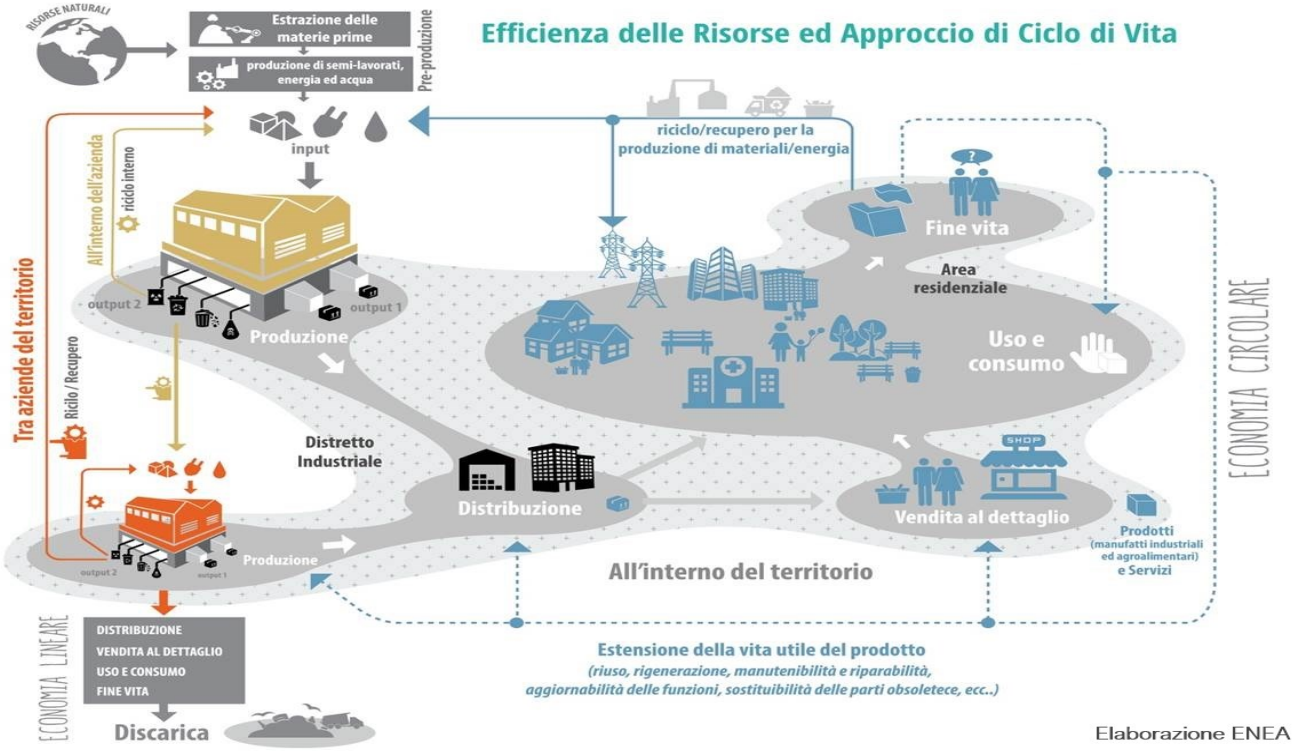
Finanziato dall'Unione europea NextGenerationEU
Ministero dell'Università e della Ricerca
Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA
SUS-MIRRI.IT

Combination of membrane filtration and fermentation to produce poly-hydroxyalkanoates (PHA): the BIOCOSI' project

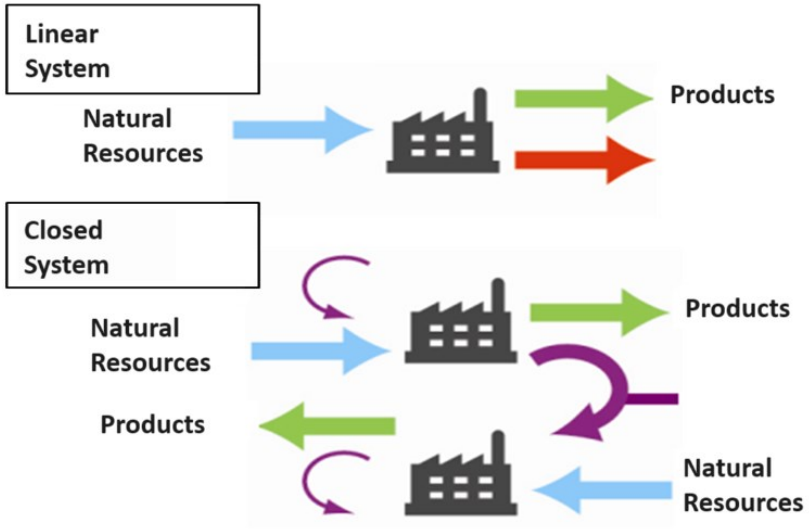
November 28, 2023
Training course SUS-MIRRI.IT

