



Soya Food: An Important Part of Healthy Eating Guidelines

Dispelling Myths and Putting the Science into Context

by Prof. Mark Messina, Adjunct Associate Professor
at Loma Linda University

Summary

- Soya foods are excellent sources of high-quality protein and polyunsaturated fat.
- The nutritional profile of soya foods fits well with the UK Eatwell Guide, which recommends an increase in plant-based food sources of protein, reductions in saturated fat and higher intakes of fibre.
- Consumption of soya foods as part of a healthy diet and lifestyle has been proven to support heart health.
- Soya is the main dietary source of isoflavones, which are naturally occurring phytoestrogens.
- The American Institute of Cancer Research, the American Cancer Society and the World Cancer Research Fund International agree that soya foods can form part of a healthy balanced diet for those at risk of or survivors of breast cancer.
- The European Food Safety Authority concluded that isoflavones do not adversely affect breast tissue in postmenopausal women.
- Concerns about the untoward effects of isoflavones are based primarily on results from rodent studies, which have limited applicability to humans. Human research, including both observational and clinical studies, supports the safety of isoflavones.

Introduction

Soya foods have been part of traditional Asian diets for many centuries and, over the past two decades, the popularity of these foods has greatly increased in the UK and other countries in Europe. This increased popularity can be attributed to the wide variety of appealing soya products that have become commercially available and consumer awareness of research indicating soya foods have a number of health benefits. However, in recent years, some confusion has arisen about the healthfulness of soya. Much of this confusion can be attributed to the results of rodent studies, which have limited value for understanding soya due to differences in physiology between rodents and humans and in how isoflavones are metabolised between them.^{1,7} Isoflavones are bioactives found in uniquely rich amounts in soya beans which account for much of the research interest in soya.

This fact sheet summarises the current understanding of the impact of soya food consumption on health by focusing on the totality of the evidence from clinical and epidemiological studies.



For health professional
use only

Soya Foods in the Diet

In Asia, both unfermented (e.g. soya drinks, tofu and edamame) and fermented (e.g. tempeh and miso) soya foods are consumed, although there are striking differences in the types of soya foods consumed among countries.

For example, in China,⁸ Singapore⁹ and Hong Kong,¹⁰ nearly all of the soya consumed is in unfermented form whereas in Japan, about half of soya intake comes in the form of fermented foods.^{11,12} In the UK and Europe, unfermented soya foods, such as soya alternatives to milk and yogurt and soya mince, dominate the market.

More Plant-based Eating

There is a growing consensus among experts that Western populations should adopt a more plant-based dietary pattern for health and environmental reasons.¹³⁻¹⁹ Their versatility and nutritional attributes make soya foods obvious choices for plant-based diets.

Nutritional Profile of Soya

Soya beans (*Glycine max*) have a very different macronutrient composition from other commonly-consumed legumes such as lentils and kidney beans. They are higher in protein and fat and much lower in carbohydrate.^{20,21} In addition, as already noted, they are uniquely rich sources of isoflavones, a group of naturally-occurring plant chemicals.²² Isoflavones have been intensely investigated over the past three decades, as evidenced by more than 20,000 peer-reviewed publications focused on these soya bean constituents.

Soya foods are excellent sources of protein and polyunsaturated fat, and many are good sources of fibre.^{21,23}

Protein: The quality of soya protein is similar to that of meat and dairy protein and higher than that of nearly all plant proteins.^{24,25} The high quality of soya protein is not surprising because both the digestibility of soya protein (~95%) and its amino acid profile are excellent. Thus, when consumed at the amounts recommended for total dietary protein intake, soya protein will provide all of the required essential amino acids.

Fat: The soya bean is high in polyunsaturated fat and low in saturated fat, and is one of the few good sources of both essential fatty acids.²⁶ The predominant fatty acid in soya oil is the essential omega-6 fatty acid, linoleic acid (~53%), but it also contains significant amounts of the omega-3 essential fatty acid, alpha-linolenic acid (~6%).

