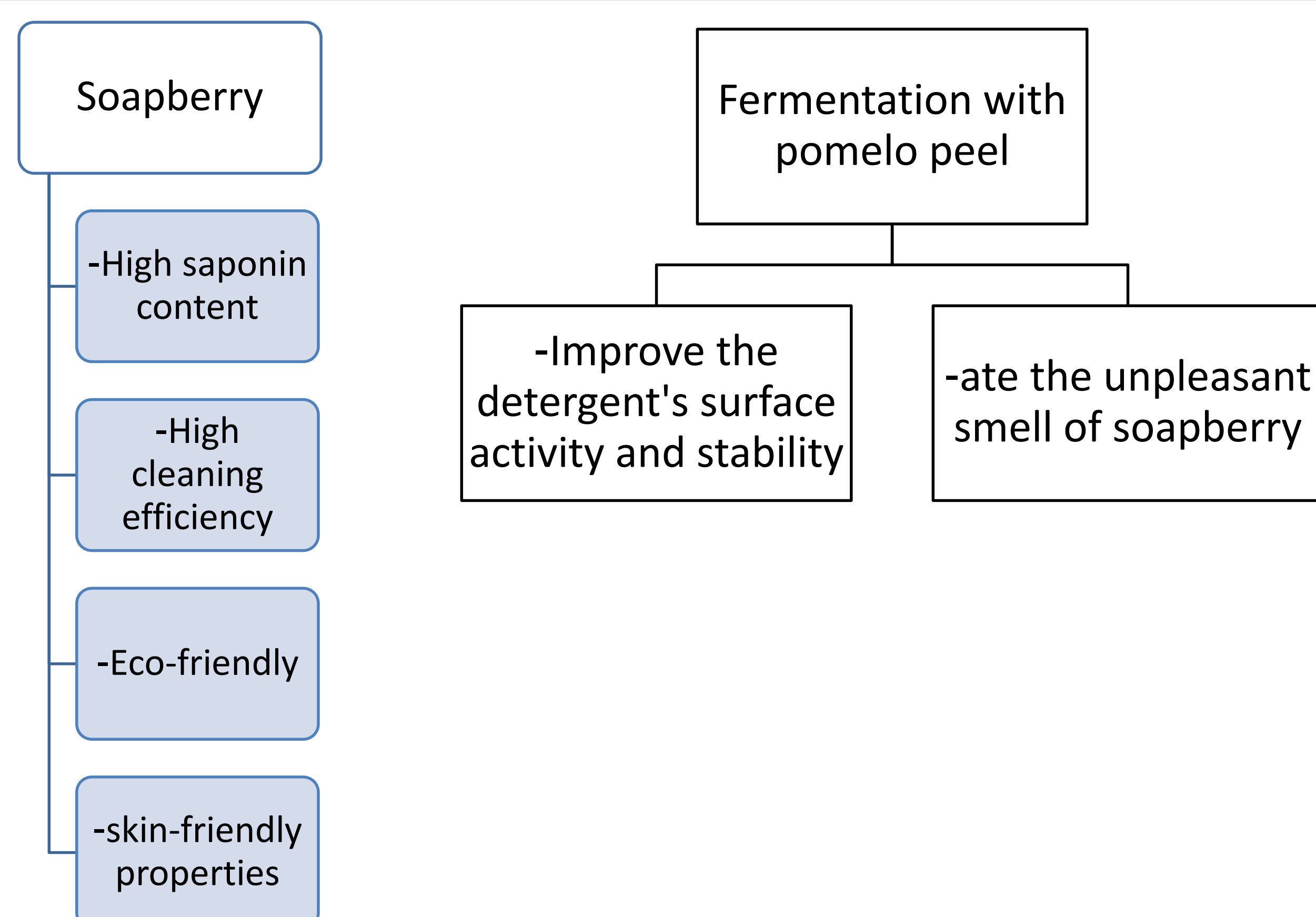


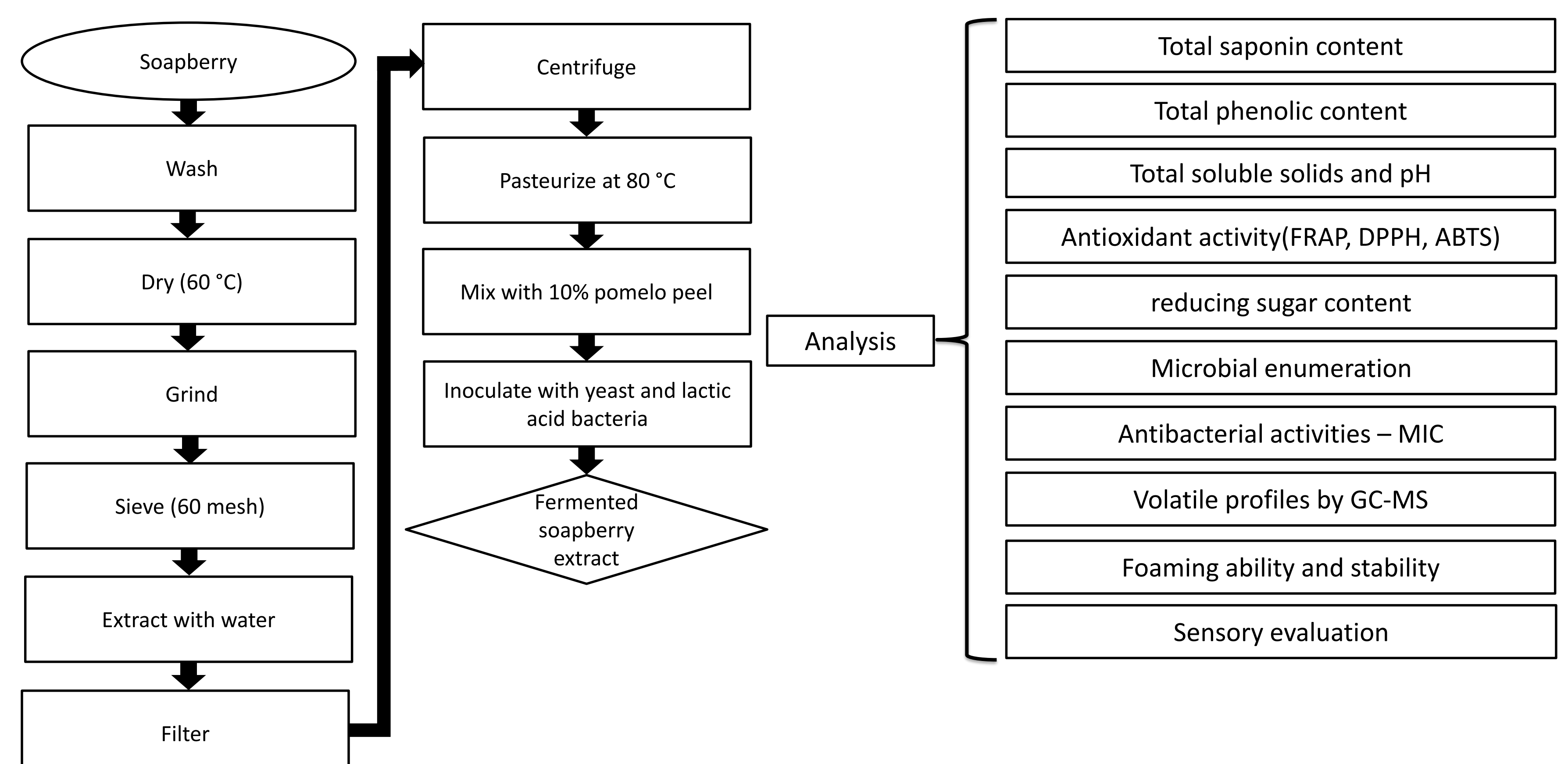
ABSTRACT

Soapberry (*Sapindus mukorossi* Gaertn) is a popular woody plant in Vietnam, often used as a cleaning product due to its ability to wash, foam and emulsify due to high saponin content. In this study, the performance of fermentation by two microbial strains, namely *Saccharomyces cerevisiae* active dry yeast (ADY) and *Levilactobacillus brevis* lactic acid bacteria (LB) along with the addition of pomelo peel (flavedo) was evaluated during 15 days in terms of sugar removal, antioxidant and antibacterial activities, foaming power, volatile composition, and sensory acceptability. The results showed that the soluble solid content of original extracts experienced a significant decrease from 14.5% to a stable range of 9.4–11.0% until day 15 for all fermented samples, which correlated with a reduction by approximately 60% in reducing sugars (from 12.52 g L⁻¹ to 4.77–6.56 g L⁻¹). In addition, the saponin content of fermented extracts was in the range of 118.2–145.0 mg L⁻¹ while antioxidant activities were extremely reduced after 15 days of fermentation. Increases in pomelo peel imparted fermented extracts with greater antibacterial activity against *Staphylococcus aureus* ATCC 6538, *Proteus mirabilis* ATCC 25933, and *Candida albicans* ATCC 10231, and LB had higher activity than ADY overall. Regarding the volatile profiles, two main compounds in the original extracts, including trilaurein (75.02%) and 1-dodecanoyl-3-myristoyl glycerol (24.85%), were completely removed and replaced by new alkanes, alkenes, alcohols, esters, and organic acids, and particularly D-limonene (86.34–95.31%) upon pomelo addition. Additionally, the foaming ability and stability of fermented extracts were also enhanced and there was clear distinction between fermented and unfermented samples using principal component analysis based on sensory liking data which showed consumers' preference towards fermented samples with a high percentage of pomelo peel. [6]

