

CHAPTER 06

Harvesting Benefits: The Health and Economic Rewards of Pea Cultivation

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Abstract

Pea (*Pisum sativum* L.) is one of the world's most important pulse crops because of its exceptional nutritional value, health-promoting properties, and contribution to sustainable agricultural systems. Rich in plant-based protein, dietary fiber, vitamins, minerals, and diverse bioactive compounds, peas support human nutrition while contributing to the prevention and management of several chronic diseases. Beyond their nutritional significance, peas play a vital role in environmentally sustainable agriculture through biological nitrogen fixation, improved soil fertility, and reduced dependence on synthetic fertilizers, complementing the crop-diversification strategies discussed for Pakistan's land-use systems in Chapter 4. The crop also provides substantial economic opportunities owing to its increasing demand in food, feed, and value-added industries. Recent advances in crop improvement, processing technologies, and the expanding market for plant-based protein have further enhanced the commercial importance of pea cultivation worldwide. This chapter reviews the historical development, nutritional composition, health benefits, economic importance, environmental contributions, and future prospects of pea cultivation. It further discusses the role of peas in sustainable food systems, climate-smart agriculture, and rural economic development while highlighting opportunities for enhancing agricultural productivity and global food security.

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6.1 Introduction

Pea (*Pisum sativum* L.) is among the earliest domesticated food legumes and has remained an important component of human nutrition for more than 10,000 years. Archaeological evidence suggests that pea cultivation originated in the Fertile Crescent of the Near East before spreading throughout Europe, Asia, and subsequently to other parts of the world. Owing to its adaptability to diverse agroecological conditions, high nutritional value, and relatively low production cost, pea has become one of the most widely cultivated pulse crops and continues to contribute significantly to global food and nutritional security (Dahl et al., 2012; Wu et al., 2023).

Pulses have gained renewed global attention because they provide sustainable sources of plant protein while simultaneously contributing to environmental conservation. Among these crops, peas occupy a unique position because they combine high nutritional quality with important agronomic benefits. Their seeds are rich in proteins, complex carbohydrates, dietary fiber, essential vitamins, minerals, and numerous phytochemicals, including polyphenols, flavonoids, carotenoids, and saponins, which collectively contribute to improved human health (Dahl et al., 2012; Wu et al., 2023). Regular consumption of peas has been associated with improved digestive health, better glycaemic regulation, reduced cardiovascular disease risk, enhanced antioxidant capacity, and strengthened immune function (Dahl et al., 2012).

From an agricultural perspective, pea cultivation contributes substantially to sustainable farming systems. As a leguminous crop, peas establish a symbiotic relationship with *Rhizobium* bacteria, enabling biological nitrogen fixation that enriches soil fertility, reduces the requirement for synthetic nitrogen fertilizers, and improves the productivity of subsequent crops grown in rotation (Peoples et al., 2009). This ecological

function not only lowers production costs but also minimizes greenhouse gas emissions and supports climate-smart agricultural practices.

The global market for peas has expanded considerably during the past decade owing to increasing consumer demand for healthy foods, plant-based proteins, and environmentally sustainable agricultural products. Pea-derived ingredients are increasingly utilized in functional foods, meat alternatives, dairy substitutes, nutraceuticals, and food-processing industries, creating new economic opportunities for farmers, processors, and agribusinesses (Wu et al., 2023). Consequently, pea cultivation contributes not only to food and nutritional security but also to income generation, rural development, and sustainable economic growth.

This chapter provides a comprehensive review of pea cultivation from both health and economic perspectives. It discusses the origin and diversity of pea varieties, nutritional composition, health-promoting properties, economic importance, environmental benefits, value-added processing opportunities, and prospects. The chapter further highlights the contribution of pea cultivation to sustainable agriculture, climate resilience, and food system transformation, thereby demonstrating why peas remain one of the most valuable crops for achieving health, environmental, and economic sustainability.

