Hes·so
Haute Ecole Spécialisée de Suisse occidentale
Fachhochschule Westschweiz
University of Applied Sciences and Arts Western Switzerland

Master of Science HES-SO in Life Sciences

Optimized fermentation of okara, pomegranate peel and cranberry pomace for bioactive compound liberation

Yannick Erismann

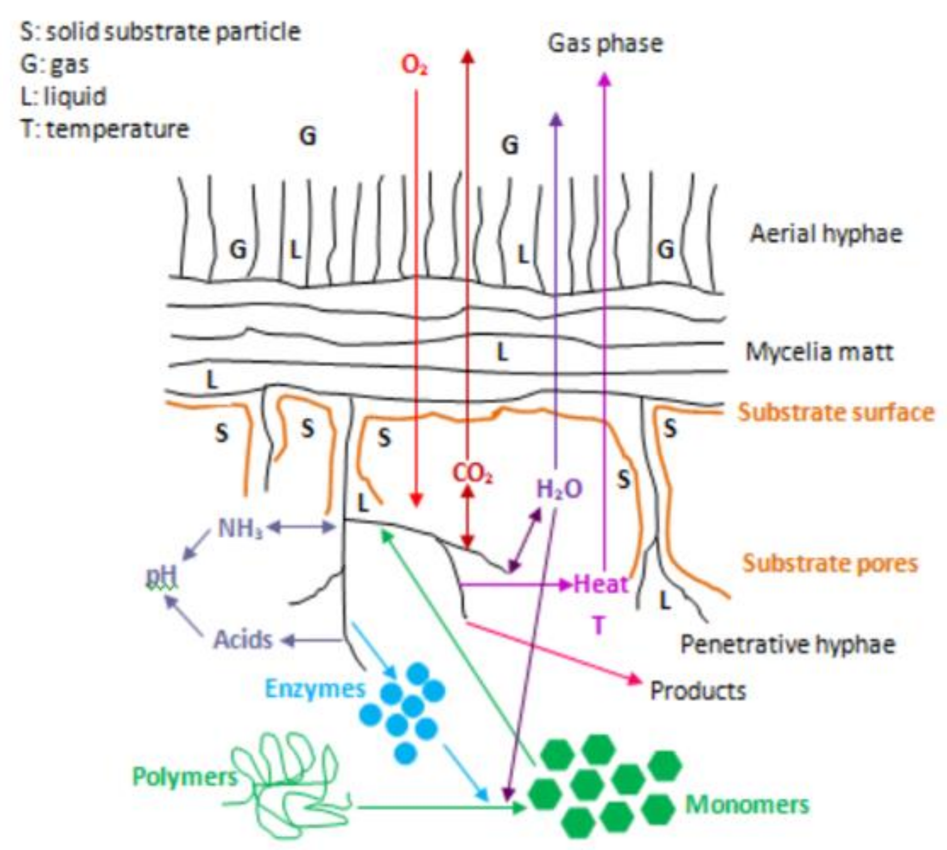
APPLIED BIOSCIENCES

HES-SO Valais

Advisors: Prof. Dr. Wolfram Brück & Prof. Dr. Wilfried Andlauer

DESCRIPTION

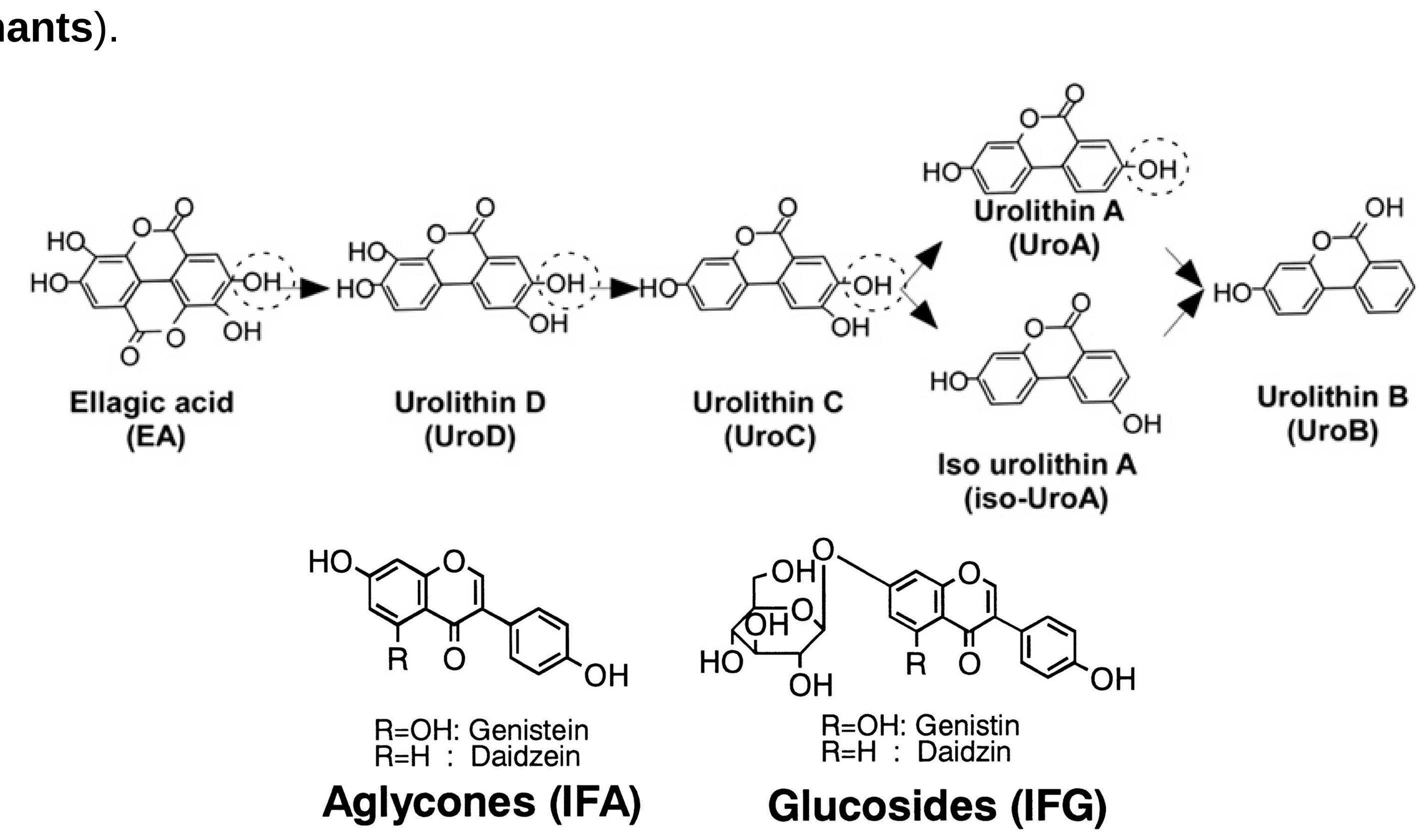
- Solid-state fermentation (**SSF**) as a strategy to **enhance bioactive compound bioavailability** from agro-industrial by-products (okara, pomegranate peel and cranberry pomace).
- Rich in polyphenols, antioxidants and isoflavones, but limited bioaccessibility reduces **functional potential**.
- Generally Recognized as Safe (**GRAS**) strains (*R. oligosporus*, *A. oryzae* and *S. thermophilus*).
- Impact of fermentation on **polyphenol content**, **antioxidant capacity**, **isoflavone bioconversion** and **microbial safety**.



Schematic of the micro-scale processes that occur during SSF involving fungi.[1]