INTRODUCTION



METHODS AND MATERIALS



RESULTS AND DISCUSSION

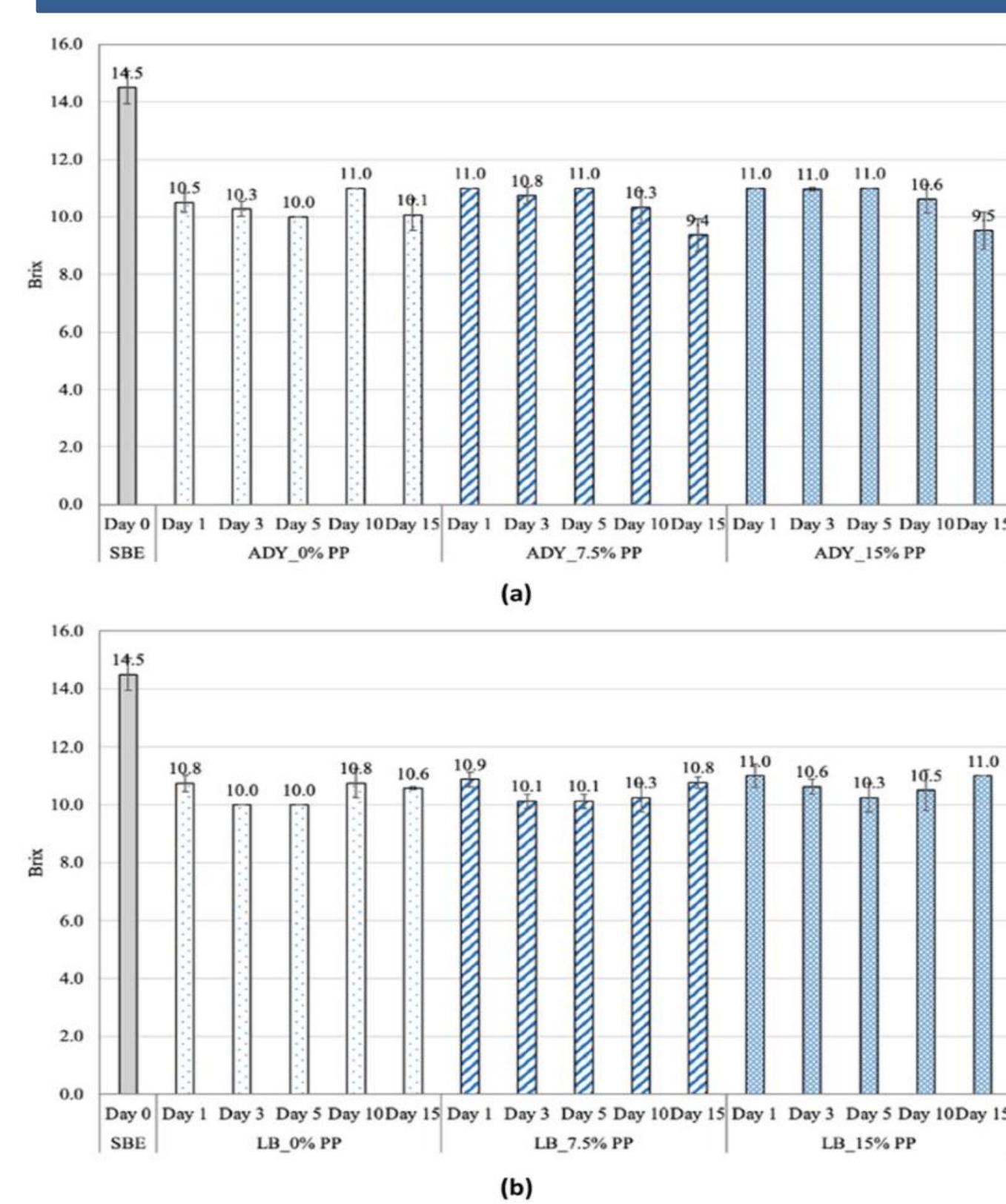


Fig 1. Changes in total soluble solids (*Brix) of soapberry extracts fortified with 0%, 7.5% and 15% pomelo peels (PP) during 15 days fermentation by (a) active dry yeast *Saccharomyces cerevisiae* (ADY) and (b) lactic acid bacteria *Levilactobacillus brevis* (LB). [6]