Fibre: Many soya foods are good sources of fibre, including soya mince, dried and fresh soya beans, edamame, and soya nuts. For example: 100g soya mince provides 3.0g - 5.8g (10-19% of UK fibre recommendations) and 100g cooked soya beans provide 8.1g fibre (27% UK fibre recommendations).^{21,27}

Minerals and vitamins: The soya bean is notable for being a source of vitamins B6, folate, biotin and K, and the minerals iron, phosphorus, magnesium, copper, potassium and manganese.²¹ Nutrient content will vary somewhat according to how each of the different soya foods is processed.

Soya Alternatives to Dairy

Soya alternatives to milk and yogurt, which are now readily available, provide high-quality protein and, in the main, are fortified with calcium and vitamins B2, B12 and D.

Additionally, the leading soya drink on the market is now also fortified with iodine (22.5µg per 100ml).

Understanding Soya Isoflavones

The three isoflavones in soya: genistein, daidzein and glycitein, and their glycosides represent approximately 50%, 40% and 10% of total isoflavone content, respectively.²⁸

Isoflavones have structural similarities to the hormone oestrogen (17β-oestradiol). Although classified as phytoestrogens, they behave differently to oestrogen in the body.

In addition to being phytoestrogens, isoflavones are classified as natural selective oestrogen receptor modulators (SERMs).²⁹ SERMs exert oestrogenic effects in some tissues, anti-oestrogenic effects in others and no effect at all in some tissues affected by oestrogen.

- SERMs developed by the pharmaceutical industry, such as tamoxifen and raloxifene, are designed to have some of the benefits of oestrogen without the adverse side effects.

At the molecular level, isoflavones differ from oestrogen because of the two known oestrogen receptors (ER), ERα and ERβ.

Isoflavones preferentially bind to and activate ERβ in comparison with ERα.³⁰⁻³³ In contrast, the hormone oestrogen has equal affinity for both receptors.

- This difference in binding is important because, when activated, these two receptors can have different and sometimes opposite physiological effects. In general, activation of ERα has a proliferative effect in tissues, whereas activation of ERβ is anti-proliferative.³⁴

Much of the concern about isoflavones can be attributed to the results of rodent studies. Rodent studies are of questionable utility for providing insight into human nutrition due to the significant physiological differences between the two species. Rodent studies are especially of limited value for evaluating isoflavones, because rodents metabolise isoflavones very differently to humans.¹⁻⁷

Soya's Health Credentials

Asian soya food-consuming populations tend to have relatively low incidence rates of chronic diseases that plague Western countries, such as coronary heart disease^{36,37} and breast and prostate cancer.³⁸ In addition, research shows that Asian individuals who regularly consume soya tend to have lower rates of these diseases than infrequent soya consumers.^{39,40}

Heart Health

Coronary heart disease (CHD) remains one of the UK's biggest killers: 2.3 million individuals are currently living with the disease and 180 lives are lost daily to CHD.⁴¹

A major modifiable CHD risk factor is elevated low density lipoprotein cholesterol (LDL-C). Currently, over 50% of the UK population are living with elevated serum cholesterol levels.⁴² It is well-established that replacing saturated fat with polyunsaturated fat is key to lowering LDL-C⁴³⁻⁴⁵ and risk of CHD.^{46,47}

“...to reduce CHD risk, saturated fats should be replaced with unsaturated fat, and polyunsaturated fat especially.”



Saturated fat

Reducing saturated fat (SFA) intake has been a key dietary recommendation for reducing risk of CHD for more than three decades. Nevertheless, in recent years, controversy has arisen over the value of this recommendation, with some claiming lowering SFA intake doesn't reduce CHD risk.^{48,49} The American Heart Association (AHA) recently addressed this controversy in the form of a Presidential Advisory. After comprehensively reviewing the data, the AHA did indeed conclude that SFA intake should be reduced.⁴⁵ However, the AHA also emphasised that to reduce CHD risk, SFA should be replaced with unsaturated fat, and polyunsaturated fat especially. This is also in line with the 2016 World Health Organization's⁵⁰ and the 2018 Scientific Advisory Committee on Nutrition's review of the evidence.⁴³ Replacing SFA with refined carbohydrate, as many Westerners have done in an attempt to lower their total SFA intake, doesn't lower CHD risk. Population studies failing to show that lower SFA intake is associated with a lower CHD risk have failed to consider the impact of the macronutrient that replaces SFA.^{51,52} One relatively easy way to lower SFA intake is to replace animal foods with plant foods, such as soya foods. The fatty acid profile of plant-based dietary patterns more closely matches dietary fat intake recommendations than typical Western dietary patterns do.

