

Use of whey from dairy industry for the production of starter cultures and antimicrobial metabolites

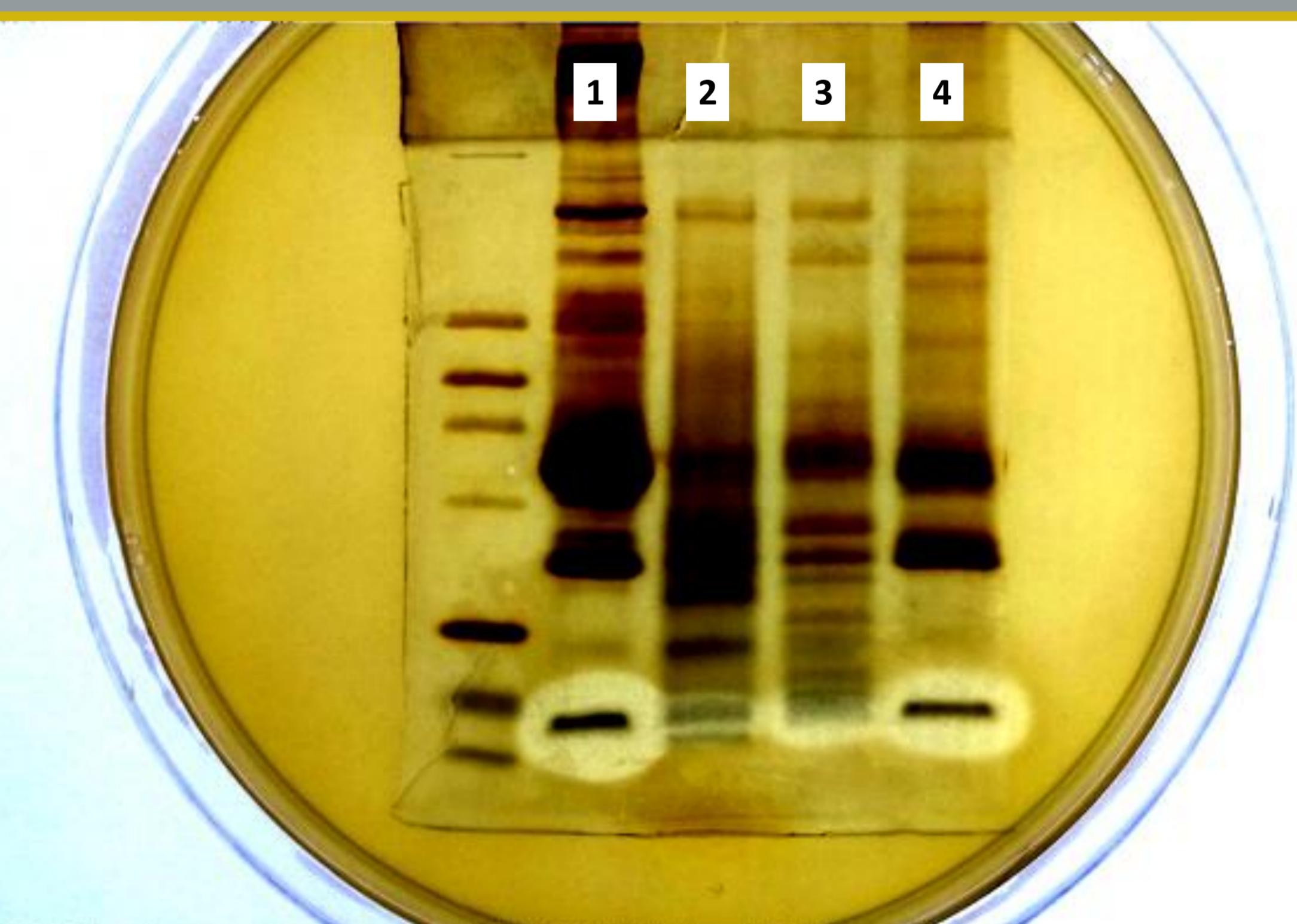
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INTRODUCTION

