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Enhancing the Gastrointestinal Stability of Spinach-Derived miRNAs through Sodium Alginate Encapsulation

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Abstract : Dietary microRNAs (miRNAs) have emerged as potential key regulators of gene expression across kingdoms with promising implications for human health. However, their stability and bioavailability when ingested, particularly from plant sources, remain relatively unexplored. This study investigated the stability of three spinach-derived plant miRNAs (ath-miR159, ath-miR166, and ath-miR168) and explored the protective effects of sodium alginate encapsulation during in vitro digestion. miRNA levels were quantified following post-digestion by employing the simulated gastrointestinal digestion model (INFOGEST). miRNAs were isolated and then quantified through quantitative real-time PCR. Secondary structure predictions were conducted under physiological conditions to correlate miRNA stability with thermodynamic properties. Sodium alginate encapsulation significantly improved the stability of ath-miR159 and ath-miR166 compared to the non-encapsulated form. Secondary structure predictions revealed a more stable conformation for ath-miR168 compared to ath-miR159 and ath-miR166. These findings underscore the complex interplay between miRNA structure, encapsulation, and the gastrointestinal environment. While sodium alginate encapsulation has been demonstrated to be beneficial for enhancing the stability of certain miRNAs, tailored strategies are essential for accomplishing the most effective miRNA delivery.

Keywords : dietary miRNA, In vitro digestion, plant miRNA, sodium alginate encapsulation
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