ACV-ProPABio project

Simplified LCA methodology taking into account scaling up considerations for the development of eco processes in agroindustry and biotechnology

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ACV-ProPABio project

Ongoing regional project (2015-2017) involving 4 partners :

This project aims to develop a new expertise within regional research teams to **take into account environmental issues during research and innovation processes**. Thus, introducing life cycle thinking from the research and process design phases, in order to acquire concepts of sustainability and environmental impact. The goal is to provide a **simplified LCA methodology adapted to the stage of process development** (laboratory scale), adding the **scaling up issue** to understand the **environmental impacts** of process in large-scale (pilot and industrial scale). The target zone for this project is **agroindustry** and **biotechnology**.

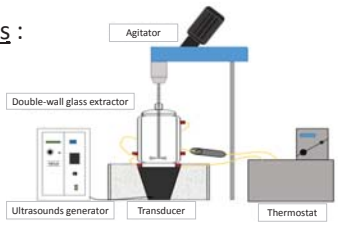
Innovation · Industrial scale · Life cycle thinking · LCA · Laboratory scale · Scaling up · Processes · Food industry · Biotechnologies · Eco design · Research · Methodology · Multi criteria optimization · Environmental impact

Studying LCA as a tool to include environmental impacts in multicriteria optimization of processes

Case study : ultrasound assisted extraction of polyphenols from a food industrial by-product (chicory ground)

Assays at varied operating conditions :

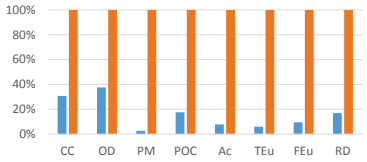
- ✓ Temperature (20-60°C)
- ✓ Solvent composition (0-60% ethanol)
- ✓ Ultrasound power (0-100 Watts)
- ✓ Extraction time (0-120 min)



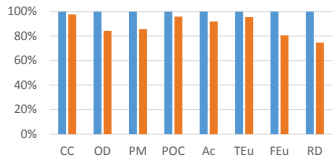
Comparative LCA :

Examples with the same target for all assays : obtaining 0.55 L of extract exhibiting 250 µM Trolox antioxidant capacity.

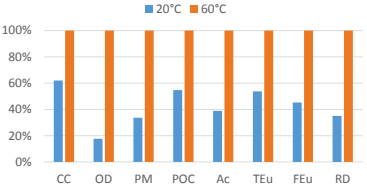
Effect of solvent composition
(20°C ; without US)



Effect of US assistance
(20°C ; water as solvent)



Effect of temperature
(water as solvent ; without US)



- ➢ As expected, temperature raise implies important raise on all impact categories
- ➢ US assistance enables a reduction of impacts (for all impact categories)
- ➢ Use of ethanol in the solvant implies huge increase of impacts, which moderates gains in terms of extraction yield obtained thanks to ethanol

Next steps and perspectives :

- ➢ Analysis of LCA results for the whole set of experimental assays
- ➢ Analysis of operating parameters impact taking into account both LCA results and process efficiency (extraction yield, productivity...)
- ➢ Studying the possibility of proposing a tool for processes multi-criteria optimization including environmental impact (LCA results) in addition to classical yield and energy consumption criteria

Studying the impact of process scaling up on LCA results

Case study : production of carrot soup

Small scale : 1 bottle

SCALE UP

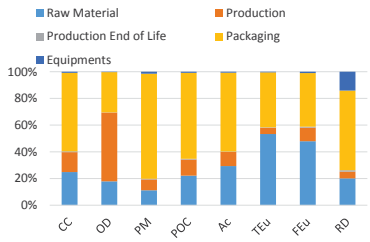
Industrial scale : *n* bottles

Impact on LCA results ?

LCA results for a large scale production (100 bottles) :

Hotpoints :
- Production
- Packaging
- Raw materials

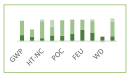
➢ Paths of potential improvements in the frame of an eco design approach



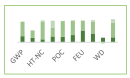
Next steps and perspectives :

- ➢ Small scale production (15 bottles) and data inventory
- ➢ Small scale LCA
- ➢ Comparative study of LCA results at both scales
- ➢ Studying the potentialities of estimating LCA results at large scale on the base of LCA results at small scale

1 bottle of carrot soup from a small scale production



1 bottle of carrot soup from a large scale production



Impact on LCA results?
Possibility of estimating LCA results at higher scale?
(like processes performances at higher scale can be estimated thanks to process engineering tools)

Tool : SimaPro PhD v. 8.1.1.16 - Data : EcoInvent 3.1 - Method : ILCD 2011 midpoint - CC: Climate change; OD: Ozone depletion; PM: Particulate matter; POC: Photochemical ozone creation; Ac: Acidification; TEu: Terrestrial eutrophication; FEu: Freshwater eutrophication; RD: Mineral, fossil & ren resource depletion.

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La Pensée Cycle de Vie, levier du manager visionnaire
avniR conference – 8th &9th November 2016 - Lille