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Research article

Improving probiotic preservation through phycocyanin enriched skim milk as a protective drying medium

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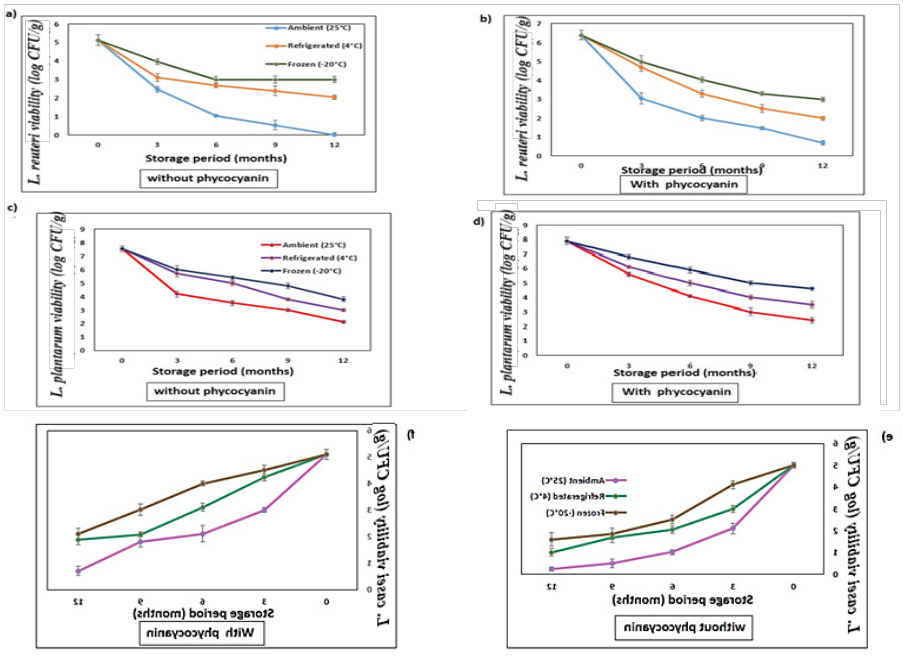

Figure (1): Viability of *L. reuteri* (a,b), *L. plantarum* (c,d), and *L. casei* (e,f) under different storage conditions (Room Temperature, 4°C, and -20°C), with and without phycocyanin, over a period of 12 months.

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Table (1): Lactic acid production (g/L) before and after drying

Strain	Condition	Before Drying (g/L)	After Drying (g/L)	% Metabolic Retention
L. reuteri	Without phycocyanin	1.60 ± 0.05^{a}	0.95 ± 0.04^{c}	59.4%
L. reuteri	With phycocyanin	1.68 ± 0.04^{a}	1.38 ± 0.03^{a}	82.1%
L. plantarum	Without phycocyanin	2.20 ± 0.06^{b}	1.32 ± 0.05^{b}	60.0%
L. plantarum	With phycocyanin	2.28 ± 0.04^{b}	1.90 ± 0.04^{a}	83.3%
L. casei	Without phycocyanin	1.85 ± 0.03^{c}	1.00 ± 0.03^{c}	54.1%
L. casei	With phycocyanin	1.92 ± 0.05^{c}	1.56 ± 0.04^{a}	81.3%

†Statistical analysis denoted by the superscripts [a], [b], and [c] indicates that values within the same column sharing the same letter are not significantly different ($p > 0.05$). Horizontal comparisons between 'Without phycocyanin' and 'With phycocyanin' for the same strain at a given time point were also performed; statistically significant differences are reflected by differing letters in the "After Drying" column, showing the protective effect of phycocyanin on lactic acid production.

