Studies on the use of Environmental Lactic Acid Bacteria (LAB) as an Antioxidant Agent in Lecithin-phytosterol Oleogel Emulsions

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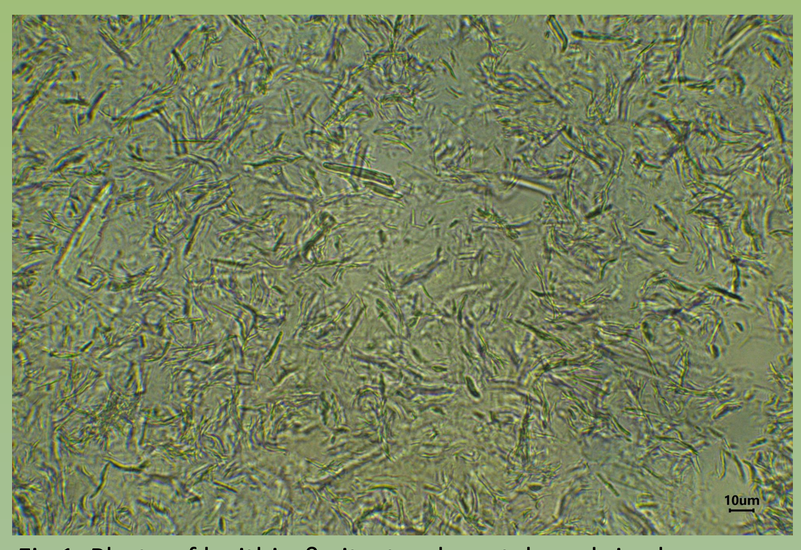
Introduction

In recent years, increasing attention has been paid to oleogels – an innovative, solid lipid system derived from liquid oil and oleogelling agents. The oleogelator, by forming a three-dimensional network, has the ability to retain oil. The research involved using blends of oleogelators: lecithin, phytosterols (75% β-sitosterol), and rice bran wax. Rapeseed oil, a source of unsaturated fatty acids, was used for structuring.

The research aimed to produce a w/o emulsion based on oleogel with the addition of selected strains of environmental lactic acid bacteria (LAB) with antioxidant properties and to investigate their effect on storage properties.

Four emulsion variants were prepared with a proportion of 80% oleogel and 20% aqueous phase – 0.85% NaCl solution (control) – and three LAB strains were suspended: Lactiplantibacillus pentosus S2B, Lactiplantibacillus plantarum OP5, and OP8, with proven antioxidant properties in in vitro studies. The emulsions were stored at room and refrigerated temperatures for five weeks. The oxidative changes and LAB survival were analyzed.



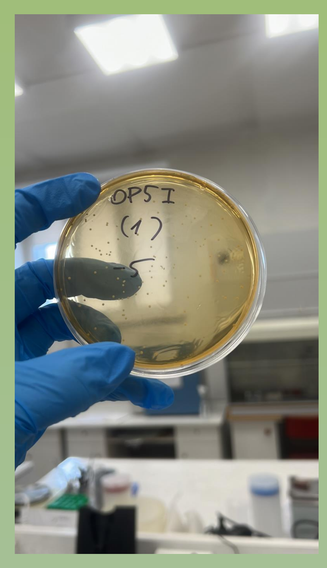


Fig 1. Photo of lecithin-β-sitosterol crystals and rice bran wax in a rapeseed oil-based oleogel

