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TECHNOLOGY FOR BUSINESS

New functional faba bean ingredients with fermentation

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Introduction

Faba bean flour is an economically sound and sustainable raw material to make new functional ingredients high in protein. The protein content of faba beans is approx. 30%. However, consumption of faba beans is hindered by their poor digestibility and presence of several anti-nutritional factors, a bitter taste and poor technological functionality.

This study aimed to 1) characterise lactic acid bacteria for faba bean fermentations 2) study the *in vitro* dextran production 3) improve protein release 4) apply fermented ingredients in extruded snacks.

Materials and methods

Indigenous LAB were isolated and identified with partial 16S rRNA gene sequencing. Partial pheS gene was also sequenced from *Weissella cibaria* and *W. confusa* strains. Faba bean flour fermentations with different LAB including *Lactobacillus plantarum* and exopolysaccharide (EPS) producing strains such as *Leuconostoc lactis* and *W. confusa* were carried out in 0.5 kg and in 15 kg scales. EPS fermentations were supplemented with 5% sucrose. The functionality of fermented faba bean flours as ingredients was studied in extruded snacks. Extruded samples were made with 25, 50 and 100 % fermented faba flour mixed with rice flour using APV Baker Perkins twin screw extruder.

Results

1) Faba beans were found to be natural source for exopolysaccharide (EPS) producing LAB (Fig.1). *Weissella* and *Leuconostoc* bacteria were the predominant LAB.