Whey, a by-product in the dairy industry (estimated production at 180 to 190 million tonnes / year), still contains valuable nutrients such as proteins, carbohydrates and minerals. Instead of being discarded as a biological waste, whey can be further used in food industry. One of the possibilities is the cultivation of lactic acid bacteria, in order to produce viable biomass intended for starter cultures, protective cultures or probiotic cultures, as well as their metabolites with diverse biological activities. In the present study, acid whey derived from the production of fresh curd cheese ("skuta") was evaluated as a medium for the cultivation of lactic acid bacteria and production of bacteriocins.



SDS-PAGE detection method for bacteriocins, combined with antimicrobial activity monitoring. 1 – nisin standard, 2 – nisin standard degraded with pronase E, 3 – nisin standard degraded with α -chymotrypsin, 4 – nisin standard degraded with trypsin.

METHODS

Whey was neutralized, sterilized, enriched with growth supplements and inoculated with the commercial probiotic strains *Lactococcus (Lc.) lactis* ssp. *lactis* ATCC 11454 (IM407), *Propionibacterium freudenreichii* ssp. *shermanii* JS (IM315), *Lactobacillus (Lb.) plantarum* LMG 23545 (IM526) and with our own isolates *Lb. plantarum* MP 2026, *Lb. gasseri* K7 (IM105), *Lc. lactis* ssp. *lactis* IM143, *Lc. lactis* ssp. *lactis* IM145. We further focused on bacteriocin nisin production with selected *Lactococcus* strains in whey medium and developed a novel SDS-PAGE detection method combined with antimicrobial activity testing with the indicator strain *Lactobacillus sakei* ATCC 15521.

CONCLUSIONS

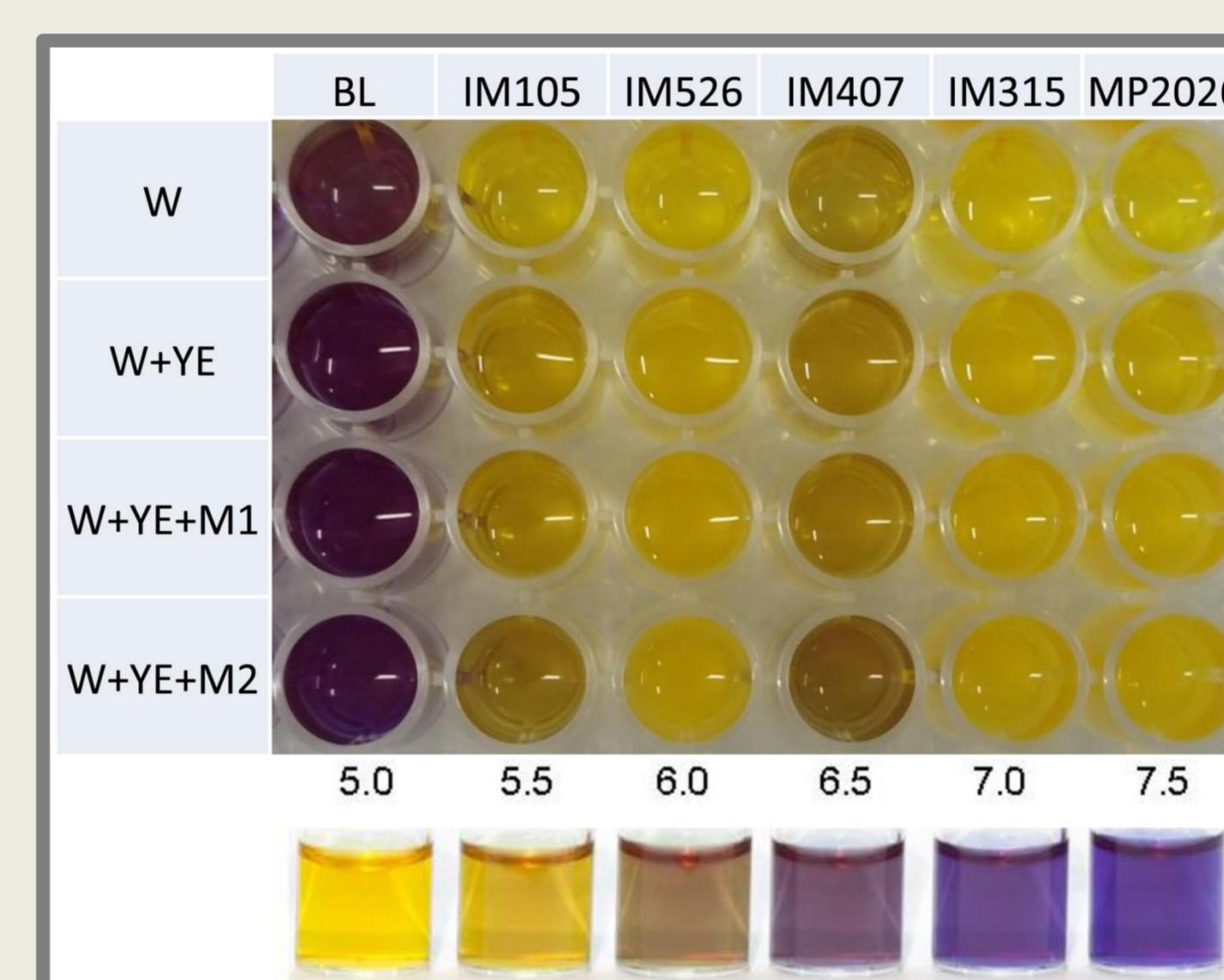
The development of the processes of further use of whey as a by-product helps to reduce the amount of waste from dairy industry and thus contributes to the circular economy.

