ASEC 2025 Conference

The 6th International Electronic Conference on Applied Sciences

09–11 December 2025 | Online

MDPI

Temporal Dynamics of Antioxidant Capacities in Fermentation Brines: Multi-Assay Evidence for Plant-Matrix–Driven Release of Bioactive Compounds and Prospects for Sustainable Functional Food Applications

Imane THAIFA[1], Hicham WAHNOU[1], Oumaima ANACHAD[1], Wafaa TAHA[1], Imad FENJAR[1], Houssam ASSIOUI[1,2], Faiza BENNIS[1], Fatima CHEGDANI[1]

[1]Laboratory of Integrative Biology, Faculty of Sciences Aïn Chock, Hassan II University of Casablanca, Morocco

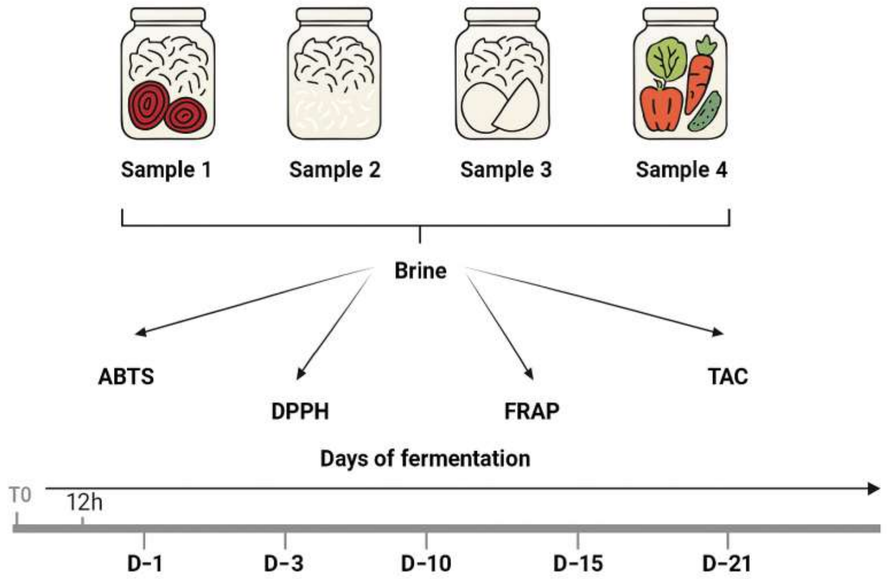
[2] Aix-Marseille Université - Campus Santé Timone - Faculté de Médecine 27, Bd Jean Moulin, 13005 Marseille

INTRODUCTION & AIM

Fermentation is recognized as one of the oldest techniques for preserving and processing food. Lacto-fermented vegetables are increasingly valued as functional foods due to their enrichment with bioactive metabolites released during fermentation. While the solid vegetable fraction is widely studied, fermentation brine remains an underutilized resource despite its potential as a source of health-enhancing compounds.

Oxidative stress is an unbalanced state between the production reactive oxygen species, and their elimination by protective mechanisms known as antioxidants. This imbalance leads to a significant damage of both biomolecules and cells, potentially impacting the entire organism, resulting in a range of diseases, particularly chronic inflammation. Consequently, there is a growing demand for new natural therapeutic alternatives with multifunctional benefits and fewer side effects compared to conventional medications. This study aims to examine the temporal changes in antioxidant capacities of fermentation brines.

METHOD



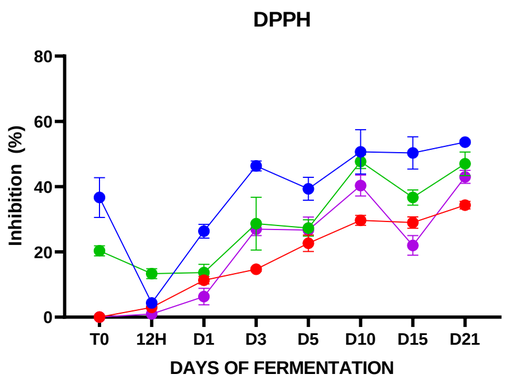
Sample 1 included cabbage brine with cabbage and beet. Sample 2 used cabbage brine with only cabbage. Sample 3 used beet brine with cabbage. Sample 4 used standard brine with sterilized, filtered water mixed with salt on a mixture of beets, carrots, cucumbers, and peppers.