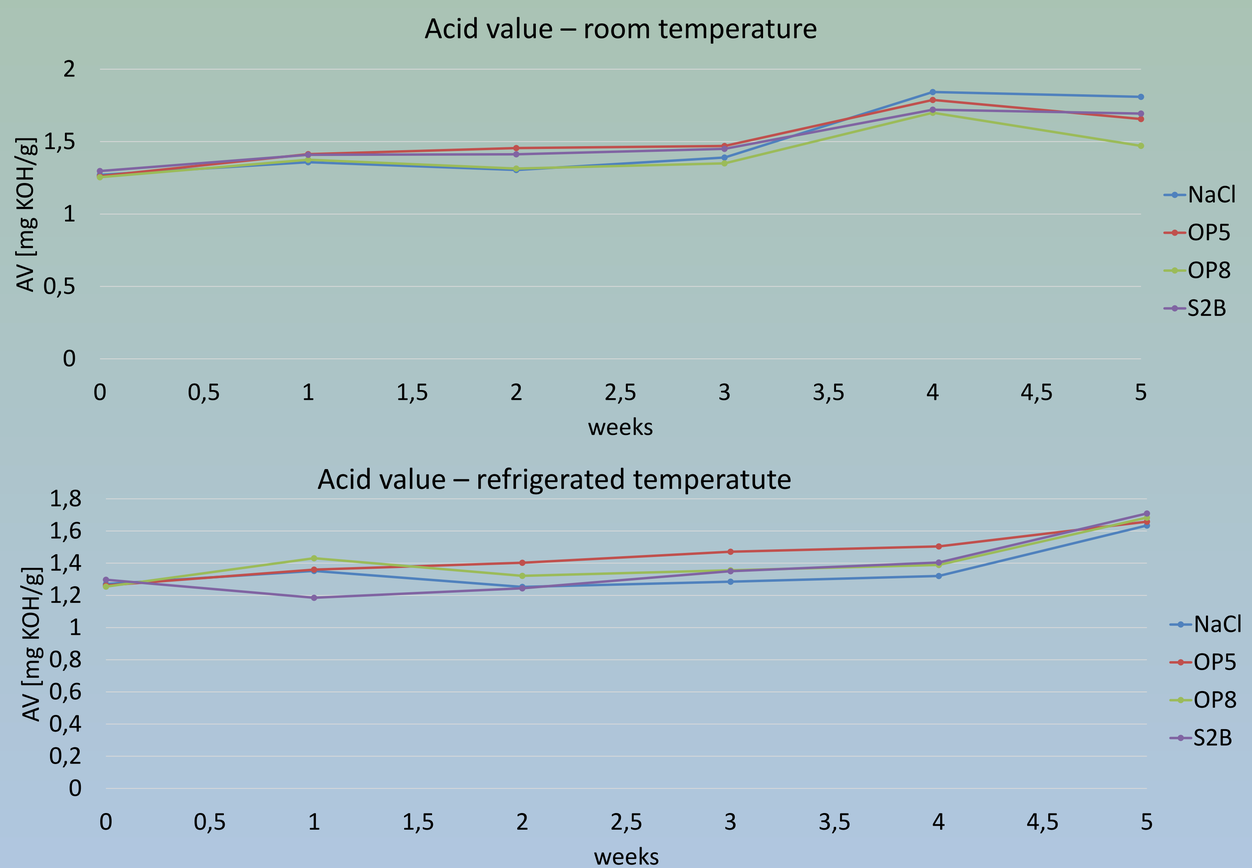
Table 1. Composition of saturated fatty acids (SFA), monounsaturated fatty acids (MUFA), polyunsaturated fatty acids (PUFA) and sterols of rapeseed oil, oleogel and emulsion