As part of the Sustainable Development Goals identified by the United Nations for the fight against poverty, the protection of the planet and the achievement of prosperity for all, the action plan will serve to achieve, by 2030, the 17 sustainable development goals identified

The European Union is convinced of the need to give a strong acceleration, since the bioeconomy has all the potential necessary to address many of the priority challenges for the future of Europeans: from food security to energy needs and the reduction of the environmental impact of agriculture and industry, from providing healthy food at affordable costs to encouraging coastal and rural development, from fighting climate change to achieving the goal of zero waste to landfill.



Elaborazione ENEA



12 RESPONSIBLE CONSUMPTION AND PRODUCTION

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POR Puglia FESR - FSE 2014-2020 Azione 1.6 “InnoNetwork”: Biocosì

Development of innovative technologies and processes for the production of 100% BIODEGRADABLE and COMPOSTABLE packaging for a Sustainable, circular and Intelligent industry

From the vision of wastewater no longer as waste but as a resource to the use of green technology, designed on the principles of the circular economy, BIOCOSI' allows a complete reduction of pollutants in the dairy industry and their complete valorisation (zero waste at the end of the process), represent the distinctive features of a "disruptive solution" oriented towards the market and the modernization of the agri-food supply chain.

INNO NETWORK
REGIONE PUGLIA

The general objective of the BIOCOSI' proposal is to provide a revolutionary and concrete solution to the problem of wastewater from the dairy supply chain, no longer seen as waste but as a resource (raw material) for the production of bioplastic (PHA - polyhydroxyalkanoates), 100% biodegradable and biocompatible, suitable for rigid packaging for food use and usable within the same supply chain. Inspired by the principles of the circular economy and biomimicry, BIOCOSI' allows a complete reduction of pollutants in the dairy industry and their complete valorization through a zero waste process, a "disruptive solution" oriented to the market and the modernization of the supply chain agri-food.

Case studies ENEA

Among the resources shared by the companies participating in this innovative business model there are waste, water and energy, but also transport and logistics. All with the aim of reducing waste and industrial waste to optimize efficiency and sustainability, minimizing the economic and environmental impact of production processes.

be & save

PON Ricerca e Competitività 2007-2013

MIUR, Bando PON 2007-2013, Operational objective – Integrated Actions for Sustainable Development and for the development of the information society

