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REVIEW ARTICLE

Pea, *Pisum sativum*, and Its Anticancer Activity

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ABSTRACT

Pisum sativum (Family: Fabaceae), as known as green pea or garden pea, has long been important in diet due to its content of fiber, protein, starch, trace elements, and many phytochemical substances. It has been shown to possess antibacterial, antidiabetic, antifungal, anti-inflammatory, antihypercholesterolemia, and antioxidant activities and also shown anticancer property. Its nonnutritive biologically active components include alkaloids, flavonoids, glycosides, isoflavones, phenols, phytosterols, phytic acid, protease inhibitors, saponins, and tannins. This plant is rich in apigenin, hydroxybenzoic, hydroxycinnamic, luteolin, and quercetin, all of which have been reported to contribute to its remedial properties including anticarcinogenesis property. Based on established literature on the anticancer property of *P. sativum* and possible mode of action, this review article has focused to demonstrate that *P. sativum* could be further explored for the development of anticancer treatment.

Key words: Anticancer, pea, *Pisum sativum*, plant, traditional medicine

LEGUME

Legume or pulse is one of the traditional medicines used globally because it has the amount of nutritional substances and has the efficiency of therapeutic treatments. Legumes include beans, grains, and peas as well as alfalfa, carob, clover, copaifera, fenugreek, indigo, lentil, licorice, lupin, mesquite, natto, soybean, peanut, rosewood, and tamarind are the member of the Fabaceae family.[1] The nutritional values of legume are low fat, high protein, dietary fiber, and various of micronutrients and phytochemical substances which exhibit the medicinal properties, especially anticancer property.[2] Pea is one of the major food legumes that can grow in different regions, and it ranks the fourth in world food legume productions next to soybean, peanut, and dry bean.[3] Seed and sprout of pea have become increasingly consumed because people concern about their health problem by changing dietary habits.[4] The present review explores scientific evidences to provide updated information about the properties of green pea or garden pea (*Pisum sativum*), one of the anticancer plants that is being investigated for its mechanism.

TAXONOMICAL CLASSIFICATION

The taxonomy of *P. sativum* is in the Kingdom (*Plantae*); Subkingdom (*Viridiplantae*); Infrakingdom (*Streptophyta*); Superdivision (*Embryophyta*); Division (*Tracheophyta*); Subdivision (*Spermatophytina*); Class (*Magnoliopsida*); Superorder (*Rosanae*); Order (*Fabales*); Family (*Fabaceae*); Genus (*Pisum*); and Species (*P. sativum*).[5]

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NOMENCLATURE

The origin of *Pisum* spp. is in Southwestern Asia including Afghanistan, India, Pakistan, and then spreads to subtropic and tropic regions.[6] The vernacular names of *P. sativum* include Chinese pea, edible pod pea, field pea, garden pea, green pea, honey pea, sugar pea, and sweet pea (English); ertjie (Afrikaans); katar (Bengali); ervilha (Brazil); jia wan dou (Chinese); doperwten (Dutch); petiti pois (French); erbse (German); kacang ercis (Indonesian); endo (Japanese); sandaek (Khmer); kacang manis (Malaysia); ervilha (Portuguese); gorach (Russian); aroeja (Spanish); spritart (Swiss); thua lan tao (Thai); bezelye (Turkish); ropox (Ukranian); and dau hoa lan (Vietnamese).[7]

PLANT DESCRIPTION OF *PISUM SATIVUM*

P. sativum is an herbaceous annual, with a climbing hollow stem growing up to 2–3 m long. Leaves are alternate, pinnately compound, and consist of 2–3 pairs of 1.5–8 cm long large leaf-like stipules. Flowers have five green fused sepals and five white to reddish-purple petals of different sizes. Fruit grows into a pod, 2.5–10 cm long that often has a rough inner membrane. The pod is a seed container which composed by two sealed valves and splitted along the seam which connects the two valves. Seeds are round, smooth, and green color [Figure 1].[8]

PHYTOCHEMICAL SUBSTANCES

The active phytochemical substances of *P. sativum* are as follows: Asparaginase;[9] flavonoids including apigenin, daidzein, genistein, and kaempferol;[10] lectin;[11-13] phenolic compounds including caffeic, catechin, coumaric acids, gentisic acids, ferulic, protocatechuic, and vanillic acids;[14,15] pisatin and an allelopathic active substances;[16,17] proanthocyanidin;[18] saponins;[19,20] steroid phytohormone including brassinosteroid;[21,22] and tannins.[23]

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Figure 1: Fruit of *Pisum sativum* (a) external morphology (b) cut face and (c) seeds