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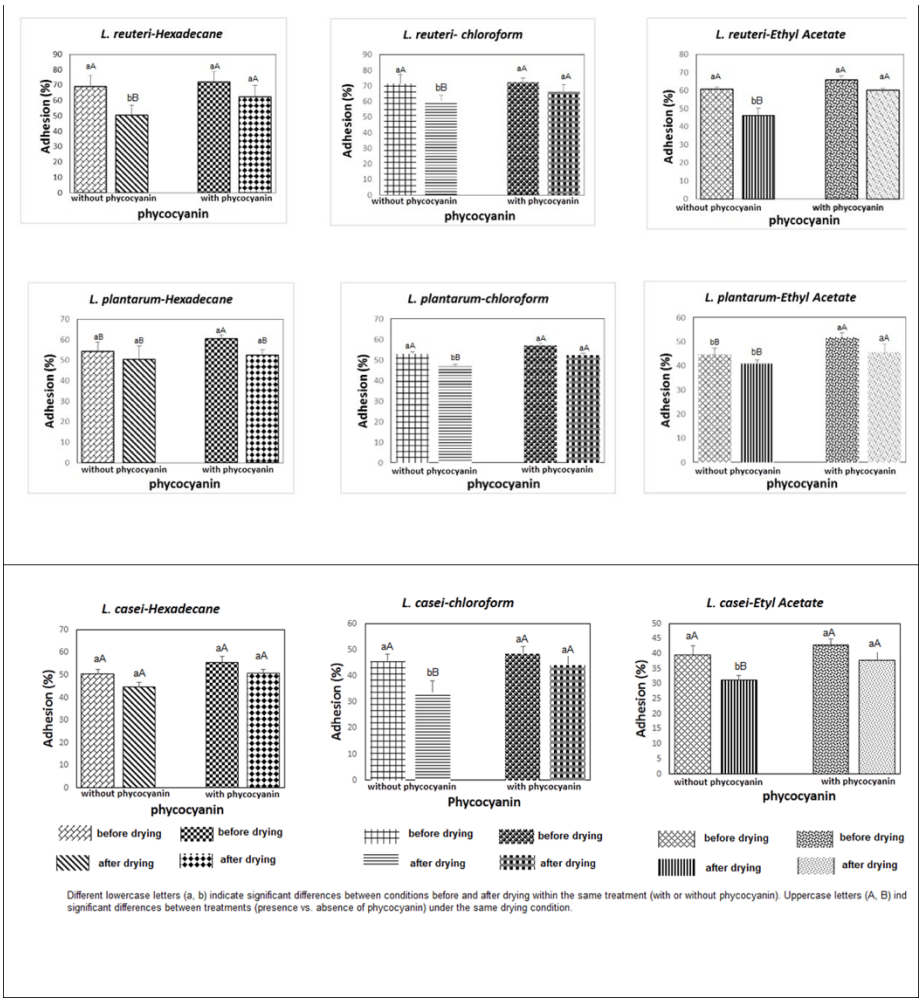

Figure (2): Effect of drying and phycocyanin presence on the adhesion properties of *L. reuteri*, *L. plantarum*, and *L. casei* strains to hexadecane, chloroform, and ethyl acetate solvents.

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Table (2): Viability of Probiotic Strains in Biofilm (MTT Assay)

Strain	Condition	Absorbance (Mean ± SD)
L. reuteri	Before drying, without phycocyanin	$0.87^{b} \pm 0.05$
	After drying, without phycocyanin	$0.62^{e} \pm 0.04$
	Before drying, with phycocyanin	$0.94^{a} \pm 0.03$
	After drying, with phycocyanin	$0.81^{c} \pm 0.06$
L. plantarum	Before drying, without phycocyanin	$0.91^{ab} \pm 0.06$
	After drying, without phycocyanin	$0.67^{de} \pm 0.05$
	Before drying, with phycocyanin	$0.98^{a} \pm 0.04$
	After drying, with phycocyanin	$0.86^{bc} \pm 0.05$
L. casei	Before drying, without phycocyanin	$0.89^{b} \pm 0.04$
	After drying, without phycocyanin	$0.65^{e} \pm 0.03$
	Before drying, with phycocyanin	$0.95^{a} \pm 0.05$
	After drying, with phycocyanin	$0.80^{cd} \pm 0.04$

†*Statistical analysis was performed for each strain separately. Values sharing the same letter within a given strain are not significantly different ($p > 0.05$). Comparisons were made vertically between conditions (Before drying vs. After drying, without or with phycocyanin) for the same strain*

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