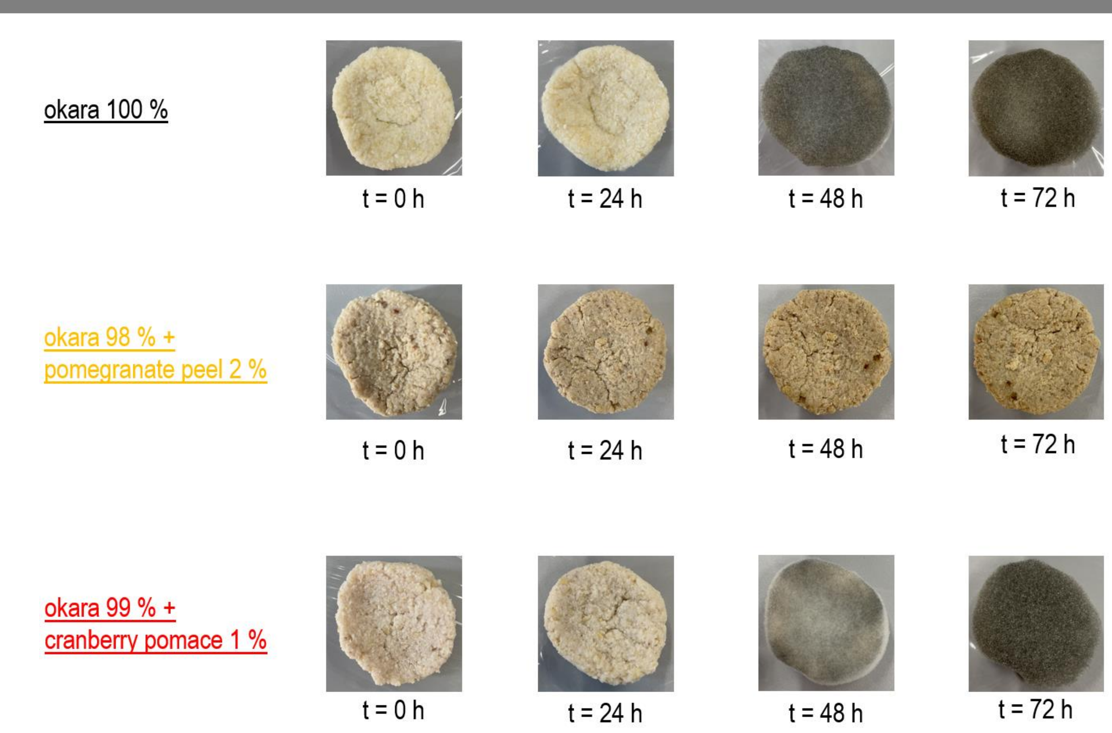
OBJECTIVES

- Evaluate **microbial strain** and **substrate composition effects** on bioactive compound release.
- Monitor *B. cereus*, *E. coli* and coagulase-positive staphylococci presence (considered as **contaminants**).



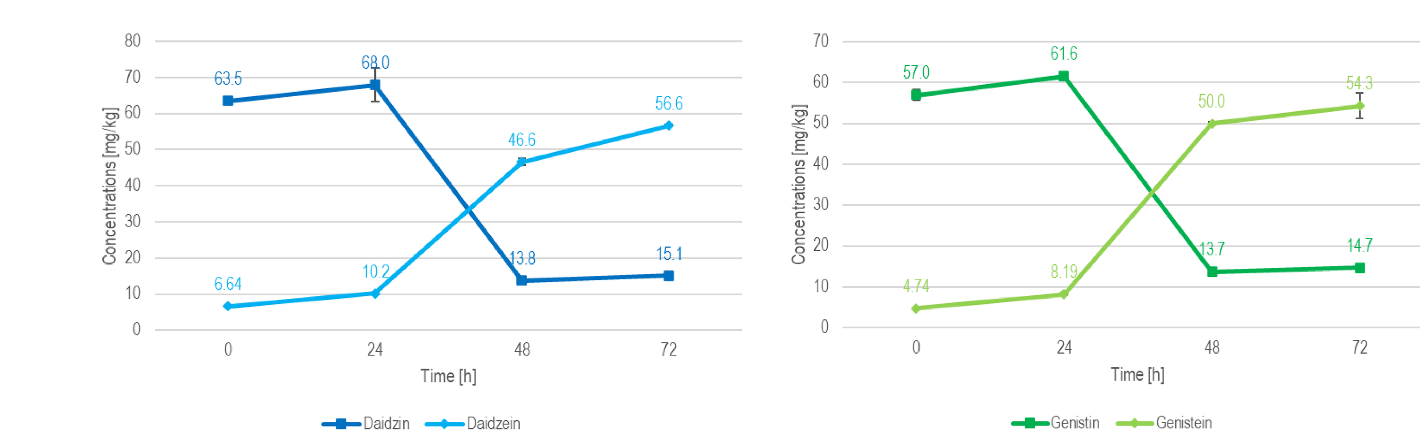
Examples of bioactive compounds.[2,3]

