Medicinal Potential of Plant Pisum Sativum In Modern Medicine

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Abstract

Pisum sativum L., commonly referred to as dry, green, or field pea, is one of the most common legumes that is popular and economically important. Due to its richness in a variety of nutritional and bioactive ingredients, the consumption of pea has been suggested to be associated with a wide range of health benefits, and there has been increasing focus on its potential as a functional food. However, there have been limited literature reviews concerning the bioactive compounds, health-promoting effects, and potential applications of pea up to now. This review, therefore, summarizes the literature from the last ten years regarding the chemical composition, physicochemical properties, processing, health benefits, and potential applications of pea. Whole peas are rich in macronutrients, including proteins, starches, dietary fiber, and non-starch polysaccharides. In addition, polyphenols, especially flavonoids and phenolic acids, are important bioactive ingredients that are mainly distributed in the pea coats. Anti-nutritional factors, such as phytic acid, lectin, and trypsin inhibitors, may hinder nutrient absorption. In addition, physicochemical and functional properties of pea starches and pea proteins can be improved by chemical, physical, enzymatic, and combined modification methods. Owing to the multiple bioactive ingredients in peas, the pea and its products exhibit various health benefits, such as antioxidant, anti-inflammatory, antimicrobial, anti-renal fibrosis, and regulation of metabolic syndrome effects. Pea and its components can be further developed into more valuable and nutritious products.

1. INTRODUCTION

Plants have been a great source of medical agents for many years.Natural medicines have gained popularity in the treatment of numerous ailments as a result of public perceptions that these Phyto-medicines are safe, easily available, inexpensive, and have fewer side effects. Compared to traditional pharmaceuticals, many plant-based remedies are more affordable and accessible to the majority of people. After use, there are negative effects. These factors may be responsible for their widespread use and attention. The primary source of novel pharmaceutical and healthcare products is medicinal plants. These "green factories" have produced some high-profile medications through the extraction and characterization of some potent phytocompounds. Garden Pea (Pisum sativum L.) is one of the most important winter vegetable crops grown on commercial scale the world over and is consumed either as a fresh succulent vegetable or in processed form.

Different species of Green Pea:

- Pisum sativum (garden pea)
- P. elatius (Mediterranean pea)
- P. arvense (field pea)
- P. abyssinicum (Abyssinian pea)
- P. humile (dwarf pea)
- P. fulvum (red yellow pea)

1.1Taxonomic Classification

- **Kingdom** – Plantae
- **Sub-division** – Spermatophyte
- **Division** – Magnoliophyta
- **Class** – Magnoliopsida
- **Sub-class** – Rosidae
- **Order** – Fabales
- **Family** – Fabaceae
- **Genus** – Pisum L.
- **Species** – Pisum Sativum L.
- **Botanical Name** : Pisum Sativum L.
- **Common Name** : Green Pea
- **Hindi Name** : Matar
- **Sanskrit Name** : Mataraka
- **Tamil name** : Pachai Pattani

1.2 NUTRITIVE VALUE

Pea is highly nutritive, containing high percentage of digestible proteins, carbohydrates, fats along with minerals (Ca, P and Mg) and vitamins A, B and C (Table 1). High quality starch, protein, or oligoside isolates are being extracted from dry pea seeds. Because dry seeds contain little anti-nutritional factors, they are used as a protein source.

Table: 1: Nutritional value of garden peas

Nutrient	Value
Energy	81 Kcal
Protein	5.4 g
Carbohydrates	14.5 g
Sugars	5.7 g
Dietary Fibre	5.1 g
Fat	0.4 g
Vitamin A Equiv.	38 mg
-Beta-Carotene	449 mg
lutein and zeaxanthin	2593 mg
Thiamine (Vit. B1)	0.3 mg
Riboflavin (Vit.B2)	0.1 mg
Nacin (Vit. B3)	2.1 mg
Pantothenic acid (Vit.	0.1 mg

B5)	
Vitamin B6	0.2 mg
Folate (Vit. B9)	65 mg
Vitamin C	40.0 mg
Calcium	25.0 mg
Iron	1.5 mg
Magnesium	33.0 mg
Phosphorus	108 mg
Potassium	244 mg
Zinc	1.2 mg

The Pisum Sativum, a pod plant, also commonly called pea, is a fruit but known as a vegetable. They are eaten in large quantities everywhere and therefore the amount of their peels discarded as waste is also significant. Various studies reveal that they contain high amounts of chlorophyll proteins, carotenoids, vitamins, carbohydrates, flavonoids, and antioxidants. Sucrose is a carbohydrate that is found in large quantities in PPs, which we can also extract from peels by different ways. This sucrose can then be used in various fields such as bio plastics etc. other nutrient also perform many functions in our body such as improving the immune system against diseases, keeping the skin fresh, losing weight, etc.

2. Cultivation :

1. Soil preparation: Peas prefer well-draining, fertile soil with a pH between 6.0 and 7.0.
2. Sowing: Sow seeds 1-2 inches deep and 2-3 inches apart in early spring or late summer/early fall, depending on your location.
3. Support: Provide support for the plants to climb, such as trellises, fences, or cages.
4. Watering: Keep the soil consistently moist during the first few weeks after sowing.
5. Fertilization: Feed the plants with a balanced fertilizer once they reach 6 inches tall.
6. Pest and disease management: Keep an eye out for pests like aphids, slugs, and snails, and diseases like powdery mildew and root rot.
7. Harvesting: Pick peas when they are tender and bright green, usually within 50-60 days of sowing.

3. Comprehensive study of different parts of Pea Plant:

3.1. Roots:

3.1.1. Characteristic:

- Taproot system: Pea plants have a taproot system, with a main root that grows straight down into the soil.
- Nitrogen-fixing nodules: Pea roots have nodules containing Rhizobia bacteria, which convert atmospheric nitrogen into a usable form.
- Fine root hairs: The roots have fine hair-like structures that increase surface area for nutrient absorption.
- Shallow root depth: Pea roots typically grow in the top 12-18 inches (30-45 cm) of soil.
- Lateral roots: In addition to the taproot, pea plants develop lateral roots that spread out from the main root.
- White or cream-colored: Pea roots are typically white or cream-colored, becoming darker with age.
- Fibrous roots: As the plant matures, the roots become more fibrous and branched.
- Symbiotic relationships: Pea roots form symbiotic relationships with beneficial microorganisms, enhancing nutrient uptake.
- Adaptability: Pea roots can adapt to various soil types and conditions, making them a versatile crop.