BIOCOSI IL BIOPACKAGING INTELLIGENTE

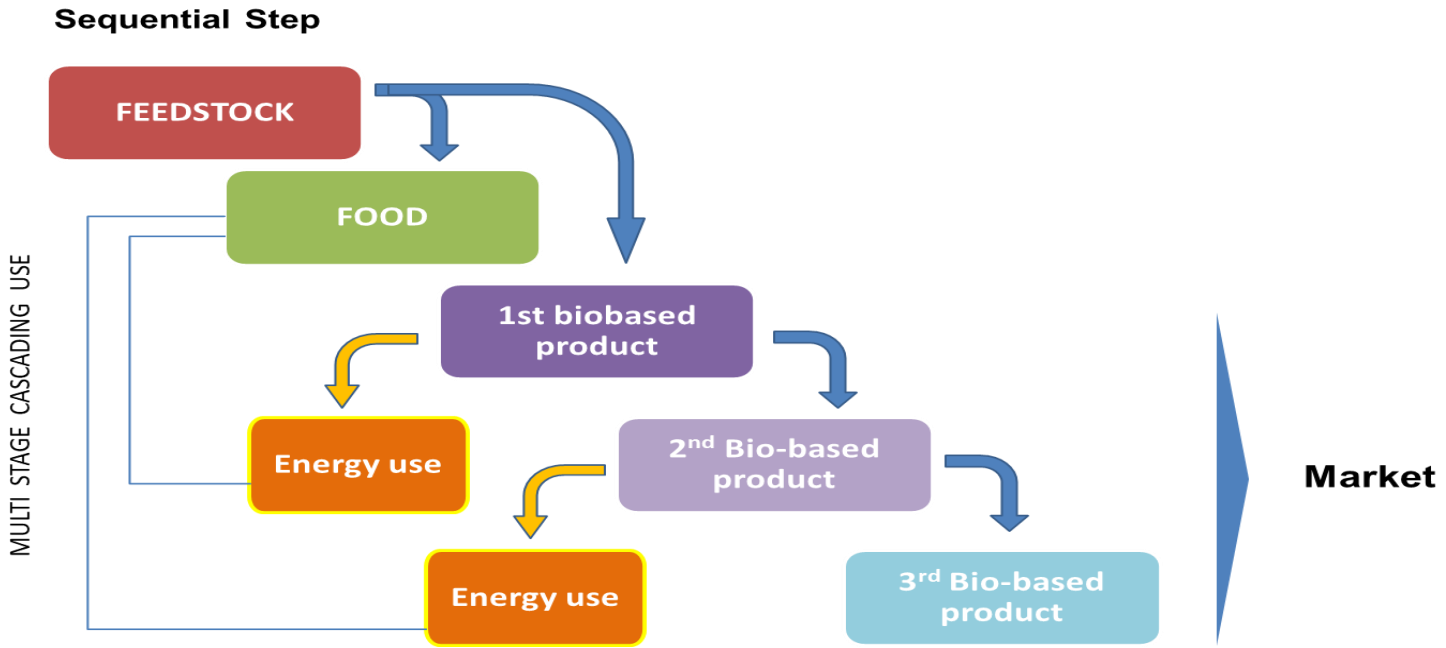
INNO NETWORK

REGIONE PUGLIA

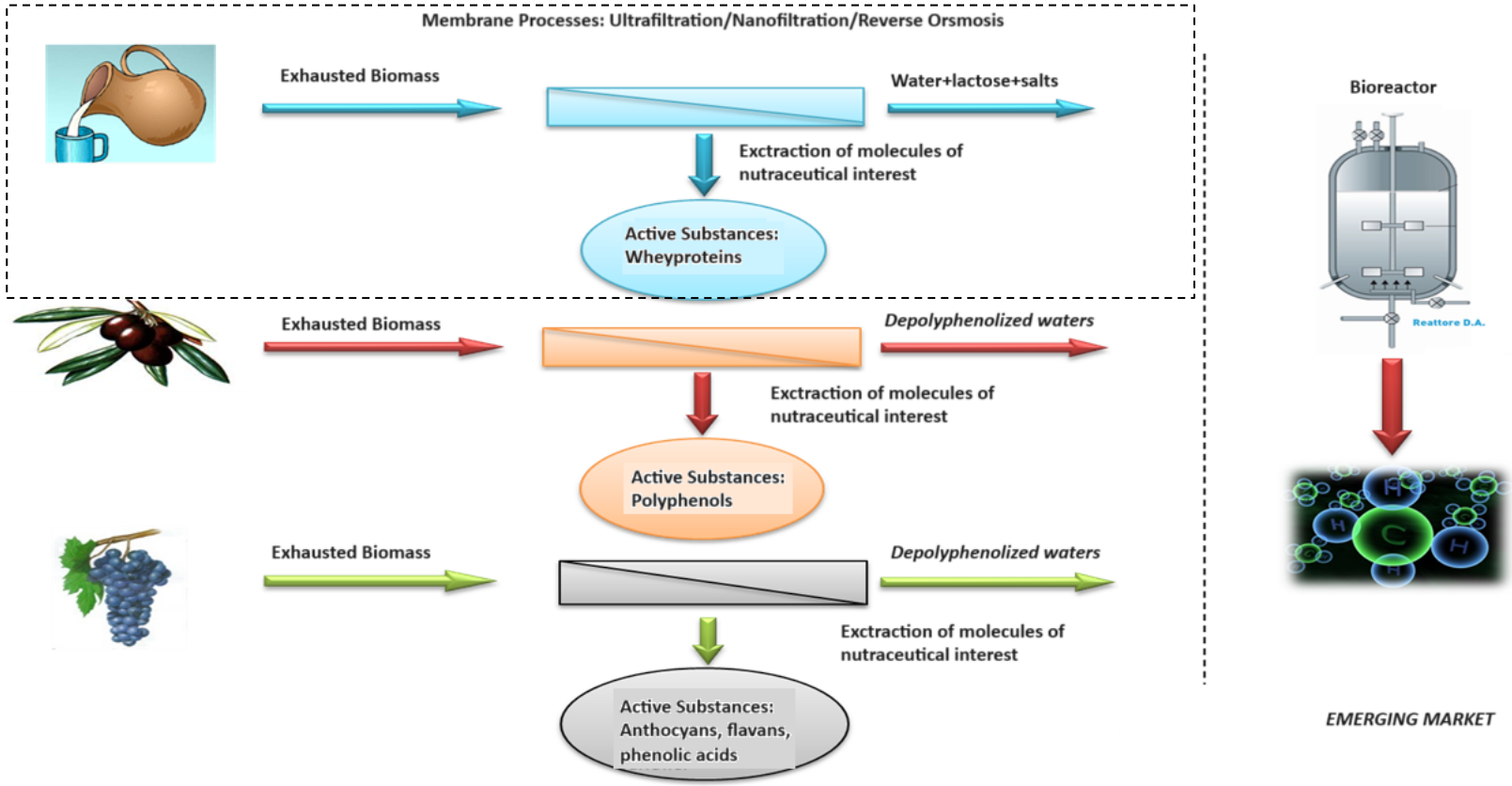
POR Puglia FESR - FSE 2014-2020 Azione 1.6 “InnoNetwork”

The Cascade

In a circular economy the cascading use of renewable resources should be encouraged along with its innovative potential for new materials, chemicals and processes, as suggested by the European Commission.



