Poster # 89

Life Cycle Assessment of an Egg-Based Cellular Agriculture Growth Medium: Hotspots and Pathways for Impact Reduction

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Abstract

Cellular agriculture has emerged as a transformative platform for producing cultivated meat and seafood; however, the sustainability of upstream inputs such as growth media remains a critical uncertainty. This study evaluates the environmental performance of an egg-based cellular agriculture product developed by YEX Inc., designed as a replacement for conventional fetal bovine serum (FBS) in cell culture applications. The objective was to benchmark cradle-to-grave impacts, identify environmental hotspots, and propose actionable reduction strategies to support eco-design and transparent reporting. The assessment responds to growing demand for quantitative evidence on the sustainability of novel bioproducts and aligns with ISO 14044 and the Product Category Rules (PCR) for Basic Chemicals.

Introduction

Cellular agriculture has emerged as a transformative platform for producing cultivated red meat, poultry and seafood; however, the sustainability of upstream inputs such as growth media remains a critical uncertainty. Various well-established and novel technologies, including molecular biology, synthetic biology, and tissue culture, are driving advancements in this field of food innovation. Ethics, safety, technological and environmental impacts of Fetal Bovine Serum (FBS) has raised interests in developing economical, environmentally friendly, ethical alternatives/replacement for FBS. YEX Inc. produces an alternative to FBS based on specific pathogen free eggs. University of Fraser Valley Food and Agriculture Institute (UFV-FAI) has partnered with YEX Inc., which is a partnership that prioritizes sustainability without compromising innovation and scientific progress. Assessment of cradle-to-grave impact, environmental hotspots & eco-friendliness was performed for YEX product and compared to FBS and Serum Free Media (SFM).

Methodology

A process-based life cycle assessment was conducted using a declared unit of 1 kg of cellular agriculture product (excluding packaging mass). System boundaries followed a cradle-to-grave approach comprising upstream resource extraction and input manufacturing, core wet-lab production in Toronto, and downstream distribution and end-of-life. Primary inventory data were collected via an LCI questionnaire covering formulation, energy use, consumables, and transport. Energy demand was estimated from equipment nameplate ratings and operating times. Generic background datasets were sourced from ecoinvent 3.11 with EN 15804+A2 (EF 3.1) characterization. Impact assessment included global warming potential (GWP), eutrophication, acidification, abiotic depletion, and water scarcity indicators. Contribution and sensitivity analyses tested key parameters including plastic packaging intensity, electricity use, and egg inputs. Efficacy of YEX media on meat production was also researched.

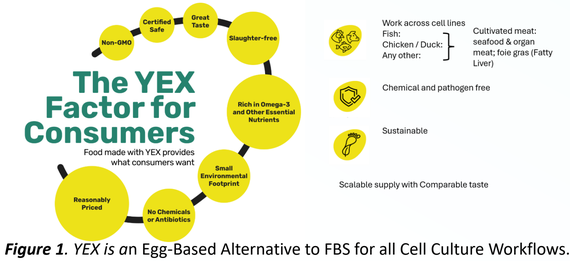


***Figure 1**. YEX is an* Egg-Based Alternative to FBS for all Cell Culture Workflows.

Results

➢ **Life cycle analysis for producing 1 kg of YEX**

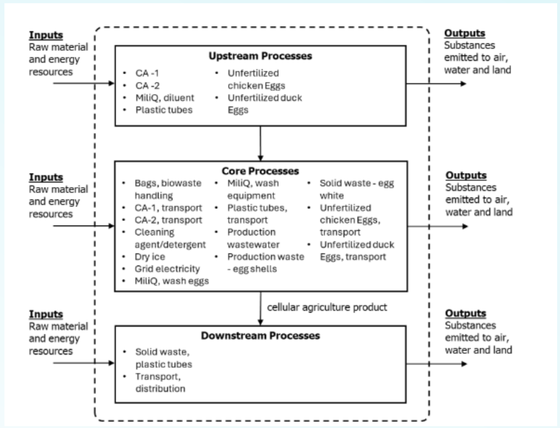
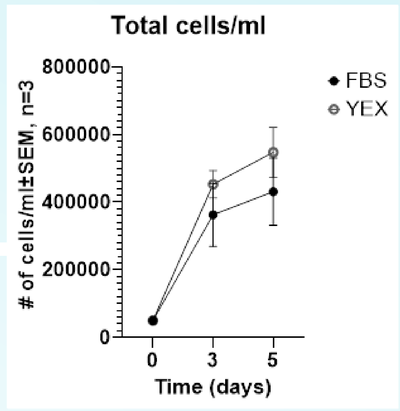
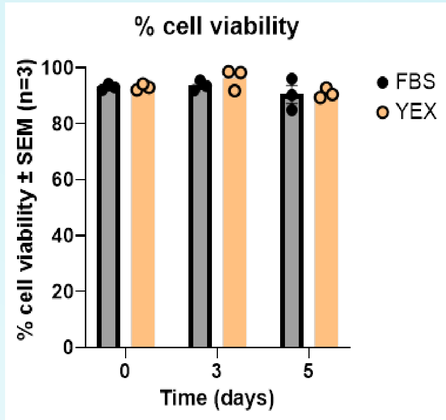