3.1.2. Function:

- Absorb water and nutrients from the soil.
- Anchor the plant, providing stability.
- Store food and nutrients.
- Interact with beneficial microorganisms like Rhizobia.

3.1.3. Use:

- Digestive issues: Pea roots have been used to treat digestive problems like constipation, diarrhea, and indigestion.
- Inflammation: Pea roots have anti-inflammatory properties, making them useful for reducing swelling and pain.
- Fever reduction: Pea roots have been used to reduce fever and alleviate symptoms of colds and flu.
- Respiratory issues: Pea roots have been used to treat respiratory problems like bronchitis, asthma, and coughs.
- Skin issues: Pea roots have been used to treat skin conditions like eczema, acne, and dermatitis.
- Antibacterial properties: Pea roots have antibacterial properties, making them effective against infections.
- Antioxidant properties: Pea roots have antioxidant properties, which help protect against cell damage and oxidative stress.
- Menstrual relief: Pea roots have been used to ease menstrual cramps, bloating, and other symptoms associated with PMS.
- Diuretic properties: Pea roots have diuretic properties, making them useful for reducing water retention and treating urinary issues.
- Immune system support: Pea roots have been used to boost the immune system and prevent illnesses.

3.2. FLOWERS:

3.2.1. Characteristic:

- Color: Pea flowers are typically purple, pink, white, or bi-colored, depending on the variety.
- Shape: The flowers are irregularly shaped, with a distinctive "keel" petal that forms a boat-like structure.
- Size: Pea flowers are relatively small, measuring about 1-2 inches (2.5-5 cm) in length.
- Arrangement: Flowers are arranged in clusters or racemes along the stem.
- Fragrance: Pea flowers have a sweet, floral scent.
- Self-pollinating: Pea flowers are self-pollinating, but may also be cross-pollinated by insects.
- Papilionaceous: Pea flowers are classified as papilionaceous, meaning they have a distinctive "butterfly-like" shape.
- Five petals: Each flower has five petals: one standard (upper), two wings (side), and two keel petals (lower).
- Nectar-rich: Pea flowers contain nectar, attracting pollinators like bees and butterflies.Short-lived: Individual pea flowers are short-lived, typically lasting only a few days.

3.2.2. Function:

- Reproduction: produce pollen and ovules for seed formation.
- Attraction: attract pollinators like bees, butterflies, and hummingbirds.

3.2.3. Use:

- Coughs and colds: Pea flowers have been used to treat coughs, colds, and respiratory issues.
- Fever reduction: Pea flowers have been used to reduce fever and alleviate symptoms of flu.
- Inflammation: Pea flowers have anti-inflammatory properties, making them useful for reducing swelling and pain.
- Skin issues: Pea flowers have been used to treat skin conditions like eczema, acne, and dermatitis.
- Eye problems: Pea flowers have been used to treat eye issues like conjunctivitis and blepharitis.
- Antibacterial properties: Pea flowers have antibacterial properties, making them effective against infections.
- Antioxidant properties: Pea flowers have antioxidant properties, which help protect against cell damage and oxidative stress.
- Menstrual relief: Pea flowers have been used to ease menstrual cramps, bloating, and other symptoms associated with PMS.
- Anxiety and stress: Pea flowers have been used to calm anxiety and stress.
- Sleep aid: Pea flowers have been used as a natural sleep aid.

3.3. STEM:

3.3.1. Characteristic:

- Tendrils: Pea stems have tendrils, which are thin, curly structures that help the plant climb.
- Hollow: Pea stems are hollow, making them lightweight and flexible.
- Green or purple color: Pea stems are typically green, but some varieties may have a purple tint.
- Long and slender: Pea stems can grow quite long (up to 6 feet) and are relatively slender.

- Node and internode structure: Like most stems, pea stems have nodes (where leaves meet the stem) and internodes (the stem segments between nodes).
- Vines or semi-leafless: Some pea varieties have semi-leafless stems, which allow more sunlight to reach the leaves.
- Thigmotropic: Pea stems exhibit thigmotropism, meaning they bend and twine around nearby objects for support.
- Herbaceous: Pea stems are non-woody and herbaceous, meaning they die back after the growing season.
- Succulent: Some pea stems can be slightly succulent, storing water and nutrients.
- Hairiness: Some pea varieties have hairy stems, which can help with climbing and protection.

3.3.2. Function:

- Supports the plant's growth and bears leaves, flowers, and pods.
- Transports water, nutrients, and sugars throughout the plant.
- Provides structural support and maintains the plant's upright posture.

3.3.3. Use

- Digestive issues: Pea leaves have been used to treat digestive problems like constipation, diarrhea, and indigestion.
- Inflammation: Pea leaves have anti-inflammatory properties, making them useful for reducing swelling and pain.
- Fever reduction: Pea leaves have been used to reduce fever and alleviate symptoms of colds and flu.
- Respiratory issues: Pea leaves have been used to treat respiratory problems like bronchitis, asthma, and coughs.
- Skin issues: Pea leaves have been used to treat skin conditions like eczema, acne, and dermatitis.
- Antibacterial properties: Pea leaves have antibacterial properties, making them effective against infections.
- Antioxidant properties: Pea leaves have antioxidant properties, which help protect against cell damage and oxidative stress.
- Menstrual relief: Pea leaves have been used to ease menstrual cramps, bloating, and other symptoms associated with PMS.
- Eye problems: Pea leaves have been used to treat eye issues like conjunctivitis and blepharitis.
- Wound healing: Pea leaves have been used to aid in wound healing and tissue repair.

3.4. Pea Pods:

3.4.1. Characteristic:

- Flat and linear shape: Pea pods are typically flat and linear, with a slight curve.
- Green color: Pea pods are usually green, but some varieties may have a purple or yellow tint.
- Dehiscent: Pea pods are dehiscent, meaning they split open to release seeds when mature.
- Inflated and tender: Garden pea pods are typically inflated and tender, while snow pea pods are flat and tender.