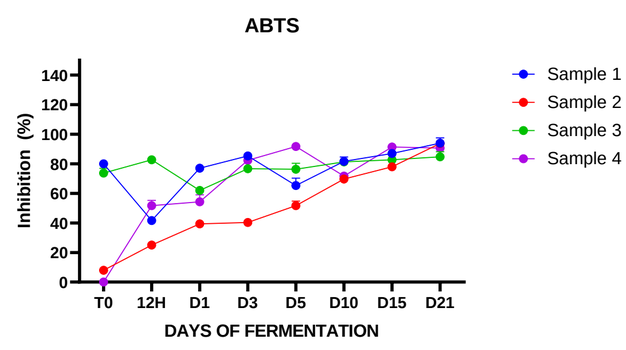
CONCLUSION

Overall, the antioxidant activity exhibited a distinct temporal profile in all four tests. Typically, fermented vegetables show an increase in antioxidant activity, but the extent of the increase, or the presence of subsequent decreases, varies depending on the raw material, and the compounds it contains. Our tests were performed on the brine itself, not on homogenized plant tissues. The results are therefore directly relevant to the liquid phase, where soluble phenolic compounds, organic acids, pigment derivatives, and other postbiotic compounds are released. Since each vegetable produces different compounds in the brine at different times, it's an interesting approach to consider mixed fermentation to achieve a broader chemical spectrum and more stable antioxidant production.

RESULTS & DISCUSSION

The antioxidant activity of all samples was evaluated using four different tests (ABTS, DPPH, TAC, FRAP). The findings were presented as a percentage of inhibition for the DPPH and ABTS tests, and as optical density (OD) for the FRAP and TAC tests.



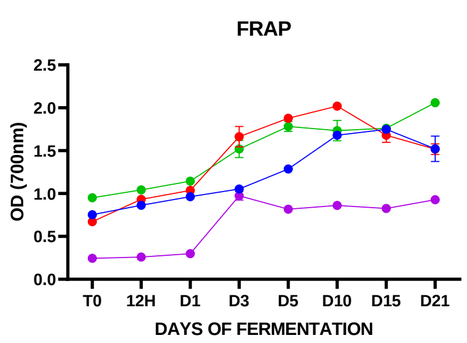


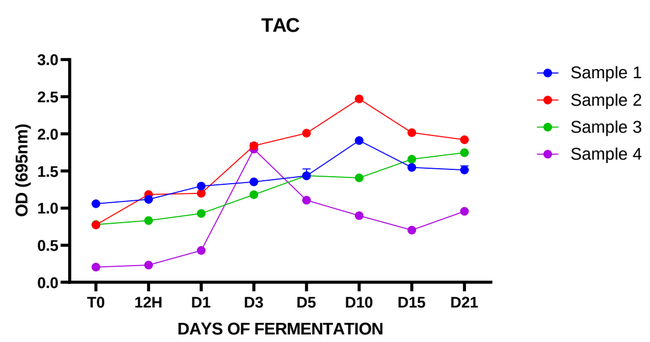
Sample1

DPPH and ABTS displayed an early decrease of the inhibition percentage at 12 hours, followed by a clear peak on day 3, a transient decrease on day 5, and then a continuous increase, reaching highest values on day 21 (53.6% and 94%). FRAP OD increased gradually until day 15, with a slight decrease on day 21. For TAC , the OD reached its maximum on day 10, decreased on day 15, and showed a slight recovery on day 21

Sample2

The DPPH and ABTS inhibition percentages increased steadily throughout fermentation, reaching 34.3% and 93.66% respectively on day 21. FRAP and TAC followed similar trajectories in terms of OD, peaking on day 10, followed by a slight decline around day 21.





Sample3

DPPH inhibition reached its maximum on day 10, decreased on day 15, and then increased back up on day 21 (47%). ABTS showed a brief reduction on day 1, followed by a notable increase until day 5, remaining stable until day 21 (84.6%). FRAP and TAC showed continuous increases, with maximum OD values on day 21.

Sample4

DPPH inhibition was highest on day 10, dropped on day 15, and partly recovered on day 21 (43%). ABTS achieved an early peak on day 5, dropped on day 10, and then increased again until day 21 (90.6%).For FRAP and TAC , both OD peaked on day 3; it stabilized for the FRAP test , in contrast to TAC, which decreased sharply after day 3 and partially recovered on day 21.