Life Cycle Assessment of Valorizing Olive Cake Waste in Animal Feed Production

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Olive cake (OC) waste, a byproduct of olive oil production, poses environmental challenges due to its high organic content and potential for soil and water contamination. However, it can be transformed into valuable products through various valorization pathways [1, 2]. One such promising pathway is solid-state fermentation (SSF), which involves the use of microorganisms to convert the waste into bio-based materials that could be used as feed ingredient in the animal diet. This pathway has recently been suggested in the NEWFEED Project [3] (Figure 1) for the production of high-value secondary feedstuff for poultry from waste OC as a potential sustainable option. Conducting a Life Cycle Assessment (LCA) of this valorization approach can provide insights into its environmental impacts and contribute to sustainable decision-making. Therefore, in this study, the environmental impacts of turning waste OC into high-value secondary feedstuff for poultry were quantified through LCA. The valorization process was modeled for the identification of the most influential stage/s and the evaluation of potential impacts on the environment. The system boundary was selected as cradle to gate and the functional unit used for LCA was set as 1 ton of OC-based animal feed produced. ReCiPe 2016 Midpoint (H) method is used as the impact assessment method.

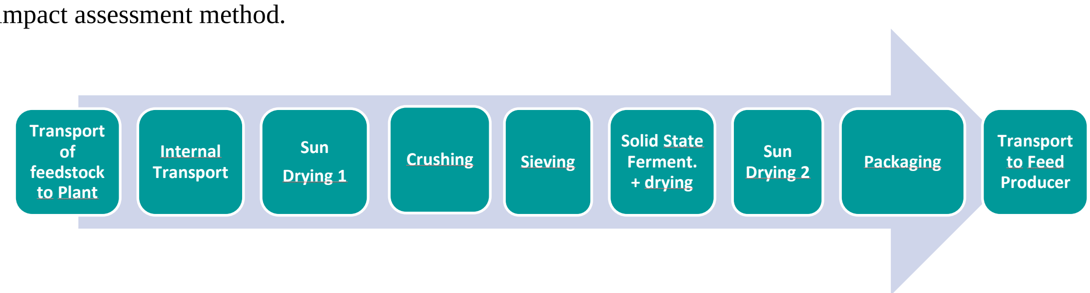

Figure 1. Valorization process flow chart

For the OC feed ingredient production stage, the highest impact was observed in the "Human Carcinogenic Toxicity (HCT)" impact category to which SSF process contributes at the highest level as indicated in Figure 2. Further, the HCT category is followed by the "freshwater ecotoxicity (FET)" to which SSF process contributes mostly. When the most influencing input parameter was sought, it was seen that the "fodder yeast (mold isolate)" is responsible for both categories. The contribution of the "fodder yeast" to the HCT impact category is 81% whereas the second most influencing parameter appeared as the "electricity" used in the process contributing by 18%. These figures are 58% and 31% for the FET impact category, respectively.

In an attempt to see the contribution of the OC-based feed ingredient to the impacts during the animal feed production stage, in comparison to the other ingredients (present in the animal feed diet for poultry), LCA runs for the animal feed production stage were performed (Figure 3). As seen, the most affected impact category is "freshwater ecotoxicity (FE)" followed by "HCT" to which the ingredient of "soybean meal" contributes at highest. Further, the contribution of the "OC feed ingredient" to these impacts, as well as to the other impact categories is almost negligible. The results demonstrate the innovative strategy developed to turn OC waste into a high-value secondary animal feed does not have significant environmental impacts.