6.2 Diversity and Types of Peas

Pea (*Pisum sativum* L.) is a versatile legume crop cultivated for fresh vegetable consumption, processing, mature dry seeds, and animal feed. Considerable diversity exists within cultivated pea with respect to pod morphology, seed characteristics, plant architecture, maturity, and end use. From a horticultural perspective, garden or English pea, snow pea, and snap pea represent the principal vegetable types, while field pea is primarily produced as a grain or forage crop. These differences in morphological characteristics and harvesting stage determine the way peas are produced, marketed, processed, and consumed (Ram et al., 2021; Wu et al., 2023; Zhang et al., 2025).

6.2.1 Garden or English Pea

Garden pea, also known as English pea or shelling pea, is cultivated primarily for its immature green seeds. A characteristic feature of the garden peas is the presence of a parchment or sclerenchymatous layer on the inner surface of the pod. This layer becomes relatively fibrous as the pod develops and therefore makes the pod unsuitable for consumption at the normal harvesting stage. Consequently, the pods are shelled, and the immature seeds are consumed either fresh or after processing. Garden peas are widely marketed as fresh vegetables and are also preserved through freezing, canning, dehydration, and other processing methods (Ram et al., 2021; Wu et al., 2023).

Substantial morphological and genetic variation occurs within garden peas. Cultivars differ in plant height, maturity duration, pod characteristics, seed color and shape, and other agronomic and quality traits. Both smooth- and wrinkled-seeded forms occur, reflecting important genetic variation in seed development and carbohydrate composition. Such diversity provides valuable material for breeding programs aimed at improving yield, nutritional quality, stress tolerance, disease resistance, and adaptation to different production environments (Khatri et al., 2025; Kreplak et al., 2019).

The genetic diversity of *P. sativum* has gained additional importance with the development of genomic resources. The chromosome-level reference genome of pea has facilitated the study of genetic variation and agronomically important traits and provides a foundation for more efficient crop improvement. Consequently, the diversity found within garden pea germplasm can increasingly be exploited through molecular breeding and genomic approaches to develop cultivars with improved productivity and quality (Kreplak et al., 2019; Verma et al., 2026).

6.2.2 Snow Pea

Snow pea is an edible-podded type of pea harvested at an immature stage when the pods are tender, and the seeds are only partially developed. Unlike shelling peas, snow pea pods lack the well-developed parchment layer that makes mature garden-pea pods fibrous. As a result, the entire young pod can be consumed without

removing the seeds. Snow pea pods are characteristically broad, flat, and relatively thin, although considerable variation in pod size, shape, and color exists among cultivars (Ram et al., 2021).

The edible-podded nature of snow pea makes it particularly suitable for fresh vegetable markets. The pods may be eaten raw or cooked and are commonly used in salads, stir-fries, and other vegetable preparations. Their market value is closely associated with pod tenderness, crispness, appearance, sweetness, and freedom from defects. Breeding efforts have consequently focused on improving pod quality together with yield, disease resistance, and adaptation to different production environments (Ram et al., 2021; Zhang et al., 2025).

6.2.3 Snap Pea

Snap pea, commonly known as sugar snap pea, is another edible-podded form of *P. sativum*. It differs from snow pea mainly in pod morphology. Snap pea produces relatively thick, fleshy, and rounded or inflated pods in which the seeds become substantially developed while the pod remains tender and edible. In contrast, snow pea generally produces flatter pods with less-developed seeds at the edible stage. Snap peas are therefore distinguished by their combination of crisp edible pods and relatively well-developed, sweet seeds (Ram et al., 2021).

Snap pea has a distinctive breeding history associated with the development and selection of desirable pod characteristics. Breeding objectives have included pod quality, sweetness, crispness, yield, disease resistance, plant architecture, and adaptation to production environments. The development of snap pea cultivars has consequently expanded the range of fresh-market pea products available to consumers (Myers et al., 2001; Ram et al., 2021).

6.2.4 Field Pea

Field pea differs from the principal fresh-market vegetable types primarily in its production purpose and harvesting stage. It is cultivated predominantly for mature dry seeds, livestock feed, forage, and other agricultural uses. Field peas are therefore generally managed as grain or forage crops rather than harvested primarily for immature green seeds or edible pods (Wu et al., 2023; Zhang et al., 2025).

