

# Anticancer properties of soybean: an updated review

## Abstract

Soybean is one of the important nutrition rich crops having maximum anticancer activities. The uses of daily Soy products are the subject of increasing scientific interest due to their many health benefits. The detailed analysis of the research studies revealed the anticancer properties of different soybean genotypes. The secondary metabolites of wild, transgenic and black soybean genotypes and their products have been reported by different researchers that showed maximum inhibitory activities against breast cancer, laryngeal cancer, colon cancer, etc. The fermented soy foods were also found useful against cancer. The present review focuses on latest up-to-date literature from last five years, on the anticancer activities of different types of soybean and its important products. In addition, the anticancer potentials of its important metabolites against various types of cancer have been discussed. However, further studies should be performed to check association between dose concentrations with reference to type of cancer and to check its possible side effects.

**Keywords:** anticancer activity, secondary metabolites, soybean, soy products

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## Introduction

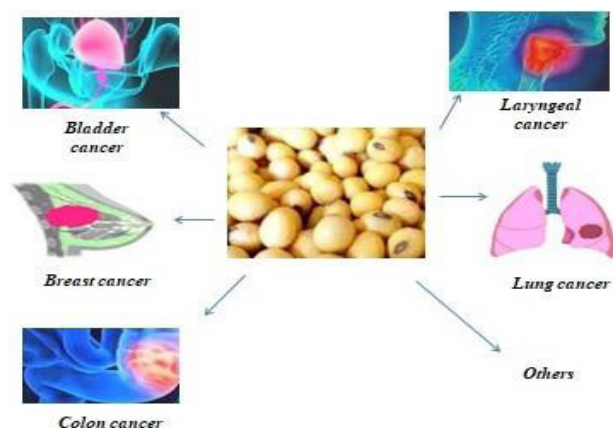
About 30-40% of cancer diseases are linked to imbalanced diet and other correlated factors.<sup>1</sup> Epidemiological reports give a direct relation between the intake of vegetables and fruits and lower mortality rate from cancer, heart and other degenerative diseases.<sup>2-5</sup> Medicinal plants are a major source for the controlling and treatment of diseases.<sup>6-9</sup> Herbal medicine provides a very feasible alternative to western medicine against cancer.<sup>10-12</sup>

Soybean is an important oilseed crop of family *Leguminosae* and mainly grown for edible seeds. It is the most economical source of protein and edible oil for human food.<sup>13</sup> On the basis of dry weight of mature raw seeds, it normally contains about 35 to 40% protein, 20% lipids, 9% dietary fiber, and around 8.5% of moisture.<sup>14</sup> However, its composition varies with type of varieties, location and planting conditions. It is used for the production of the majority of the products such as roasted soybean, boiled soybean, soymilk, soy cheese, Tofu, and many more.<sup>15</sup> Soybean is a rich source of important secondary metabolites. Soybean and its products can play an essential role for the treatment of many diseases. Several researchers proved its anticancer activities against different types of cancer. Here we discussed up-to-date literature from the last five years on the important phytochemicals isolated from different types of soybean genotypes and highlighted the use of soybean extracts and its products for treatments of different types of cancer.

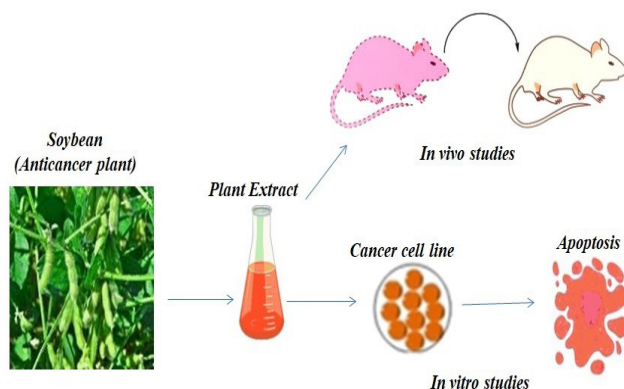
Different researchers proved its anticancer activities against different cancer types. For example, El-Keiy et al.<sup>16</sup> reported that saponin present in soybean has potent anti-proliferation activity in *in-vitro* Caco mouse colon cancer cells. The apoptosis-inducing effect leads to activation of caspase-9 enzyme and loss of plasma membrane asymmetry. They concluded that soy saponin may have a proliferation inhibitory effect against human colon cancer. The wild soybean contains anti laryngeal cancer activities. In a study by

Kusumoningrum & Dwira,<sup>17</sup> the ethanol extract of wild beans have alkaloids, flavonoids, tannins, triterpenoids, saponins, and glycosides that showed moderate cytotoxicity activity against Hep-2 laryngeal cancer cells. In addition, the ethanol extract of wild beans was found to be less toxic than cisplatin. Similarly, Amaani & Dwira<sup>18</sup> studied that ethanol extract of black soybean processes important secondary metabolites (flavonoids, alkaloids, saponins, tannins, triterpenoids, and glycosides) that show moderate anticancer activities against A549 lung cancer cells. Wada et al.<sup>19</sup> studied a significant lower risk of bladder cancer among men who had higher intakes of total soy and isoflavones. In a recent study by Hao et al.<sup>20</sup>, the transgenic soybean plants expressing lunasin peptide showed anti-inflammatory and anti-cancer activities more than wild transgenic plants. They described that transgenic soybean having lunasin in their genome could be used as a food source by the cancer patient.

The important products (steamed soybean, soymilk and tofu) of three Thai soybean cultivars (Chiang Mai 6 (CM6), Chiang Mai 60 (CM60) and Chiang Mai 84-2 (CM 84-2)) are full of phytochemicals and showed low anticancer activities.<sup>21</sup> Khosravi & Razavi<sup>22</sup> described that fermented soybean and black soybean products possess maximum polyphenolic compounds that show anticancer activities. Other studies also showed that during fermentation, the glycoside isoflavones is converted to an active form of aglycone, which can be adsorbed faster in our body. Wang et al.<sup>23</sup> reported that Soybean should be used as a food to control breast cancer diseases. Their uses inhibit the development of breast cancer by downregulating the level of Histone demethylase JMJD5 (an important epigenetic molecule). According to Shirabe et al.<sup>24</sup> fermented soy foods may be associated with decreased risk of nonlocalized breast cancer. In contrast with these findings, Jargin<sup>25</sup> investigated that the phytoestrogens and its active metabolite such as equol can remain in food/meat and influence the hormonal balance of the consumers. In animals, the phytoestrogens may affect fertility, sexual development, and behavior.



**Figure 1** The anticancer activities of soybean against different types of cancer.



**Figure 2** *In vitro* and *in vivo* anticancer activities of soybean extracts/ phytochemicals.

## Conclusion

Soybean and its products could help to prevent the onset of numerous cancer types. Possessing a high amount of important natural compounds, it can be used for the control and treatment of various types of cancer by dose dependent manner. However, further animal models and human trials are needed to check cancer protective effects of soy phytochemicals. In addition, new transgenic plants expressing important peptides should be developed against different cancer types. Further research is needed to identify new novel secondary metabolites in soybean genotypes that may help reduce the side effects of cancer treatment.

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## Conflicts of interest

Authors declare that there is no conflict of interest.

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