“Population studies failing to show that lower saturated fatty acids intake is associated with lower CHD risk have failed to consider the impact of the macronutrient that replaces it.”

Food	Average serving size (g/ml)	Soya protein per serving (g)
Soya alternatives to dairy fortified with calcium and vitamins B2, B12 and D		
Soya alternative to milk*	250	7.3
High protein plant-based alternatives to strained yogurt: plain, strawberry-raspberry, mango, passion fruit and blackcurrant**	150	7.5-9.3
Soya alternatives to yogurt: plain, vanilla and fruit varieties**	125	4.5-5.0
Soya beans		
Fresh or frozen young soya (edamame) beans***	80	9.3
Soya nuts (roasted edamame beans)	28	15.0
Dried soya beans, boiled and drained	85	14.0
Soya meat alternatives		
Soya mince/chunks (chilled or frozen)***	100	16.4
Tofu, silken hard	75	11.5
Tofu, marinated	50	14.0
Soya desserts		
Soya desserts or custard**	125	3.8

Source: Dietplan7 – 2018 unless otherwise highlighted with an asterisk/./
 *Soya drinks nutrition information: the average of current soya drinks on the market (n=7) excluding specialised drinks (formulated to meet the nutrition needs of 1-3 year olds, 'super-fortified' with protein, fibre or calcium and organic variants).
 **Alpro, leading manufacturer of soya custards, desserts and alternatives to yogurts – website nutrition information www.alpro.com
 ***Average of current brands on the market.

Isoflavone Content of Soya Foods and Drinks:

An average estimate of 3.5mg isoflavones per 1g soya protein is commonly accepted.³⁵ However, isoflavone content varies considerably depending on soil, growing conditions and production methods, where up to 80% of isoflavones can be lost.



Soya and LDL Cholesterol

Certain foods and dietary constituents directly lower blood cholesterol levels. These include soya protein,⁵³ phytosterols,⁵⁴ nuts⁵⁵ and beta-glucans from oats and barley.⁵⁶⁻⁵⁸ An advantage of incorporating soya foods into the diet is that they potentially reduce cholesterol through direct and indirect mechanisms:⁵⁹

- **Direct:** Soya protein directly lowers LDL-C by approximately 4-5%.^{53,60,61} One proposed explanation for the hypo-cholesterolaemic effect is that peptides formed from the digestion of soya protein upregulate LDL receptors in the liver, allowing cholesterol to be removed from the bloodstream more efficiently.⁶²
- **Indirect:** When soya foods replace common sources of protein in Western diets, which are typically high in saturated fat, the favourable change in fatty acid intake will lower LDL-C.⁵⁹

Breast Cancer

Breast cancer incidence and mortality rates are low in soya food-consuming countries.³⁸ Furthermore, Asian women who consume soya are less likely to develop breast cancer in comparison to Asian women who consume little soya.³⁹ Nevertheless, as a result of research conducted in rodents, concern arose that soya foods may be contraindicated for women with breast cancer.^{63,64} However, human research published over the past decade is extremely reassuring. Clinical studies show soya does not adversely affect indicators of breast cancer risk such as mammographic density^{65,66} and in vivo breast cell proliferation.⁶⁷⁻⁷² Additionally, prospective epidemiological studies show that consuming soya after a diagnosis of breast cancer reduces recurrence and improves survival.⁷³

“Soya could protect against breast cancer: There is growing evidence that the consumption of as little as one serving of soya per day during the teenage years may reduce later risk of developing breast cancer by 25-50%.⁷⁸⁻⁸²”