TRADITIONAL USES

P. sativum can be consumed in raw form as well as cooked or frozen form. The various bioactive compounds' current uses or phytochemical properties of *P. sativum* from several literature reviews are antibacterial,[24,25] anti-*Helicobacter pylori*,[26,27] anticancer,[28] antidiabetic,[29,30] antifungal,[31] anti-inflammatory,[32,33] antilipidemic,[34,35] and antioxidant[36,37] activities. Moreover, it can act as insecticidal activity.[38-40]

ANTICANCER ACTIVITY

The extracts of *P. sativum* have been investigated and found to be pharmacologically active inducing anticancer activity. Clemente *et al.*[41,42] compared the effect of Bowman-Birk trypsin-chymotrypsin inhibitor, a potential cancer chemopreventive agent, with the protease inhibitors, rTl1B and rTl2B, from *P. sativum* seed from the United Kingdom. They studied the inhibitory activities on the growth of human colorectal adenocarcinoma HT-29. The rTl1B showed the effective 46 μM of IC_{50}. El-Aassar *et al.*[43] studied the *P. sativum* extracted lectins from Egypt exhibited the antiproliferative property to liver cancer cell line. Patel[12] extracted lectin from leaves and buds of *P. sativum* from Saudi Arabia and studied cytotoxicity to many cancer cell lines such as MCF-7 (breast), HepG-2 (liver), HEP-2 (larynx), and HCT-116 (colon). In recently, Stanisavljevic *et al.*[28] identified the amount of phenolic compounds from pea seeds in different colors from Croatia. They reported the darker seed color, the higher total phenolic content in the form of gallic acid, epigallocatechin, naringenin, and apigenin. The seed extracts also showed the cytotoxic effects on malignant cell lines, for example, LS174 (colon), MDA-MB-453 (breast), A594 (lung), and K562 (blood). In several review articles have mentioned the health benefits of *P. sativum* due to its concentration and properties of starch, protein, fiber, vitamins, minerals, and phytochemicals.[2,44] In addition, the plants in the same Fabaceae family also show the anticancer activities such as alfalfa, *Medicago sativa*;[45] carob, *Ceratonia siliqua*;[46] lentil, *Lens culinaris*;[47] and soybean, *Glycine max*.[48]

PHYTOCHEMICAL SUBSTANCES ACT AS ANTICANCER ACTIVITY

Several studies found that a diet high in whole grains including legumes may reduce the risk of cancer such as breast cancer,[49] colorectal cancer,[50,51] and endometrial cancer.[52,53] Various phytoconstituents in legumes have been reported their anticancer activities.

Isoflavones

The most abundant isoflavones in the legume sprouts were found as genistein followed by daidzein. Sukanya and Gayathri[54] studied the growth inhibitory properties of isoflavones extract of legume sprout from India on breast cancer MCF-7. Moreover, Pudenz *et al.*[55] reported that isoflavones worked as phytoestrogens and could inhibit tumorigenesis both *in vitro* and *in vivo* studies. Their mechanisms were DNA repair, induction of apoptosis, cell proliferation, migration, and invasion.

Lectins

There are the most abundant lectin proteins in several legume tree barks, and they have great potential as antitumor and anticancer properties.[56] Other legume lectins also have antiproliferative and anticancer properties such as concanavalin A, a lectin from Jack bean seed.[57] Several studies have suggested the cytotoxicity or tumor inhibition mechanisms of lectins to various tumor cell lines such as skin,[58] liver, bile duct, and bone cell lines.[59]

Saponins

A number of legumes contain saponins such as soybean, chickpea, peanut, and lentil, which have reported to exhibit anticancer activities. Several studies suggest that legume saponins may possess anticancer activities in melanoma cell,[60] colon cancer,[61,62] and cervical cancer.[63] The mechanism of suppressing the metastatic of cancer was mentioned by Chang *et al.*[60] using sialyltransferase inhibition activity of saponin on the cell surface. The other mechanism was saponin regulation of the apoptosis pathway enzymes, leading to programmed cell death of cancer cells.[62,64]

Phenolic compounds

It has been recognized that phenolic compounds act as antioxidants and were found high amount in peas.[65] The association of antioxidant properties of plant phenolic compounds and their effects in the prevention of various oxidative stress diseases, for example, cancer or cardiovascular diseases were explained by Dai and Mumper.[66]

CONCLUSION

Legume is considered as a good and nonexpensive of plant foods. It plays important roles in human nutrition and also in prevention in many diseases, especially cancer. Several researchers reported that *P. sativum* is rich in many nutritional and nonnutritional components which can prove to be prevention and inhibition cancer. This review article has attempted to compile the new medicinal plant *P. sativum*, to be one of the choices of anticancer plants.

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Conflicts of interest

There are no conflicts of interest.

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