Plant architecture is an important consideration in field-pea production because conventional pea plants can be susceptible to lodging. The development and widespread adoption of semi-leafless types have helped address this problem by improving standability and facilitating mechanical harvesting. Comparative research has shown that semi-leafless genotypes can provide important agronomic advantages, although normal-leaved types may retain value in particular production systems, including situations where greater competitiveness with weeds is desirable (Tran et al., 2022).

Field pea is also important from a sustainable agriculture perspective because it is a legume capable of symbiotic nitrogen fixation. Its inclusion in cropping systems can contribute nitrogen to agricultural systems and reduce dependence on externally applied nitrogen fertilizers. Consequently, field pea can serve both food and feed markets while also contributing to low-input and diversified cropping systems (Tran et al., 2022; Zhang et al., 2025).

6.2.5 Genetic Diversity and Future Improvement

The diversity of pea types extends beyond differences visible at the pod and plant level. Genetic variation within *P. sativum* provides resources for improving yield, nutritional quality, disease resistance, stress tolerance, plant architecture, and other traits of agricultural importance. The availability of a high-quality reference genome has substantially strengthened the capacity to identify and utilize genetic variation in pea breeding (Kreplak et al., 2019).

Recent advances in molecular breeding have further expanded opportunities to develop pea cultivars adapted to changing environmental conditions. Abiotic stresses can constrain pea productivity, and breeding programs are increasingly combining conventional selection with genomic resources, molecular markers, quantitative trait analysis, and other advanced approaches to improve stress tolerance (Verma et al., 2026).

These developments are particularly relevant to the future sustainability of pea production under climate variability.

Recent agronomic reviews also emphasize the need to integrate cultivar improvement with appropriate cultivation, harvesting, and post-harvest management practices. Such an integrated approach can improve productivity, reduce losses, strengthen climate resilience, and enhance the contribution of pea to sustainable food systems (Zhang et al., 2025).

6.2.6 Importance of Pea Diversity

The diversity of pea types enables the crop to serve multiple food and agricultural markets. Garden or English peas are primarily valued for their immature seeds; snow and snap peas are harvested for their edible pods and developing seeds; and field peas are predominantly cultivated for mature dry seeds, forage, or feed. Differences in pod structure, seed development, plant architecture, and harvesting stage consequently influence production practices, post-harvest handling, processing requirements, and consumer preferences (Ram et al., 2021; Wu et al., 2023).

This diversity also provides an important foundation for value addition and crop improvement. Different pea types can supply raw materials for fresh vegetables, frozen and canned products, dry pulses, animal feed, and emerging plant-based food applications. At the same time, genetic diversity provides opportunities to develop cultivars that combine desirable nutritional and market characteristics with improved resistance to biotic and abiotic stresses (Khatri et al., 2025; Wu et al., 2023; Verma et al., 2026). Thus, diversity in pea should be viewed not merely as a distinction among culinary types but as an important biological, agricultural, and economic resource. Understanding the characteristics and uses of different pea types provides a necessary foundation for examining their nutritional composition, health benefits, economic significance, and contribution to sustainable agricultural systems.

6.3 Nutritional Composition of Peas

Peas (*Pisum sativum* L.) are nutritionally valuable legumes that provide a combination of macronutrients, micronutrients, dietary fiber, and biologically active phytochemicals. Their nutritional composition varies according to cultivar, genotype, maturity stage, growing environment, and processing conditions. Nevertheless, peas are generally characterized by appreciable concentrations of protein, complex carbohydrates, dietary fiber, vitamins, minerals, and bioactive compounds, making them an important component of diversified and nutrient-rich diets (Dahl et al., 2012; Wu et al., 2023; Akin et al., 2025).