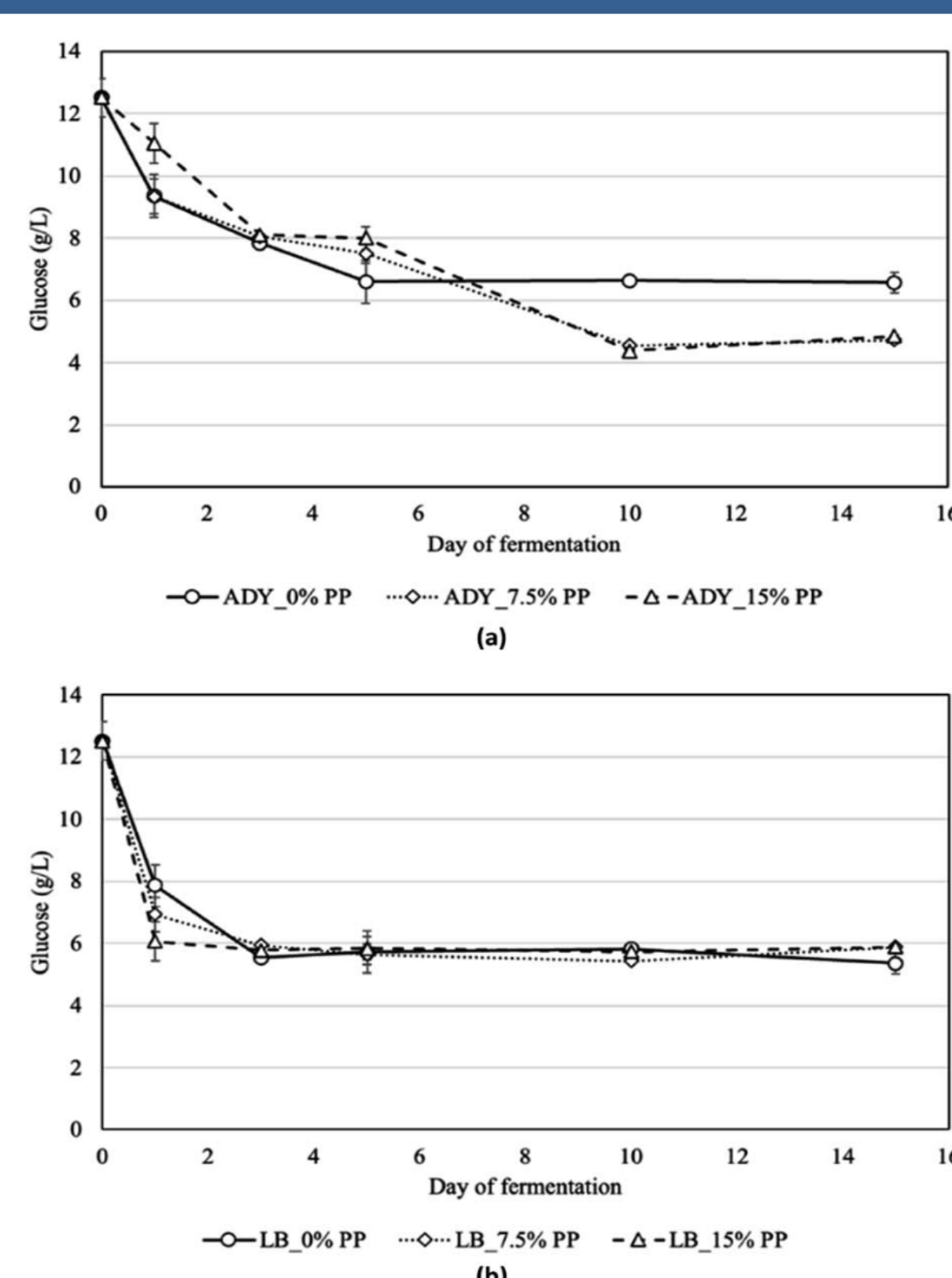


Fig 2. Changes in reducing sugar content (g glucose per L) of soapberry extracts fortified with 0%, 7.5% and 15% pomelo peels (PP) during 15 days fermentation by (a) active dry yeast *Saccharomyces cerevisiae* (ADY) and (b) lactic acid bacteria *Levilactobacillus brevis* (LB). [6]