Not surprisingly given the clinical and epidemiological data, both the American Cancer Society⁷⁴ and the American Institute for Cancer Research⁷⁵ have concluded that soya foods can be safely consumed by women with breast cancer. In addition, in 2014, the World Cancer Research Fund International concluded that soya may improve the survival of breast cancer patients.⁷⁶ And finally, after an extensive review of the scientific literature, the European Food Safety Authority (EFSA) concluded that isoflavones don't adversely affect breast tissue in postmenopausal women.⁷⁷

Soya could protect against breast cancer: There is growing evidence that the consumption of as little as one serving of soya per day during the teenage years may reduce later risk of developing breast cancer by 25-50%.⁷⁸⁻⁸² There is growing evidence that suggests that exposure to isoflavones causes cells in the developing breast to



be changed in a way that makes them permanently less likely to be transformed into cancer cells.⁸³⁻⁸⁷ This “early intake” hypothesis, which has been investigated for more than 20 years, continues to gain support.^{88,89}

Prostate Cancer

As is the case for breast cancer, prostate cancer incidence and mortality rates vary dramatically throughout the world; rates in Asian countries where soya foods are commonly consumed are very low relative to Western countries.⁹⁰ More relevant are the Asian population studies showing that higher soya consumption is associated with marked reductions in risk of developing prostate cancer, although most data come from case-control – not longitudinal – studies.⁹¹⁻⁹⁴

Intervention studies involving prostate cancer patients generally show that isoflavone exposure slows the rise in prostate specific antigen (PSA) levels.⁹⁵⁻⁹⁸ There is also some evidence from animal and clinical studies that isoflavones are able to inhibit metastasis.^{99,100} In addition, it was suggested more than a decade ago that genistein (the main isoflavone found in soya) exerts some of its proposed chemo-preventive effects through binding to ERβ.¹⁰¹ ERβ is expressed in prostate epithelial cells, and has a role in the cellular homeostasis that is anti-proliferative,¹⁰² pro-differentiative,¹⁰³ and pro-apoptotic.¹⁰⁴



Menopausal Symptoms

The significant alterations in hormone balance during the menopause – mainly the reduced production of oestrogen – has considerable health consequences for women including an increased risk of osteoporosis¹⁰⁵ and possibly CHD.¹⁰⁶ However, vasomotor symptoms, especially hot flashes, are the primary reason for seeking medical intervention for most women.¹⁰⁷

Up to 75% of Western women experience hot flashes.¹⁰⁸ Hormone Replacement Therapy (HRT) remains the most effective treatment for menopausal symptoms. However, for women not wishing to use hormones, substantial evidence indicates that soya isoflavones represent an effective alternative. To this point, a statistical analysis of 17 studies involving 1,300 women found that consuming approximately 40-50mg isoflavones daily reduces the frequency of hot flashes by ~25% beyond the placebo effect for a total reduction of approximately 50%.¹⁰⁹ One serving of a traditional soya food, such as 250ml soya drink, provides about 25mg isoflavones.^{35,110}

“...consuming approximately 40-50mg isoflavones daily (equivalent to 2 large (250ml) glasses of soya drink) reduces the frequency of hot flashes by ~25% beyond the placebo effect.¹⁰⁹”

Soya Controversies

Given that more than 40,000 soya-related scientific articles have been published over the past several decades, it isn't surprising that some studies have produced results that are inconsistent with the totality of the evidence. Selectively highlighting these outliers and placing undue emphasis on results from animal studies has led to some misunderstandings about the health effects of human soya food consumption as discussed below.

Soya and Mineral Bioavailability

In theory, compounds such as phytates and oxalates naturally present in the soya bean have to impair mineral status by inhibiting the absorption of iron, zinc and calcium. However, clinical studies show that the calcium in calcium-fortified soya drinks^{111,112} and tofu¹¹³ is absorbed as well as the calcium naturally occurring in cow's milk. In addition, much of the iron in soya is in the form of ferritin, which research suggests may not be subject to the inhibitory effect of phytate.^{114,115} Furthermore, relatively new research shows that there is adaptation to the inhibitory effects of phytate on iron absorption. That is, in response to the chronic consumption of diets high in phytate, the inhibitory effects of phytate on iron are minimised.¹¹⁶