6.3.1 Protein

Protein is one of the most important nutritional components of peas. Dry pea seeds generally contain approximately 20–25% protein on a dry-weight basis, although the concentration varies among cultivars and production environments (Wu et al., 2023). Pea proteins are composed predominantly of storage proteins, particularly globulins, with legumin and vicilin representing major protein fractions. Pea protein is also characterized by a relatively high lysine content, which is nutritionally important because lysine is often limited in cereal-based diets (Wu et al., 2023).

The nutritional importance of pea protein extends beyond its protein content. Pea proteins and their derived peptides have attracted considerable attention as ingredients for plant-based foods and as potential functional food components. Their functional properties, including water and oil binding, emulsification, gel formation, and foaming, have encouraged their incorporation into protein isolates, beverages, meat alternatives, bakery products, and other food formulations (Wu et al., 2023; Nikolić et al., 2026). However, peas do not provide an ideal balance of all essential amino acids, particularly sulfur-containing amino acids. Combining peas with complementary plant protein sources can therefore improve the overall amino acid balance of plant-based diets (Dahl et al., 2012; Wu et al., 2023).

6.3.2 Carbohydrates and Starch

Carbohydrates constitute the major proportion of dry pea seeds. Wu et al. (2023) reported that carbohydrates account for approximately 59–70% of the dry weight of pea seeds, with starch representing a substantial component. Pea starch is composed primarily of amylose and amylopectin, and its structural characteristics influence digestibility, texture, and functional properties during food processing.

The carbohydrate profile of peas differs from that of many refined cereal foods because peas also contain substantial quantities of dietary fiber and resistant carbohydrate fractions. Resistant starch escapes digestion in the small intestine and reaches the large intestine, where it can be fermented by intestinal microorganisms. Consequently, the type and structure of carbohydrates in peas are relevant not only to their energy contribution but also to their potential effects on digestive and metabolic health (Kumari & Deka, 2021; Wu et al., 2023).

6.3.3 Dietary Fiber

Dietary fiber is another important nutritional component of peas. Pea seeds contain both soluble and insoluble fiber fractions, although their relative proportions vary according to cultivar and analytical method. Wu et al. (2023) reported total dietary fiber values of approximately 23–31% in dry pea seeds, while the more recent literature indicates considerable variation depending on genotype and processing conditions.

Soluble fiber includes components such as pectins and certain oligosaccharides, whereas insoluble fiber is associated largely with structural plant components such as cellulose and hemicellulose. Pea fiber contributes to stool bulk and intestinal function, while fermentable fiber fractions can interact with the gut microbiota. Resistant starch and other fermentable carbohydrates may also contribute to the production of short-chain fatty acids during colonic fermentation, providing a potential link between pea consumption and gastrointestinal health (Dahl et al., 2012; Kumari & Deka, 2021; Nikolić et al., 2026).

The fiber content of peas is therefore nutritionally important because it contributes to satiety, digestive function, and the regulation of carbohydrate absorption. Nevertheless, claims concerning specific clinical effects should be interpreted cautiously because the strength of evidence differs among outcomes and much of the mechanistic literature is based on experimental rather than long-term human intervention studies (Dahl et al., 2012).

6.3.4 Vitamins and Minerals

Peas provide a range of micronutrients, although their exact concentrations depend on pea type, cultivar, maturity, growing conditions, and preparation method. Green peas contain vitamin C and provide several B-group vitamins, while folate is particularly relevant because of its role in DNA synthesis and normal cellular metabolism. Peas also provide minerals such as potassium, phosphorus, magnesium, iron, and zinc (Dahl et al., 2012; Wu et al., 2023).

Vitamin C is a water-soluble antioxidant that contributes to normal immune function and collagen synthesis, whereas folate is essential for nucleotide synthesis and cellular division. Potassium and magnesium contribute to normal physiological functions including nerve and muscle function and maintenance of electrolyte balance. The contribution of peas to micronutrient intake should therefore be considered alongside their protein and fiber content rather than in isolation (Dahl et al., 2012).

