Utilisation of industrial potato by-products and their processing for novel food applications

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Introduction

Lactic acid fermentation has traditionally been used in processing to preserve and improve the safety of the final products for various food applications.

Objectives

The purpose of this study was to test the feasibility of specific lactic acid bacteria (LAB) for fermentation of potato peel waste samples and to study the influence of the process on the quality of nutritional compounds, bioactive molecules and proteins.

Methods

LAB were isolated from six industrial potato peel samples or alternatively commercial LAB starter cultures were applied. LAB were isolated from MRS-agar and identified by amplifying and sequencing their 16S rDNA. Totally 50 strains were isolated and identified. In laboratory scale processes the LAB were added to the peel samples and compared with the spontaneous fermentation. pH, numbers of *Enterobacteriaceae*, yeasts, moulds and LAB were determined by standard methods. Glycoalkaloids (GAs) (α-solanine and α-chaconine) and their transformation/breakdown products (e.g. solanidine) were analyzed by LC-pESI-MS. Ion trap instrument was operated in scan mode, which allowed both qualitative and quantitative analyses of the samples. The soluble proteins were analyzed by 2-D electrophoresis.

Results

The diversity of isolated LAB was very extensive (Table 1). The added LAB improved the fermentation quality compared with spontaneous fermentation. Of the nine tested LAB isolates and two commercial starter cultures, the most efficient proteolysis was obtained by strains PP3 and RS8 (Figure 1).

In most treatments, the quantities of GAs decreased efficiently. The main GAs in the processed samples were solanidine, α-solanine and α-chaconine. Other GA forms identified were β2-solanine, β2-chaconine and β1-chaconine. Compared to α-chaconine, α-solanine was less susceptible to breakdown into the altered GA forms. (Table 2).

Table 1. Isolated species of lactic acid bacteria (LAB) from six potato peel samples.

Lb. brevis/parabrevis	*Lb. casei/paracasei*
Lb. fermentum	*Lb. agilis*
Lb. helveticus	
Lb. nantesis / crustorum	*Le. fallax*
Lb. nodensis	*Le. garlicum/lactis*
Lb. plantarum	*Le. mesenteroides/citreum*
Lb. sakei	*Le. pseudomesenteroides*

Table 2. Contents of glycoalkaloids and their major breakdown product in raw materials and fermented potato peels with or without LAB starter cultures. (A = cultivar Annabelle, N = cultivar Nicola, fw = fresh weight).

Treatment	α-Chaconine	α-Solanine	Solanidine
	mg/kg fw	mg/kg fw	mg/kg fw
N/Raw material	152.2	132.9	0.0
N/No starters	10.2	32.4	68.9
N/Lactobacillus sp.	6.1	12.0	64.3
N/Leuconostoc fallax	4.1	27.4	58.2
N/Leuconostoc sp.	5.6	35.8	69.7
A/Raw material	66.2	150.5	0.0
A/No starters	8.1	5.4	59.2
A/Lactobacillus sp.	6.7	17.3	76.4
A/Leuconostoc fallax	6.2	4.4	80.1
A/Leuconostoc sp.	5.8	4.1	70.8
N/Raw material	158.7	118.0	0.0
N/No starters	4.0	67.5	66.8
N/Lactobacillus sp.	3.8	39.1	71.2
A/Raw material	77.4	155.1	0.0
A/No starters	9.3	6.9	86.6
A/Lactobacillus sp.	6.9	5.1	69.0

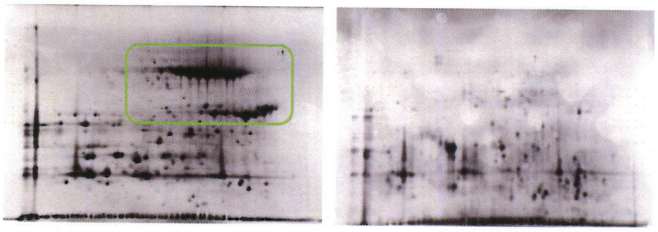

Figure 1. Soluble proteins before (A) and after (B) fermentation with RS8 strain. Majority of proteins around 25...45 kDa were degraded. Of the degrading proteins, 36 specific proteins were isolated and identified with MS/MS analysis.

Conclusions

The fermentation efficiency and quality of the final products can be improved by selected LAB cultures and the process can provide new alternatives for the utilisation of potato industrial side streams in novel food applications.

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