Experimentation and development of extractions of useful biomolecules



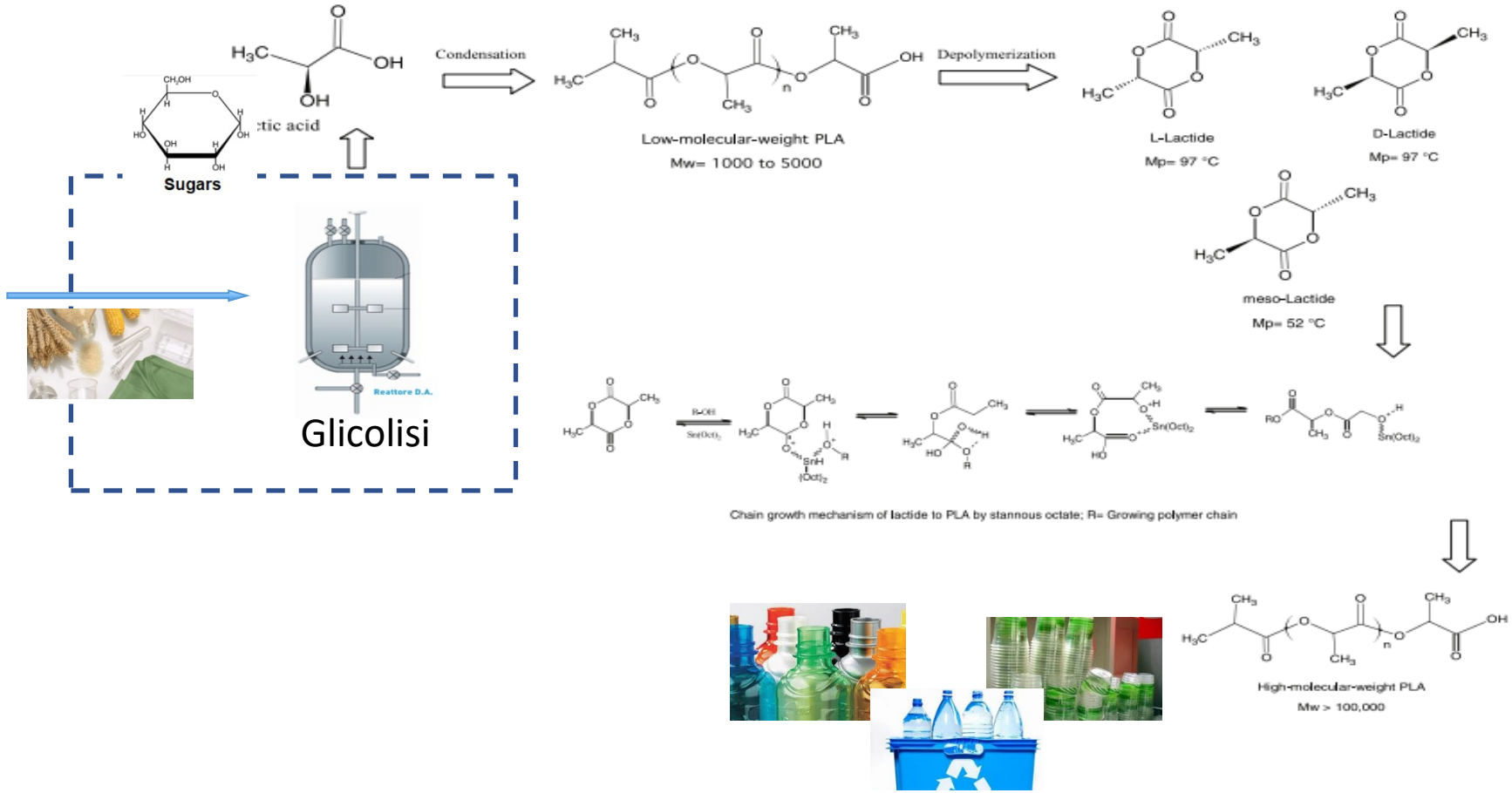
Milk whey

In Italy, as in other countries with an important dairy tradition, the quantity of whey produced every year is enormous (8 × 10^6 tons/year), while in the world it stands at around 40 × 10^6 tons/year.

