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Fermentation of carob syrup (*Ceratonia siliqua* L.) by SCOBY to produce a polyphenol-rich kombucha

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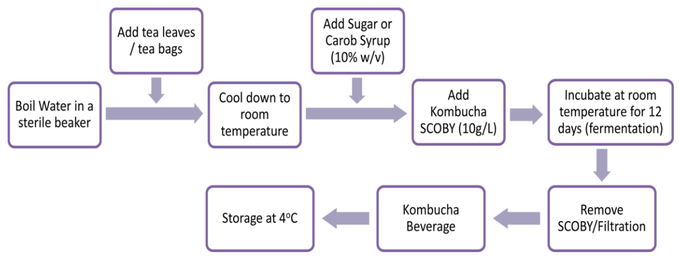
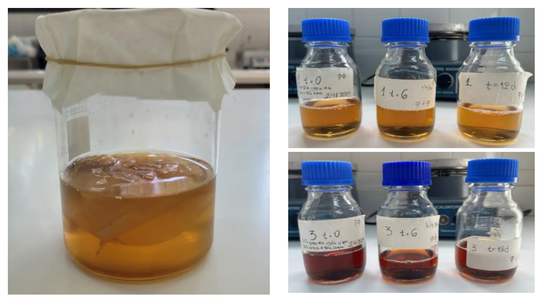
INTRODUCTION & AIM

Kombucha tea is a probiotic fermented acidic tea obtained from a symbiotic culture of bacteria and yeasts (SCOBY) mainly acetic acid bacteria (AAB), lactic acid bacteria (LAB) and yeasts attached to a floating biofilm of bacterial cellulose, in a medium containing sugars and tea and its consumption is linked to beneficial effects. The aim of this study was to prepare kombucha tea by using alternative plant raw materials used in the Mediterranean basin in order to increase the bioactivity of the final product.





METHOD

Two kombucha systems were fermented for 12 days, one system by using SCOBY (10g/L), sugar (10 % w/v) and a mixture (1% w/v) of equal quantities of green tea and mountain tea (*Sideritis* spp.) and in the second system, sugar was replaced by carob syrup from *Ceratonia siliqua* L., a xerophytic endemic species typical of the Mediterranean climate. Physicochemical and microbiological analyses were performed and total phenolic content (TPC) and antioxidant activity were measured at 0, 6 and 12 days of fermentation. The SCOBY was observed by Scanning Electron Microscopy (SEM).

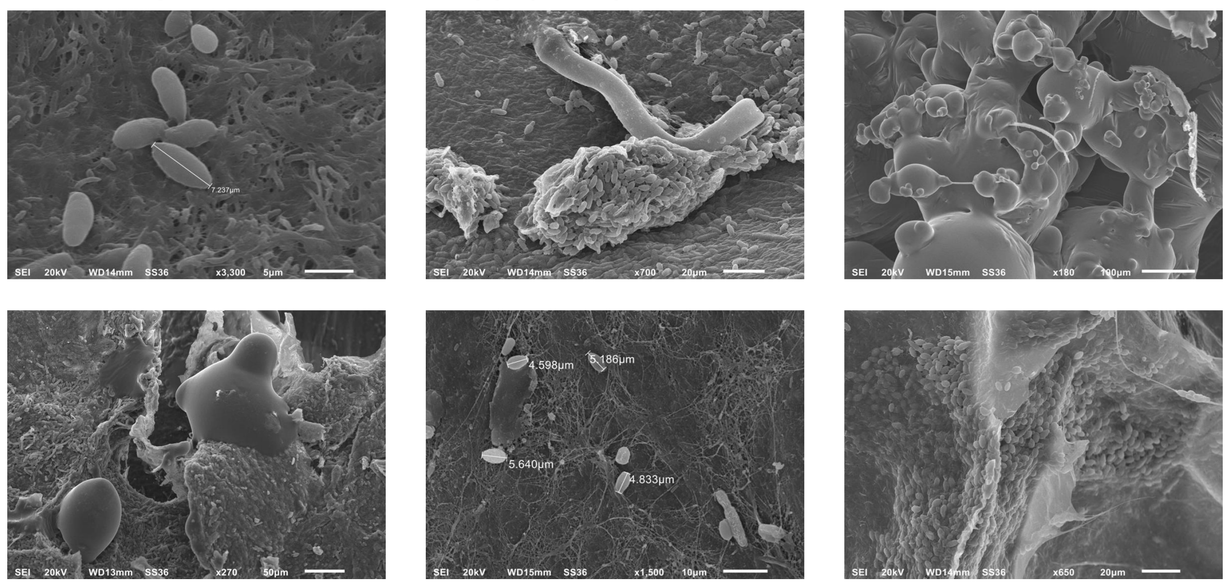


Image 1: Kombucha samples (Sugar and Carob Syrup 10% w/v) observed by SEM during fermentation (t_{d0}-t_{d12}). SEM revealed an extended net of bacterial cellulose with bacteria and yeasts attached.

