Foods 2025 Conference
The 6th International Electronic Conference on Foods
28–30 October 2025 | Online
MDPI

Sustainable Valorisation of Sea Buckthorn Leaves for the Development of Functional Beverages

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INTRODUCTION & AIM

The sustainable use of agricultural by-products is vital for circular bioeconomy goals. Sea buckthorn leaves (SBLs), an underused by-product of berry harvesting, show promise for value-added uses. However, their application in beverages is limited due to the lack of eco-friendly extraction methods that preserve heat-sensitive compounds. Pressurised cyclic solid–liquid (PCSL) extraction offers a novel solution, though it has rarely been applied to this matrix.

This study aimed to valorise SBL by extracting bioactive compounds using the innovative PCSL method for the development of a functional beverage – kombucha.

METHOD

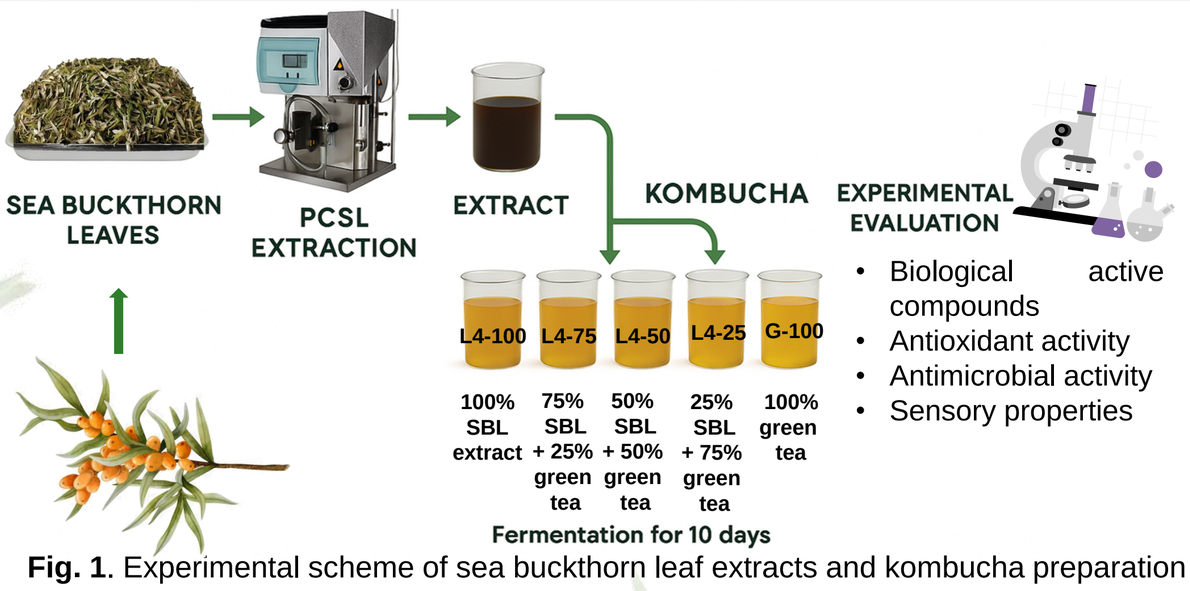

Fig. 1. Experimental scheme of sea buckthorn leaf extracts and kombucha preparation

RESULTS & DISCUSSION

- The L4 extract, obtained through PCSL extraction using 20 pressure cycles of 2 minutes each, was selected for kombucha formulation due to its efficient and sustainable production conditions.
- The L4–100 kombucha demonstrated the highest total phenolic content (Fig. 2) and the most stable antioxidant activity (Fig. 3) throughout the 10-day fermentation period.
- Kombucha beverages containing sea buckthorn leaf extract exhibited stronger antimicrobial effects (Table 1) against tested pathogens, confirming their potential to improve microbial safety and functional quality.
- Sensory evaluation revealed higher consumer acceptance (Fig. 4) and a more balanced flavour profile in SBL-based kombucha compared to the green tea control.

