

# Production and analysis of metabolites from solid-state fermentation of *Chenopodium formosanum* (Djulis) sprouts in a bioreactor

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## Abstract

Fresh fourth-day *Chenopodium formosanum* sprouts were fermented using *Rhizopus oligosporus*. Compared to plate fermentation (PF), bioreactor fermentation (BF) at 35 °C with 0.4 vvm aeration and 5 rpm yielded higher antioxidant capacity, peptide content ( $99.56 \pm 7.77$  mg/g), and enzyme activity (amylase, glucosidase, proteinase). Mass spectrometry identified two bioactive peptides (TDEYGGSIENRFMN and DNSMLTFEGAPVQGAAATEK) as potential DPP-IV and ACE inhibitors. Over 20 novel metabolites were found in BF samples. The BF system enhances nutritional and bioactive properties, offering promise for scale-up.



**Winpact Model: FS-V-SA05P**

## Introduction

*Chenopodium formosanum*, a native pseudocereal in Taiwan, is rich in essential amino acids, phenols, flavonoids, and GABA. Although similar to quinoa, it has superior nutritional value. Solid-state fermentation with *Rhizopus oligosporus* may offer a scalable way to enhance its bioactive compound profile.

## Materials and Methods

### Fermentation Process:

Fresh fourth-day *Chenopodium formosanum* sprouts (1.5 kg) were sterilized and inoculated with 75 mL of *Rhizopus oligosporus* spores at  $10^6$  spores/mL (5% v/w). Solid-state fermentation occurred in a bioreactor FS-V-SA05P (Winpact FS-V-SA05P) at 35 °C, with aeration at 0.4 vvm and rotation at 5 rpm, for four days. Free peptide content was quantified as  $99.56 \pm 7.77$  mg casein tryptone equivalent per gram dry substrate.

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Enzyme activities measured included amylase ( $2.21 \pm 0.01$  U/g),  $\beta$ -glucosidase ( $54.57 \pm 10.88$  U/g), and proteinase ( $40.81 \pm 6.52$  U/g).

Mass spectrometry was used to identify peptides and metabolites generated by fermentation; two peptides (TDEYGGSIENRFMN and DNSMLTFEGAPVQGAAATEK) were highlighted as DPP-IV and ACE inhibitors.

## Results

- Bioreactor fermentation (BF) produced significantly higher free peptide content and enzyme activities compared to plate fermentation (PF).
- Identified peptides potentially act as DPP-IV and ACE inhibitors.
- Over twenty new metabolites, including aromatics, amines, fatty acids, and carboxylic acids, were generated specifically in BF.
- Enhanced antioxidant capacity was demonstrated in BF-derived products.

## References

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