Life Cycle Assessment (LCA) in fava beverage

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Problem Statement

The increasing popularity of plant-based beverages has highlighted the need to assess and focus on enhancing the environmental sustainability of the products. The environmental footprint of novel beverages like those made from various legumes, such as fava beans, remains underexplored, necessitating a comprehensive assessment of their life cycle impacts. The primary challenges include ensuring that greenhouse gas emissions as well as the potential for eutrophication, acidification, and freshwater consumption associated with their production are minimised, thereby ensuring the economic and environmental sustainability of plant-based beverages going forward

Solution

In response, this study employs a Life Cycle Assessment (LCA) of the production chain for a fava bean beverage from field to consumer. The assessment follows ISO 14040:14044 standards, focusing on identifying key impact categories and hotspots across the entire plant beverage production chain.

Benefits

The LCA provides a baseline for the environmental impacts of a fava-based beverage, highlighting the major contributors to the main environmental categories, including global warming potential, eutrophication, acidification, and freshwater consumption. The study identifies specific processes (e.g., cultivation of fava beans and their subsequent processing to produce fava protein isolate) that can significantly contribute to environmental impacts, allowing for targeted positive interventions. Scenario analysis reveals strategies for improvement (see below), leading to further potential reductions in emissions and resource use. The results will guide stakeholders, including farmers, food

processors and indeed policymakers, towards the adoption of sustainable practices in the plant-based beverage industry.

Practical recommendations

1. **Fertilizer Optimization:** Ensure minimal fertilizer (potassium, (K) and phosphorous (P)) application rates to minimize potential runoff into waterways, thus reducing eutrophication and acidification potential. There is also a real possibility for zero fertilizer if the crop is produced on high-index soil, with sufficient P and K present already.
2. **Renewable Energy Sources:** Switch to renewable energy sources during post-harvest processing to decrease GHGs.
3. **Incorporation of novel technologies:** Implement novel and advanced processing technologies, such as pressurized liquid (PLE) or ultrasound/microwave-assisted extraction for the process of protein isolate production and high-pressure processing (HPP) for beverage pasteurization, to optimize process efficiency, energy consumption and resource use.
4. **Biodegradable Packaging:** Replace conventional plastic packaging with biodegradable materials thereby reducing waste and greenhouse gas emissions.

Environmental Impact

1. **Global Warming Potential (GWP):** Post-harvest processing contributes significantly to greenhouse gas emissions (GHGs), driven by energy consumption in the beverage production phase. Equally, cultivation and associated crop management practices produce GHG emissions, which can be reduced with tailored agronomy practices and robust soil management
2. **Eutrophication Potential (EP):** Runoff of fertilizers utilized during the cultivation stages is the primary driver of EP. Fava bean does not require nitrogen but dependent on soil profile, may necessitate phosphorous and/or potassium
3. **Acidification Potential (AP):** Emissions from both agricultural practices and beverage production (energy consumption) significantly influence AP.
4. **Freshwater Consumption:** Irrigation practices, particularly in regions with high water scarcity, dominate water consumption impacts.

This comprehensive LCA underscores the importance of targeted interventions in fava beverage production, across the whole production chain, providing a roadmap for reducing environmental impacts and promoting sustainable plant-based beverage consumption.

Weblinks

https://www.ntua.gr/en/
https://valpropath.eu/

About this practice abstract and VALPRO Path

This practice abstract is elaborated in the VALPRO Path project based on the EIP AGRI abstract format. VALPRO Path, a Horizon Europe project, spanning 4 years, from September 2022 until August 2026. With the participation of 22 partners from 9 countries, VALPRO Path is developing fresh possibilities, validating and showcasing ways to enhance plant protein production for food and feed in the EU.

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Project website: https://valpropath.eu/