Legumes and soya beans: Overview of their nutritional profiles and health effects

By Dr Mark Messina

Legumes play an important role in the traditional diets of many regions throughout the world. However, beans tend to play only a minor dietary role in Western countries, even though they are low in fat and are considered excellent sources of protein, dietary fibre, and a variety of micronutrients and phytochemicals. Soya beans are unique among the legumes because they are a concentrated source of isoflavones, a group of phytochemicals.

Isoflavones have weak oestrogenic properties and the isoflavone genistein influences signal transduction. Soya food and isoflavones have received considerable attention for their potential role in preventing and treating cancer and osteoporosis. The low breast cancer mortality rates in Asian countries and the putative anti-oestrogenic effects of isoflavones have fuelled speculation that soya food intake reduces breast cancer risk. The available epidemiological data is limited and does not make a compelling case for this hypothesis, particularly for postmenopausal breast cancer.

The data suggesting that soya or isoflavones may reduce the risk of prostate cancer is more encouraging. The weak oestrogenic effects of isoflavones and the similarity in chemical structure between soya bean isoflavones and the synthetic isoflavone ipriflavone, which was shown to increase bone mineral density in postmenopausal women, suggest that soya or isoflavones may reduce the risk of osteoporosis. Rodent studies tend to support this hypothesis, as do the limited preliminary data from studies on humans.

Legume consumption

Legumes include peas, beans, lentils, peanuts, and other pod-bearing plants that are used as food. Legumes have been cultivated for thousands of years and have played an important role in the traditional diets of many regions throughout the world. It is difficult to imagine the cuisines of Asia, India, South America, the Middle East, and Mexico without soya beans, lentils, black beans, chickpeas, and pinto beans, respectively.

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In contrast, beans play a less significant dietary role in many Western countries. In fact, bean intake has declined during the past century in many European countries and the United States (US). Beans have been labelled the 'poor man's meat', which stands in stark contrast to the rich nutritional value they offer.

Given the important role of beans in populations that consume plant-based diets, it is not surprising that legume intake is higher in vegetarians than in non-vegetarians, although the data is limited. Certainly, one would expect the consumption of beans to increase with the elimination of meat and eggs from the diet of lactovegetarians and vegans. Beans have long been recognised for their protein content and have more recently been lauded for their soluble fibre content. However, there has been little research and discussion about the nutritional attributes of legumes.

The glaring exception to this is the soya bean, which has been investigated intensively over the past five to ten years. This is largely because soya beans are a unique dietary source of isoflavones. These phytochemicals are thought to exert a myriad of biological effects, and it has been hypothesised that they reduce the risk of several chronic diseases.

Nutritional content

The nutritional profile of beans shows that they have much to offer. They are high in protein, low in saturated fat, and high in complex carbohydrates and fibre. Beans are also a good source of several micronutrients and phytochemicals. Soya beans are unique among the legumes because they are a concentrated source of isoflavones.

Protein

The protein content of beans is generally between 20 and 30%. A serving of beans (90g or 1/2 cup cooked beans) provides 7 to 8g protein or 15% of the recommended dietary allowance (RDA) for protein for an adult of 70kg. Even though legumes are recognised as being high in protein, the quality of bean protein is often underestimated.

This is because the protein-efficiency ratio, which is based on the growth of laboratory animals (most commonly rats), was the standard method of evaluating protein quality until recently. Rats have a methionine requirement that is 50% higher than that of humans. Consequently, because bean proteins are low in sulphur amino acids, the protein-efficiency ratios of beans are quite low.

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Fat

Most beans are low in fat, generally containing ≈5% energy as fat. The primary exceptions are chickpeas and soya beans, which contain 15% and 47% fat, respectively. The predominant fatty acid in beans is linoleic acid, although beans also contain the n–3 fatty acid, α-linolenic acid. However, because the overall fat content of most beans is so low, the dietary contribution of beans to α-linolenic acid intake is generally minor.

As noted, soya beans are quite high in fat, and the consumption of full-fat soya food contributes significantly to α-linolenic acid intake.

Micronutrients

Beans are an excellent source of folate, which, in addition to being an essential nutrient, is thought to reduce the risk of neural tube defects. One serving of beans provides more than half of the current RDA for folate.

Beans are also high in iron. One serving provides ≈2mg. This compares favourably with the iron RDAs of 10 and 15mg for adult men and premenopausal women, respectively. However, iron bioavailability from legumes is poor, and thus their value as a source of iron is diminished. In acute studies, the addition of vitamin C to food markedly increased non-heme iron absorption.

Fibre and the glycaemic index

Beans are an excellent source of dietary fibre. One serving provides 2 to 4g of soluble and insoluble fibre. High-fibre, high-bean diets were shown to lower serum cholesterol in hypercholesterolemic individuals. In addition, beans have a very low glycaemic index (GI). This has been attributed to many factors, including their fibre, tannin, and phytic acid contents.

Findings from a prospective study showed that women who consumed high-GI diets were 40% more likely to develop diabetes than those consuming low-GI diets, even after controlling for several diabetes risk factors. Thus, beans may be a particularly important food for individuals with diabetes and those with an elevated risk of developing diabetes.

Soya bean isoflavones

Isoflavones are a subclass of the more ubiquitous flavonoids. The basic structural feature of flavonoid compounds is the flavone nucleus, which is composed of two benzene rings (A and B) linked through a heterocyclic pyran C-ring. The position of the benzenoid B-ring is the basis for dividing the flavonoid class into flavonoids (2-position) and isoflavonoids (3-position).

The primary isoflavones in soya beans are genistein (4′,5,7-trihydroxyisoflavone) and daidzein (4′,7-dihydroxyisoflavone) and their respective β-glycosides, genistin and daidzin (sugars are attached at the 7-position of the A-ring). Much lower amounts of glycitein (7,4′-dihydroxy-6-methoxyisoflavone) and its glycoside, glycitin, are present in soya beans. In non-fermented soya food, the isoflavones appear mostly as the conjugate, whereas in fermented soya products such as miso, the aglycones dominate.

Research potential

It has been hypothesised that isoflavones reduce the risk of cancer, heart disease and osteoporosis, and help relieve menopausal symptoms. Even though there is much to learn about the effects of isoflavones on chronic disease risk, this area of research holds considerable potential. Given the nutrient profile and phytochemical contribution of legumes, nutritionists should make a concerted effort to encourage the public to consume more beans and soya food.

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