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A Review On Air Fried Peas: Sustainable And Healthy Snack

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Abstract

Peas (Pisum sativum L.) are a nutrient-dense legume crop that is an excellent source of protein, vitamins, minerals, and bioactive compounds necessary for the human body. This review provides an extensive summary of the chemical ingredients and health benefits of peas and their products, focusing on their potential as a sustainable and healthy food. We converse about the nutritional profile of peas, together with their protein quality, glycemic index, and content of essential minerals and vitamins. The review also inspects the biological activities of pea-derived bioactive compounds, such as flavonoids and polyphenolics, and their potential health care benefits, including regulation of metabolic syndrome, cardiovascular disease prevention, and antioxidant effects. Additionally, we study the processing and food application of peas and their components, along with hot air frying technology as a healthier substitute for deep-frying. This review aims to stimulate further research into the expansion of pea-based products and their ability to promote sustainable and healthy eating habits.

Keywords: Functional properties, bioactive compounds, dietary fibre, polyphenol, modifications, functional grain.

INTRODUCTION

Pisum sativum L., commonly well known as green pea, dry pea, field pea, is an important legume crop that offers a good source of protein, vitamins, minerals, and bioactive compounds required for human health. Peas exhibit two main phenotypes that are smooth and wrinkled. Their seed coats have a range of colours like cream yellow, green, brown and orange-brown. The colour variation is related to flavonoid biosynthesis, which can be influenced by factors like cultivars and environmental conditions. The dark-coated peas tend to have higher flavonoid content than light-coated ones.

The COVID-19 pandemic has highlighted the need of food self-sufficiency, since 2020. The biological activity and health benefits of peas are largely assigned to their nutrient-rich profile and bioactive compounds. Peas have a glycemic index (GI) of less than 60, classifying them as a medium- to low-GI food.

Peas are also gluten-free suitable for individuals with celiac disease. Pea proteins and peptides have multiple biological properties, including regulation of metabolic syndrome. Peas are rich in dietary fibre which provides multiple health benefits by regulating gut microbial composition. They are also good source of essential minerals (calcium, iron, and zinc) and vitamins (carotenoids and folic acid). Additionally, it also contains a high amount of polyphenolics, particularly flavonoids, which shows various biological activities **Wu *et al*., (2023).**

Peas are an important part of the human diet in temperate regions of North America, the former USSR, Europe, India, China and in sub-tropical climatic regions. They are the fourth most important legume pulse, with world production of approximately 12 Million tonnes for dry peas and 0. 7 Mt for green peas. They are majorly used for pulse production and the remaining are largely frozen for convenience food production. **Maxted & Ambrose., (2001).**

Primary regions of production are Canada, China, France, and the Russian Federation (all> 1.0 million Mt) followed by India, Germany, Australia, Ukraine, UK, and the USA **McPhee., (2007).**

Frying technology is practiced in households, restaurants, and industries. Traditionally, deep-frying includes immersing food in oil or fat. Now there is a growing trend towards consuming oil-reduced foods. In this context, hot air frying offers a healthier option reducing oil content while maintaining similar flavours and textures.

In hot air fryer, high-temperature airflow (140-200°C) surrounds the food, creating a uniform temperature gradient that allows rapid mass transfer between the hot air, water, and oil within the food. This process dehydrates the food and forms a crispy crust similar to deep-fat frying. Hot air frying enables the production of calorie-reduced foodstuffs with significantly lower fat content compared to deep-fat frying. Reports indicate that oil content can be reduced by up to 90% **Tellez *et al*., (2024).**

Process flow chart of Air fried product Peas:

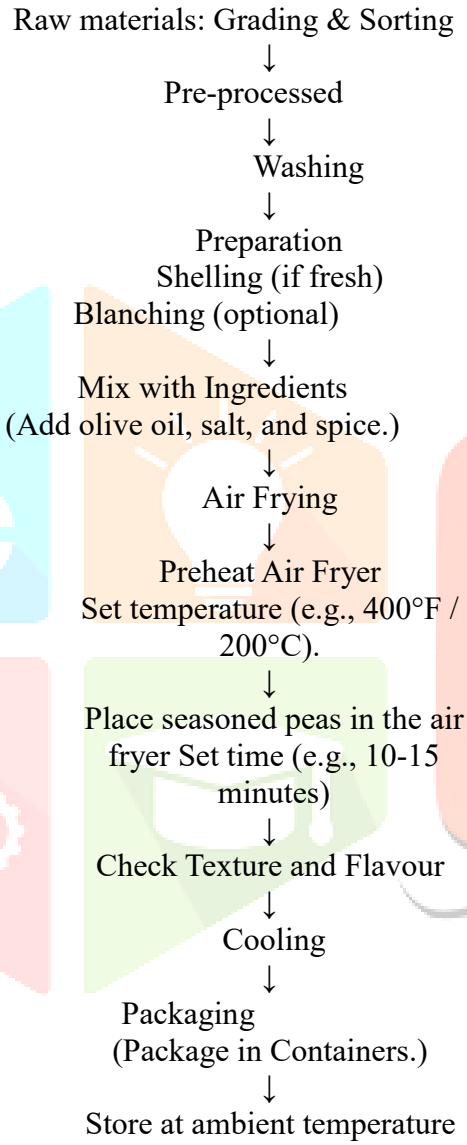

Fig. Process flowchart for development of Air Fried Product: Peas

Chemical Composition:

Protein:

Peas are a nutritious source of protein for humans and animals. Their protein content may vary due to environmental and genetic factors. A study shows 59 pea lines and found protein concentrations ranging from 13.7% to 30.7% of seed dry matter (DM), with an average of 22.3%. Pea proteins are composed of storage proteins, or globulins, whose amino acid profiles gives their nutritional value.

The amino acid profiles of these products were influenced by glutamine, aspartic acid, arginine, and lysine, while methionine, tryptophan, and cysteine were present in lower amounts. In terms of human nutritional requirements, pea protein is rich in lysine but low in methionine. The digestibility of raw pea protein is lowered by protease inhibitors, though pea protein has shown to be more digestible than soybean protein. The high protein content of peas contributes to their potential health benefits, improved cardiovascular

health and weight management. A review showed the bioactive properties of pulse proteins and peptides, including their potential anticancer and immunomodulatory effects **(Kumari & Deka., 2021).**

Starch:

Starch is the primary storage carbohydrate in plants and a biopolymer of significant importance to humans. It is a macro-constituent of many foods and has numerous industrial uses. The starch concentrate contains about 65% starch. It is composed of two essential components as amylose, a linear glucan with few branches, and amylopectin, a larger one with more highly branched molecule. The ratio of amylose to amylopectin affects starch digestibility. Pea starch contains an intermediate level of amylose, which results in unique functionality and higher levels of enzyme-resistant starch and slowly digestible starch compared to cereal, root, and tuber starches.

The low digestibility of pulse starch is attributed to various factors, including the inaccessibility of starch granules to amylases due to intact cell wall structures, the presence of anti-nutrients like amylase inhibitors, phytates, and phenolics, and significant dietary fibre content. The proportion of slowly digestible starch in peas is significant. Treatments like annealing and heat-moisture have varied effects on pea starch digestibility, with gelatinization converting most slowly digestible starch and some resistant starch to rapidly digestible starch **Wang *et al*., (2011).**

Dietary fibre:

The dietary fibre present in peas comes from seed coat and the cotyledon. The seed coat is rich in water-insoluble polysaccharides as mainly cellulose, whereas the cotyledon fibre contains a mix of soluble and insoluble polysaccharides such as hemicelluloses, pectin and cellulose.

The combination of starch and fibre in peas makes them a low-glycaemic index food, vital for preventing and managing type 2 diabetes. The fibre in peas may help lower blood cholesterol by reducing bile acid reabsorption **Brummer *et al.*, (2015).**

Mineral Content:

The mineral content of four pea samples was studied. In that the Potassium was the most important mineral (1.04% of dry weight) and phosphorus (0.39%), magnesium (0.10%), calcium (0.08%) were also present. The pea samples also contained iron (97 ppm), selenium (42 ppm), zinc (41 ppm) and others.

Though it has high mineral content, peas bioavailability is limited due to presence of high phytate levels. Phytates inhibits the absorption of zinc, iron, and calcium. The study found that phytate content only affected iron availability, not zinc or calcium. Even when iron availability was low, calcium and zinc availability increase. Peas also showed higher in vitro calcium bioavailability.

Peas are a good source of folate, with 101 µg per 100 g found that folate concentrations in yellow and green pea genotypes ranges from 23.7 to 64.8 µg/100 g dry matter. Low dietary folate levels are linked to anemia and neural tube defects in humans **Hacisalihoglu *et al*., (2021).**

Phytochemicals:

Peas contain multiple phytochemicals as phenolic compounds, phytates, saponins and oxalates. Phenolic compounds such as tannins, phenolic acids, and flavonoids, have antioxidant properties.

The seed coat of peas in dark-seeded varieties, contains high concentrations of phenolics and it found a significant correlation between seed coat colour and antioxidant properties in pea varieties. Examination of the seed coat and cotyledon in two dark-coloured pea varieties showed various phenolic compounds, including glycosides of quercetin, luteolin and apigenin.

Peas also contain other bioactive compounds like saponins and phytates, which may have hypocholesterolaemic and anticarcinogenic effects **(Fahim *et al*., 2019).**

Anti-Nutritional Factors in Peas:

Legumes, including peas, contain varied amount of anti-nutritional factors that can compromise their nutritional quality and health benefits. Common anti-nutritional factors in legumes are tannins, phytic acid, cyanogenic glycosides, saponins, oxalates, biogenic amines, lectins, protease inhibitors and α-amylase inhibitors. In peas, the anti-nutritional factors are phytic acid, lectins, oxalates and trypsin inhibitors.