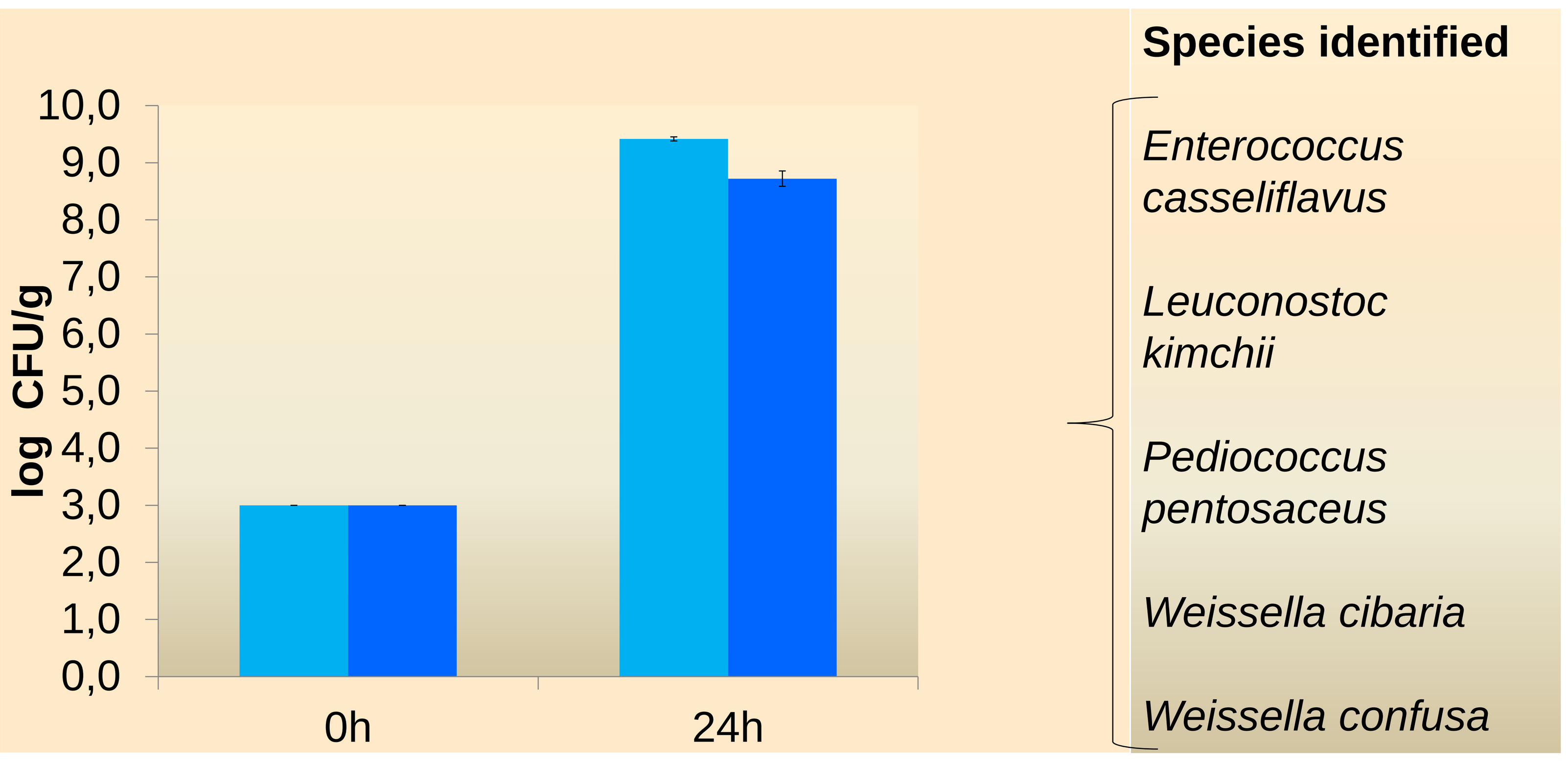

***Figure 1. LAB growth during faba bean fermentation.** Total LAB count (MRS medium) and EPS forming LAB (MRS+sucrose medium)*

2) Faba bean flour provided an excellent matrix for *in situ* EPS production (Figs. 2 and 3). EPS may function in foods as viscosifying, emulsifying, stabilising, gelling and water-binding agents.

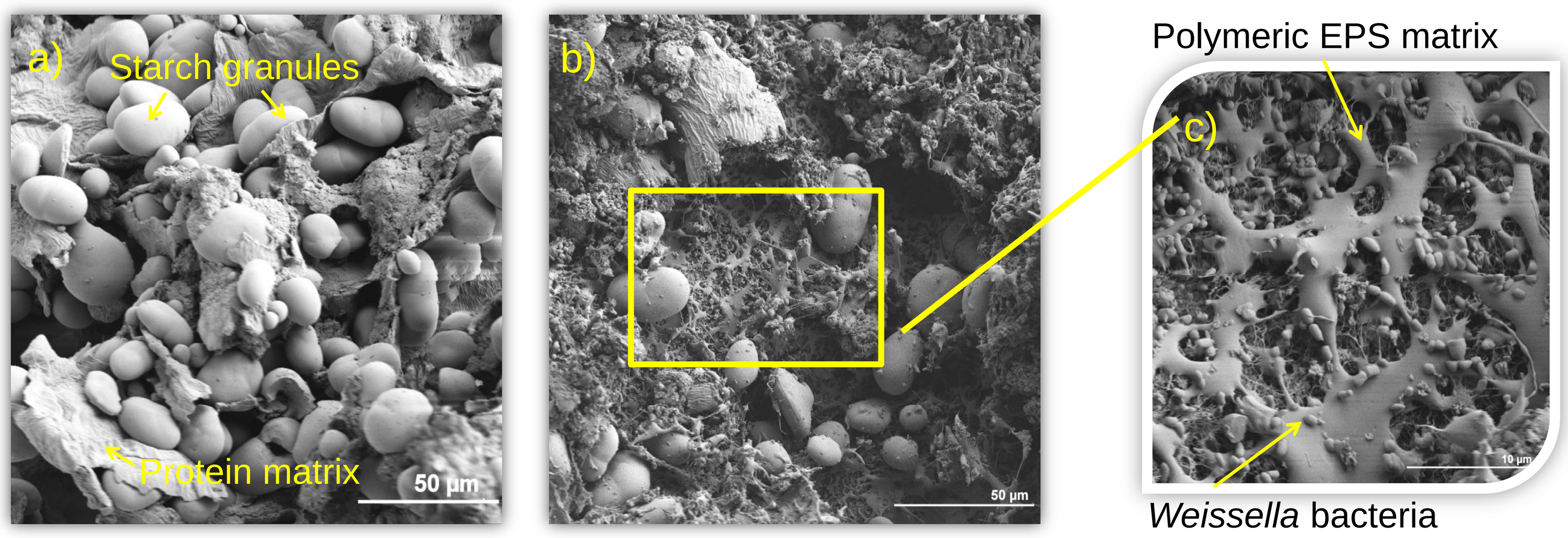

Figure 2. FESEM micrographs of L. plantarum (a) and W. confusa (b-c) fermented faba bean flours.