RESULTS & DISCUSSION

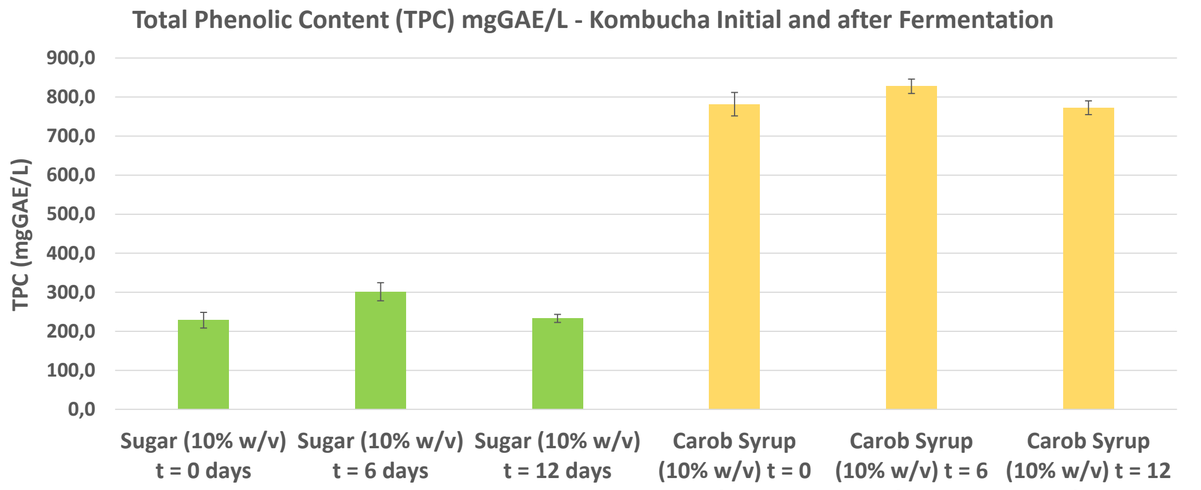
Both systems fermented the available sugars and produced a slightly carbonated, aromatic and acidic (pH 3.12-3.39) probiotic beverage with a low alcohol content (0.5-0.7% ABV). Yeasts and AAB remained at high probiotic levels (>7 logCFU/mL) and LAB at 4-5 logCFU/mL. The kombucha produced with carob syrup had at the end of fermentation an increased polyphenol content, more than three times than the sugar-based kombucha (773 mgGAE/L and 233 mgGAE/L respectively) and the antioxidant activity was increased by 2.4 times. SEM revealed an extended net of bacterial cellulose with bacteria and yeasts attached.

Samples	Days	pH	Alcohol (% v/v)
Sugar (10% w/v) mixture of Green tea and Sideritis spp (1% w/v)	0	4,57	0
Sugar (10% w/v) mixture of Green tea and Sideritis spp (1% w/v)	6	3,70	0,17
Sugar (10% w/v) mixture of Green tea and Sideritis spp (1% w/v)	12	3,13	0,69
Carob Syrup (10% w/v) mixture of Green tea and Sideritis spp (1% w/v)	0	4,55	0
Carob Syrup (10% w/v) mixture of Green tea and Sideritis spp (1% w/v)	6	3,74	0,29
Carob Syrup (10% w/v) mixture of Green tea and Sideritis spp (1% w/v)	12	3,39	0,51

