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Phenolics Bioavailability and Bioaccessibility in Millets

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Millets are small-seeded grains that have been cultivated for thousands of years, primarily in Asia and Africa. They are gaining global attention due to their nutritional value and resilience in arid and semi-arid regions [1]. Millets are rich in dietary fiber, proteins, vitamins, minerals, and bioactive compounds, particularly phenolic compounds, which have been associated with various health benefits [2].

Phenolic compounds are secondary metabolites in plants that exhibit antioxidant, anti-inflammatory, and anti-carcinogenic properties [3]. However, the health benefits of these phenolics depend not only on their presence in the food but also on their bioavailability and bioaccessibility. This article explores the bioavailability and bioaccessibility of phenolic compounds in millets and discusses factors influencing these properties.

Phenolic Compounds in Millets

Millets contain a wide range of phenolic compounds, including phenolic acids (such as ferulic acid and p-coumaric acid), flavonoids, tannins, and lignans [4]. These compounds contribute to the antioxidant capacity of millets and have been linked to a reduced risk of chronic diseases like cardiovascular diseases, diabetes, and cancer [5].

Bioavailability and Bioaccessibility

Bioavailability refers to the proportion of a nutrient or bioactive compound that is absorbed and utilized by the body after ingestion [6]. **Bioaccessibility**, on the other hand, is the fraction of a compound that is released from the food matrix in the gastrointestinal tract and becomes available for absorption [7]. Both bioavailability and bioaccessibility are critical in determining the efficacy of phenolic compounds in promoting health.

Phenolic Bioavailability in Millets

The bioavailability of phenolic compounds in millets is influenced by their chemical structure and the food matrix. Phenolic acids in millets are often bound to cell wall components, limiting their release and absorption in the small intestine [8]. Studies have shown that only a small fraction of phenolics is absorbed in the upper gastrointestinal tract, while the majority reaches the colon, where they can be metabolized by gut microbiota [9].

For example, a study by Devi et al. (2014) demonstrated that the bioavailability of ferulic acid from finger millet is low due to its strong binding to dietary fibers [10]. This suggests that although millets are rich in phenolics, their health benefits may be compromised by low bioavailability.

Bioaccessibility of Phenolics in Millets

Bioaccessibility is affected by factors such as food processing and digestion. Thermal processing, such as cooking and extrusion, can alter the structure of phenolic compounds, affecting their release from the food matrix [11]. Some processing methods may enhance bioaccessibility by breaking down cell walls and releasing bound phenolics.

In vitro digestion studies have been used to assess the bioaccessibility of phenolics in millets. Parikh and Patel (2018) reported that cooking increased the bioaccessibility of phenolic acids in pearl millet due to the breakdown of the food matrix and release of bound phenolics [12]. Similarly, fermentation has been shown to enhance the bioaccessibility of phenolics by microbial enzymes degrading cell wall components [13].

Enhancing Phenolic Bioavailability and Bioaccessibility

Several strategies can be employed to improve the bioavailability and bioaccessibility of phenolic compounds in millets:

1. **Food Processing Techniques**: Methods like fermentation, germination, and enzymatic treatment can increase the release of bound phenolics. Germination activates endogenous enzymes that break down cell walls, enhancing phenolic release [14].
2. **Use of Enzymes**: Adding exogenous enzymes during processing can help release bound phenolics. For instance, using cellulase and xylanase enzymes has been shown to increase the free phenolic content in millets [15].
3. **Food Matrix Modification**: Combining millets with other food components that enhance absorption, such as fats or certain proteins, may improve phenolic bioavailability [16].

Conclusion

While millets are a rich source of phenolic compounds with potential health benefits, their bioavailability and bioaccessibility can be limited due to their binding to the food matrix and the effects of food processing. Understanding the factors that influence these properties is essential for developing strategies to enhance the health benefits of millets. Future research should focus on optimizing processing methods and exploring food combinations that improve the bioavailability and bioaccessibility of phenolics in millets.

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