- 2-12 inches long: Pea pods can vary in length, but are usually between 2-12 inches (5-30 cm).
- Contain 2-12 seeds: Pea pods typically contain 2-12 seeds, depending on the variety.
- Attached to stem: Pea pods are attached to the stem by a small stalk.
- Fleshy and juicy: Garden pea pods are fleshy and juicy, while snow pea pods are flat and tender.
- Veins and ridges: Pea pods often have visible veins and ridges.
- Pericarp: The outer layer of the pea pod is called the pericarp, which is usually thin and tender.
- Sutures: Pea pods have sutures, which are the seams where the pod splits open.
- Indehiscent in some varieties: Some pea varieties, like snow peas, have indehiscent pods that don't split open.

3.4.2. Function:

- Protection: shield seeds from damage and moisture loss.
- Support: provide a structure for seed growth and development.
- Dispersal: help spread seeds when pods dry and split open.

3.4.3. Use:

- Digestive issues: Pea pods have been used to treat digestive problems like constipation, diarrhea, and indigestion.
- Inflammation: Pea pods have anti-inflammatory properties, making them useful for reducing swelling and pain.
- Fever reduction: Pea pods have been used to reduce fever and alleviate symptoms of colds and flu.
- Respiratory issues: Pea pods have been used to treat respiratory problems like bronchitis, asthma, and coughs.
- Skin issues: Pea pods have been used to treat skin conditions like eczema, acne, and dermatitis.
- Antibacterial properties: Pea pods have antibacterial properties, making them effective against infections.
- Antioxidant properties: Pea pods have antioxidant properties, which help protect against cell damage and oxidative stress.
- Menstrual relief: Pea pods have been used to ease menstrual cramps, bloating, and other symptoms associated with PMS.
- Eye problems: Pea pods have been used to treat eye issues like conjunctivitis and blepharitis.
- Urinary issues: Pea pods have been used to treat urinary problems like kidney stones and urinary tract infections.

3.5. LEAVES:

3.5.1. Characteristic:

- Pinnate shape: Pea leaves are pinnate, meaning they are divided into leaflets arranged along a central stem.
- 1-3 inches long: Pea leaves are typically 1-3 inches (2.5-7.6 cm) long.
- Green color: Pea leaves are usually green, but some varieties may have a purple or yellow tint.
- Ovate leaflets: Pea leaves have ovate-shaped leaflets with a pointed tip.
- Stipules present: Pea leaves have stipules, which are small, leaf-like structures at the base of the leaf.

- Petiole present: Pea leaves have a petiole, which is the stalk that attaches the leaf to the stem.
- Compound leaves: Pea leaves are compound leaves, meaning they are made up of multiple leaflets.
- Alternate arrangement: Pea leaves are arranged alternately on the stem.
- Soft and tender: Pea leaves are soft and tender, making them easy to chew and digest.
- Hairiness: Some pea varieties have hairy leaves, which can help with water retention and protection.
- Waxy coating: Pea leaves often have a waxy coating to prevent water loss.
- Veins and ridges: Pea leaves have visible veins and ridges, giving them a textured appearance.

3.5.2. Function:

- Photosynthesis: produce energy for the plant.
- Transpiration: release water vapor into the air.
- Support: provide structure for the plant's growth.

3.5.3. Use:

- Fever reduction: Pea stems have been used to reduce fever and alleviate symptoms of colds and flu.
- Digestive issues: Pea stems have been used to treat digestive problems like constipation, diarrhea, and indigestion.
- Inflammation: Pea stems have anti-inflammatory properties, making them useful for reducing swelling and pain.
- Respiratory issues: Pea stems have been used to treat respiratory problems like bronchitis, asthma, and coughs.
- Skin issues: Pea stems have been used to treat skin conditions like eczema, acne, and dermatitis.
- Antibacterial properties: Pea stems have antibacterial properties, making them effective against infections.
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- Menstrual relief: Pea stems have been used to ease menstrual cramps, bloating, and other symptoms associated with PMS.
- Urinary issues: Pea stems have been used to treat urinary problems like kidney stones and urinary tract infections.
- Wound healing: Pea stems have been used to aid in wound healing and tissue repair.

4. Chemical Composition of Pea:

4.1. Proximate Composition:

Peas are a notable source of carbohydrates, constituting 59.32–69.59% of their dry weight. The starch content in pea seeds ranges from 39.44% to 46.23%, which can exceed the levels found in faba beans (38.4–41.8%). Peas are also abundant in dietary fiber, making up 23.23% to 30.72% of the seeds, with soluble fiber ranging between 3.91% and 8.01%, and insoluble fiber between 19.32% and 23.1%. In terms of protein, peas offer about 20–25% of their dry weight, comparable to adzuki beans (23.51%) and kidney beans (23.44–24.90%). Lipid content in peas is around 3.06–7.3%, which is similar to that of cowpeas (4.22–7.17%). Additionally, pea seeds contain approximately 3.07% ash. It is important to note that the nutritional composition of peas can vary based on cultivar, growing conditions, and planting year. Further research is needed to systematically compare the chemical compositions of different pea cultivars.

4.2. Starch:

Pea starches are characterized by a significant amylose content, ranging from 17.2% to 42.6%, with wrinkled peas containing higher levels of amylose compared to round peas. Starch extracted from wrinkled peas has been found to feature longer branch chains of amylopectin than that from smooth peas. Starches with elevated amylose levels are often associated with increased resistance to digestion. The estimated glycemic index (eGI) for isolated pea starches, based on their digestive index, falls between 69.8 and 70.7. Resistant starch (RS), a key form of dietary fiber, is noted for its positive effects on intestinal health.