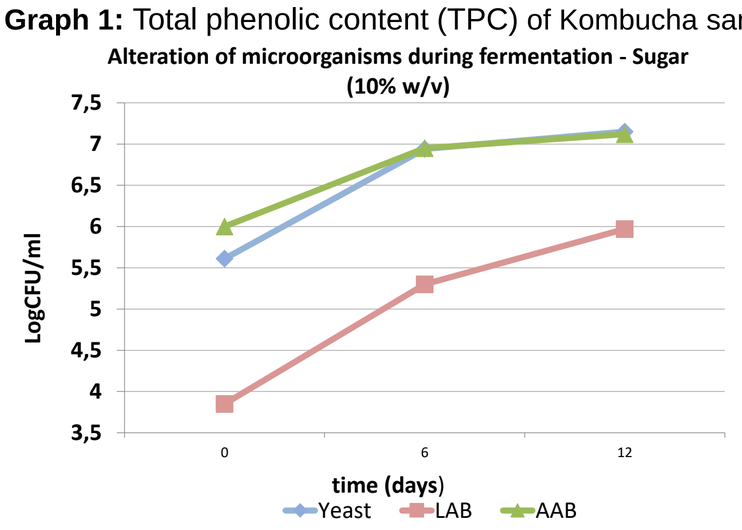
Table 1: Evaluation of physicochemical properties of Kombucha samples during fermentation (t_{d0}-t_{d12}).

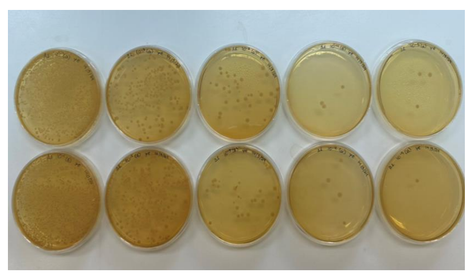
Samples	Total Phenolic Content (TPC) Average (mgGAE/L)	Standard deviation (SD)
Sugar (10% w/v) mixture of Green tea and Sideritis spp (1% w/v)_t = 0 days	228,4	20,1
Sugar (10% w/v) mixture of Green tea and Sideritis spp (1% w/v)_t = 6 days	301,3	23,1
Sugar (10% w/v) mixture of Green tea and Sideritis spp (1% w/v)_t = 12 days	233,0	10,3
Carob Syrup (10% w/v) mixture of Green tea and Sideritis spp (1% w/v)_t = 0 days	781,8	30,1
Carob Syrup (10% w/v) mixture of Green tea and Sideritis spp (1% w/v)_t = 6 days	827,6	18,4
Carob Syrup (10% w/v) mixture of Green tea and Sideritis spp (1% w/v)_t = 12 days	772,6	17,6

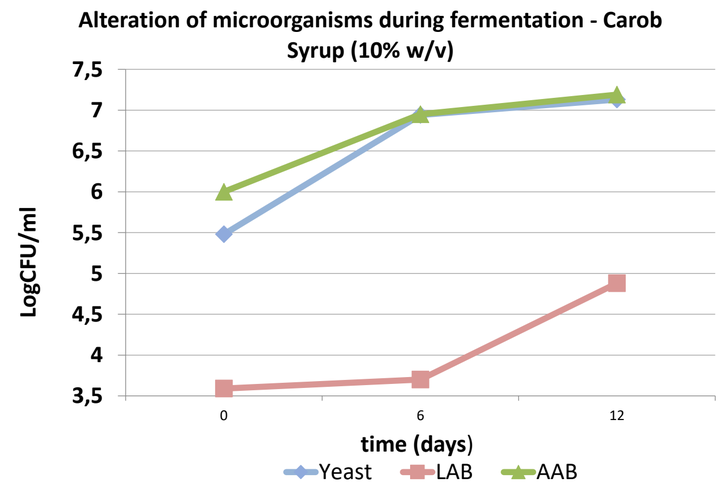
Table 2: Total phenolic content (TPC) of Kombucha samples during fermentation (t_{d0}- t_{d12}).

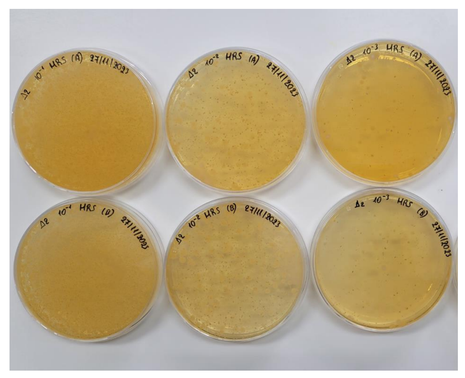


Graph 1: Total phenolic content (TPC) of Kombucha samples during fermentation (t_{d0}-t_{d12}).









Graph 2: Alteration of microorganisms (LogCFU/ml) of Kombucha samples during fermentation (t_{d0}-t_{d12}).

CONCLUSION

Carob syrup can be used as an alternative and sustainable fermentable substrate for the preparation of Kombucha and increases significantly its bioactivity. Additional studies are needed to develop a product with the optimal organoleptic characteristics and antioxidant properties.

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