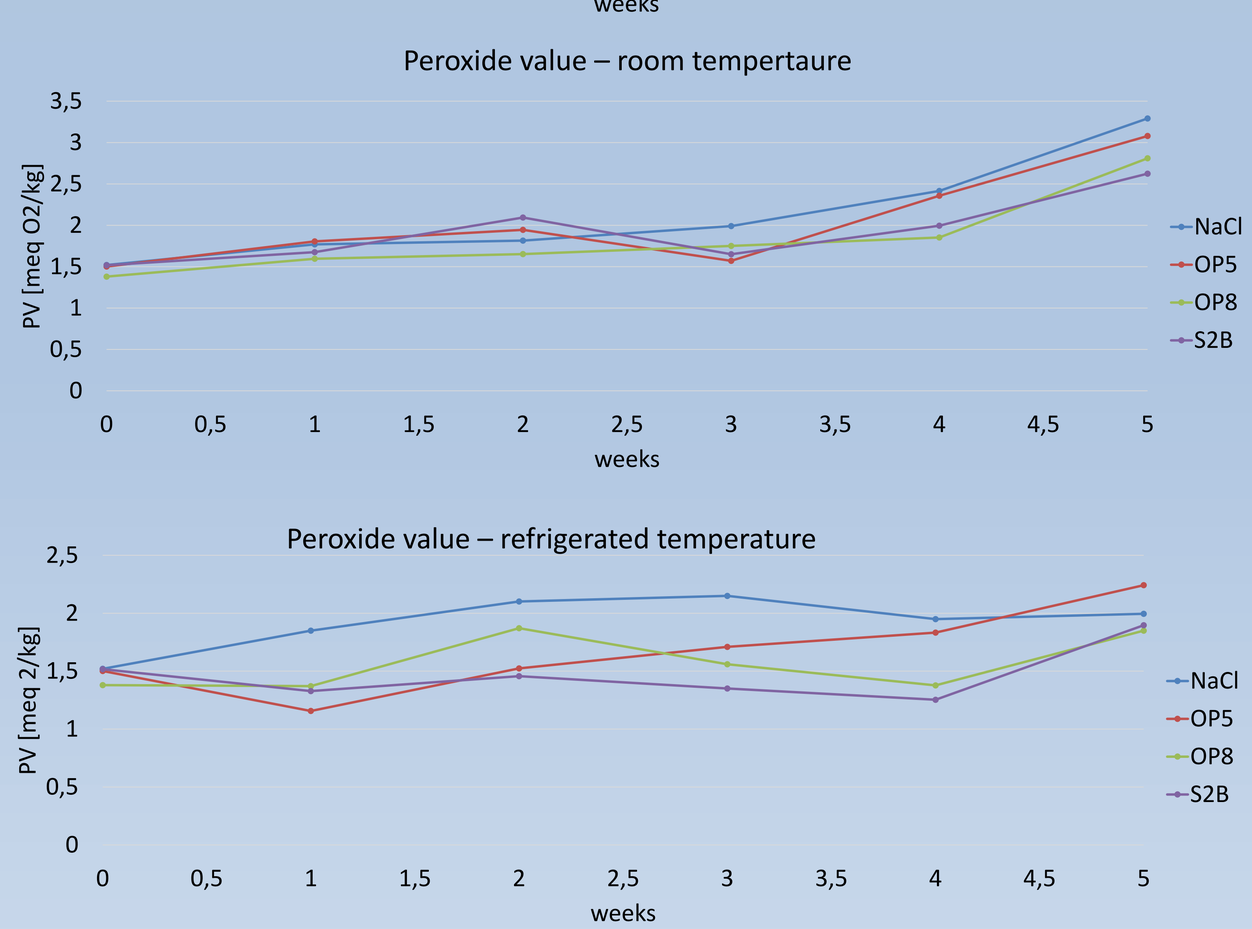
1 day	Rapeseed oil	Oleogel	Emulsion
SFA [%]	7,30	8,45	8,21
MUFA [%]	65,90	65,30	65,10
PUFA [%]	26,20	25,75	26,03
Campesterol [mg/kg]	251,1	371,2	350,9
β-sitosterol [mg/kg]	362,1	2242,7	2169,7

Refrigerated temperature – 5 weeks				
Emulsion	NaCl	OP5	OP8	S2B
SFA	8,4	8,5	8,8	8,5
MUFA	65,3	65,2	64,9	65,2
PUFA	25,6	25,6	25,6	25,7
SFA/PUFA	0,326	0,334	0,342	0,332
Campesterol [mg/kg]	288,0	247,7	258,7	285,6
β-sitosterol [mg/kg]	1831,0	1581,5	1617,9	1809,3
Room temperature – 5 weeks				
SFA	9,9	9,6	9,6	9,3
MUFA	64,0	64,1	64,1	64,5
PUFA	25,5	25,6	25,6	25,6
SFA/PUFA	0,387	0,375	0,375	0,366
Campesterol [mg/kg]	308,8	294,43	327,6	312,2
β-sitosterol [mg/kg]	1883,8	1781,6	1974,6	1897,7

Table 2. Survival of microorganisms in emulsions during storage

Time [weeks]	Room temperature			Refrigerated temperature		
	OP5 [log jtk/g]	OP8 [log jtk/g]	S2B [log jtk/g]	OP5 [log jtk/g]	OP8 [log jtk/g]	S2B [log jtk/g]
0	8,06	8,09	7,86	8,06	8,09	7,86
1	5,22	5,12	4,96	6,80	8,24	7,36
2	3,13	4,13	4,44	4,14	7,79	4,95
3	2,57	3,85	3,25	3,15	6,59	4,22
4	0	3,57	2,98	0	5,41	3,50
5	0	3,05	0	0	3,51	3,29





Summary

The beneficial antioxidant properties of microorganisms, protecting unsaturated fatty acids, were observed during storage at room temperature. At week 5 of storage, the control emulsion (NaCl) had the highest SFA levels, while the variant with the S2B strain had the lowest. The number of LAB in emulsions stored at room temperature decreased much more rapidly compared to those stored refrigerated. It can be assumed that the postbiotics (metabolites) produced by the microorganisms and the shorter bacterial viability had a beneficial effect on the lipid matrix, protecting nutritionally valuable unsaturated fatty acids. Studies have shown that the phytosterol content decreased with storage time, which may indicate their degradation caused by oxidation and microbial activity. The viability of LAB in the emulsions indicates that the developed matrix can be used as a carrier.

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