Importantly, nutritional composition should not be represented by a single universal value because substantial differences occur among cultivars and between fresh and dry peas. Cooking and other processing operations can also alter the concentration and bioavailability of certain nutrients and phytochemicals. Consequently, food-composition values should always be interpreted in relation to the specific pea product and preparation method being considered (Wu et al., 2023).

6.3.5 Bioactive Compounds

In addition to conventional nutrients, peas contain a range of biologically active compounds. These include phenolic acids, flavonoids, carotenoids, saponins, and other phytochemicals. Many phenolic compounds are concentrated in the seed coat, and differences in seed-coat color can be associated with variation in phenolic and flavonoid concentrations (Dahl et al., 2012; Wu et al., 2023).

These compounds have attracted considerable scientific interest because of their antioxidant and other biological activities. Experimental studies indicate that pea-derived phenolic compounds and other bioactive constituents may influence oxidative stress, inflammatory pathways, glucose metabolism, and lipid metabolism. However, the presence of a bioactive compound or antioxidant activity measured *in vitro* does not by itself establish a corresponding clinical benefit in humans. Human intervention studies are therefore important for determining the magnitude and practical significance of these effects (Dahl et al., 2012; Kumari & Deka, 2021).

6.3.6 Antinutritional Factors and Nutrient Bioavailability

Although peas have considerable nutritional value, they also contain naturally occurring antinutritional compounds. These include phytic acid, lectins, and protease inhibitors, which can influence the digestibility or bioavailability of certain nutrients. Phytic acid, for example, can bind minerals and reduce their bioavailability, whereas protease inhibitors may interfere with protein digestion (Wu et al., 2023).

Processing methods such as soaking, germination, cooking, milling, and other food-processing treatments can modify these compounds and improve the functional and nutritional properties of pea ingredients. Therefore, nutritional evaluation of peas should consider not only the concentration of nutrients but also their bioavailability and the effects of processing (Kumari & Deka, 2021; Wu et al., 2023).

6.3.7 Overall Nutritional Significance

The nutritional value of peas arises from the combined contribution of protein, complex carbohydrates, dietary fiber, micronutrients, and bioactive compounds rather than from any single constituent. This combination makes peas particularly relevant to diets seeking greater inclusion of plant-based protein and fiber. Their nutritional profile also supports the growing use of pea flour, protein concentrates, protein isolates, starch, and fiber in food products (Wu et al., 2023; Nikolić et al., 2026). The nutritional composition of peas provides the foundation for their potential health benefits, which are discussed in the following section. However, the strength of evidence differs among proposed health effects, and scientifically rigorous interpretation requires distinguishing established nutritional functions from potential benefits demonstrated primarily through experimental or preliminary studies.

6.4 Health Benefits of Peas

The nutritional composition of peas provides a biological basis for several potential health benefits. Their combination of plant protein, dietary fiber, slowly digestible carbohydrates, vitamins, minerals, and bioactive phytochemicals may contribute to gastrointestinal, metabolic, and cardiovascular health. However, the magnitude of these effects depends on the amount and form of pea consumed, the overall dietary pattern, and individual characteristics. Therefore, the health effects of peas should be considered as part of a balanced diet rather than as evidence that peas alone prevent or treat disease (Dahl et al., 2012; Kumari & Deka, 2021; Wu et al., 2023).

6.4.1 Digestive and Gut Health

The dietary fiber and fermentable carbohydrate fractions of peas can contribute to normal gastrointestinal function. Insoluble fiber increases stool bulk and can support regular bowel movements, whereas soluble and fermentable fiber fractions can interact with the intestinal microbiota. During fermentation in the large

intestine, selected carbohydrates and fiber fractions can contribute to the production of short-chain fatty acids, which participate in maintaining intestinal homeostasis (Dahl et al., 2012; Kumari & Deka, 2021).

Peas also contain resistant starch and other carbohydrates that are not completely digested in the small intestine. These components can reach the colon and become substrates for microbial fermentation. Consequently, regular inclusion of fiber-rich legumes such as peas in the diet may support a more favorable dietary environment for gastrointestinal health. Nevertheless, individual responses to fermentable carbohydrates vary, and excessive intake may cause gastrointestinal discomfort in susceptible individuals (Kumari & Deka, 2021; Wu et al., 2023).