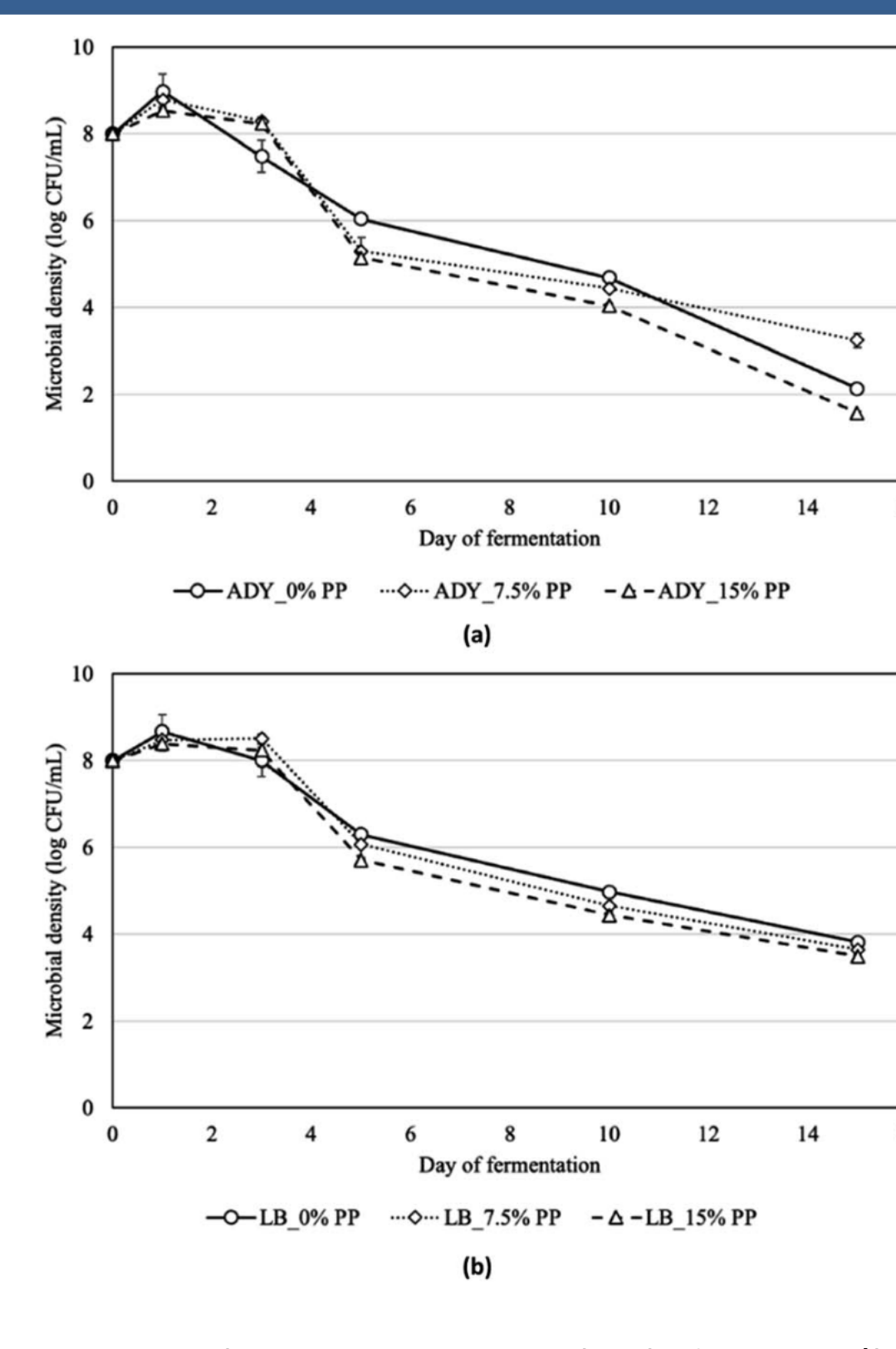


Fig 3. Changes in microbial density (log CFU mL⁻¹) of soapberry extracts fortified with 0%, 7.5% and 15% pomelo peels (PP) during 15 days fermentation by (a) active dry yeast *Saccharomyces cerevisiae* (ADY) and (b) lactic acid bacteria *Levilactobacillus brevis* (LB). [6]