ACKNOWLEDGEMENTS

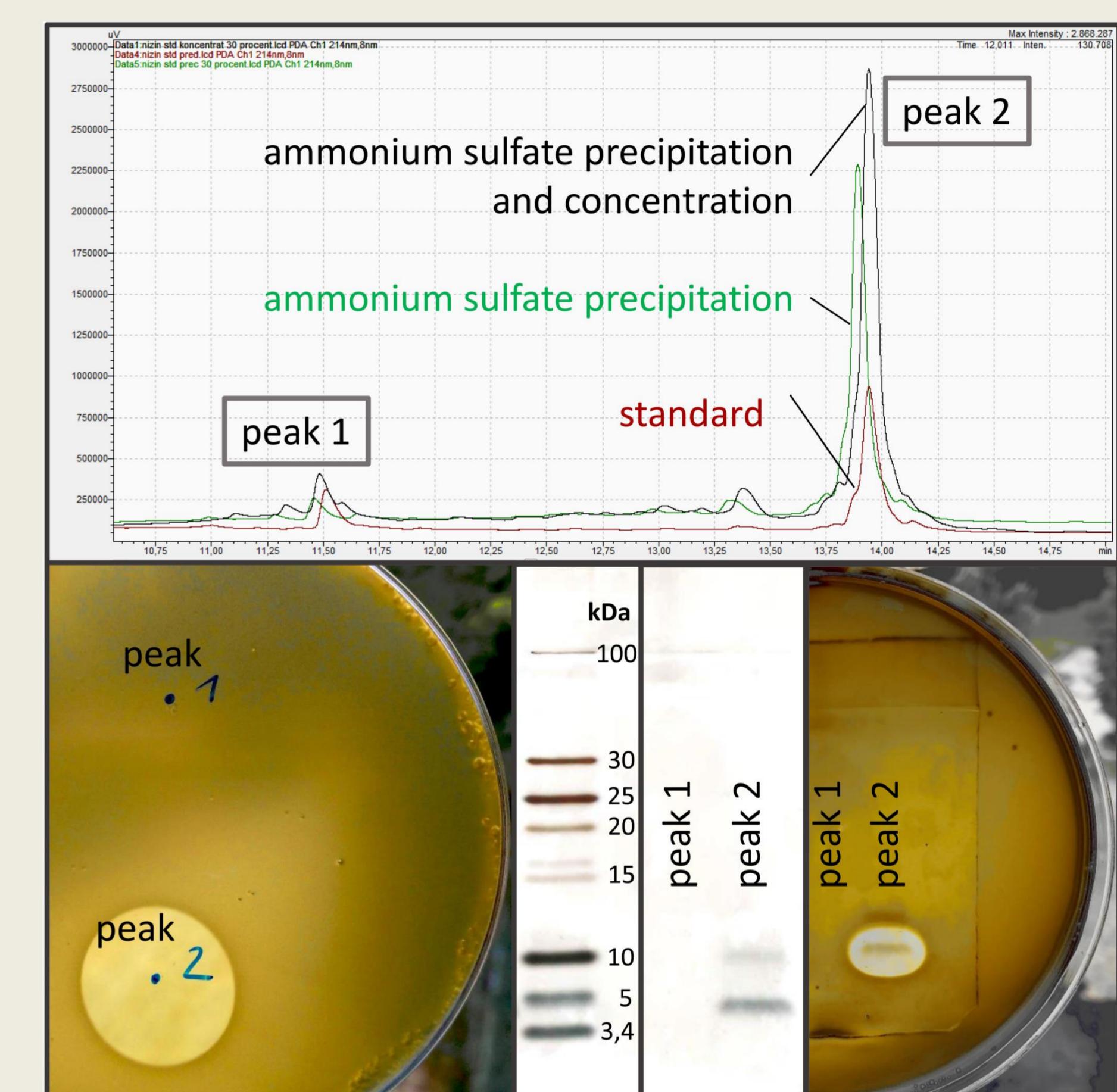
This research was supported by LIFE16 ENV/SI/000335 LIFE for Acid Whey.