The relationship between pea consumption and gut health is therefore biologically plausible and supported by evidence concerning fiber and fermentable carbohydrate intake, but more human intervention studies specifically examining whole-pea consumption are required before specific clinical effects can be attributed exclusively to peas.

6.4.2 Glycaemic Regulation and Metabolic Health

Peas have nutritional characteristics that can contribute to relatively gradual carbohydrate digestion and absorption. Their protein and dietary fiber content can slow gastric emptying and carbohydrate absorption, while resistant starch and other slowly digestible carbohydrate fractions may further influence the postprandial glucose response (Dahl et al., 2012; Wu et al., 2023).

Experimental and human studies provide evidence that pea-based foods and pea-derived ingredients can influence postprandial glycaemic responses. In a randomized crossover study, Johnston et al. (2021) found that extruded pea fractions affected postprandial glucose, insulin, appetite, and subsequent food intake in healthy young adults. More recently, a 2026 randomized crossover pilot study found that consuming pea protein before a carbohydrate-rich meal reduced the postprandial glucose excursion compared with the carbohydrate control in healthy adults (Elbira et al., 2026). These findings are promising, although the latter study involved only ten participants and therefore should be interpreted as preliminary evidence rather than definitive clinical evidence. The potential metabolic benefits of peas are therefore likely to arise from the combined effects of protein, fiber, resistant starch, and other components rather than from a single compound. Importantly, evidence supporting improved postprandial glycaemia should not be interpreted as demonstrating that peas independently prevent or treat diabetes. Rather, their incorporation into balanced diets may be useful as part of broader dietary strategies for improving carbohydrate quality and metabolic health (Dahl et al., 2012; Wu et al., 2023).

6.4.3 Cardiovascular Health

Several characteristics of peas are relevant to cardiovascular health. Their dietary fiber can contribute to improved dietary quality, while their potassium, magnesium, and other micronutrients contribute to normal physiological functions involved in cardiovascular regulation. Peas also provide plant protein and bioactive compounds that have been investigated for their potential effects on lipid metabolism and oxidative processes (Dahl et al., 2012; Wu et al., 2023). Evidence from human intervention studies, however, indicates that cardiovascular effects should be described cautiously. A randomized controlled trial published in 2024 compared regular consumption of peas with beans and rice in adults with mild hypercholesterolemia. After six weeks, the pea group did not show a statistically significant reduction in LDL cholesterol compared with the rice control, although the study provides useful evidence concerning the cardiovascular effects of regular pulse consumption (Bell et al., 2024).

Earlier research reviewed by Dahl et al. (2012) also reported mixed findings regarding the effects of peas and pea fiber on blood lipids. Some interventions suggested favorable effects on postprandial lipid responses, whereas short-term studies did not consistently demonstrate reductions in fasting cholesterol concentrations. Consequently, it is more scientifically appropriate to describe peas as a nutrient-dense food that can form part of a cardiovascular-friendly dietary pattern rather than claiming that pea consumption directly lowers cholesterol or prevents cardiovascular disease.

6.4.4 Antioxidant and Anti-inflammatory Potential

Peas contain several classes of bioactive compounds, including phenolic compounds, flavonoids, carotenoids, and saponins. These compounds can exhibit antioxidant activity in experimental systems and may interact with biological pathways associated with oxidative stress and inflammation (Kumari & Deka, 2021; Wu et al., 2023).

Oxidative stress and chronic inflammation are involved in the development of numerous chronic diseases. The antioxidant properties of pea-derived compounds have therefore generated interest in their potential contribution to health maintenance. However, antioxidant activity measured in chemical or cell-based assays does not necessarily translate directly into disease prevention in humans. The physiological effects of individual phytochemicals also depend on their concentration, absorption, metabolism, and interactions with other dietary components (Wu et al., 2023). Accordingly, peas can reasonably be considered a source of antioxidant and potentially anti-inflammatory dietary components, but stronger clinical evidence is required before specific disease-prevention claims are made. This distinction is particularly important when communicating the health value of functional foods in an academic context.