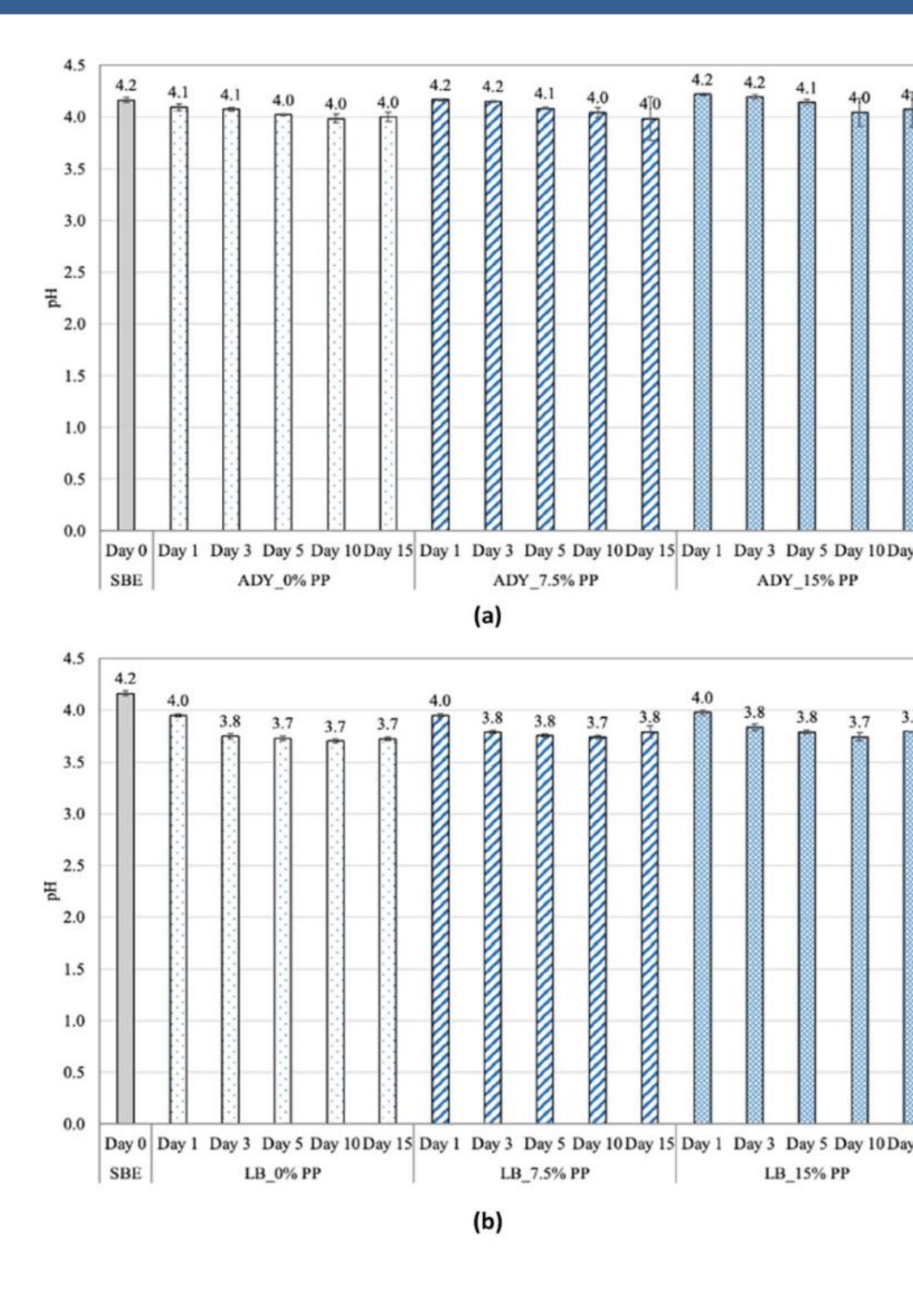


Fig 4. Changes in pH of soapberry extracts fortified with 0%, 7.5% and 15% pomelo peels (PP) during 15 days fermentation by (a) active dry yeast *Saccharomyces cerevisiae* (ADY) and (b) lactic acid bacteria *Levilactobacillus brevis* (LB). [6]