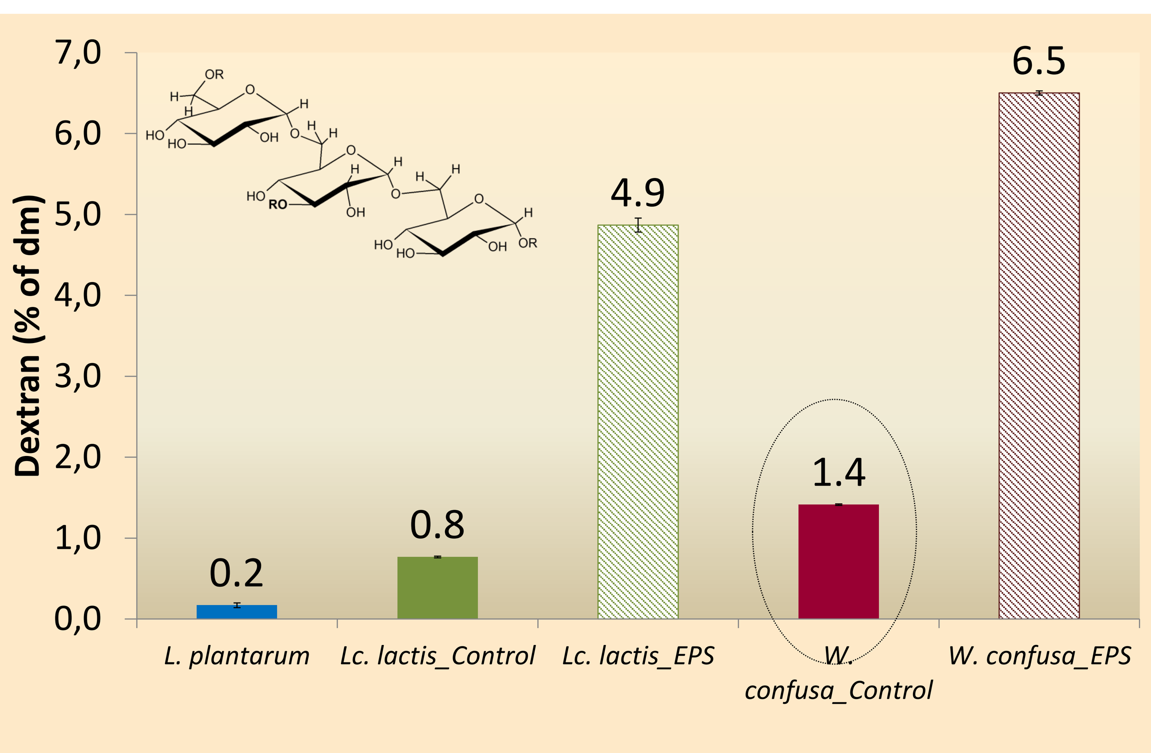

Figure 3. Dextran yield after 24h fermentation.

The sucrose content of native faba flour was 2.9%.

Control: without additional sucrose.

3) Fermentation improved protein release from the cell wall matrix and enhanced *in vitro* protein digestability (data not shown). Increased amounts of free amino acids (FAA) was measured after 24h (Fig.4). Nearly all the essential amino acid levels were elevated.

