Nutritional and Health Benefits of Pulses: A Chemistry Perspective

Introduction

A. General Discussion of Benefits of Pulses

Pulses are the edible seeds of legumes such as lentils, soybeans and fresh beans. The term "legume" refers to plants whose fruit is enclosed in a pod and the term “pulse” refers only to the dried seed.\(^1\) Pulses are dense in micro- and macronutrients such as protein, carbohydrates, iron, zinc, phosphorous, and B-vitamins. In addition, pulses are a good source of both soluble and insoluble fiber.\(^2\) Consuming pulses for at least three weeks has been associated with a significant reduction in LDL-cholesterol levels. The inclusion of legumes in daily diet was also associated with other beneficial physiological effects, such as the potential for metabolic disease prevention, pertaining primarily to diabetes mellitus, colon cancer, and coronary heart disease. Many of these benefits are derived from the effects of soluble and insoluble fiber from pulses. The soluble fiber helps to decrease harmful cholesterol levels and control blood sugar levels, while the insoluble fiber helps with the digestion of food and regularity of colon movement.\(^3\)

Scheme 1. Benefits of Pulses in Crop Rotation

The benefits of pulses are not limited to the dietary and health benefits of consumption, but also extend to the planting and harvesting of pulse crops. Pulse crops are often cycled into planting for soil enrichment and nitrification of the soil, benefiting the fertility of a region for future crop growth. The inclusion of pulse crops in the growing rotation has also been shown to
disrupt harmful disease and insect cycles (Scheme 1), and allows beneficial microbial life to flourish. In addition, pulse crops are a protein dense alternative to the more polluting process of animal protein production. Producing one kilogram of legumes was shown to leave only a 0.5 kg CO₂ footprint, whereas the production of one kilogram of beef was shown to leave a 9.5 kg CO₂ footprint. From the data, the case can easily be made for the increased consumption of pulses, not only for personal health, but for environmental health as well.

B. General Discussion of Beneficial Phytochemicals

Phytochemistry is the chemistry of plant processes and their product phytochemicals. Phytochemicals, which are abundant in pulses, lack nutritional value in calories and essential nutrients, but contain many protective and disease preventative benefits. Many phytochemicals are valued for their antioxidant and anti-carcinogenic properties, but are less well known for their effects on gene expression and regulation, and benefits against pathogens. The phytochemicals that are found in pulses include saponins, protease inhibitors, tannins, and phytic acid (Scheme 2); which are phytochemicals associated with anti-carcinogenic and antioxidant effects.

Scheme 2. Common Phytochemical Classes Found in Pulses
Tannins (Scheme 3) and phytic acid have been shown to prevent oxidative damage, by free radicals, to DNA in cells.\(^7\) While saponins and protease inhibitors slow or inhibit the reproduction of cancer cells, preventing tumor growth.\(^7\)

**Scheme 3. Free Radical Neutralization by Gallic Acid**

[Diagram of free radical neutralization by gallic acid]

Legumes contain many other classes of phytochemicals, including lectins, phytoestrogens, oligosaccharides, and phenolic compounds.\(^9\) Phytochemicals have been shown to affect gene expression at multiple levels, from the DNA itself, to mRNA, proteins, and metabolites.\(^8\) Some phytochemicals also provide protective effects against pathogens, by adhering to human cell walls and preventing the adhesion to and recognition of these cells by attacking pathogens, preventing infection.\(^10\) Although all the benefits of phytochemicals are unknown, phytochemicals are proving to exhibit a wide range of biological activities, arising mainly from their antioxidant properties, their anti-inflammatory strengths, and their ability to boost the body’s natural detoxification systems.

C. Statement of Need and Outline of Approach

**Materials & Methods**

**Results**
Discussion

Conclusion

References