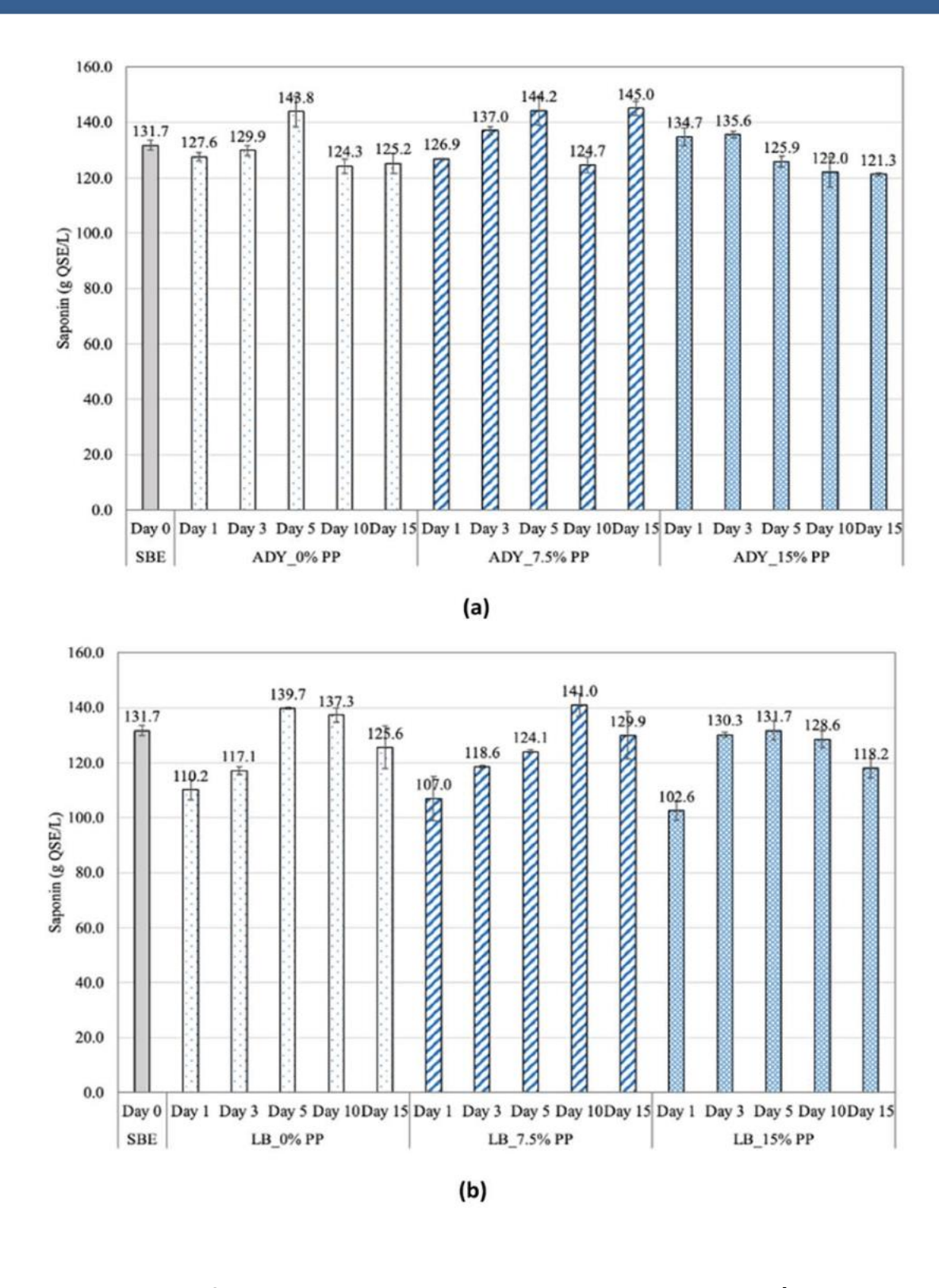


Fig 5. Changes in saponin content (g QSE per L) of soapberry extracts fortified with 0%, 7.5% and 15% pomelo peels (PP) during 15 days fermentation by (a) active dry yeast *Saccharomyces cerevisiae* (ADY) and (b) lactic acid bacteria *Levilactobacillus brevis* (LB). [6]

CONCLUSIONS

Fermentation of soapberry extract by yeast and bacteria improved saponin purity by removing impurities, mainly sugars, in the original extract. In particular, the combination of fermentation and pomelo flavedo has completely eliminated the unpleasant smell of soapberry extracts and imparted a pleasant scent, mainly D-limonene to the fermented extracts. This is also reflected in the high sensory acceptability of fermented samples and the clear clustering between fermented and unfermented ones. In addition, the foaming ability and antibacterial activity of the extract were also significantly enhanced compared to original soapberry extract. [6]