4.3. Dietary fiber:

Dietary fiber, which consists of non-digestible carbohydrates, offers numerous health benefits by influencing gut microbial composition. It is typically categorized into soluble dietary fiber (SDF) and insoluble dietary fiber (IDF) based on water solubility. Pea seeds are notably rich in dietary fiber, containing between 23.23% and 30.72%, with SDF making up 3.91% to 8.01% and IDF ranging from 19.32% to 23.1%. Comparative analyses have shown that the SDF content in peas is comparable to that in broad beans (4.89–5.05%), white kidney beans (4.57–5.14%), cowpeas (4.23–5.82%), red beans (5.04–5.59%), and black soybeans (6.59–8.11%). Pea IDF levels are also similar to those found in soybeans (18.28–21.99%), mung beans (17.92–20.17%), red beans (20.41–24.73%), and cowpeas (17.89–22.33%), though they are lower than in white kidney beans (24.73–26.75%), red kidney beans (26.52–26.96%), lentils (23.57–24.93%), and broad beans (26.85–28.69%). Notably, ultrafine grinding technology can enhance SDF content in peas from 1.26% to 4.97%.High dietary fiber content in foods is associated with reduced serum cholesterol and glycemic indexes, suggesting that peas could be beneficial for preventing diabetes and hypercholesterolemia. The SDF in pea seeds primarily consists of galacturonic acid, arabinose, galactose, glucose, mannose, rhamnose, xylose, and fucose, with galacturonic acid being the most prevalent. This composition indicates a significant presence of pectic polysaccharides. In contrast, IDF in peas contains glucose, arabinose, galacturonic acid, xylose, galactose, mannose, and rhamnose, with glucose, xylose, and arabinose being predominant, suggesting the presence of cellulose, xylans, and arabinans.The molecular weights of SDFs in pea seeds range from 25 to 478 kDa, with intrinsic viscosities between 0.84 and 0.85 dL/g and apparent viscosities from 1.73 to 1.87 mPa·s. The microstructures of polysaccharide fractions from pea seeds display a smooth surface. Moreover, pea dietary fibers and polysaccharides have demonstrated significant antioxidant and hypoglycemic activities in vitro and in vivo. However, the precise chemical structures of SDFs and dietary polysaccharides in peas remain to be fully elucidated and require further investigation.

4.4. Protein:

Pea protein is often divided into four key types: globulin, albumin, prolamin, and glutenin. Among these, globulin is the primary storage protein, representing approximately 55–65% of the total protein content in field peas. Pea protein mainly comprises 7S/11S globulins and 2S albumins and is notably rich in lysine, which can help address lysine deficiencies often found in cereal-based diets. The health benefits of pea protein and its hydrolysates are well-documented, including their antioxidant, anti-diabetic, and anti-hypertensive properties, as well as their ability to modulate intestinal microbiota. Pea proteins are also versatile in food applications, including the encapsulation of bioactive compounds, the creation of biodegradable films, and as a substitute for animal proteins. However, variations in the globulin-to-albumin ratio and in the levels of soy protein versus vecillin can influence allergen presence and intensity. Notably, the pea allergen Pis s 1, a 7S globulin, is a significant allergen for individuals with pea allergies, particularly in children. Pis s 2, a contaminant in the vecillin component, has also been identified as an allergenic protein. Additionally, two lesser-known allergenic proteins, PA1 and PA2, are present in the albumin fraction. Research into the allergenic properties of peas remains incomplete, and the impact of food processing on pea allergens is not fully understood.Pea proteins offer a well-balanced amino acid profile, being rich in essential amino acids. However, methionine and cysteine are considered limiting amino acids (LACs) in pea seeds, similar to other legumes. For infants consuming cooked peas, aromatic amino acids are the main LACs, whereas lysine becomes the primary LAC for older children, adolescents, and adults. To achieve a balanced diet, it is important to complement pea proteins with other protein sources to cover the full range of essential amino acids.Recent studies suggest that the physicochemical properties of pea proteins are quite similar to those of soybean proteins, positioning them as a viable alternative. Both pea and soybean proteins exhibit a characteristic "U shape" in their pH-dependent solubility curves, though neither performs optimally in highly acidic conditions below pH 5. The isoelectric point of pea proteins (pH 4–5) closely matches that of soybean proteins (pH 4–6). High-pressure and heat treatments notably decrease pea protein solubility. Pea proteins show impressive foaming stability at approximately 89.74%, comparable to soybean proteins (82.44%) and surpassing rice (50%) and wheat proteins (68.03%). Their water absorption capacity is around 3.389 g/g, significantly higher than that of rice (1.46 g/g) and wheat proteins (1.376 g/g). The least gelation concentration for pea proteins is 14%, similar to that of soybean proteins (12%). The emulsifying activity and emulsion stability indices of pea proteins are comparable to those of soybean proteins,

indicating their potential as a substitute for soybean proteins in meat and sausage products. However, given the limited sample sizes and genotypes studied, these comparative results may not be entirely accurate and warrant further systematic research.

4.5. Lipids:

Peas have a relatively low lipid content, classifying them as a low-fat food. The lipids in pea seeds are primarily composed of polyunsaturated fatty acids, which make up 42.01% to 60.68% of the total fatty acids. Peas have a lower proportion of unsaturated fatty acids, ranging from 17.46% to 24.95%. Key fatty acids found in peas include palmitic acid (12.39%–19.24%), linoleic acid (34.56%–47.74%), and linolenic acid (7.37%–12.55%). The bioavailability of these unsaturated fatty acids during digestion is not yet fully understood, indicating the need for further research to confirm these findings.

4.6. Minerals and Vitamins:

Peas are a valuable source of various minerals, including nitrogen, potassium, and phosphorus. Research has shown that the mineral content in pea seeds, such as nitrogen, phosphorus, potassium, manganese, copper, and zinc, varies among different pea genotypes. The major minerals found in pea seeds are nitrogen (ranging from 28.49 to 54.78 g/kg), phosphorus (1.648 to 4.04 g/kg), and potassium (13.13 to 50.41 g/kg). Additionally, trace amounts of copper (3.51 to 21.79 mg/kg), iron (29.32 to 80.69 mg/kg), zinc (28.15 to 55.80 mg/kg), and manganese (7.96 to 22.83 mg/kg) are present, with variations among genotypes. Peas also contain selenium, though in smaller quantities (28.6 μg/100 g), which is still notably higher compared to mung beans. However, the bioavailability of these minerals in peas is not yet fully understood and warrants further research.Peas are also rich in certain vitamins, notably α-tocopherol and γ-tocopherol. The total tocopherol content in pea seeds ranges from 48.44 to 57.00 μg/g, which is higher than in lentils (29.65 to 46.18 μg/g) and kidney beans (22.53 to 35.82 μg/g), but lower than in chickpeas (150.29 to 170.51 μg/g). γ-tocopherol is the predominant form of tocopherol in peas, with concentrations ranging from 46.14 to 54.17 μg/g. Despite these findings, additional research is needed to verify these results. Moreover, the impact of food processing on the bioavailability of minerals and vitamins in peas remains uncertain and requires further investigation.