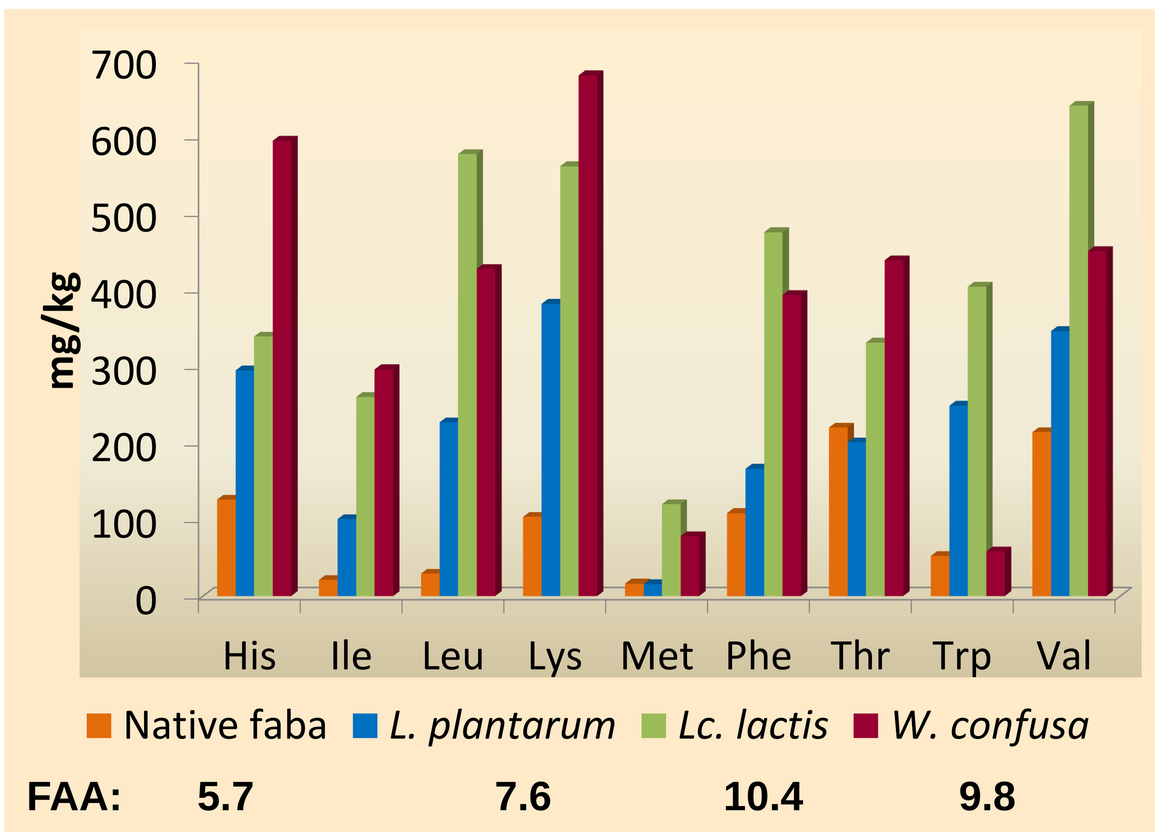

Figure 4. Essential amino acids (mg/kg) and total amount of free amino acids (g/kg) after 24h fermentation (n=2).

4) Fermentation with *L. plantarum* improved mechanical properties of extruded snacks with addition level 50 and 25% (Fig. 5)