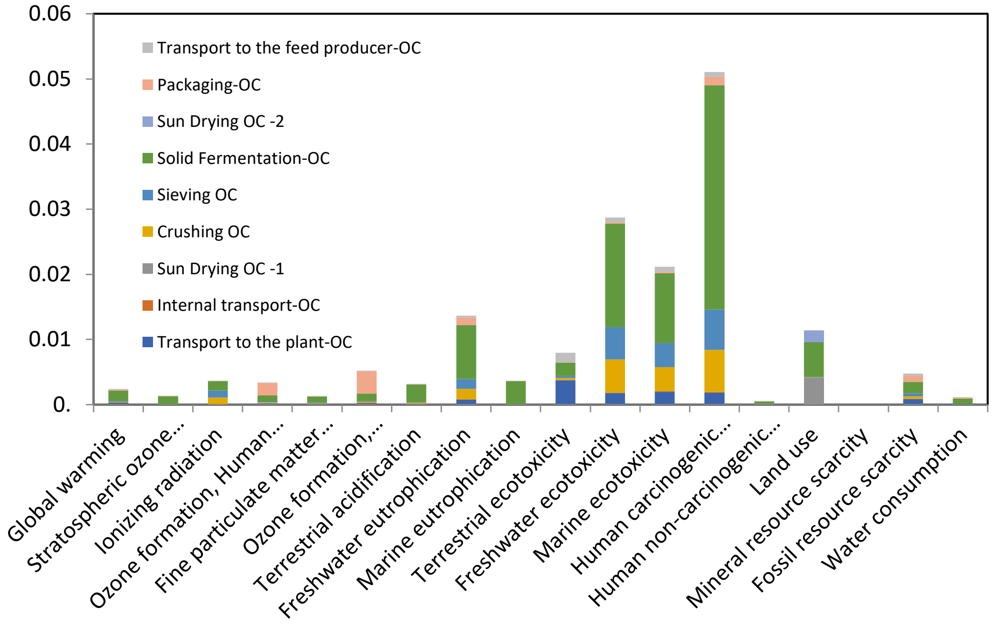

Figure 2. Normalized impacts of different process stages of OC feed ingredient production.

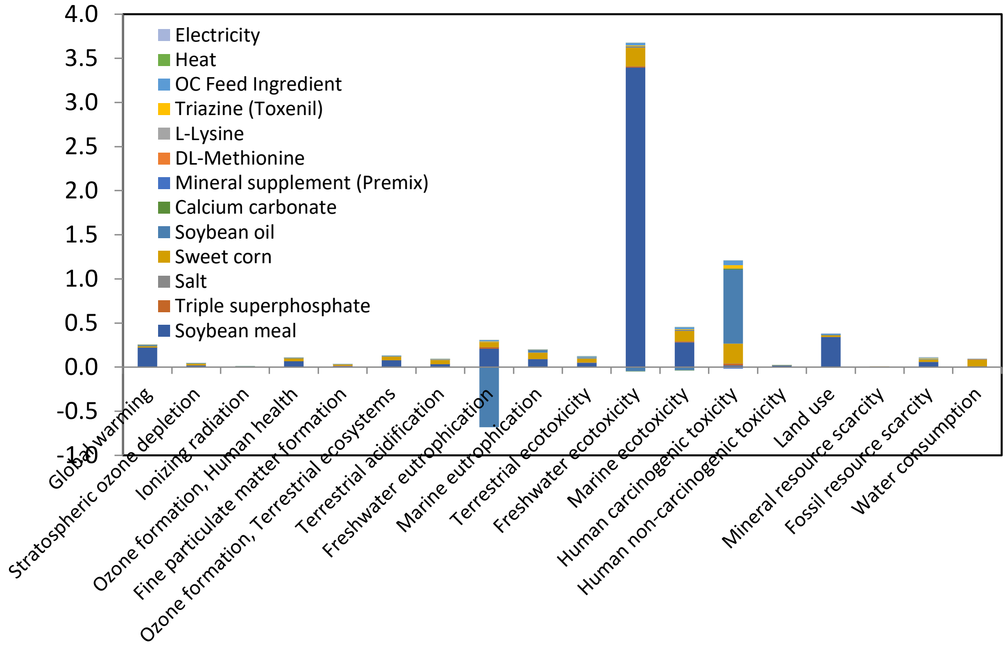

Figure 3. Normalized impacts of OC-based animal feed production.

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References

1. Tzamaloukas O, Neofytou MC, Simitzis, PE. Application of Olive By-Products in Livestock with Emphasis on Small Ruminants: Implications on Rumen Function, Growth Performance, Milk and Meat Quality. Animals 2021, 11(2), 531. https://doi.org/10.3390/ani11020531
2. Amici A, Verna M, Martillotti F. Olive by-products in animal feeding: improvement and utilization. In : Tisserand J.-L. (ed.), Alibés X. (ed.). Fourrages et sous-produits méditerranéens . Zaragoza : CIHEAM, 1991. p. 149-152. http://om.ciheam.org/om/pdf/a16/91605061.pdf
3. NEWFEED Project, Turn Food Industry By-products into Secondary Feedstuffs via Circular-Economy Schemes. European Union's Horizon 2020 research and innovation programme, Grant Agreement number: 2013, Call 2020 Section 1 Farming IA, 2021-2025.