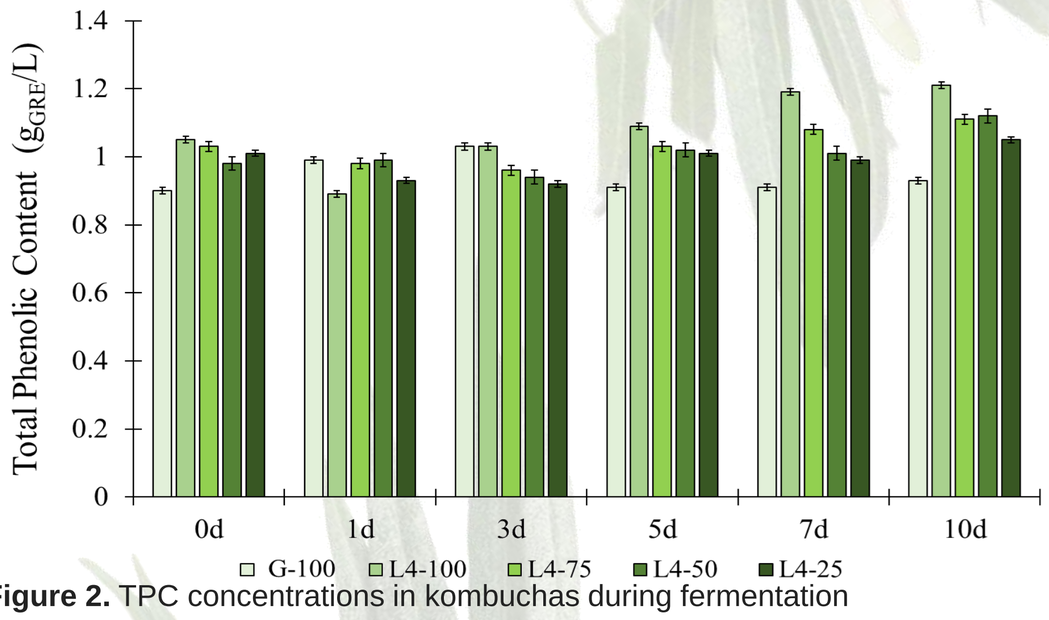

Figure 2. TPC concentrations in kombuchas during fermentation

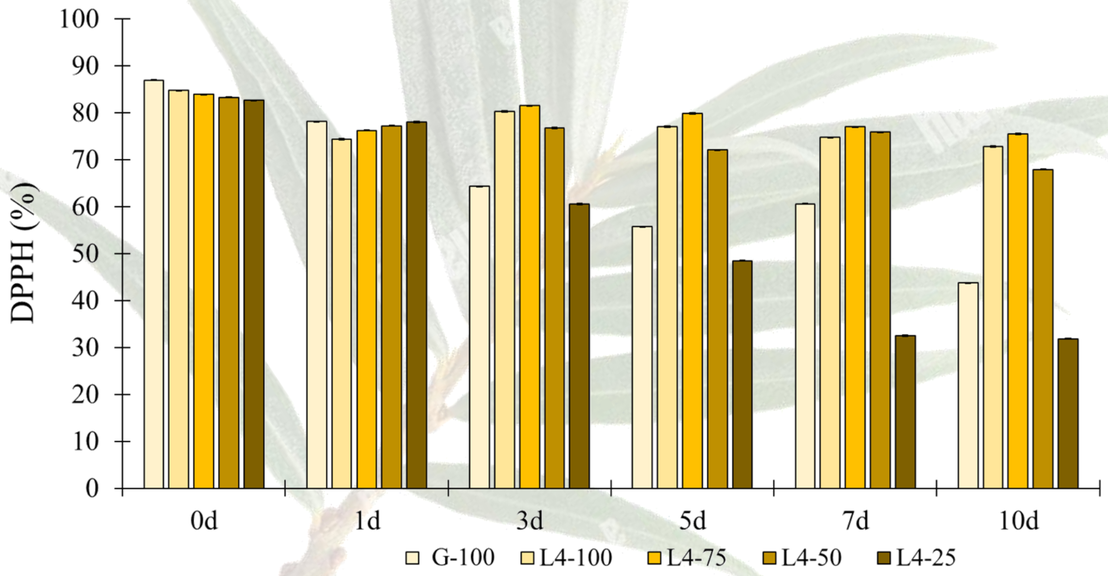

Figure 3. Antioxidant efficacy in kombuchas during fermentation

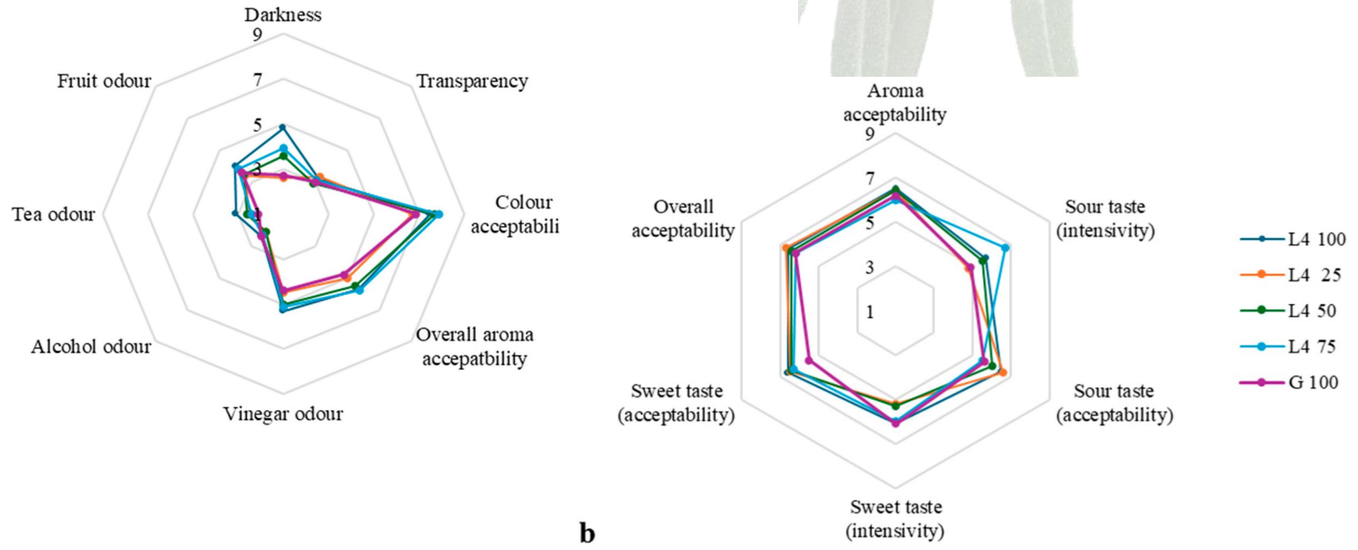

Figure 4. Sensory properties of kombucha: color, aroma (**a**), taste, and acceptability (**b**)

Table 1. Inhibition zones of kombucha.

Sample	Fermentation, Days	Inhibition Zone Diameter, mm			
		E. coli ATCC 8739	*S. aureus* ATCC 25923	*E. faecalis* ATCC 19433	*S. saprophyticus* ATCC 15305
L4-100	0	0.0 ± 0.0 a	16.3 ± 0.5 c	0.0 ± 0.0 a	14.5 ± 1.0 c
	10	17.5 ± 0.6 b	17.3 ± 1.0 c	16.3 ± 0.5 c	19.8 ± 1.5 d
L4-75	0	0.0 ± 0.0 a	13.3 ± 0.5 b	0.0 ± 0.0 a	10.5 ± 0.6 b
	10	16.8 ± 1.5 b	13.5 ± 0.6 b	16.3 ± 0.5 c	17.0 ± 0.0 d
L4-50	0	0.0 ± 0.0 a	0.0 ± 0.0 a	0.0 ± 0.0 a	0.0 ± 0.0 a
	10	17.8 ± 1.3 b	12.3 ± 0.5 b	13.0 ± 1.2 b	17.2 ± 1.3 d
L4-25	0	0.0 ± 0.0 a	0.0 ± 0.0 a	0.0 ± 0.0 a	0.0 ± 0.0 a
	10	16.8 ± 0.5 b	16.0 ± 0.0 c	11.3 ± 1.0 b	13.0 ± 1.4 bc
G-100	0	0.0 ± 0.0 a	0.0 ± 0.0 a	0.0 ± 0.0 a	0.0 ± 0.0 a
	10	0.0 ± 0.0 a	0.0 ± 0.0 a	0.0 ± 0.0 a	12.5 ± 0.6 c

CONCLUSION

These results indicate that SBLs, as an underutilised secondary biomass, represent not only a nutritional resource but also a significant source of bioactive compounds. This valorisation approach highlights the potential of using such biomass in the formulation of functional foods aligned with sustainable and circular economy principles.

Acknowledgements:

This research was supported by Lithuanian Rural Development Program 2014- 2020 under activity “Support for the creation and development of EIP activity groups” project Circular manufacturing model for producing biologically active material No. 35BV-KK-22-1- 05005-PR001