6.4.5 Potential Role in Weight Management and Satiety

The combination of protein and dietary fiber in peas may contribute to satiety and appetite regulation. Protein generally has a relatively high satiating capacity, while dietary fiber can increase food volume and delay digestion. These characteristics may make pea-containing foods useful components of dietary patterns designed to improve satiety and overall diet quality (Dahl et al., 2012; Wu et al., 2023).

Evidence from acute feeding studies also suggests that pea-derived ingredients can influence appetite-related outcomes. Johnston et al. (2021), for example, reported changes in appetite and food intake following consumption of extruded pea fractions in healthy young adults. Nevertheless, short-term effects on appetite should not be interpreted as proof that pea consumption alone causes long-term weight loss. Sustainable weight management depends on overall energy intake, dietary composition, physical activity, and other behavioral and physiological factors.

6.4.6 Eye Health

Green peas contain carotenoids, including lutein and zeaxanthin, which are important dietary xanthophylls associated with ocular tissues. Lutein and zeaxanthin accumulate in the retina, particularly in the macular region, where they contribute to protection against oxidative stress and help filter high-energy blue light (Mares, 2016; Abdel-Aal et al., 2013).

Research on dietary lutein and zeaxanthin has linked adequate intake and tissue concentrations of these carotenoids with aspects of visual function and age-related eye health. However, the concentration of these compounds varies considerably among foods and pea cultivars, and the presence of lutein and zeaxanthin in peas should not be interpreted as evidence that pea consumption alone prevents age-related macular degeneration or cataracts (Abdel-Aal et al., 2013; Mares, 2016). Thus, peas can contribute to dietary intake of carotenoids that are relevant to eye health, particularly when consumed as part of a diverse diet rich in vegetables and other nutrient-dense foods.

6.4.7 Immune and General Health

Peas provide several nutrients involved in normal immune and physiological functions, including vitamin C, folate, zinc, iron, and other micronutrients. Vitamin C contributes to normal immune function and antioxidant protection, while adequate iron and zinc intake is important for a range of physiological processes. The contribution of peas to these nutrient intakes can therefore support general nutritional adequacy (Dahl et al., 2012; Wu et al., 2023).

It is important, however, to distinguish between supporting normal physiological function and claiming a therapeutic effect. Peas should not be presented as a treatment for infections, inflammatory diseases, or

immune disorders. Their principal contribution is as part of a nutritionally diverse dietary pattern that supplies essential nutrients and bioactive compounds.

6.4.8 Gluten-Free Dietary Suitability

Peas are naturally gluten-free because they are legumes rather than cereals containing wheat, barley, or rye gluten proteins. This makes whole peas and appropriately processed pea ingredients potentially suitable for individuals following gluten-free diets, including people who must avoid gluten for medical reasons (Wu et al., 2023). Nevertheless, the gluten-free status of a particular commercial pea product depends on processing and handling. Cross-contact with gluten-containing grains can occur during harvesting, transportation, milling, manufacturing, or packaging. Individuals who require a medically strict gluten-free diet should therefore select products that are appropriately labelled and manufactured according to relevant gluten-free standards.

6.4.9 Overall Health Significance

The health significance of peas arises from the interaction of several nutritional components rather than from a single "active" ingredient. Protein, dietary fiber, slowly digestible carbohydrates, vitamins, minerals, carotenoids, phenolic compounds, and other phytochemicals collectively contribute to the nutritional quality of the crop (Dahl et al., 2012; Kumari & Deka, 2021; Wu et al., 2023).

Current evidence is strongest for the nutritional value of peas and the physiological relevance of their protein and fiber content. Evidence for specific clinical outcomes including cholesterol reduction, glycaemic control, weight management, cardiovascular protection, and disease prevention is more variable and continues to develop. Recent human trials involving pea protein and whole-pea consumption are encouraging but also demonstrate why claims should be matched carefully to the strength and duration of available evidence (Bell et al., 2024; Elbira et al., 2026). Overall, incorporating peas into a balanced dietary pattern can provide an accessible source of plant protein, dietary fiber, micronutrients, and bioactive compounds. Their nutritional characteristics make them particularly relevant to dietary patterns emphasizing plant-based foods, dietary diversity, and sustainable sources of protein.