4.7. Other Beneficial Components:

Other beneficial compounds are also present in peas, such as β-carotene and zeaxanthin. A comparative study found that the contents of total carotenoids varied widely in different pea varieties, ranging from 16.72 to 59.39 mg β-carotene/kg DW. In addition, the content of carotenoids in green cotyledons of peas was found to be 10–27 μg/g DW, which was slightly higher than that in yellow cotyledons (5–17 μg/g DW). Indeed, the mean concentrations of lutein, β-carotene, zeaxanthin, and violaxanthin in 94 pea accessions were measured to be 11.2 μg/g, 0.5 μg/g, 0.3 μg/g, and 0.3 μg/g, respectively. The existence of other beneficial compounds in peas remains to be investigated in the future.

4.8. Anti-Nutritional Factors:

Legumes, including peas, often contain anti-nutritional factors that can affect their nutritional quality. These factors include tannins, phytic acid, cyanogenic glycosides, saponins, oxalates, biogenic amines, lectins, protease inhibitors, and α-amylase inhibitors. In peas, the primary anti-nutritional factors identified are phytic acid, lectins, oxalates, and trypsin inhibitors.

- Phytic Acid: This compound can form insoluble complexes with minerals such as copper, iron, and zinc, thereby reducing their absorption in the human digestive system. For instance, phytic acid significantly inhibits in vitro iron absorption in mature peas, though iron bioavailability is higher in immature peas. Peas contain 8.55–12.40 mg/g DW of phytic acid, comparable to lentils (8.56–15.56 mg/g DW) and chickpeas (11.33–14.00 mg/g DW), but less than faba beans (19.65–22.85 mg/g DW), common beans (15.64–18.82 mg/g DW), and soybeans (22.91–35.9 mg/g DW). Processing methods such as soaking, roasting, boiling, pressure cooking, and sprouting can effectively reduce phytic acid levels, with a combination of soaking, roasting, and pressure cooking being particularly effective.
- Lectins: These proteins are found in peas at levels (5.53–5.64 hemagglutinin units/mg DW) similar to those in faba beans (5.52–5.55 hemagglutinin units/mg DW), but significantly lower than in red kidney

beans (88.52 hemagglutinin units/mg DW), soybeans (692.82 hemagglutinin units/mg DW), and lentils (10.91–11.07 hemagglutinin units/mg DW). Cooking methods can significantly lower the lectin content in peas.

- Oxalates: The total oxalate content in peas (244.65–293.97 mg/100 g DW) is similar to that in faba beans (241.5–291.42 mg/100 g DW), but lower than in soybeans (370.49 mg/100 g DW). Cooking and soaking methods can effectively reduce oxalate levels.
- Tannins: Peas contain 161.26 mg/100 g DW of tannins, comparable to chickpeas (165.68 mg/100 g DW) but lower than lentils (282.3 mg/100 g DW) and common beans (410.93 mg/100 g DW). While tannins can reduce nutrient bioavailability, they also possess health benefits such as antioxidant, anti-diabetic, anti-inflammatory, anti-cancer, anti-allergic, and antimicrobial properties. Although their application in food is limited, tannins are widely used in the pharmaceutical industry**.**

5. Phytoconstituents present in pea plant:

Pea plants (Pisum sativum) contain a variety of phytoconstituents, including:

1**. Alkaloids**: Pisatine, pisamine, and hompisatine

2. **Flavonoids**: Quercetin, kaempferol, and naringenin

3. **Phenolic acids**: Ferulic acid, sinapic acid, and caffeic acid

4. **Saponins**: Pisumoside and pisavinoside

5. **Steroids**: Stigmasterol and sitosterol

6. **Carotenoids**: Lutein, zeaxanthin, and beta-carotene

7. **Glycosides**: Vicine and Convicine

8. **Amino acids**: Aspartic acid, glutamic acid, and arginine

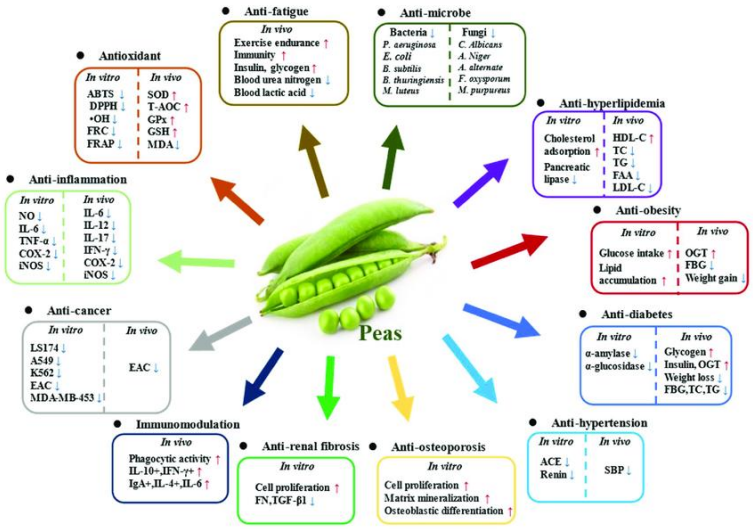
9. **Polysaccharides**: Galactomannans and arabinogalactans

10. **Isoflavones**: Daidzein and genistein

These phytoconstituents contribute to the plant's medicinal and nutritional properties, such as antioxidant, anti-inflammatory, and antimicrobial activities. They also play a role in plant defense mechanisms and have been explored for their potential health benefits.

