**Insights into the ability of microalgal proteins to promote the survivability of *Lacticaseibacillus rhamnosus* GG during processing, storage and *in vitro* digestion**

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Structurally engineered xero-carriers (anhydrobiotics) are widely employed in the development of probiotic supplements1. To fulfill their basic function, these carriers must maintain the biological activity of living cells when exposed to common physicochemical stressors such as highly acidic conditions, elevated temperatures, varying ionic strengths, exposure to water vapor, oxygen, and bile salts, etc2. Milk proteins are considered as the golden standard for protecting the biological functions of various probiotic bacteria, including Lactobacilli and Bifidobacteria, but face limitations due to dietary restrictions, allergies, cultural factors, and environmental concerns3. Microalgal proteins, such as those extracted from *arthrospira platensis* (spirulina) and *chlorella vulgaris*, offer a promising substitute due to their high protein content (60-70%), abundance of bioactive compounds (e.g., phycocyanins, carotenoids, polyphenols, and chlorophylls), high biological value, and environmentally sustainable nature4.

In the present work the impact of protein isolate obtained from spirulina and chlorella on the survival rate of *Lacticaseibacillus rhamnosus* GG (LGG) during lyophilization, storage and *in vitro* digestion was investigated. Different approaches in structuring the powder precursors i.e., solution or hydrogel prepared via indirect acidification, were assessed. The microstructural, physicochemical and thermal properties of the powders were determined. Accelerated storage trials at different temperatures (T = 4, 20, 37 °C) and water activities (aw = 0.11 and 0.54/0.75) were conducted for modelling the LGG cell inactivation kinetics. Moreover, the biological activity of LGG as associated to the colloidal changes of the delivery systems were analysed under simulated in-vitro digestion conditions (INFOGEST 2.0). Matrix disintegration, peptic cleavage during *in vitro* gastrointestinal transit were analysed using confocal laser scanning microscopy, SDS-PAGE combined with the OPA assay, respectively. Finally, the adhesion properties of LGG to a mucus-secreting co-culture intestinal cell line model (Caco-2/HT-29) were evaluated.

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