Acid whey as growth medium for probiotic and lactic acid bacteria

Diana Paveljšek[1], Jernej Oberčkal[1], Tjaša Žohar[1], Neja Pristovšek[1], Timeja Planinšek Parfant[2], Nika Osel[2], Robert Roškar[2], Marko Kete[3], Maja Zupančič Justin[3], Bojana Bogovič Matijašić[1]

[1]University of Ljubljana, Biotechnical faculty, Slovenia; [2]University of Ljubljana, Faculty of Pharmacy, Slovenia, [3]Arhel Ltd, Ljubljana, Slovenia

Introduction

Acid whey, a nutritious by-product of the **fresh curd cheese production**, represents a technological challenge for further processing in the dairy industry because of its **high lactic acid content** and **bacterial load**. Therefore, acid whey is often discarded as a **biological waste**.

Objectives

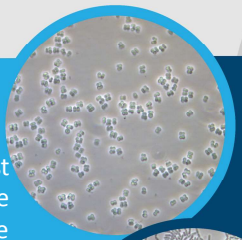
We further used **acid whey** enriched with **yeast extract** as a growth medium for various **probiotic bacteria** and **lactic acid bacteria**, and for the production of various metabolites such as **bacteriocin nisin** and **vitamin B12**.

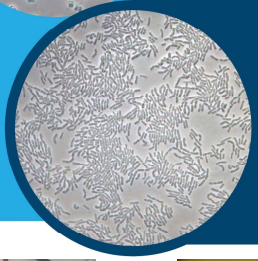
Methods

Selected bacterial isolates were inoculated into yeast extract-**enriched**, **neutralized** and **microfiltrated** acid whey. The experiments were initially conducted on a small laboratory scale and later scaled up to 1-2.5 L in **benchtop bioreactors**. During fermentation we monitored **pH**, **optical density** and also **antimicrobial activity** in nisin production and production yield of **B12**.

Results

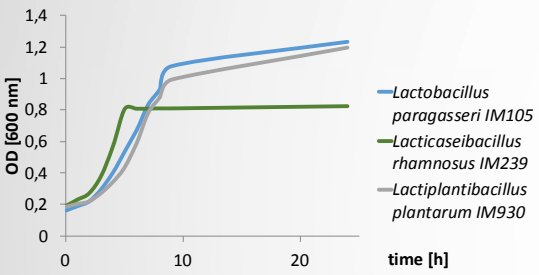
All strains used were able to grow in acid whey enriched with yeast extract and their yield was higher when **pH was not regulated** during the fermentation process. Acid whey-based media were also suitable for the production of **nisin** with *Lactococcus lactis* IM145 and **vitamin B12** with *Propionibacterium freudenreichii* subsp. *freudenreichii* van Niel 1928. Bacteriocin activity was highest after 6 to 8 h. Nisin was further semi-purified by RP, HIC or cation-exchange **chromatography**. Using *Propionibacterium* fermentation in enriched acid whey, we obtained two forms of B12, **adenosylcobalamin** and **cyanocobalamin** after 4 days.



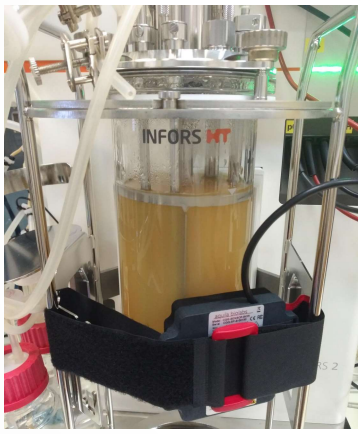


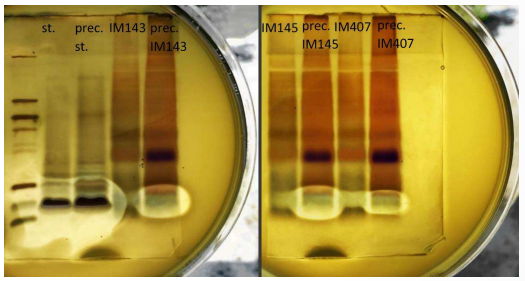
Conclusions

We confirmed that **acid whey** is a suitable growth medium for **probiotic** and **lactic acid bacteria** and for the production of **nisin** and **B12**, showing a new way of utilization that could contribute to the **reduction of waste** from the dairy industry.

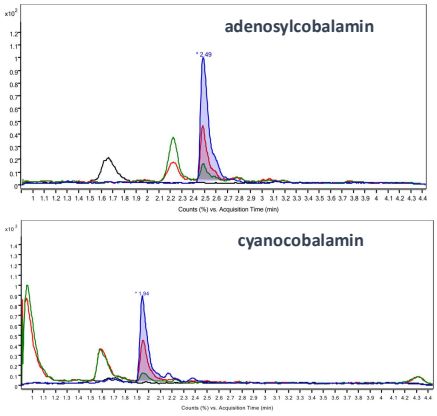


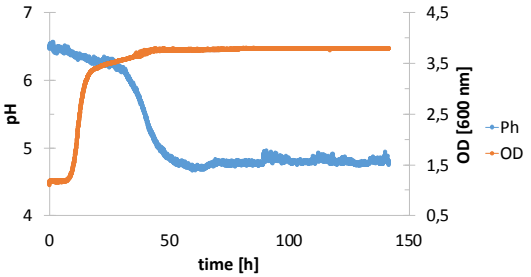
Optical density of various probiotic strains during fermentation process.

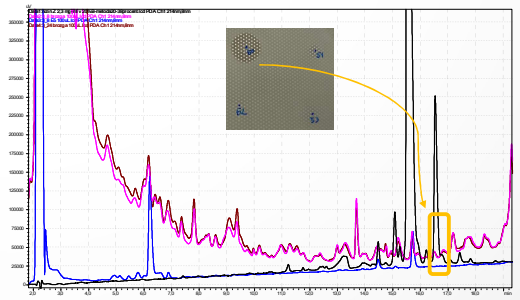




Antimicrobial activity and SDS-PAGE electrophoresis – detection of nisin before and after precipitation. Nisin was obtained by fermentation of yeast extract-enriched acid whey with strains *Lc. lactis* IM143, *Lc. lactis* IM145, *Lc. lactis* IM407. St. – standard, prec. – precipitation.







RP-HPLC detection of nisin, produced with strain *Lc. lactis* IM145 after 8 h in 2.5 L bioreactor.

Production yield of B12 – adenosylcobalamin and cyanocobalamin. *Propionibacterium* fermentation was carried out in enriched acid whey with 5 % yeast extract, $CoCl_2$ (40 mg/L) and DMBMZ (70 mg/L). For conversion and determination of vitamin B12 with LC-MS/MS analysis, the fermentation broth was mixed with KCN and autoclaved, cell debris was removed with centrifugation and microfiltration. Blue – B12 obtained from enriched acid whey; red – B12 obtained from commercial growth media RCM; green – B12 obtained from commercial growth media BHI.

CONTACT

Diana.Pavelisek@bf.uni-lj.si
http://www.iml-pro.si/en
http://lifeforacidwhey.arhel.si/en

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