Whey production in Italy equal to 8 million tons/year

http://www.fao.org/agriculture/dairy-gateway/milk-production/en/#.WCniXy3hDIV

Using specific bacterial strains and enzymatic process, is possible to transform the lactose into lactic acid and then produce bioplastics



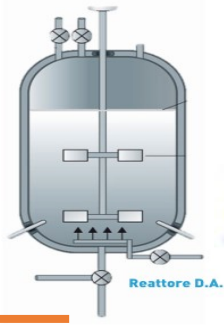
exhausted biomass

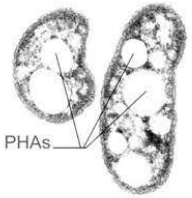
Water+lactose+salts

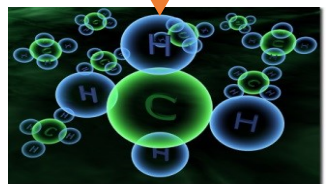
Molecule extraction of nutraceutical interest

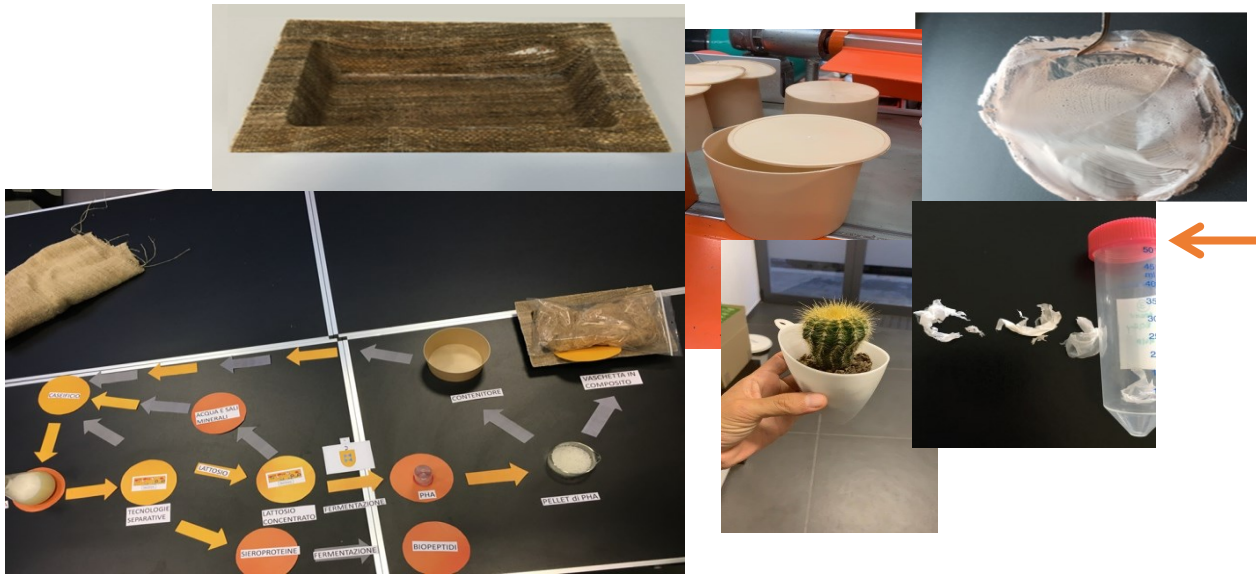
Active Ingredients:
Whey proteins

Bioreactor

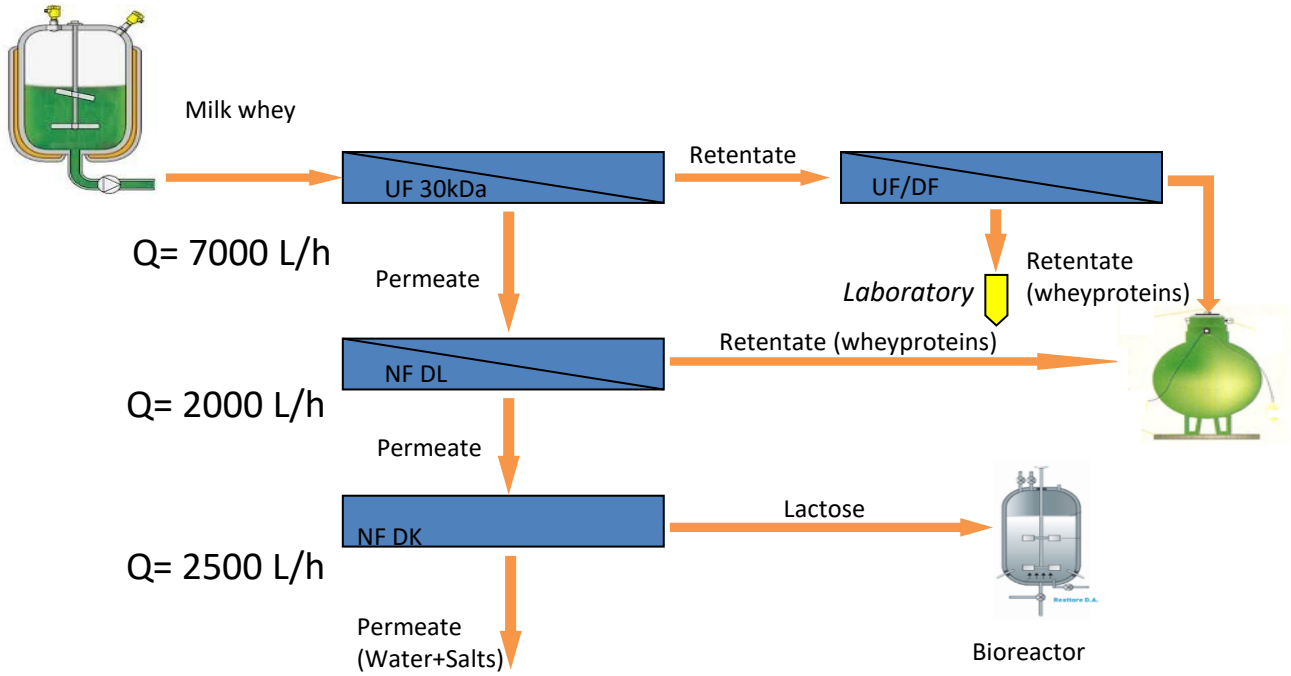


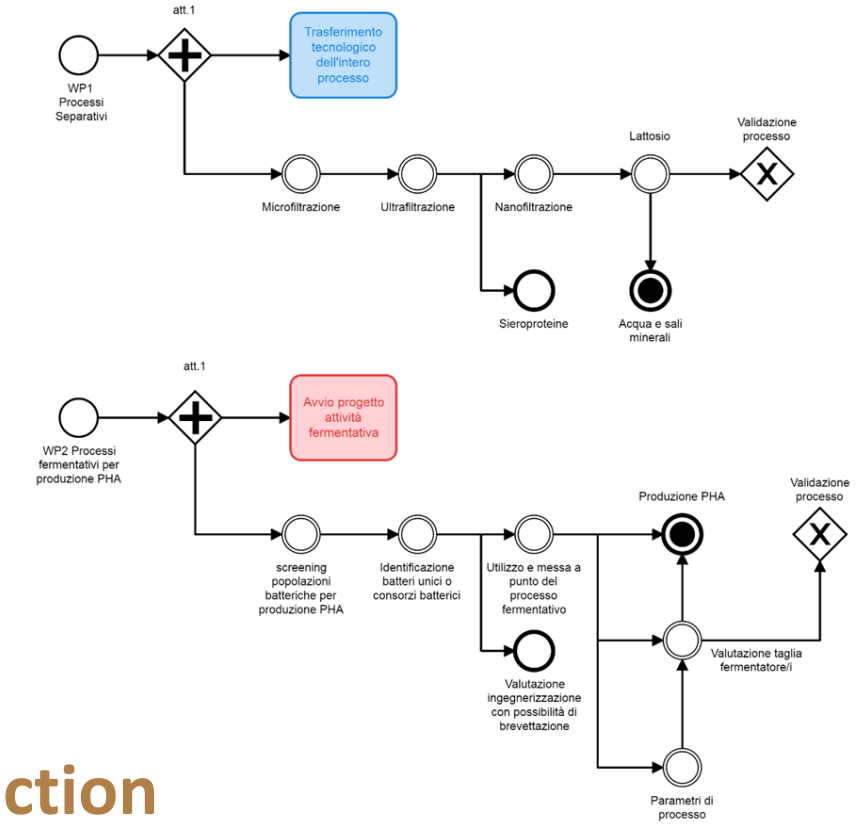






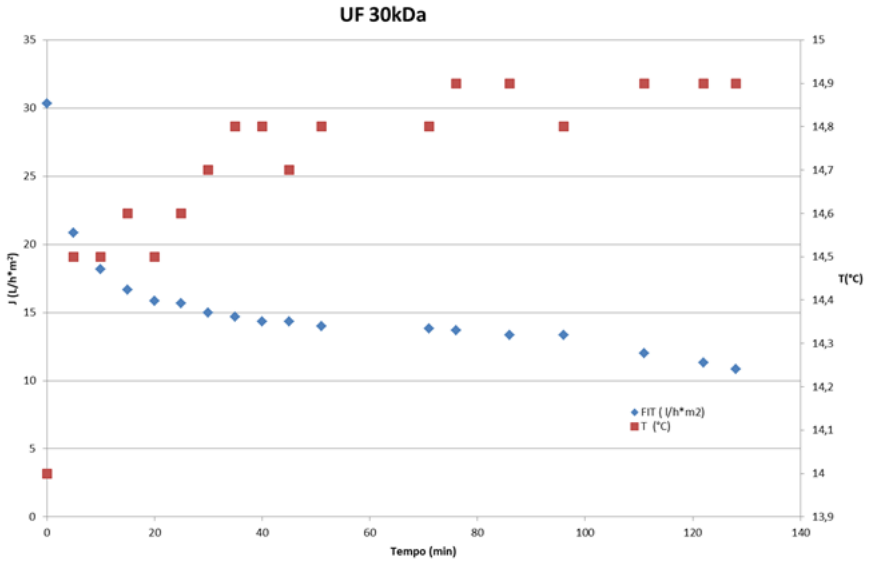
Separation technologies applied on whey

