A Nanotechnology approach to enhance the sweetness profile in low-sugar foods

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Abstract

Sugar consumption has become a major contributing factor to many common health diseases affecting the population. In response, the food industry has been taking steps to reduce sugar content and develop sugar alternatives with lower calorie intake. However, it's important to note that the substitution and reduction of sugar may lead to decreased consumer acceptance of certain food products. Nonetheless, with the potential to enhance food quality, extend shelf life, develop intelligent packaging, and create new ingredients with a higher sweetening capacity, nanotechnology presents an opportunity to revolutionize the food industry. Nanoencapsulation can also be used to develop food additives that can enhance the nutritional value of food products [1]. Furthermore, nanotechnology can help improve the sensory properties of food products such as flavour, texture and appearance. For example, nanoparticles can be used to create emulsions that improve the texture of food products, or to encapsulate flavours and fragrances that can be released when the food is consumed.

This project aimed to evaluate the use of nanotechnology to produce new ingredients for food formulations. In this way, two approaches were tested to develop a novel method to reduce the sugar content in cookie formulations: nanospray dryer (NSD) and nanoemulsions (NE). The first approach involved reducing the particle size of sucrose to increase sweet mouth sensation, while the second approach was used to encapsulate trans-anethol, an essential oil with sweetening properties, in nanoemulsions produced by ultrasounds using modified starch as the emulsifier. After producing the nanoemulsion was produced also NSD was used for drying. From the first strategy, we obtained a powder composed of particles with size average of 2.13 ±0.67 µm (n=400). In the second strategy, the nanoemulsion showed particle sizes below 300 nm and PDI below 0.3 that after the NSD resulted in a powder of particles presenting a size average of 2.07± 0.59 µm.

To validate the sweetening capacity of the proposed strategies, obtained powders were incorporated into a cookie formulation with a 10% of sugar reduction and later compared to the commercial cookie brand as a control sample. A Temporal Check-All-That-Apply (TCATA) analysis with a semi-trained panel showed that the proposed formulations had a similar sweet profile compared to the control sample. However, the tests showed that formulations developed with trans-anethole nanoemulsions had undesired flavours that could be improved reformulating of the recipe. Overall, the study suggests that stabilising sweetener alternatives and restructuring sucrose using nanotechnologies are effective strategies for reducing sugar in food formulations.

Figures

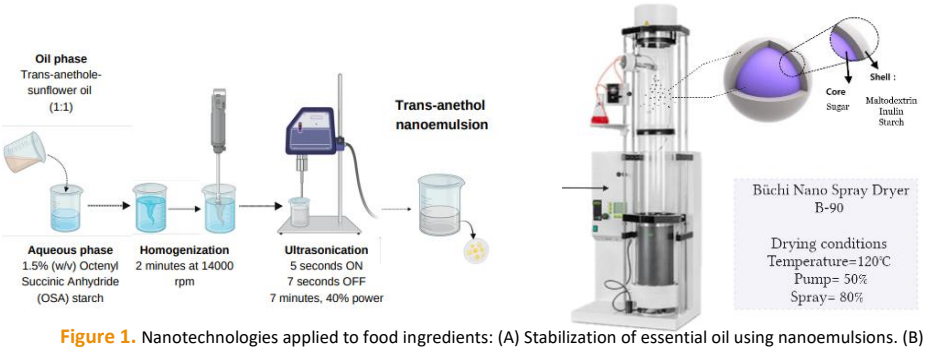

Figure 1. Nanotechnologies applied to food ingredients: (A) Stabilization of essential oil using nanoemulsions. (B) Microsized sugar obtained by nanospray-drying

References

[1] Sahoo, M., Vishwakarma, S., Panigrahi, C., & Kumar, J. (2021). Nanotechnology: Current applications and future scope in food. Food Frontiers, 2(1), 3-22.