6.5 Economic Importance and Value-Addition Opportunities

Pea cultivation has considerable economic importance because the crop generates value at several stages of the agricultural and food-supply chain. At the farm level, peas provide an additional income-generating option for crop diversification and can be incorporated into rotations with cereals and other crops. Their biological nitrogen-fixing capacity can also contribute to improved soil fertility and potentially reduce dependence on externally applied nitrogen fertilizers, although the magnitude of these benefits varies with soil conditions, rhizobial activity, cultivar, and production practices (Zhang et al., 2025; Nikolić et al., 2026). Thus, the economic contribution of peas should be considered not only through direct crop returns but also through their potential contribution to resource-efficient cropping systems.

The expanding demand for plant-based foods has created additional market opportunities for peas. Pea protein is increasingly used in meat alternatives, beverages, nutritional products, and other functional foods, while whole peas and pea flour can be incorporated into a wide range of processed foods. This diversification of end uses creates opportunities for processors and agribusinesses to move beyond the sale of raw agricultural produce toward higher-value products (Wu et al., 2023; Nikolić et al., 2026).

Processing and value addition can substantially increase the economic utility of pea biomass. Peas can be processed into frozen, canned, dried, milled, and flour-based products, while specialized processing can produce protein concentrates and isolates. Pea starch and dietary fiber also have functional properties that support their incorporation into food products. Importantly, recent research emphasizes the potential to utilize starch- and fiber-rich side streams generated during pea-protein extraction, thereby reducing processing waste and creating additional sources of economic value (Nilsson et al., 2026). Such approaches are

consistent with circular-economy principles because more components of the crop can be utilized rather than discarded.

The economic prospects of pea cultivation are therefore linked closely to developments in plant-based food markets, processing technologies, breeding, supply-chain efficiency, and consumer demand for nutritious and sustainably produced foods. Investment in improved cultivars, post-harvest handling, storage, processing infrastructure, and market linkages can help farmers and processors capture a greater share of the value generated by pea-based products (Wu et al., 2023; Zhang et al., 2025). For developing agricultural economies, strengthening these linkages may also create opportunities for employment, rural enterprise development, and diversification of farm income. Overall, peas represent an economically versatile crop whose value extends from primary production to food processing and emerging plant-based industries. Their combination of nutritional quality, agronomic benefits, and expanding applications provides a foundation for further development of sustainable and value-oriented pea production systems.

6.6 Conclusion

Pea (*Pisum sativum* L.) is a nutritionally valuable and economically versatile crop with an important role in modern food and agricultural systems. Its seeds provide plant-based protein, dietary fiber, complex carbohydrates, vitamins, minerals, and diverse bioactive compounds, making peas an important component of nutritious diets. Evidence also indicates potential benefits for digestive, metabolic, and cardiovascular health, although the strength of evidence varies among specific health outcomes. Beyond human nutrition, pea cultivation offers important agronomic and economic advantages. As a legume, pea can contribute to biological nitrogen fixation and diversified crop rotations, supporting more resource-efficient agricultural systems. At the same time, increasing demand for plant-based foods has expanded opportunities for pea protein, flour, starch, fiber, and other value-added products. Improved processing and utilization of by-products can further increase economic value while reducing waste. Future development of the pea sector will depend on improved cultivars, sustainable production practices, efficient post-harvest management, processing technologies, and stronger market linkages. Integrating nutritional, environmental, and economic perspectives can strengthen the contribution of peas to sustainable food systems, rural livelihoods, and food security. Thus, pea cultivation represents not merely the production of a nutritious vegetable or pulse, but an opportunity to connect human health, agricultural sustainability, resource efficiency, and economic development within a single crop system.

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