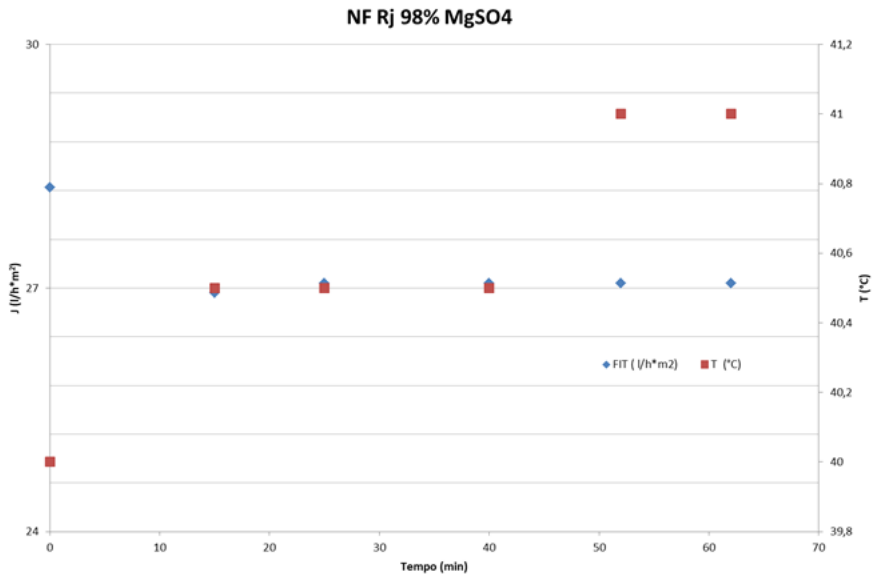




Logical scheme for PHA production

Separation technologies





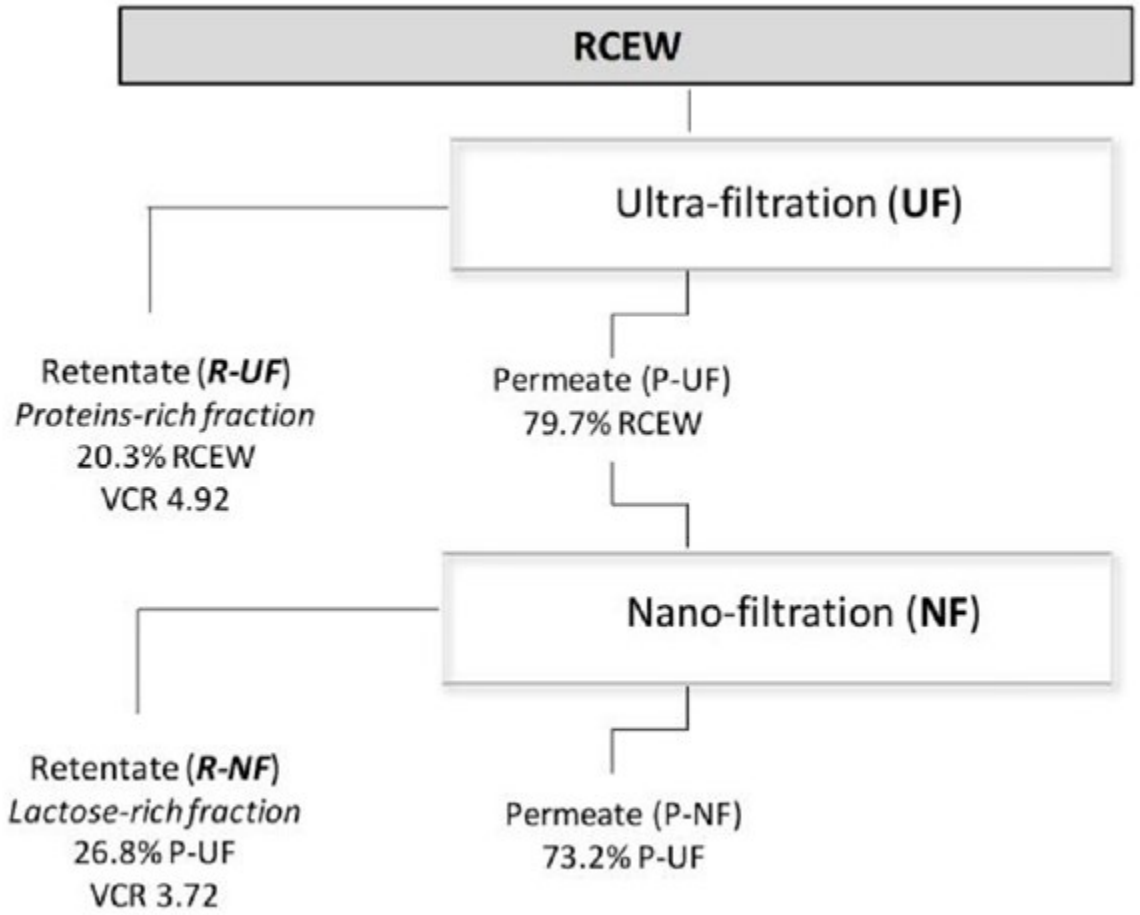

RCEW
Ultra-filtration (UF)
Retentate (R-UF)
Proteins-rich fraction
20.3% RCEW
VCR 4.92
Permeate (P-UF)
79.7% RCEW
Nano-filtration (NF)
Retentate (R-NF)
Lactose-rich fraction
26.8% P-UF
VCR 3.72
Permeate (P-NF)
73.2% P-UF

Table 1. Proximal composition of RCEW, and R-UF, P-UF, and R-NF fractions. Protein content is calculated as Total Nitrogen × 6.38.

	RCEW	R-UF	P-UF	R-NF
pH	5.2 ± 0.2 ^{a,b}	5.2 ± 0.1 ^{b}	5.2 ± 0.1 ^{b}	5.6 ± 0.2 ^{a}
Total Nitrogen (mg/L)	59.12 ± 1.23 ^{b}	285.12 ± 8.09 ^{a}	1.36 ± 0.08 ^{d}	5.07 ± 0.15 ^{c}