RESULTS



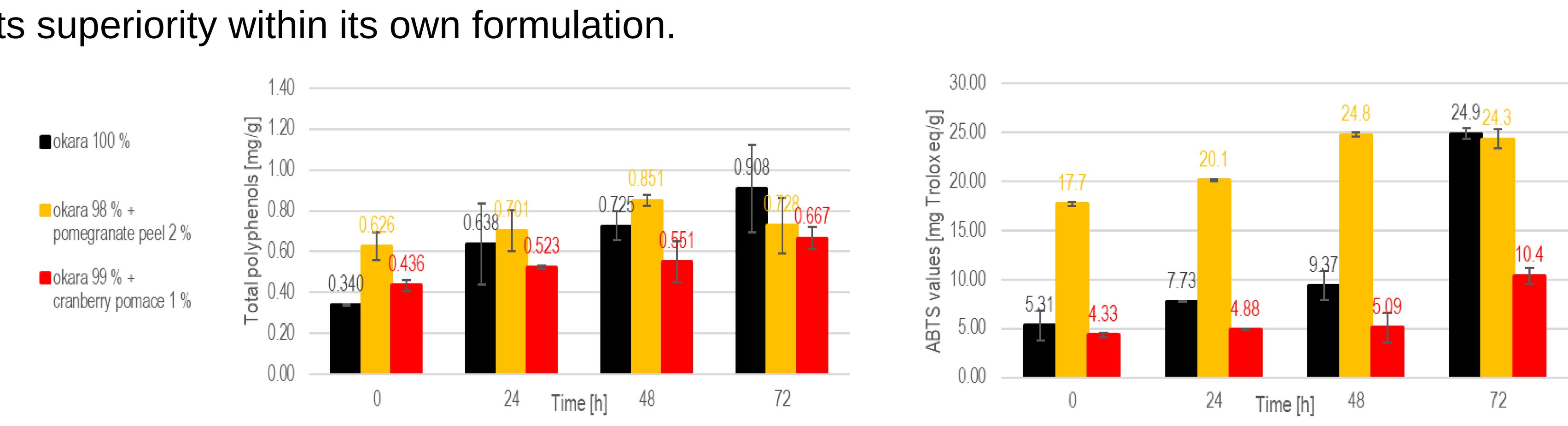
Growth progression for SSF with co-culture (R. oligosporus & S. thermophilus).

- Co-culture (*R. oligosporus* & *S. thermophilus*) significantly increased **daidzein** (+752 %) **and genistein** (+1050 %) in 100 % okara over 72 h.



Evolution of daidzin/daidzein (left) and genistin/genistein (right) during SSF with co-culture (R. oligosporus & S. thermophilus) for the samples containing 100 % okara.

- 100 % okara had the highest total polyphenol content (**TPC**) at 72 h, surpassing all fermentations and substrates.
- Cranberry pomace-enriched formulation had the highest TPC within the 2 % cranberry-enriched substrate.
- 100 % okara exhibited the highest **antioxidant capacity** among all SSF systems, maintaining its superiority within its own formulation.



Evolution of total polyphenols (left) and antioxidant capacity (right) during SSF with co-culture (R. oligosporus & S. thermophilus).

- Cranberry pomace significantly reduced *B. cereus* contamination, suggesting antimicrobial activity during fermentation.
- Pomegranate peel also contributed to **microbial safety** but inhibited β-glucosidase activity, delaying genistin and daidzin hydrolysis and slowing isoflavone bioconversion.
- Despite ellagic acid in pomegranate peel, no **urolithins** were detected, indicating that none of the tested microbial strains could convert ellagic acid into these gut-derived metabolites under the applied conditions.

CONCLUSION

- **SSF with *R. oligosporus* and *S. thermophilus* co-culture** enhances the **bioactive potential** of okara and enriched formulations, offering a **sustainable strategy** for upcycling food by-products into functional ingredients.
- Further **optimization** is needed to improve enzyme activity, urolithin bioconversion and extraction techniques to fully exploit the potential of these fermented substrates.

yannick.erismann@master.hes-so.ch
yerismann@gmail.com

[1] Manan, M. A., et al. (2017). Journal of Applied Biotechnology & Bioengineering, 4(1), 511–532.
[2] Kang, I., et al. (2016). Advances in Nutrition, 7(5), 961-972.
[3] Izumi, T., et al. (2000). Journal of Nutrition, 130(7), 1695-1699.

SWISS UNIVERSITIES OF APPLIED SCIENCES AND ARTS
MLS MASTER OF SCIENCE IN LIFE SCIENCES