Figure 2. System boundaries by lifecycle stage and product and waste flow included.

➢ **Embryonic fibroblast-initiated tissue production in YEX growth media under laboratory conditions**





Tissue formation

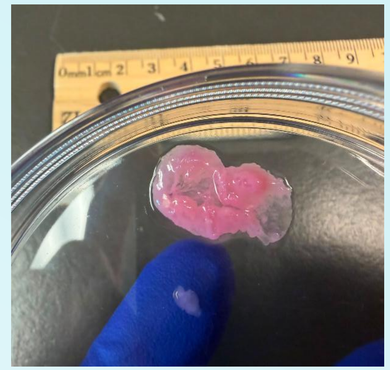


Figure 5. Culturing differentiating fibroblasts to form cellular agricultural product in small scale. (A) Comparison of cell growth rate (10% YEX and 10% FBS as growth media), (B). Cell viability comparison between FBS and YEX growth media. (C) Tissue growth in YEX growth media.

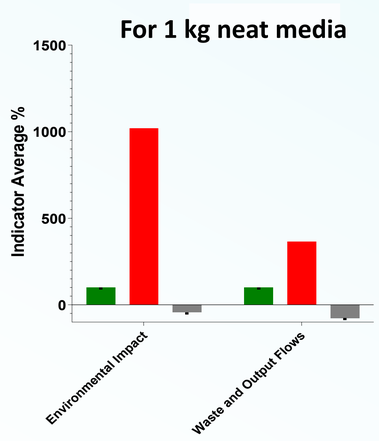


Figure 3. Environmental impact and waste and output flow of YEX (green), FBS (red) and Serum Free Media (SFM/synthetic, gray).

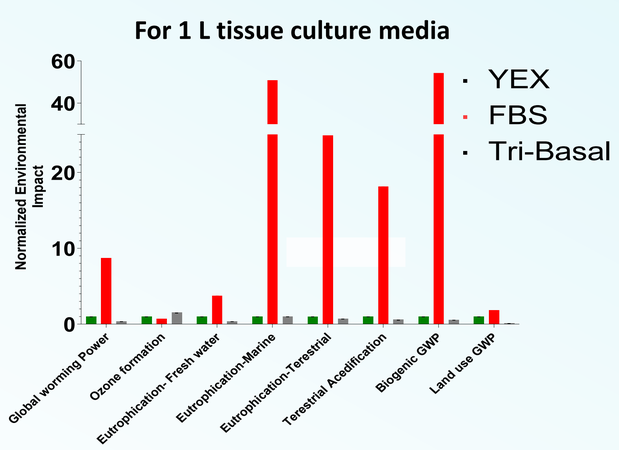


Figure 4. Normalized environmental impacts of YEX (green), FBS (red) and SFM (gray).

Conclusion

YEX Inc. is motivated to carry out this LCA study due to emerging regulatory and market requirements for cell culture media products. The study identified key environmental hotspots and opportunities for process and product improvement across its full life cycle, evidence-based comparison with alternative materials and provided quantitative data to demonstrate sustainability performance to stake holders as well as cellular agriculture producers.

Citations & Acknowledgments

Wali M.E. *et al.* 2024, (29), 2077-2093p; The international Journal of life Cycle Assessment
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International EPD® System, 2024, General Program Instructions for the International EPD System Version 5.0.1
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ISO 14040:2006"Environmental management-Life cycle assessment-Principles and framework"
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ISO 14025:2006"Environmental labels and declarations-Type III environmental declarations-Principles and procedures"
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