Development of edible films as protective carriers of a novel *Lacticaseibacillus paracasei* strain isolated from Kefalonian feta-type cheese

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Abstract

Cheese whey consists a high pollutant side stream of the dairy industry. The amount of cheese whey, that is annually worldwide produced, is about 190 x 10^6 ton/year, and only half of it is used as food or feed ingredient. The enormous volume of the produced cheese whey, combined with its high organic load, makes its utilization an essential and emergent scientific topic. Cheese whey components can be exploited to generate functional and high added-value products. Likewise, the lactose-rich fraction of cheese whey can be utilized as substrate for the growth of various beneficial microorganisms, such as lactic acid bacteria (LAB) showing probiotic properties, while the protein fraction can be utilized in a multitude of food applications or even as encapsulating agent of LAB.

This study presents a holistic approach for cheese whey valorization in the field of circular bioeconomy. In particular, biomass of *Lacticaseibacillus paracasei* (F70*),* which has been previously isolated from a Kefalonian feta-type cheese and characterized as potential probiotic, was produced by fermentation using the lactose-rich stream of cheese whey. The recovered biomass was lyophilized and the effect of different cryoprotectants on its viability was evaluated, whereas the whey protein fraction was valorized for the production of edible films. Edible films were utilized as carriers of LAB, aiming to increase their viability during a three-month storage study. Additionally, parameters like storage temperature (at 5 °C and 25 °C) and the addition of bacterial nanocellulose were also evaluated for their effect on cells viability. Actually, the incorporation of *Lacticaseibacillus paracasei* into edible films, resulted in its increased viability, compared to the lyophilized biomass case. Moreover, by grafting bacterial cellulose in edible films, cells viability was further prolonged. Specifically, bacterial viability was only slightly reduced (20 %) after 3 months of storage, whereas in the case of lyophilized and non encapsulated biomass, cells viability was significantly reduced (54 %). Interestingly, in all cases the bacterial load in edible films maintained higher than 10^6- 10^7 log cfu/mL, which is considered an adequate probiotic concentration, to provide a health benefit to the host. The concept of incorporating health-beneficial bacteria into protein-based edible films combines the maintenance of cell viability during storage with the production of healthy food products, and thus contributes towards the establishment of sustainable food systems.

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