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Mini Review

Waste Generated by Food Industry and Reuse in A Circular Economy Approach: The Whey Processing

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The popularity of the circular economy is due to the increasing amount of waste-produced in the agro-food processing industry; new solution of waste recycling with biotech innovation are available. In the EU 3.5 ton per capita of waste are annually produced, including more than 400kg per person per year of domestic waste. The projections suggest that this increase at worldwide level, will continue at least until 2030 and there is no real evidence of decoupling between waste and economic growth despite progresses in waste recycling. While all sectors are potentially eligible for funding under the Eco-innovation initiative, certain activities have been singled out as priority areas because of their considerable impact on the environment and their potential contribution to meeting the EU's own environmental objective. In the modern Agro-food system, the proper treatment of organic effluents to avoid their discharge as sewage water or sewage sludge, to prevent the pollution of the ground and water resources (oceans, lakes, rivers) is becoming especially important. Water is essential not only for direct uses, but also for ensuring the integrity of the ecosystems and the goods and services they provide to humans. The case we have considered is the whey, a by product of the cheese production, requiring urgent solutions to improve water efficiency and water quality used in the cycle.

The Cheese Manufacturing and Whey Processing

Cheese whey (CW) is the liquid part after milk has been curdled and strained in cheese production; it is the main by-product of the cheese making [1] After coagulation casein curd separates from the milk, under the action of chymosin or mineral/organic acid producing; the remain is the whey, a watery and thin liquid solution. Approximately from ten parts of milk, one part of cheese and nine parts of whey are produced with appreciable quantity of water soluble components [2]. It is estimated that the whey produced annually by the European dairy industry is about 75 million tons. it is a by-product of cheese making process, in the past it was discharged as waste into soil, rivers, lakes, causing pollution. When poured into a waterway, or sewer, the whey can deplete the water oxygen levels, causing serious environmental damage. The whey pollution is measured by the BOD and COD indexes (1.18) many authors have reported the following results: BOD_5 varies between 30 and 60 thousand ppm (35-45 kg/m^3) while COD varies between 50 and 100 thousand ppm.(50-100Kg/m^3). According to Siso, only 50% of the total quantity of CW is treated and turned into non polluting products, then the whey wastewater disposal of the whey is becoming a major environmental problem in the world with the production of cheese whey is estimated over 10^8 tonnes per year. The whey dispersion is now forbidden by recent legislation act. In Italy in 2015, 1.2 million tons of cheese and 9.5 million tons of whey were produced; in most of the northern regions the conversion ratio cheese/milk was around 1.1 to 10 due to the prevailing medium hard cheese while in the south the ratio around 1.4 to 10 for the prevailing production of mozzarella cheeses. The hard and semi-hard cheeses represent the 59% of Italian production, followed by fresh and soft cheeses, with 41%. Four Italian regions located in the northern regions: Lombardia, Emilia Romagna, Veneto and Piemonte produce almost seven million ton of whey representing the 72% of the total amount. Grana Padano is the most diffused hard cheeses accounting for 22% of total milk output. The first step of whey processing is the separation of the retentate fraction containing proteins from permeate fraction containing lactose; different methods are now available as ultrafiltration, diafiltration, inverse osmosis and nanofiltration. Our interest in Lactose is for its use in production of biopolymer namely PHA group after fermentations. PHA (polyhydroxy-alkanoate) is a collective name for a family of biodegradable intracellular bio-polymers made of chemically similar building blocks. PHB (poly-3-hydroxybutyrate) is the most widespread member of the PHA family produced by a wide range of prokaryotic genera starting from renewable feedstocks. A particular characteristic of PHA is its biocompatibility, making them suitable for medical applications. PHA also has good barrier properties, of interest for food product packaging. For these