6.05.1.113 Poster

AMYLOLYTIC LACTIC ACID BACTERIA: A NEW PROSPECT FOR COMPLEMENTARY FOOD PRODUCTION?

J.P. Guyot, S. Dupont, C. Mouquet, S. Trèche
Institut de Recherche pour le Développement, Unité de Recherche 106 'Nutrition, Alimentation, Sociétés', Montpellier, France

Numerous starchy fermented foods are widely used in Africa to elaborate complementary foods, i.e. gruels. However these gruels do not have the required energy density. This indicates that amylolytic lactic acid bacteria (ALAB) isolated from traditional fermentations are not able, in natural conditions, to efficiently hydrolyze starch, in order to obtain products having the expected rheological properties for being used as complementary foods.

This work investigates the effects of selected ALAB (Lactobacillus fermentum OGI E1, Lactobacillus manihotivorans OND32 and Lactobacillus plantarum A6) on the fermentation of different crude or gelatinized suspensions (CFS or GFS respectively) of barley, wheat, oat, maize or cassava flours, at a concentration of 20% (DW). For the viscosity measurements, the CFS were gelatinized after the fermentation step. When CFS or GFS were fermented by these strains, the pH was reduced to 3.5–4.0 in less than 24 hours. The fermentation of the GFS allowed a decrease of the viscosity of nearly 90% for cassava and all cereals, except for oat. A lower decrease of viscosity was observed with the fermented CFS. However with strains OND32 and A6 the decrease of viscosity after fermentation was between 80–90% for wheat, barley and maize CSF, and 50% and 35%, respectively, for the cassava CFS. Scanning electron microscopy indicated that starch granules in all suspensions were partially degraded by the action of ALAB.

Control experiments with non amylolytic strains of lactic acid bacteria showed that they did not reduce the viscosity and the pH of the flour suspensions as efficiently as ALAB

Such results imply that the use of selected ALAB as starter cultures could be a possible way for the partial hydrolysis of starch necessary for increasing the energy density of infant gruels, while promoting acidification for safe food production and meeting organoleptic requirements of some populations.

Guyot JP, Dupont S, Mouquet C, Trèche S. Amylolytic lactic acid bacteria: a new prospect for complementary food production ? *Annals of Nutrition & metabolism*, 2001, 45(suppl 1): 438 *(abstract d'un Poster présenté au 17th International Congress of Nutrition, août 2001, Vienne, Autriche)*.

Amylolytic lactic acid bacteria: new prospect for complementary food production ?

J.P. Guyot, S. Dupont, C. Mouquet and S. Trèche

Unité R106 « Nutrition, Alimentation, Sociétés », IRD, BP 5045, F-34032 Montpellier cedex 1

IRD Institut de recherche pour le développement

WHO Collaborating Centre for Nutrition

Introduction

Traditional African fermented cereal and cassava doughs and porridges used to prepare complementary foods do not have the required energy density for young children feeding. The use of amylolytic lactic acid bacteria (ALAB) as culture starters could lead to the improvement in the nutritional quality of complementary foods by combining amylolysis with the recognized beneficial properties of lactic acid bacteria (LAB).

To investigate the potential of ALAB for such a purpose, we analysed the ability of ALAB to modify the rheological properties of crude or gelatinised flour suspensions (CSF or GSF, respectively) by partial hydrolysis of starch, and compared this ability with the action of non-amylolytic lactic acid bacteria.

Materials and Methods

Microorganisms:

- ALAB: *Lactobacillus fermentum* Ogi E1, *Lactobacillus plantarum* A6, *Lactobacillus manihotivorans* OND 32^T

- non amylolytic LAB: *Lactococcus lactis* ssp *cremoris*, *Lactobacillus plantarum* 541

Flours: barley, wheat, oat, maize, cassava

Fermentation conditions: inoculation: 10% v/v (~10^8 Colony Forming Unit/ml) ; incubation: 30°C, 24h . CFS was fermented then gelatinised to measure viscosity GFS was gelatinised before fermentation.

Results are means of duplicate experiments.

Gelatinisation conditions: 75°, 15 min.

Analysis: viscosity was measured with a Haake VT550 viscometer fitted with the appropriate spindle. Reducing sugars were measured by the DNS method.

Fermentation of crude flour suspensions (CFS)

- After CFS fermentation, ALAB induced a larger reduction in viscosity and a lower final pH (3.5-4.0) than non amylolytic LAB. Using the ALAB *L. plantarum* A6 and *L. manihotivorans* OND32, viscosity reduction was respectively 85 and 82% for maize, 87 and 79% for wheat and 90 and 92% for barley (Fig. 1). Using *L. fermentum* Ogi E1 similar results were obtained for wheat (83%) and barley (88.5%), but viscosity reduction of fermented maize CFS (63%) was lower. A decrease in efficiency in viscosity reduction was observed for oat and cassava CFS irrespective of the ALAB species used.
- Partial hydrolysis by ALAB of starch granules was also confirmed by an increase in reducing sugar content (Table 1) and by scanning electron microscopy (Fig. 2); however not all starch granules presented evidences of hydrolysis.

