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Biotech Processes to Recover Valuable Fraction from Buffalo Whey Usable in Probiotic Growth, Cosmeceutical, Nutraceutical and Food Industries

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Abstract : The main objective of this study regards the setup of an efficient small-scale platform for the conversion of local renewable waste materials, such as whey, into added-value products, thereby reducing environmental impact and costs deriving from the disposal of processing waste products. The buffalo milk whey derived from the cheese-making process, called second cheese whey, is the main by-product of the dairy industry. Whey is the main and most polluting by-product obtained from cheese manufacturing consisting of lactose, lactic acid, proteins, and salts, making whey an added-value product. In Italy, and in particular, in the Campania region, soft cheese production needs a large volume of liquid waste, especially during late spring and summer. This project is part of a circular economy perspective focused on the conversion of potentially polluting and difficult to purify waste into a resource to be exploited, and it embodies the concept of the three "R": reduce, recycle, and reuse. Special focus was paid to the production of health-promoting biomolecules and biopolymers, which may be exploited in different segments of the food and pharmaceutical industries. These biomolecules may be recovered through appropriate processes and reused in an attempt to obtain added value products. So, ultrafiltration and nanofiltration processes were performed to fractionate bioactive components starting from buffalo milk whey. In this direction, the present study focused on the implementation of a downstream process that converts waste generated from food and food processing industries into added value products with potential applications. Owing to innovative downstream and biotechnological processes, rather than a waste product may be considered a resource to obtain high added value products, such as food supplements (probiotics), cosmeceuticals, biopolymers, and recyclable purified water. Besides targeting gastrointestinal disorders, probiotics such as Lactobacilli have been reported to improve immunomodulation and protection of the host against infections caused by viral and bacterial pathogens. Interestingly, also inactivated microbial (probiotic) cells and their metabolic products, indicated as parabiotic and postbiotics, respectively, have a crucial role and act as mediators in the modulation of the host's immune function. To boost the production of biomass (both viable and/or heat inactivated cells) and/or the synthesis of growth-related postbiotics, such as EPS, efficient and sustainable fermentation processes are necessary. Based on a "zero-waste" approach, wastes generated from local industries can be recovered and recycled to develop sustainable biotechnological processes to obtain probiotics as well as post and parabiotic, to be tested as bioactive compounds against gastrointestinal disorders. The results have shown it was possible to recover an ultrafiltration retentate with suitable characteristics to be used in skin dehydration, to perform films (i.e., packaging for food industries), or as a wound repair agent and a nanofiltration retentate to recover lactic acid and carbon sources (e.g., lactose, glucose..) used for microbial cultivation. On the side, the last goal is to obtain purified water that can be reused throughout the process. In fact, water reclamation and reuse provide a unique and viable opportunity to augment traditional water supplies, a key issue nowadays.

Keywords : biotech process, downstream process, probiotic growth, from waste to product, buffalo whey
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