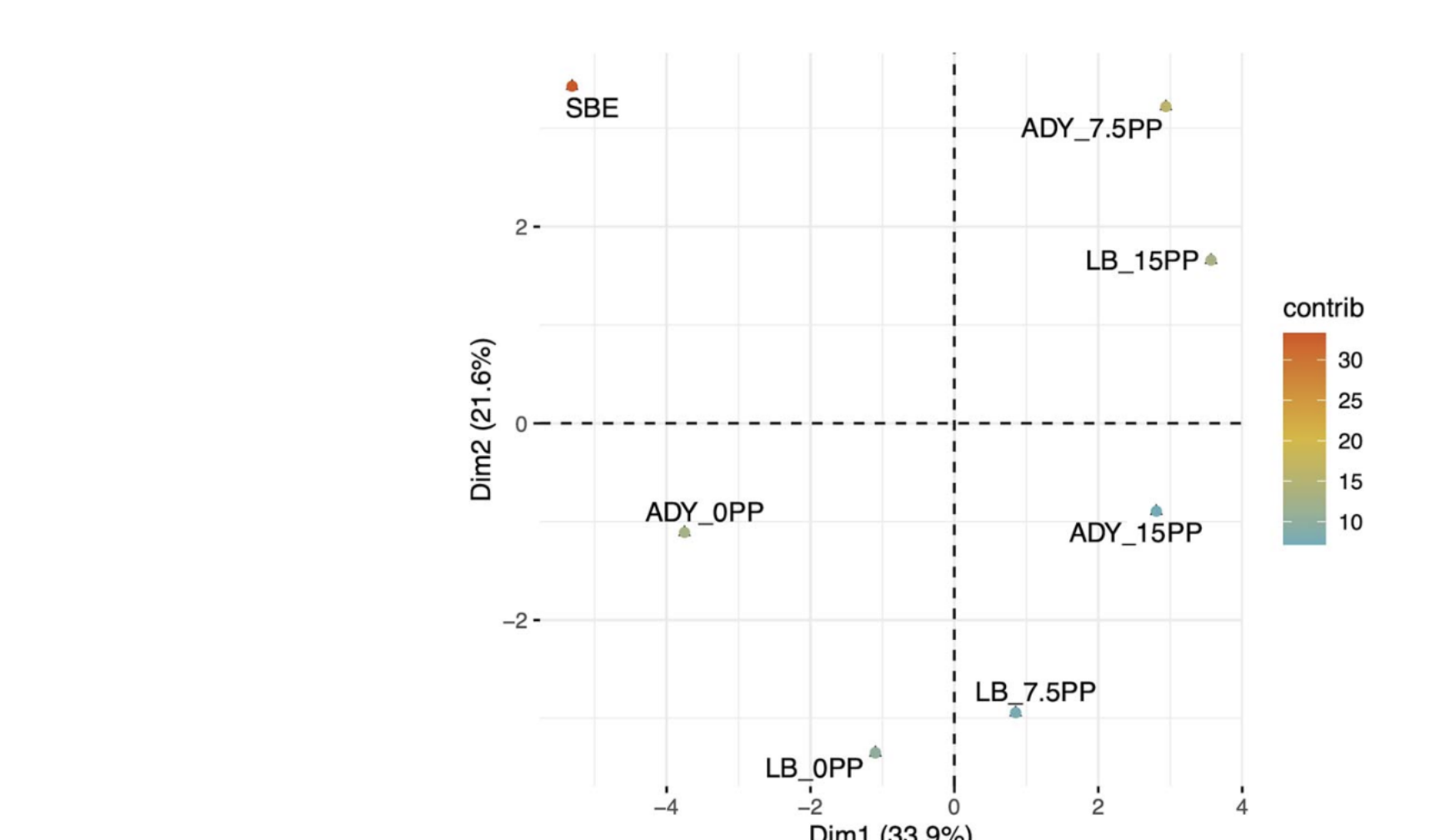


Fig. 6 Preference mapping of unfermented (SBE) and fermented soapberry extracts fortified with 0%, 7.5% and 15% pomelo peels (PP) after 15 days fermentation by active dry yeast *Saccharomyces cerevisiae* (ADY) and lactic acid bacteria *Levilactobacillus brevis* (LB) in the first two dimensions of PCA plot. [6]

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References

- C.-C. Chen, C.-J. Nien, L.-G. Chen, K.-Y. Huang, W.-J. Chang and H.-M. Huang, *Int. J. Mol. Sci.*, 2019, 20, 2579.
- M. Wei, J. Qiu, L. Li, Y. Xie, H. Yu, Y. Guo and W. Yao, *J. Ethnopharmacol.*, 2021, 268, 113552.
- C. Chen, R. Li, D. Li, F. Shen, G. Xiao and J. Zhou, *New J. Chem.*, 2021, 45, 952–960.
- M. Sochacki and O. Vogt, *Plants*, 2022, 11, 2355.
- I. G'oral and K. Wojciechowski, *Adv. Colloid Interface Sci.*, 2020, 279, 102145.
- Q. D. Nguyen, Q. D. La, & N. N. Nguyen. Green removal of unpleasant volatiles from soapberry (*Sapindus mukorossi*) extracts by two-phase microbial fermentation fortified with pomelo peel waste. *RSC advances*, 2023, 13(19), 13282–13291.