Figure 1: Amount of calcium that is bioavailable from cow's milk and soya drinks with a calcium content of 120mg per 100ml.¹¹²



Fermented versus Unfermented Soya Foods for Health

Most of the soya consumed in the world is unfermented.⁸ There is little evidence to suggest that fermentation improves the healthfulness of soya products. For example, although fermentation could in theory improve protein digestion, it is well established that the digestibility of soya protein in unfermented foods ranges from between 90% and 100%.^{24,25} Also, although fermentation converts some of the isoflavone glycosides in unfermented soya foods to the aglycone form, the evidence suggests total isoflavone absorption is unaffected.¹¹⁷⁻¹¹⁹

“There is little evidence to suggest that fermentation (e.g. tempeh and miso) improves the healthfulness of soya products”.

Phytoestrogens and Men's Health

A 2010 comprehensive review of the clinical data conclusively demonstrated that the consumption of soya foods does not raise oestrogen levels (older men actually produce more oestrogen than older women).¹²⁰ Similarly, a statistical analysis of more than 30 clinical studies concluded that soya does not lower testosterone levels.¹²¹

Also, clinical studies show soya does not adversely affect sperm or semen.^{122,123} In addition, soya food intake by men was unrelated to clinical outcomes, including fertilisation rates among couples presenting at an infertility clinic.¹²⁴

“...a statistical analysis of more than 30 clinical studies concluded that soya does not lower testosterone levels.¹²¹”

Soya and Children's Growth and Development

Only limited clinical research on the effects of soya in children has been conducted; this research indicates that neither soya nor isoflavone intake affects endogenous hormone levels in younger people.¹²⁵⁻¹²⁷ In addition, US cross-sectional studies involving Seventh-day Adventist girls¹²⁸ and boys¹²⁹ show that puberty onset falls well within the normal range of very-high-soya-consumers. (For more in-depth information please see our *Soya and The Health of Young People Fact Sheet* at www.alpro.com/healthprofessional)



Soya and Breast Cancer

Extensive clinical evidence involving healthy women and women at risk of developing breast cancer indicates even large amounts of soya do not adversely affect breast tissue.⁶⁵⁻⁷² Population studies involving over 11,000 breast cancer survivors show post-diagnosis soya consumption reduces recurrence and improves survival.⁷³



“The position of the American Institute for Cancer Research⁷⁵ and the American Cancer Society⁷⁴ is that breast cancer patients can safely consume soya foods. Also, the World Cancer Research Fund International identified a possible link between soya foods and improved survival from breast cancer.⁷⁶”

Isoflavones and Thyroid Function

A 2006 review of 14 clinical studies demonstrated no harmful effect of soya food consumption in individuals with normal thyroid function.¹³⁰ Studies published subsequently to this review concur with these findings. This research includes studies that have been conducted for three years in duration and employed very sensitive indicators of thyroid function in postmenopausal women.^{131,132} Not surprisingly, given the evidence, the EFSA concluded that isoflavones don't adversely affect the thyroid.⁷⁷

“14 clinical studies demonstrated no harmful effect of soya food consumption in individuals with normal thyroid function.¹³⁰”

For hypothyroid patients, although there is some evidence soya protein¹³³⁻¹³⁶ like fibre, calcium, and many herbs and drugs can interfere with the absorption of levothyroxine, soya foods are not contraindicated for those with low thyroid function.¹³⁷⁻¹⁴⁵ It is generally recommended that soya consumption should not occur within at least one hour of taking thyroid medication, which is typically taken in the fasting state.¹⁴⁶

Conclusion

The extensive clinical and epidemiological evidence demonstrates that soya foods, as part of a healthy balanced diet and lifestyle, are beneficial to health. Benefits include cholesterol reduction, alleviation of menopausal hot flushes and possibly reducing the risk of breast and prostate cancer. Misunderstandings about soya often come from the results of studies in rodents. The nutritional profile and health attributes of soya foods fit well with the latest Eatwell Guide, which encourages the consumption of plant-based proteins, reductions in saturated fat intake and higher fibre intake. With the array of soya foods on the market today, it is relatively easy to incorporate one to two servings of soya foods in the daily diet.



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