has been shown to be highly available in clinical studies. One recently conducted study, designed specifically to assess the effect of soyfoods on mineral status, found no differences in serum hemoglobin or iron or in transferrin saturation among premenopausal women consuming either animal products or two to three servings of soyfoods daily.<sup>30</sup>

In contrast to other foods with high oxalate content, calcium absorption from soyfoods is generally favorable. Calcium absorption from soymilk is similar to that of cow's milk when calcium carbonate is used and about 25% lower when tricalcium phosphate is used.<sup>31</sup> Absorption from tofu processed with calcium sulfate is also similar to that of cow's milk.<sup>32</sup>

Soybeans contain protease inhibitors, which can inhibit the action of enzymes required for protein digestion. While fermentation can reduce the protease inhibitor content of soybeans, which theoretically improves their digestion, extensive research shows that the digestibility of unfermented soy products, such as isolated soy protein and tofu, is excellent and comparable to the digestion of animal protein.<sup>33</sup>

## Intake Recommendations

Asian soy consumption can serve as one guide for Western soy intake recommendations. Information about soy intake in Asia comes from a number of different resources including epidemiologic studies designed to examine the effects of diet on health, Japan's National Nutrition Survey and the Food and Agriculture Organization (FAO) of the United Nations. The results show a fairly wide range of intake among different Asian countries and even within populations. While average Japanese intake is about 1 ½ servings per day, surveys reveal that the upper range among older Japanese—who would be expected to eat a more traditional diet—is about two to three servings of soyfoods per day. A serving is considered ½ cup tofu or tempeh or one cup of soymilk.<sup>34</sup>

Extensive data from Shanghai, where large epidemiologic studies of health habits include dietary data from close to 100,000 adult men and women,

show average intake to be a bit higher than in Japan. But the range of intake is considerable and a large number of the adults in these studies—as many as 15 to 20 percent of the men and 10 percent of the women—consumed two to three servings of soyfoods per day.<sup>35,36</sup>

In Japan, about half of soy consumption comes from the fermented foods miso and natto and half comes from tofu and dried soybeans. In Shanghai, most of the soyfoods consumed are unfermented, with tofu and soymilk being the biggest contributors. Even in Indonesia, where the fermented product tempeh is an important part of cultural diets, unfermented soy products like tofu account for approximately half of soy intake.

Soyfoods have been consumed in China for at least 1,500 years and in Japan for 1,000 years. The evidence shows that soyfoods—both unfermented and fermented—continue to be a significant part of traditional Asian diets. Based on the diets of Asians, Western vegetarians can safely consume as many as three servings of soyfoods per day within the context of a varied diet.

## References

References for this resource are available at <http://vndpg.org/resources/safety-of-soyfoods>