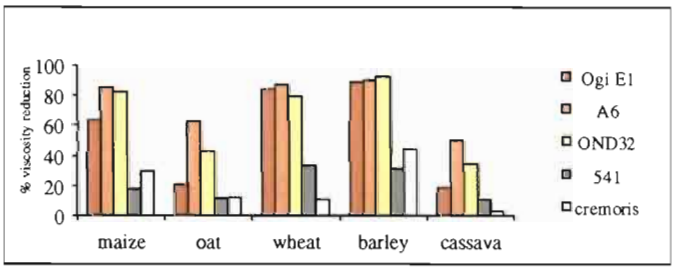

Fig. 1. Reduction of viscosity after 24h fermentation of crude flour suspensions (20 % dw/v) by amylolytic (« ogi E1 », « A6 », « OND32 ») and non amylolytic lactic acid bacteria (« cremoris », « 541 »)

Fermentation of gelatinised flour suspensions (GFS)

- Gelatinisation of flour suspensions before fermentation improved the efficiency of starch hydrolysis by ALAB.
- Viscosity reduction by *L. fermentum* Ogi E1, *L. plantarum* A6 and *L. manihotivorans* was respectively 96, 92 and 93% for wheat, 90, 91 and 90% for barley and 86, 90, 91% for maize.Viscosity reduction was markedly improved for cassava GFS (99%) while the lowest efficiency was observed for oat GFS (Fig. 3). At the end of GFS fermentation, reducing sugar concentrations (Table 2) were higher than with fermented CFS.

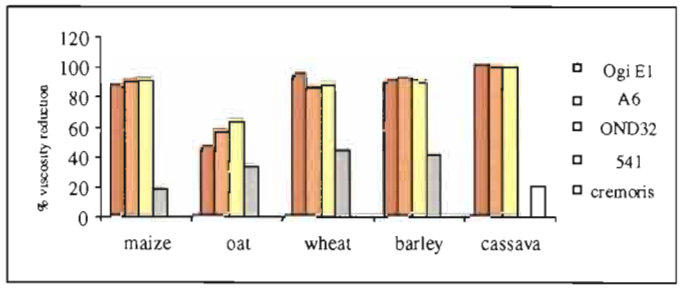

Fig. 3. Reduction of viscosity after 24h fermentation of gelatinized flour suspensions (% dw/v: 10% for maize, oat and cassava; 12% for barley; 15% for wheat) by amylolytic (« ogi E1 », « A6 », « OND32 ») and non amylolytic lactic acid bacteria (« cremoris », « 541 »)

Table 1. Reducing sugar concentration (g/l) in CFS fermented by ALAB

	Maize	Oat	Wheat	Barley	Cassava
Unfermented CFS	0.9	0.8	1.2	1.0	0.3
***L. plantarum* A6**	2.8	2.9	1.6	5.2	1.7
***L. manihotivorans* OND32**	4.1	4.9	2.4	5.4	1.5
***L. fermentum* Ogi E1**	5.1	3.2	1.4	1.6	1.6

Table 2. Reducing sugar concentration (g/l) in GFS fermented by ALAB

	Maize	Oat	Wheat	Barley	Cassava
Unfermented GFS	0.5	0.8	1.4	1.1	0.3
***L. plantarum* A6**	11.4	8.2	9.6	13.2	14.5
***L. manihotivorans* OND32**	12.5	15.7	22.4	17.4	28.7
***L. fermentum* Ogi E1**	14.1	8.0	14.5	10.8	19.8

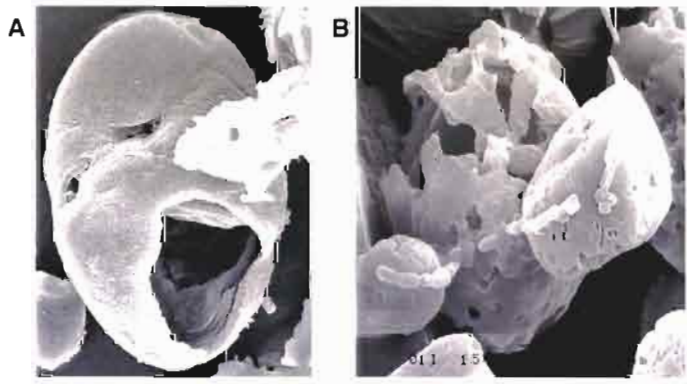

Fig. 2. Scanning electron microscopy of raw starch granules of wheat (A) and cassava (B) hydrolysed by *L. plantarum* A6

Conclusion

- **Amylolytic lactic acid bacteria are able to partially hydrolyse the starch fraction of either crude or gelatinised cereal and cassava flour suspensions.**
- **The efficiency of viscosity reduction of fermented CFS depends on the ALAB species and on the type of flour used.** Best results were obtained with maize, wheat and barley CFS, whereas oat and cassava CFS were more resistant to amylolysis by ALAB.
- **The combination of selected ALAB culture starters with a gelatinisation step before fermentation appears to be a promising way to modify rheological properties of gruels.** However, the process remains to be optimised to obtain the necessary viscosity reduction in gruels prepared at appropriate energy density (>25% dry matter).

Contact. jpguyot@mpl.ird.fr

Guyot Jean-Pierre, Dupont S., Mouquet Claire, Trèche Serge. (2001).

Amylolytic lactic acid bacteria : a new prospect for complementary food production ? : poster.

Annals of Nutrition and Metabolism, 45 (Suppl. au No 1), 438.

International Congress of Nutrition, 17., Vienne (AUT), 2001/08/27-31.