6. Significance Ecological /Benefits:

Pea plants (Pisum sativum) have been used in traditional medicine for centuries, and research has confirmed their potential health benefits. Pea and its bioactive components possess various health benefits in vitro and in vivo, such as antioxidant, anti-inflammatory, immunomodulatory, anti-cancer, anti-hypertensive, anti-obesity, anti-diabetic, anti-hyperlipidemia, anti-fatigue, antimicrobial, anti-osteoporosis, and anti-renal fibrosis effects. A594, lung carcinoma; ABTS, 2,2 azinobis 3-ethylbenzo-thiozoline-6-sulfonic acid; ACE, angiotensin I-converting enzyme; COX-2, cyclooxygenase-2; DPPH, 2,2-Diphenyl-1-picrylhydrazyl; EAC, Ehrlich ascites carcinoma; FAA, free amino acid; FBG, fasting blood glucose; FN, fibronectin; FRAP, ferric reducing antioxidant power; FRC, ferric ion-reducing capacity; GPx, glutathione peroxidase; GSH, glutathione; HDL-C, high-density lipoprotein cholesterol; IFN-γ, interferon-gamma; IgA+, immunoglobulin class A+; IL, interleukin; iNOS, inducible nitric oxide synthase; K562, myelogenous leukemia; LS174, human colon denocarcinoma; LDL-C, low-density lipoprotein cholesterol; MDA, malondialdehyde; MDA-MB-453, breast carcinoma; NO, nitric oxide; OGT, oral glucose tolerance; ·OH, hydroxyl radical; SBP, systolic blood pressure; SOD, superoxide dismutase; T-AOC, total antioxidant capacity; TC, total cholesterol; TG, triglyceride; TGF-β, transforming growth factor beta; TNF-α, tumor necrosis factor α.



Here are some medicinal activities of pea plants:

6.1. Anti-inflammatory:

Pea extracts have been shown to reduce inflammation and alleviate conditions like arthritis.The anti-inflammatory activity of pea plants has been demonstrated in various studies, including:

- Inhibition of inflammation in animal models of arthritis, asthma, and allergic reactions.
- Reduction of inflammatory markers in human studies, such as C-reactive protein (CRP) and erythrocyte sedimentation rate (ESR).
- Inhibition of inflammatory enzymes like COX-2, 5-LOX, and iNOS. The anti-inflammatory effects of pea plants may be beneficial for managing conditions like: 1. Arthritis 2. Asthma 3. Allergies
- Inflammatory bowel disease (IBD)
- Cardiovascular disease While the anti-inflammatory activity of pea plants is promising, more human studies are needed to confirm its efficacy and optimal uses

6.2. Antioxidant:

Peas contain antioxidants that protect against cell damage, oxidative stress, and chronic diseases like cancer and heart disease.The antioxidant activity of pea plants has been demonstrated in various studies, including:

- Inhibition of lipid peroxidation and oxidative stress in animal models.
- Scavenging of free radicals and reactive oxygen species (ROS) in vitro.
- Protection against oxidative damage in human cells and tissues.
- Reduction of oxidative stress markers in human studies, such as malondialdehyde (MDA) and glutathione (GSH). The antioxidant activity of pea plants may be beneficial for managing conditions like: Cancer, Cardiovascular disease, neurodegenerative diseases. (e.g., Alzheimer's, Parkinson's)
- Inflammatory diseases Overall, the antioxidant activity of pea plants makes them a nutritious and potentially health-promoting food.

6.3. Antidiabetic:

Pea extracts have been found to have antidiabetic properties, improving insulin sensitivity and glucose metabolism.The antidiabetic activity of pea plants has been demonstrated in various studies, including:

- Inhibition of glucose absorption in animal models.
- Reduction of blood glucose levels in animal models of diabetes.
- Improvement of insulin sensitivity in human studies.
- Reduction of HbA1c levels (a marker of long-term glucose control) in human studies. The antidiabetic activity of pea plants may be beneficial for managing: Type 2 diabetes, Prediabetes, Insulin resistance.

- Metabolic syndrome The bioactive compounds responsible for the antidiabetic activity of pea plants include: Polyphenols (e.g., flavonoids, phenolic acids) , Protease inhibitors (e.g., PPIs) Saponins ,Fiber (e.g., soluble fiber, insoluble fiber) , Minerals (e.g., chromium, magnesium) Overall, the antidiabetic activity of pea plants makes them a nutritious and potentially health-promoting food for managing blood sugar levels.

6.4. Cardiovascular health:

Peas are rich in fiber, potassium, and antioxidants, which support heart health by reducing cholesterol, blood pressure, and inflammation. The pea plant (Pisum sativum) has been found to have numerous beneficial effects on cardiovascular health, including:

- Hypolipidemic activity: Pea extracts have been shown to reduce total cholesterol, LDL cholesterol, and triglycerides.
- .Antihypertensive activity: Pea extracts have been found to lower blood pressure in animal models.
- Endothelial function improvement: Pea extracts have been shown to improve endothelial function, which is important for maintaining healthy blood vessels.
- Platelet aggregation inhibition: Pea extracts have been found to inhibit platelet aggregation, which can help reduce the risk of cardiovascular events.
- Fibrinolytic activity: Pea extracts have been shown to have fibrinolytic activity, which can help dissolve blood clots. The bioactive compounds responsible for the cardiovascular health benefits of pea plants include: Polyphenols (e.g., flavonoids, phenolic acids), Protease inhibitors (e.g., PPIs), Saponins, Fiber (e.g., soluble fiber, insoluble fiber), Minerals (e.g., potassium, magnesium)
- Phytosterols The cardiovascular health benefits of pea plants may be beneficial for managing: Hyperlipidemia, Hypertension, Atherosclerosis, Cardiovascular disease, Stroke.

6.5. Anti-cancer:

Pea extracts have been shown to have anti-proliferative and anti-tumor effects, inhibiting cancer cell growth and inducing apoptosis (cell death).The pea plant (Pisum sativum) has been found to have anticancer activity, with various bioactive compounds contributing to its potential anticancer effects.