Phytic Acid

Phytic acid is a notable anti-nutritional factor in peas, which forms insoluble complexes with minerals like copper, iron, and zinc which decreases their absorption in the human gut . For example, phytic acid inhibited in vitro iron absorption in mature peas, whereas iron bioavailability was higher in immature peas. The phytic acid content in peas (8.55-12.40 mg/g DW) is alike to that in lentils and chickpeas but lower than in faba beans, common beans and soybeans.

Lectins, Oxalates, Tannins and Trypsin Inhibitors

The lectin content in peas (5.53-5.64 hemagglutinin unit/mg DW) is much same to faba beans but lower than in red kidney beans, soybeans, and lentils. Cooking methods substantially lowers lectin levels in peas. The total oxalate content in peas is nearly same to that of faba beans but lower than in soybeans. Both cooking and soaking methods can reduce total oxalate levels in peas.

The tannin content in peas is alike to that in chickpeas but significantly lower than in lentils and common beans. Whereas tannins can decrease nutrient bioavailability, they also possess various health benefits including antioxidant, anti-diabetic, and anti-inflammatory properties.

Peas contain trypsin inhibitors, which affects trypsin and chymotrypsin activities influence protein digestion. The trypsin-inhibitory activity of peas (2.27 TIU/g) is same as that of faba beans and lentils but particularly lower than in chickpeas and soybeans. Heat processing as cold-pelleting and extruding help reduce trypsin-inhibitory activity in peas **(Wu *et al*., 2023).**

Removal Methods of Anti-Nutritional Factors:

Processing of field pea varieties: All the field pea varieties were subjected to varied processing methods like soaking, dehulling, roasting and germination as per methods given below:

Soaking: The cleaned field pea seeds are to be soaked in distilled water (1:4 w/v) for 12 hours at room temperature, and then wash and rinse with distilled water.

Dehulling: After the process of soaking seeds overnight (12 hours), hulls can be removed manually.

Roasting: Seeds soaked for 4 hours, sun dried and are then subjected to roasting in an open pan.

Germination: Soaked seeds (12 hrs) are to be kept in Petri dishes lined with wet filter paper for germination in an incubator at 37ºC for 24 hours. Seeds should be kept moist by sprinkling distilled water frequently. All the processed samples can be dried in hot air oven at 55°C for 5h.

Health Benefits:

Air-fried peas are nutritious and healthier snack compared to traditional fried peas, due to the reduced amount of oil used in air frying.

Here are some of the health benefits of air-fried peas:

Lower in Calories and Fat: Air frying uses comparatively less oil than deep frying, reducing the calorie and fat content of the peas while maintaining a crunchy texture. This makes air-fried peas as a healthier alternative to traditional fried snacks.

High in Protein: Peas are an excellent source of plant-based protein, which is important for muscle growth, tissue repair and immune functioning. Air-frying doesn't mainly affect their protein content, so it remains a great source of protein.

Rich in Fiber: Peas are a good source of dietary fibre, it supports digestion, helps to maintain healthy blood sugar levels, and promotes heart health by lowering cholesterol.

Nutrient Rich: Air-fried peas hold on a lot of their vitamins and minerals, such as vitamin C, vitamin K, folate, iron, and potassium. These nutrients support immune function, bone health, red blood cell production and helps in blood pressure regulation.

Antioxidant Properties: Peas contain various antioxidants namely flavonoids, carotenoids and vitamin C, which helps to neutralize harmful free radicals in the body, bringing down oxidative stress and lowering the risk of chronic diseases like heart disease and cancer.

Supports Weight Management: The high fibre and protein content in peas help with satiety, keeping you feeling full for longer time. This can be advantageous for weight management or weight loss by reducing overeating.

Gluten-Free and Plant-Based: Air-fried peas are naturally gluten-free and can be a good snack substitute for those with gluten sensitivities or those following a plant-based diet **(Dahl *et al*., 2012)**

Conclusion:

In conclusion, the review highlights the significant nutritional and health benefits of air-fried peas (Pisumsativum L.). They are an excellent source of plant-based protein, dietary fibre and essential vitamins and minerals which makes them a valuable addition to a balanced diet. The unique chemical composition with bioactive compounds such as flavonoids, contributes to their antioxidant properties and overall health-promoting effects. Air-fried peas, are lower in calories and fat compared to traditionally fried snacks, which offers a healthier alternative without compromising taste or its texture. As consumer interest in sustainable and nutritious food options continues to grow, air-fried peas have its potential to be developed into functional foods that support health and well-being. Future research should focus on optimizing their processing methods and exploring new applications in the food industry to maximize the benefits of these versatile legumes.

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