RESULTS

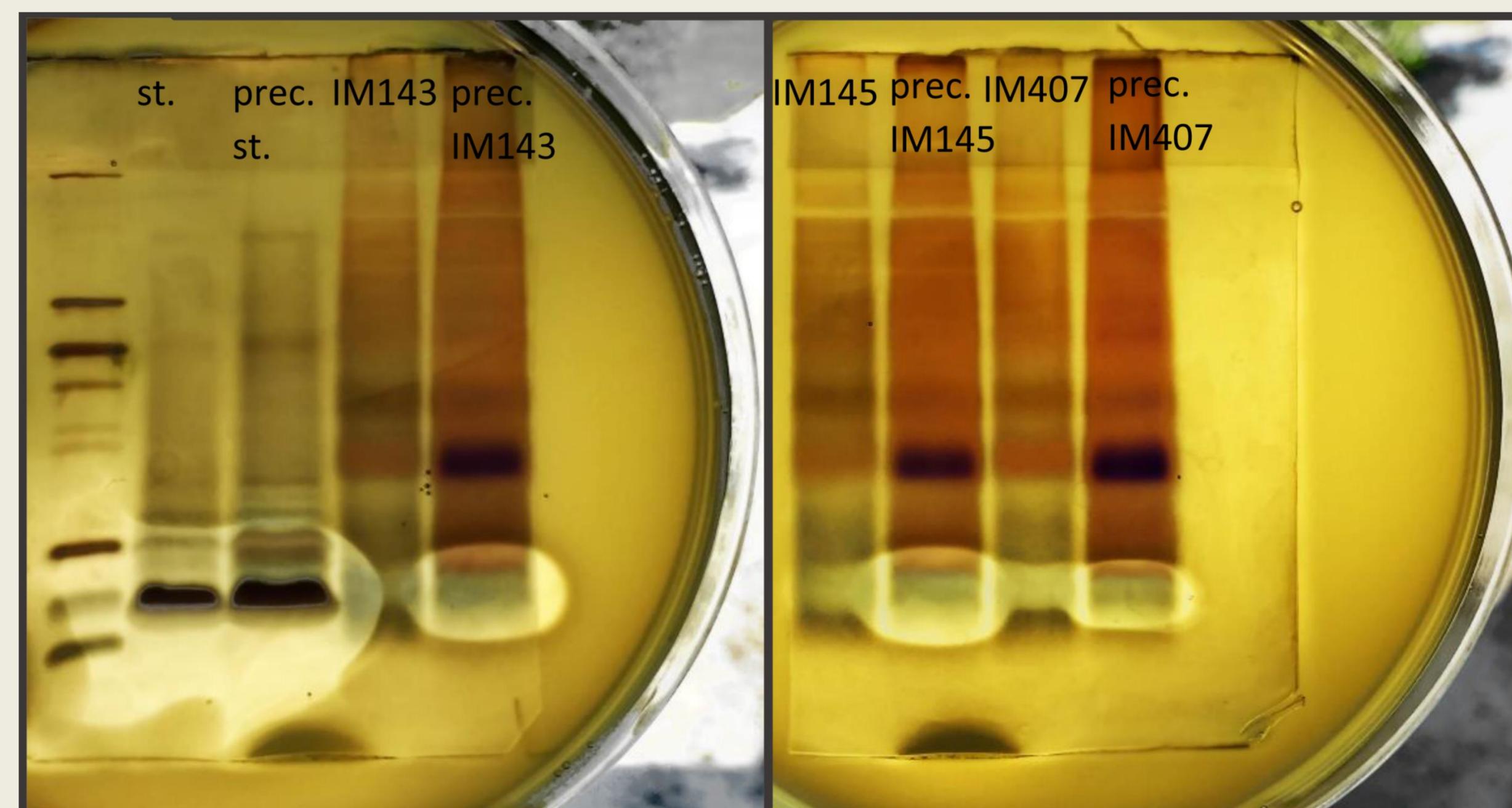
All selected strains were cultivable in whey without additional supplements, but the growth was improved when yeast extract was included. Whey can thus be used for probiotic and starter culture growth medium. Similar results were obtained with lactococcal nisin production, where the concentration of nisin was enhanced when the growth supplements were added. Semi-purified nisin, treated with temperatures above 80 °C, withheld antimicrobial activity during production process, which enables its better application as natural preservative in food or cosmetic industry. The novel SDS-PAGE / antimicrobial activity detection method proved to be specific and effective. Compared to HPLC detection, this method has better selectivity and gives information about nisin activity.



Cultivation of lactic acid bacteria in whey alone or in whey supplemented with yeast extract (YE) and mineral salts (M1, M2). Bromocresol purple was used as an indicator of change in pH. BL – blank, IM105 – *Lb. gasseri* K7, IM526 – *Lb. plantarum* LMG 23545, IM407 – *Lc. lactis* ssp. *lactis* ATCC 11454, IM315 – *Propionibacterium freudenreichii* ssp. *shermanii* JS, MP 2026 – *Lb. plantarum* MP 2026.



Antimicrobial activity and detection of the nisin standard, before and after precipitation and concentration, on a RP-HPLC system. SDS-PAGE electrophoresis was performed on the collected fractions from the RP-HPLC analysis. Antimicrobial activity was observed in fraction that contained peak 2.



Antimicrobial activity and SDS-PAGE electrophoresis – detection of nisin before and after precipitation. Nisin was obtained by fermentation of whey with strains *Lc. lactis* IM143, *Lc. lactis* IM145, *Lc. lactis* IM407. St. – standard, prec. – precipitation.