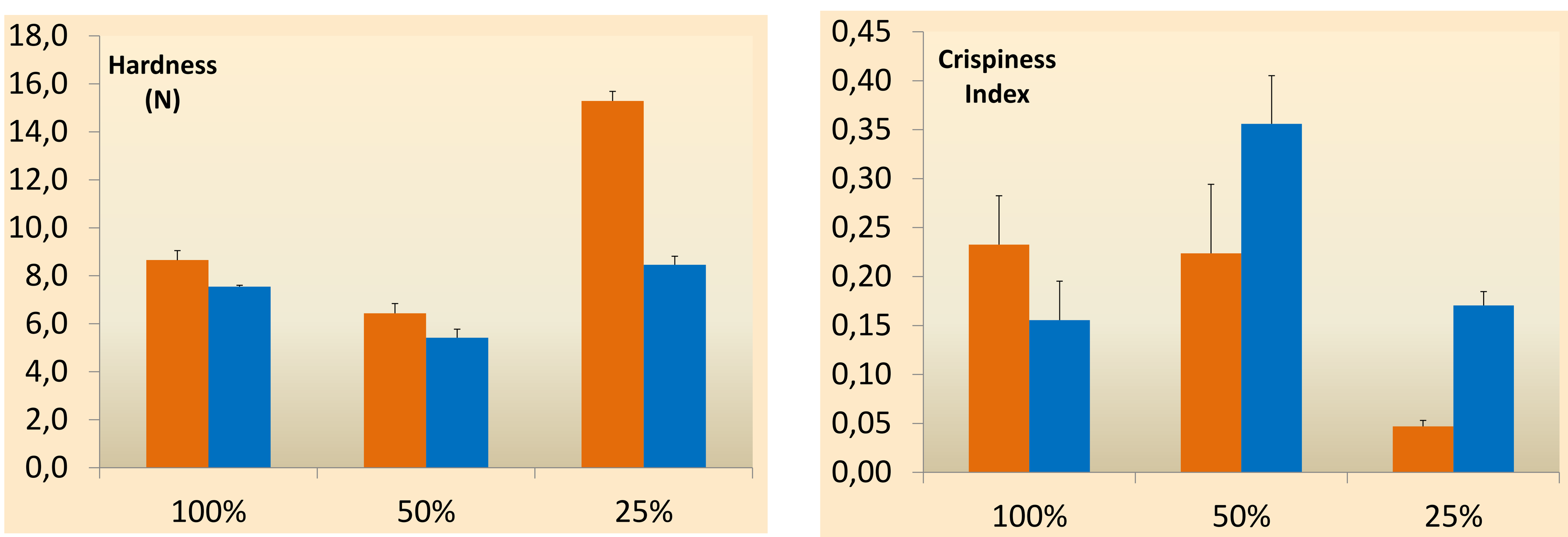

Figure 5. a) Hardness and b) crispiness index of control (native) and L. plantarum extruded snacks

In protein-rich material, additional benefits were not observed with EPS-producers. EPS fermentation of bran ingredients have improved expansion (data not shown). Browning of bean matrix was observed due to Maillard reactions, especially for EPS fermented samples (Fig. 6).

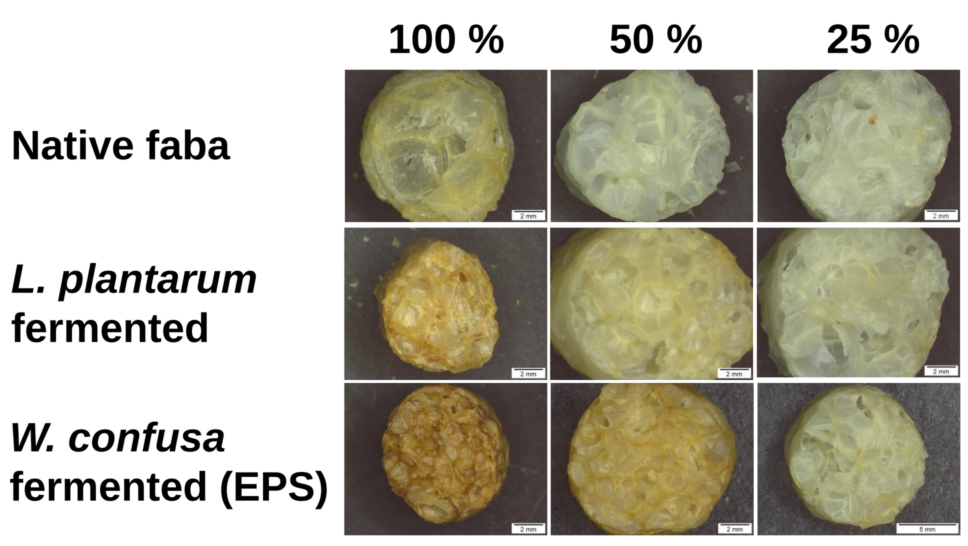

Figure 6. Cross-section pictures of extrudates.

Native: unprocessed faba bean.

100, 50 and 25% of fermented ingredient in extrusion (mixed with rice flour).

Conclusions

LAB fermentation provides a natural bioprocessing tool for modification of nutritional profile and functional properties of high protein legume ingredients and products made from them.

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