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Enhancing Micronutrient Bioaccessibility and Food Quality: Designing Fortified Foods with Encapsulation and Improved Sensory Attributes

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Abstract

This low bioaccessibility hampers the full utilization of the nutrients by the body, highlighting the need for innovative solutions. One promising approach is the encapsulation of micronutrients, which has shown to significantly enhance their bioaccessibility at the food level. In this article, we delve into the importance of micronutrient bioaccessibility, explore the benefits of encapsulation and discuss its potential application in improving the nutritional quality of Chilean government legume soup. Bioaccessibility refers to the proportion of a nutrient that is released from the food matrix and becomes available for absorption in the gastrointestinal tract. While a food may contain an abundance of micronutrients, their low bioaccessibility limits their effective utilization by the body. This issue becomes particularly relevant in the context of legume soup, where the bioaccessibility of micronutrients is suboptimal. Encapsulation involves the incorporation of micronutrients into protective matrices, such as microcapsules or nanoparticles, which shield them from degradation and enhance their stability. This technology has gained attention for its potential to improve the bioaccessibility of encapsulated compounds in various food products. In the case of Chilean government legume soup, encapsulating key micronutrients holds the promise of significantly increasing their bioaccessibility and subsequent nutritional impact.

Keywords: Micronutrient • Bioaccessibility • Fortified foods

Introduction

Micronutrients play a vital role in maintaining optimal health and preventing nutrient deficiencies. In Chile, legume soup is a staple in the government's food program, aimed at providing nutritious meals to vulnerable populations. However, recent research has revealed that the bioaccessibility of micronutrients in this soup falls below 50%. This low bioaccessibility hampers the full utilization of the nutrients by the body, highlighting the need for innovative solutions. One promising approach is the encapsulation of micronutrients, which has shown to significantly enhance their bioaccessibility at the food level. In this article, we delve into the importance of micronutrient bioaccessibility, explore the benefits of encapsulation and discuss its potential application in improving the nutritional quality of Chilean government legume soup [1].

Literature Review

Bioaccessibility refers to the proportion of a nutrient that is released from the food matrix and becomes available for absorption in the gastrointestinal tract. While a food may contain an abundance of micronutrients, their low bioaccessibility limits their effective utilization by the body. This issue becomes particularly relevant in the context of legume soup, where the bioaccessibility of micronutrients is suboptimal. Encapsulation involves the incorporation of micronutrients into protective matrices, such as microcapsules or nanoparticles, which shield them from degradation and enhance their stability. This technology has gained attention for its potential to improve the bioaccessibility of encapsulated compounds in various food products. In the case of Chilean government legume soup, encapsulating key micronutrients holds the promise of significantly increasing their bioaccessibility and subsequent nutritional impact [2].

Apart from boosting bioaccessibility, encapsulation offers additional advantages in terms of sensory quality. Extruded flours, which are commonly used in encapsulation processes, have been found to reduce the presence of micronutrient inhibitors, thereby improving both the nutritional quality and taste of the fortified soup. This dual benefit ensures that the enhanced micronutrient content not only reaches the target population but is also well-received, encouraging greater consumption and nutritional benefits. To ensure the effective design of fortified foods, *in vitro* digestion assays can be employed. These assays simulate the human digestive system and provide valuable insights into the release and bioaccessibility of encapsulated micronutrients during digestion. By utilizing *in vitro* models, researchers and food technologists can optimize the encapsulation process and fine-tune the formulation to maximize the bioaccessibility and stability of the encapsulated micronutrients [3].

The current low bioaccessibility of micronutrients in Chilean government legume soup poses a challenge in achieving optimal nutritional benefits for the target population. However, through the innovative approach of encapsulation, this hurdle can be overcome. Encapsulation techniques can significantly enhance the bioaccessibility of micronutrients, making them more available for absorption by the body. Furthermore, the use of extruded flours and *in vitro* digestion assays can further optimize the nutritional quality and sensory attributes of fortified foods. By adopting these strategies, the nutritional impact of Chilean government legume soup can be maximized, contributing to improved health outcomes among vulnerable populations.

Discussion

Food fortification has emerged as a key strategy to combat nutrient deficiencies and improve public health. However, fortification efforts face

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challenges in maintaining food sensory quality while ensuring optimal nutrient delivery. In recent years, extruded flours with lower micronutrient inhibitors have shown promise in enhancing food sensory quality, while *in vitro* digestion assays have proven valuable for the effective design of fortified foods. In this article, we delve into the significance of extruded flours in improving sensory attributes and explore the role of *in vitro* digestion assays in formulating fortified foods that maximize nutritional impact without compromising taste and texture. Extrusion is a food processing technique that involves subjecting flours to high temperature and pressure, resulting in transformed physical and chemical properties. Extruded flours have been found to possess reduced levels of micronutrient inhibitors, such as phytates and polyphenols, which can hinder the bioavailability of essential nutrients. By lowering these inhibitors, extruded flours enhance the sensory quality of fortified foods by reducing undesirable flavors and textures associated with traditional fortification methods. This improvement in sensory attributes contributes to greater consumer acceptance and promotes increased consumption of fortified foods [4]

Designing fortified foods that deliver nutrients effectively requires a comprehensive understanding of their release, bioaccessibility and subsequent absorption during digestion. *In vitro* digestion assays simulate the conditions of the human digestive system and provide valuable insights into the behavior of fortified food matrices. These assays allow researchers to evaluate the release of encapsulated nutrients, their interaction with food components and their bioaccessibility. By considering *in vitro* digestion assays during the formulation stage, fortified foods can be optimized to ensure maximum nutrient availability and absorption, leading to enhanced nutritional impact.

The combination of extruded flours and *in vitro* digestion assays offers a powerful approach to optimize fortified food formulation. Extruded flours not only reduce micronutrient inhibitors but also enhance the stability and dispersibility of added nutrients, leading to improved sensory characteristics. By incorporating *in vitro* digestion assays, manufacturers can assess the impact of encapsulation, ingredient interactions and processing conditions on nutrient release and bioaccessibility. This knowledge enables the fine-tuning of formulation parameters to achieve the desired nutritional objectives without compromising sensory appeal [5,6].

Conclusion

Fortified foods play a crucial role in addressing nutrient deficiencies and improving public health. The use of extruded flours with lower micronutrient inhibitors presents an effective strategy for enhancing sensory quality, making fortified foods more palatable and appealing to consumers. Furthermore, incorporating *in vitro* digestion assays during the design process allows for the optimization of nutrient release and bioaccessibility, maximizing the nutritional impact of fortified foods. By embracing these innovative approaches, food manufacturers can create fortified products that effectively deliver essential nutrients while meeting consumer expectations for taste, texture and overall sensory experience. Ultimately, this synergy between improved sensory quality and effective nutrient delivery has the potential to significantly enhance the success and impact of fortified foods in combating malnutrition and promoting better health.

Acknowledgement

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Conflict of Interest

None.

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