Proteins (%*w*/*v*)	0.38 ± 0.06 ^{b}	1.81 ± 0.05 ^{a}	0.08 ± 0.01 ^{c}	0.03 ± 0.01 ^{c}
Total Free Amino Acids (mg/L)	420 ± 12 ^{c}	50 ± 5 ^{d}	510 ± 15 ^{b}	1897 ± 21 ^{a}
Lactose (%*w*/*v*)	3.78 ± 0.05 ^{c}	5.2 ± 0.1 ^{b}	3.41 ± 0.07 ^{d}	12.6 ± 0.07 ^{a}
Glucose (%*w*/*v*)	<0.01	<0.01	<0.01	<0.01
Galactose (%*w*/*v*)	<0.01	<0.01	<0.01	<0.01
Fat (%*w*/*v*)	0.16 ± 0.10 ^{b}	0.75 ± 0.04 ^{a}	<0.01	<0.01
Ash (%*w*/*v*)	1.10 ± 0.10 ^{b}	0.22 ± 0.05 ^{c}	1.32 ± 0.09 ^{a}	0.32 ± 0.13 ^{c}

The data are the means of three independent experiments ± standard deviations ($n = 3$). $^{a–c}$ Values in the same raw, with different superscript letters, differ significantly ($p < 0.05$).

Fonte: Production of the Polyhydroxyalkanoate PHBV from Ricotta Cheese Exhausted Whey by Haloferax mediterranei Fermentation
Susanna Raho [1], Vito Emanuele Carofiglio[1], Marco Montemurro[2], Valerio Micelli[3], Domenico Centrone[1], Paolo Stufano[1], Monica Schioppa[3], Erica Pontonio[2] and Carlo Giuseppe Rizzello[2],*
Foods 2020, 9, 1459; doi:10.3390/foods9101459

Conclusions

The separation technologies are immediately transferable with TRL 8-9 as the raw-secondary materials generated have separated and concentrated two bio molecules present in the wastewater: lactose and whey proteins. The whey proteins that after the fermentation phase, have generated the active biopeptides which, when returned to the dairy , have created new dairy products. The lactose after the fermentation processes have generated a bio plastic.