- Antiproliferative activity: Pea extracts have been shown to inhibit cancer cell growth and proliferation.
- Apoptosis induction: Pea extracts have been found to induce apoptosis (programmed cell death) in cancer cells.
- Anti-angiogenic activity: Pea extracts have been shown to inhibit angiogenesis (the formation of new blood vessels), which is essential for tumor growth.
- Antimetastatic activity: Pea extracts have been found to inhibit cancer cell migration and invasion.
- Antioxidant activity: Pea extracts have antioxidant properties, which can help protect against oxidative stress and DNA damage. The bioactive compounds responsible for the anticancer activity of pea plants include: Polyphenols (e.g., flavonoids, phenolic acids),Protease inhibitors (e.g., PPIs), Saponins

5.6. Immune system support:

Peas contain immunomodulatory compounds that stimulate the immune system and increase its response to infections. The pea plant (Pisum sativum) has been found to have anticancer activity, with various bioactive compounds contributing to its potential anticancer effects.

- Antiproliferative activity: Pea extracts have been shown to inhibit cancer cell growth and proliferation.
- Apoptosis induction: Pea extracts have been found to induce apoptosis (programmed cell death) in cancer cells.
- Anti-angiogenic activity: Pea extracts have been shown to inhibit angiogenesis (the formation of new blood vessels), which is essential for tumor growth.
- Antimetastatic activity: Pea extracts have been found to inhibit cancer cell migration and invasion.
- Antioxidant activity: Pea extracts have antioxidant properties, which can help protect against oxidative stress and DNA damage. The bioactive compounds responsible for the anticancer activity of pea plants include: Polyphenols (e.g., flavonoids, phenolic acids) Protease inhibitors (e.g., PPIs) 3. Saponins

6.7. Anti-microbial:

Pea extracts have been found to exhibit anti-bacterial, anti-fungal, and anti-viral properties, effective against various pathogens. The pea plant (Pisum sativum) has been found to have antimicrobial properties, inhibiting the growth of various microorganisms, including:

- Bacteria: Pea extracts have been shown to inhibit the growth of bacteria such as E. coli, Staphylococcus aureus, and Bacillus subtilis.
- Fungi: Pea extracts have been found to inhibit the growth of fungi such as Candida albicans, Aspergillus niger, and Fusarium oxysporum.
- Viruses: Pea extracts have been shown to inhibit the replication of viruses such as HIV, herpes simplex, and influenza.

7. Conclusions:

Pisum sativum (pea plant) in pharmacy and its potential as a source of valuable bioactive compounds. The plant's nutritional richness, including its high protein content and essential nutrients, supports its use in dietary supplements and functional foods. Its diverse phytochemicals, such as antioxidants and flavonoids, present promising opportunities for therapeutic applications, including anti-inflammatory and anti-cancer treatments. Traditional medicinal uses combined with modern research underscore Pisum sativum's potential in developing new pharmaceuticals and nutraceuticals. Its sustainability and safety profile further enhance its appeal as a versatile ingredient in the pharmaceutical industry. Overall, Pisum sativum represents a compelling candidate for future exploration and innovation in pharmacy.

8. References

1. Castaldo, L.; Izzo, L.; Gaspari, A.; Lombardi, S.; Rodriguez-Carrasco, Y.; Narvaez, A.; Grosso, M.; Ritieni, A. Chemical Composition of Green Pea (*Pisum sativum* L.) Pods Extracts and their Potential Exploitation as Ingredients in Nutraceutical Formulations. *Antioxidants* **2022**, *11*, 105
2. Zhang, S.J.; Hu, T.T.; Chen, Y.Y.; Wang, S.Y.; Kang, Y.F. Analysis of the Polysaccharide Fractions Isolated from Pea (*Pisum sativum* L.) at Different Levels of Purification. *J. Food Biochem.* **2020**, *44*, e13248.
3. Xu, M.J.; Saleh AS, M.; Liu, Y.; Jing, L.Z.; Zhao, K.; Wu, H.; Zhang, G.Q.; Yang, S.O.; Li, W.H. The Changes in Structural, Physicochemical, and Digestive Properties of Red Adzuki Bean Starch after Repeated and Continuous Annealing Treatments. *Starch-Starke* **2018**, *70*, 1700322.
4. Zhang, Z.S.; Tian, X.L.; Wang, P.; Jiang, H.; Li, W.H. Compositional, Morphological, and Physicochemical Properties of Starches from Red Adzuki Bean, Chickpea, Faba Bean, and Baiyue Bean Grown in China. *Food Sci. Nutr.* **2019**, *7*, 2485–2494.
5. Wang, M.; Chen, X.; Dong, L.; Nan, X.; Ji, W.; Wang, S.; Sun, W.; Zhou, Q. Modification of Pea Dietary Fiber by Ultrafine Grinding and Hypoglycemic Effect in Diabetes Mellitus Mice. *J. Food Sci.* **2021**, *86*, 1273–128.
6. Mayengbam, S.; Lambert, J.E.; Parnell, J.A.; Tunnicliffe, J.M.; Nicolucci, A.C.; Han, J.; Sturzenegger, T.; Shearer, J.; Mickiewicz, B.; Vogel, H.J.; et al. Impact of Dietary Fiber Supplementation on Modulating Microbiota-Host-Metabolic Axes in Obesity. *J. Nutr. Biochem.* **2019**, *64*, 228–236.
7. Castaldo, L.; Izzo, L.; Gaspari, A.; Lombardi, S.; Rodriguez-Carrasco, Y.; Narvaez, A.; Grosso, M.; Ritieni, A. Chemical Composition of Green Pea (*Pisum sativum* L.) Pods Extracts and their Potential Exploitation as Ingredients in Nutraceutical Formulations. *Antioxidants* **2022**, *11*, 105.
8. Abdelghffar, E.A.; Obaid, W.A.; Elgamal, A.M.; Daoud, R.; Sobeh, M.; El Raey, M.A. Pea (*Pisum sativum*) Peel Extract Attenuates Dox-Induced Oxidative Myocardial Injury. *Biomed. Pharm.* **2021**, *143*, 112120.
9. Guo, F.H.; Tsao, R.; Wang, X.Y.; Jiang, L.; Sun, Y.; Xiong, H. Phenolics of Yellow Pea (*Pisum sativum* L.) Hulls, their Plasma and Urinary Metabolites, Organ Distribution, and In Vivo Antioxidant Activities. *J. Agric. Food Chem.* **2021**, *69*, 5013–50.
10. Zhao, T.Y.; Su, W.J.; Qin, Y.; Wang, L.Y.; Kang, Y.F. Phenotypic Diversity of Pea (*Pisum sativum* L.) Varieties and the Polyphenols, Flavonoids, and Antioxidant Activity of their Seeds. *Cienc. Rural.* **2020**, *50*, e20190196.

