The choice of allocation criteria influences the distribution of environmental impacts between co-products: example of dairy protein fractionation process

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Amongst human activities, food is a significant contributor to environmental impacts. The Life Cycle Assessment (LCA) method allows to quantify and analyze the environmental impacts throughout the production and transformation steps of a product. However, many agro-industrial transformations are multi-product systems and their impacts must be distributed among the different co-products. Several allocation methods exist, based on economic or physical criteria (mass, dry extract, protein content, lipid content, etc. of products) (Espagnol et al., 2017; Jolliet et al., 2017). The objective of this work is to study the influence of the allocation choice on the environmental impacts of co-products obtained from a dairy protein fractionation process (Gésan-Guiziou et al., 2019). The share of impacts allocated to the production of one of these proteins, ?-lactalbumin, was calculated using several allocation methods and the most contributing factors to environmental impacts were identified. The results show that, regardless of the allocation methods, the contribution of targeted protein to the environmental impacts of the system is low compared to other co-products, due to its small quantity. For example, ?-lactalbumin reaches a maximum of 2.8% of contribution to the greenhouse gas emissions for dry matter allocation. Dry matter or protein allocations attribute more impacts to ?-lactalbumin than mass or economic allocations. The mass allocation penalizes the weightiest co-products (casein retentate, lactose). The economic allocation fluctuates with market prices and penalizes the cream and casein retentate, which generate the highest economic revenues. In the LCA of ?-lactalbumin fractionation process, cleaning contributes from 3% to 22% of environmental impacts, depending on category. The other contributing factors are the energy of drying (from 1% to 35%) and that of membrane separations (from 0,5% to 36%). The allocation method is therefore a strategic decision and its choice must be considered in order to achieve the eco-design of products, processes and food chains.
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