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INTERPRETATION OF THE LCA AND CHOICE FOR THE BEST SCENARIOS

DELIVERABLE 6.5

PulpIng

Developing of **Pu**mpkin Pu**lp** Formulation using a Sustainable **Inte**grated Strategy

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1. Summary

This document is deliverable 6.5 - *Interpretation of the LCA and choice for the best scenarios* of the Work Package 6 of the PulpIng project. In this report, the life cycle assessment (LCA) presented in Deliverable 6.4 is interpreted and the best scenarios are selected.
The LCA allowed to estimate the environmental sustainability of the current life cycle of packaged pumpkin pulp and of the alternative scenarios, incorporating solutions developed in this project. Its results will help optimize the developed process/natural ingredient, boosting their industrial and commercial relevance.

2. Description of work

Within the scope of the PulpIng project, a new preservative (natural ingredient) obtained from pumpkin by-products was developed for incorporation in the packaged pumpkin pulp product from the Portuguese company Decorgel, allowing for a 50% reduction of artificial preservative use. An alternative, non-thermal process that allows for complete preservative exclusion was also successfully tested (HPP – high pressure processing). To ensure the environmental sustainability of the different processes involved in this pumpkin-based product value chain, including these new alternatives, a life cycle assessment (LCA) was performed. An interpretation of the LCA results is performed to select the most interesting scenarios and identify future research efforts.

2.1. Goal

To select the most interesting scenarios for pumpkin pulp production based on the LCA results.

3. Discussion

The current life cycle of the packaged pumpkin pulp was found to be significantly influenced by the production of the pumpkin flesh, for which the fact that a part of the pumpkin is treated as biowaste can have a contribution that is not irrelevant, highlighting the importance of finding alternatives to the parts of pumpkin that are considered waste. Conversely, while the production of the technical ingredients is also a step requiring attention, such is primarily due to the use of the hydrocolloid, followed by the acidity regulators, with the preservative production and transport having a relatively minor impact on the overall environmental footprint of the packaged pumpkin pulp.
Hence, while the natural ingredient production appears as an interesting alternative to reduce the impacts of the packaged pumpkin pulp, its production process, as a consequence of the energy-intensive drying method, deemed all scenarios that incorporated it less interesting, and significantly increased the environmental footprint of the product. It must, however, be mentioned that this is a lab scale process, that still requires optimization for scale up purposes and to become environmentally competitive in comparison to the traditional artificial preservative. While not enough to make it a better option than the current life cycle of the product under assessment, using photovoltaic energy in the natural ingredient production reduces its impacts in most categories.
On the other hand, HPP presents a more promising avenue for the reduction of the environmental impacts of the pumpkin product. The most striking difference in impacts results from HPP using fresh pumpkin flesh, avoiding a more impactful type of transport. However, such does not imply that simply maintaining the current life cycle but changing the raw material state would be an equally suitable solution. While it is

so for the sole purpose of reducing the environmental impacts, opting for HPP allows for the exclusion of the preservative, contributing to a clean label, without increasing the product footprint. In the case of HPP, it is important to mention that organoleptic testing was not performed yet. A potential shelf-life increase that could contribute to food waste avoidance and further reduce the environmental impacts was also not accounted for.

In summary, the best scenario is the application of HPP without any preservative use. If the natural ingredient production is optimized, it could also become an interesting scenario, in conjunction with HPP or, in an alternative scenario than those studied, in the current life cycle but recurring to fresh pumpkin flesh.

4. Prospection

Future work should focus on the optimization of the natural ingredient production, as there is room for a reduction of its environmental impacts. A reduction of the energy used during the drying of the extract, which might require alternative methods, in conjunction with photovoltaic energy use, might make the natural ingredient an interesting option. The feasibility of additional concentration of the solution through evaporation prior to spray-drying should be examined.

Future work on the HPP process should focus on optimizing the primary packaging solutions, ensuring also that in each HPP cycle the maximum mass of pumpkin pulp is processed. The potential of shelf life extension and a possible food waste reduction also require further studies. The suggested studies could also improve the LCA through a reduction of the uncertainty associated to the alternative scenarios, which needs to be addressed as well.

For both natural ingredients use and HPP, potential health benefits of avoiding an artificial preservative (and for the natural ingredient, of the ingredient itself) and the broader contribution to long-term sustainability goals through a promotion of waste valorization and cleaner production practices should also be considered. Conducting a comprehensive economic analysis is also crucial to inform decision-making.

On a different note, the feasibility of using the pumpkin waste to obtain other technical ingredients could be deliberated upon, as the hydrocolloid use results in a higher impact than potassium sorbate use.