

Dual Influence of Polyphenols on Health

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Introduction

Polyphenols are a sub class of phenolic class of secondary metabolite found abundantly in various plant-based foods. Structurally, the basic monomer in polyphenols is phenolic ring and generally polyphenols are classified as phenolic acids, flavonoids, stilbenes, phenolic alcohols, and lignans. Polyphenols have long been celebrated for their associated health benefits like antioxidant properties and their role in remedy of cardiovascular disease, osteoporosis, neurodegenerative disease, cancer,

and diabetes mellitus (Table 1). However, recent research suggests a more nuanced understanding of polyphenols, revealing both their positive impacts on health and their potential to inhibit protein digestion (Özdamar et al, 2018). This article delves into the dual nature of polyphenols, exploring their beneficial effects as antioxidants and their challenges when interacting with dietary proteins.

The Health Benefits of Polyphenols

Polyphenols offer various health benefits and that can be explained by "biochemical scavenger theory" which suggests that these compounds neutralize free radicals by creating stable chemical complexes, preventing subsequent reactions (Cory et al., 2018). Health benefits of polyphenol includes

- **Antioxidant properties:** Polyphenols are renowned for their potent antioxidant activity, scavenging free radicals and reducing oxidative stress in the body.
- **Improves cardiovascular health:** Numerous studies have linked polyphenol consumption to reduced risk factors for

cardiovascular diseases, such as improved lipid profiles and blood pressure regulation.

- **Anti-inflammatory effects:** Polyphenols exhibit anti-inflammatory properties, which may help mitigate chronic inflammation and associated diseases. The anti-inflammatory effect is possibly through moderation of cytokine pathways
- **Cancer prevention:** Some polyphenols have shown promise in cancer prevention and treatment through mechanisms such as inhibiting tumour growth and inducing apoptosis in cancer cells.

- Anti-diabetic: Polyphenols can influence blood sugar levels through several means, such as preventing the intestinal

absorption of glucose or preventing peripheral tissues from absorbing it.

Disease	Polyphenols involved
Neuro-degenerative	epigallocatechin gallate (EGCG), Curcumin, Anthocyanin cyanidin-3-glucoside, Resveratrol,
Obesity	Catechin polyphenols, anthocyanins, Resveratrol, curcumin
Cardio-protective effect	Quercetin, 4-O-methylgallic acid (4OMGA), Resveratrol
Anticancer	Theaflavins and thearubigins, Quercetin, Resveratrol
Anti-diabetic	Catechin, epicatechin, epigallocatechin, epicatechin gallate, isoflavones, tannic acid, glycyrrhizin, chlorogenic acid and saponins, Resveratrol, quercetin, Ferulic acid

Protein Digestion Inhibition by Polyphenols

Polyphenol can bind to proteins covalently or non-covalently. Non-covalent interactions are hydrogen bonding, hydrophobic interactions, Van der Waals forces, ionic interactions that occur between the aromatic ring or hydroxyl group of phenolic compounds and the hydrophobic parts or carbonyl groups of proteins. Covalent interactions take place between functional groups of proteins (amine or amide groups) and oxidation products of phenolics as a result of non-enzymatic or enzymatic oxidation. This protein polyphenol interaction can change the structural and functional characteristics of protein as well as bioavailability of both protein and polyphenol. Effect of this complex formation are:

- **Inhibition of Digestive Enzymes:** Polyphenols, particularly tannins, can bind to and inhibit digestive enzymes such as pepsin and trypsin, hindering protein

breakdown in the stomach and small intestine.

- **Impact on Nutrient Absorption:** By interfering with protein digestion, polyphenols may reduce the absorption of essential amino acids and other nutrients, potentially leading to nutritional deficiencies.
- **Reduce availability of protein substrate:** Binding of polyphenol to dietary proteins such as casein and whey in milk, storage proteins in legumes reduces their availability for the proteolysis action of the proteases, which results in lowering the digestibility of the proteins.
- **Gastrointestinal Discomfort:** In some individuals, consumption of polyphenol-rich foods alongside protein-rich meals may result in gastrointestinal discomfort, including bloating, gas, and indigestion.

The way forward

To maximize the nutritional benefits of our meals, it's crucial to minimize the negative impact of polyphenol on protein. This can be achieved through various approaches:

- **Meal Planning Strategies:** Separating polyphenol-rich foods from protein-rich meals or consuming them at different times of the day may help minimize the interference with protein digestion.
- **Processing methods:** Techniques such as soaking in water or alkaline solutions, heat treatments like cooking or autoclaving,

dehulling, extrusion, malting, fermentation, germination can help mitigate the antinutritional effects of polyphenols on protein digestion. These methods can decrease the levels of polyphenols in foods, disrupt protein-polyphenol complexes, and enhance the bioavailability of proteins by breaking down inhibitory bonds.

- **Food Pairings:** Choosing complementary food pairings that enhance rather than inhibit protein digestion, such as pairing

polyphenol-rich vegetables with lean

proteins, can optimize nutrient absorption.

Conclusion

In conclusion, understanding the dual role of polyphenols as antioxidants and potential disruptors of protein digestion is essential for optimizing dietary choices. By practicing mindful eating and experimenting with innovative culinary techniques, individuals can maximize the benefits of polyphenols while

minimizing digestive discomfort. Embracing a comprehensive approach to nutrition empowers individuals to make informed dietary decisions that support overall health and well-being, effectively navigating the complexities of polyphenol-protein interactions for a vibrant lifestyle.

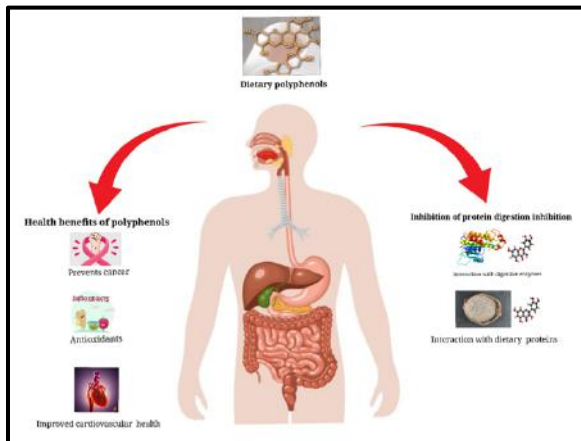


Fig. Dual effect of polyphenol on human health

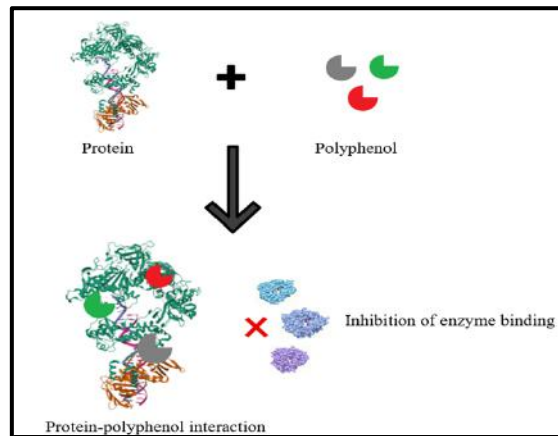


Fig. Inhibition of protein digestion by enzymes

Reference

1. Cory, H., Passarelli, S., Szeto, J., Tamez, M., & Mattei, J. (2018). The role of polyphenols in human health and food systems: *A mini-review. Frontiers in nutrition, 5*, 370438.
2. Özdal, T., Yalçinkaya, İ. E., Toydemir, G., & Çapanoglu, E. (2018). Polyphenol-protein interactions and changes in functional properties and digestibility.