





## Gaining value from waste: synthesis of sugar building blocks from cheese whey permeate

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**Keywords**: Lactose,  $\beta$ -Galactosidase, Biotransformation, Polyesters.

## Abstract:

Cheese whey (CW) is the main by-product of the Italian dairy industry and is mainly composed of protein and lactose. While CW proteins are marketed as a dietary supplement, lactose is still little exploited, and the lactose-rich CW permeate (CWP) can be considered as a secondary by-product.

Here we describe a new way to valorise CWP in a circular economy perspective. CWP was used as an alternative inducer for the recombinant production of a cold-active  $\beta$ -galactosidase (M- $\beta$ gal) in *Escherichia coli* cells. M- $\beta$ gal was used to hydrolyse CWP lactose into glucose and galactose, its constituent monomers. These monosaccharides were then chemically modified to obtain a library of sugar building blocks for the synthesis of new biopolyesters. Synthetic strategies were optimised to obtain in high quantities and with good yields methyl 2,4:3,5-di-O-methylene-D-gluconate and glux-diol from glucose, and galactaric acid from galactose. Preliminary data concerning their properties suggest that these sugar-derived molecules may form the basis for the synthesis of new biodegradable and biocompatible polymers. This type of strategy therefore has the dual value of affecting lactose disposal costs and producing new materials, i.e. biodegradable biopolymers.

This work has been supported by Fondazione Cariplo, grant n° 2020-0838.