11. Arif, U.; Ahmed, M.J.; Rabbani, M.A.; Arif, A.A. Assessment of Genetic Diversity in Pea (*Pisum sativum* L.) Landraces Based on Physico-Chemical and Nutritive Quality Using Cluster and Principal Component Analysis. *Pak. J. Bot.* **2020**, *52*, 575–580.
12. Abdel-Aal, E.-S.M.; Ragaee, S.; Rabalski, I.; Warkentin, T.; Vandenberg, A. Nutrient Content and Viscosity of Saskatchewan-Grown Pulses in Relation to their Cooking Quality. *Can. J. Plant. Sci.* **2019**, *99*, 67–77.
13. Aluko, R.E.; Girgih, A.T.; He, R.; Malomo, S.; Li, H.; Offengenden, M.; Wu, J.P. Structural and Functional Characterization of Yellow Field Pea Seed (*Pisum sativum* L.) Protein-Derived Antihypertensive Peptides. *Food Res. Int.* **2015**, *77*, 10–16.
14. Shanthakumar, P.; Klepacka, J.; Bains, A.; Chawla, P.; Dhull, S.B.; Najda, A. The Current Situation of Pea Protein and its Application in the Food Industry. *Molecules* **2022**, *27*, 5354.
15. Ge, J.; Sun, C.X.; Mata, A.; Corke, H.; Gan, R.Y.; Fang, Y.P. Physicochemical and pH-Dependent Functional Properties of Proteins Isolated from Eight Traditional Chinese Beans. *Food Hydrocolloid* **2021**, *112*, 106288.
16. Chahbani, A.; Fakhfakh, N.; Balti, M.A.; Mabrouk, M.; El-Hatmi, H.; Zouari, N.; Kechaou, N. Microwave Drying Effects on Drying Kinetics, Bioactive Compounds and Antioxidant Activity of Green Peas (*Pisum sativum* L.). *Food Biosci.* **2018**, *25*, 32–38.
17. Elessawy, F.M.; Bazghaleh, N.; Vandenberg, A.; Purves, R.W. Polyphenol Profile Comparisons of Seed Coats of Five Pulse Crops Using a Semi-Quantitative Liquid Chromatography-Mass Spectrometric Method. *Phytochem. Anal.* **2020**, *31*, 458–471.
18. Guo, F.H.; Tsao, R.; Li, C.Y.; Wang, X.Y.; Zhang, H.; Jiang, L.; Sun, Y.; Xiong, H. Green Pea (*Pisum sativum* L.) Hull Polyphenol Extracts Ameliorate Dss-Induced Colitis through Keap1/Nrf2 Pathway and Gut Microbiota Modulation. *Foods* **2021**, *10*, 2765.
19. Mejri, F.; Ben Khoud, H.; Njim, L.; Baati, T.; Selmi, S.; Martins, A.; Serralheiro, M.L.M.; Rauter, A.P.; Hosni, K. In Vitro and In Vivo Biological Properties of Pea Pods (*Pisum sativum* L.). *Food Biosci.*
20. Kan, L.; Nie, S.; Hu, J.; Wang, S.; Bai, Z.; Wang, J.; Zhou, Y.; Jiang, J.; Zeng, Q.; Song, K.; et al. Comparative Study on the Chemical Composition, Anthocyanins, Tocopherols and Carotenoids of Selected Legumes. *Food Chem.* **2018**, *260*, 317–326.
21. Ye, S.X.; Shah, B.R.; Li, J.; Liang, H.S.; Zhan, F.C.; Geng, F.; Li, B. A Critical Review on Interplay Between Dietary Fibers and Gut Microbiota. *Trends Food Sci. Technol.* **2022**, *124*, 237–249.
22. Ciurescu, G.; Toncea, I.; Ropota, M.; Habeanu, M. Seeds Composition and Their Nutrients Quality of Some Pea (*Pisum sativum* L.) and Lentil (*Lens culinaris* Medik.) Cultivars. *Rom. Agric. Res.* **2018**, *35*, 101–108.
23. El-Saadony, M.T.; El-Hack, M.E.A.; Swelum, A.A.; Al-Sultan, S.I.; El-Ghareeb, W.R.; Hussein, E.O.S.; Ba-Awadh, H.A.; Akl, B.A.; Nader, M.M. Enhancing Quality and Safety of Raw Buffalo Meat Using the Bioactive Peptides of Pea and Red Kidney Bean under Refrigeration Conditions. *Ital. J. Anim. Sci.* **2021**, *20*, 762–776.
24. El-Araby, M.M.; El-Shatoury, E.H.; Soliman, M.M.; Shaaban, H.F. Characterization and Antimicrobial Activity of Lectins Purified from Three Egyptian Leguminous Seeds. *Amb. Express* **2020**, *10*, 90.
25. Belghith-Fendri, L.; Chaari, F.; Ben Jeddou, K.; Kallel, F.; Bouaziz, F.; Helbert, C.B.; Abdelkefi-Mesrati, L.; Ellouz-Chaabouni, S.; Ghribi-Aydi, D. Identification of Polysaccharides Extracted from Pea Pod By-Products and Evaluation of their Biological and Functional Properties. *Int. J. Biol. Macromol.* **2018**, *116*, 947–954
26. Hadrich, F.; El Arbi, M.; Boukhris, M.; Sayadi, S.; Cherif, S. Valorization of the Peel of Pea: *Pisum sativum* by Evaluation of its Antioxidant and Antimicrobial Activities. *J. Oleo Sci.* **2014**, *63*, 1177–1183.