ELSEVIER

Process Biochemistry 40 (2005) 691–697

PROCESS BIOCHEMISTRY

www.elsevier.com/locate/procbio

Sourdough bread production with lactobacilli and *S. cerevisiae* isolated from sourdoughs

Hülya Gül [a], Sami Özçelik [b], Osman Sağdıç [c,*], Muharrem Certel [d]

[a] *Agricultural Faculty, Department of Food Engineering, University of Çukurova, 01330 Adana, Turkey*
[b] *Agricultural Faculty, Department of Food Engineering, University of Süleyman Demirel, 32260 Isparta, Turkey*
[c] *Engineering Faculty, Department of Food Engineering, University of Erciyes, 38039 Kayseri, Turkey*
[d] *Agricultural Faculty, Department of Food Engineering, University of Akdeniz, 07070 Antalya, Turkey*

Received 12 November 2003; received in revised form 29 December 2003; accepted 30 January 2004

Abstract

The interactive effects of lactic acid bacteria (LAB) and yeasts were identified through isolation of sourdough sponges. Fourteen sourdough samples were collected from different bakeries in Isparta. *Carnobacterium divergens* (*Lactobacillus divergens*) (6.1%), *Lactobacillus brevis* (15.1%), *Lactobacillus amylophilus* (6.1%), *Lactobacillus sake* (6.1%), *Lactobacillus acetotolerans* (6.1%), *Lactobacillus plantarum* (3.0%), *Pediococcus pentosaceus* (6.1%) and *P. acidilactici* (6.1%), *Tetragenococcus halophilus* (*Pediococcus halophilus*) (3.0%) were isolated from sourdoughs as LAB while *Saccharomyces cerevisiae* (27.0%), *S. delbrueckii* (2.7%), *Torulopsis holmii* (10.8%) and *T. unisporus* (2.7%) were also isolated from sourdough sponges as yeasts. Seven kinds of bread were made with the inoculation 1.5% *S. cerevisiae* and/or 1.5% lactobacilli (*Lb. amylophilus*, *Lb. brevis*, *Lb. plantarum*, *Lb. sake* and *Lb. acetotolerans*). Six kinds of bread were produced with the mixture of the above five different LAB and *S. cerevisiae*, and the seventh bread made with *S. cerevisiae* (commercial culture) alone as control bread. The sample prepared with 1.5% *Lb. amylophilus* and 1.5% *S. cerevisiae* showed the best results on rheological properties of bread while that with 1.5% mixed LAB and 1.5% *S. cerevisiae* was the poorest. LAB used in sourdough breads increased shelf life and delayed staling. In sensory analyses, 1.5% *Lb. sake* and 1.5% *S. cerevisiae* application were preferred well by the panel.

Keywords: Sourdough; Lactic acid bacteria; Yeasts; Bread making

1. Introduction

Sourdough is an acidic sharp tasting mixture of flour and water for making bread from cereal flours [1]. Sourdough bread is a traditional product with a great potential which can only be achieved if the interactions between the lactic acid bacteria (LAB) and yeasts that populate the sourdough are understood [2]. The major focus of recent studies on cereal fermentations was the characterisation of sourdough fermentations based on wheat or rye flour as raw materials [3].

Wheat and rye sourdoughs are ecosystems where fundamental interactions between LAB and yeasts take place. As a general rule, LAB are the predominant organisms although in many cases yeast cells are also present in significant numbers [3]. Most LAB isolated from sourdough belong to the genus *Lactobacillus*, but species of *Pediococcus*, *Leuconostoc* and *Enterococcus* are occasionally found or used in sourdough processes [2,4]. *Lactobacillus sanfranciscencis* (synonym *Lb. brevis* ssp. *lindneri*), *Lactobacillus plantarum* and *Lactobacillus brevis* are frequently isolated from sourdough [2]. Several species of yeasts are also found in sourdoughs; *Saccharomyces cerevisiae* is frequently present or is added. In particular, *S. exiguus*, *Torulopsis holmii*, *Candida krusei*, *Pichia norvegensis* and *Hansenula anomala* are generally found in yeast genera from the sourdoughs [5].

Sourdough fermentation is generally evaluated by the measurement of parameters such as pH, acidity and microflora [6]. Bread produced with spontaneous sourdoughs with low pH and a high ratio of lactic and acetic acids have the highest volumes and the lowest rates of staling during storage [7,8]. Sourdough LAB and yeasts have been shown

* Corresponding author. Tel.: +90-352-4374937; fax: +90-352-4375264.
E-mail address: o_sagdic@yahoo.com (O. Sağdıç).

0032-9592/$ – see front matter © 2004 Elsevier Ltd. All rights reserved.
doi:10.1016/j.procbio.2004.01.044

to compete for carbon sources which influence acid production by bacteria. Acidification of the dough, proteolysis of gluten and moderate hydrolysis of starch are LAB activities which vary among sourdough strains and which may affect the physicochemical changes throughout shelf life of bread [8,9].

Some researchers have studied the physicochemical and microbiological characteristics of sourdoughs and sourdough bread [1,6,8–15].

In Turkey, sourdough is generally prepared using wheat flour [16]. In this study, LAB and yeasts were isolated from sourdough samples obtained from Isparta province in Turkey. The appropriate isolates of LAB and yeasts were then used for bread production. The objective was to study various combinations of LAB and yeast starters and to observe their influence on certain characteristics of sourdough bread.

2. Materials and methods

2.1. Collection of samples

Fourteen sourdoughs were obtained from different bakeries in Isparta, Turkey. Samples were aseptically collected into sterilised jars. The collected sourdough samples had been fermented for bread production by bakeries. The wheat flour samples used for bread production were obtained from the local markets in Isparta. Combinations of microorganisms isolated from the sourdoughs and commercial yeast (Compressed bakers' yeast, from Pakmaya, Turkey) were used as starter cultures for the experimental breads (Table 1). For bread production, the dough were prepared with type V wheat flour. According to Turkish Standard (TS 4500) [17], type V flour contains 1.20% of ash and 8.5% of dry gluten with 0.08% acidity.

2.2. Production of experimental breads

A conventional straight-dough baking procedure was conducted [15]. An amount of 1.2% NaCl and 1.5% (w/w) yeast and 1.5% (w/w) lactic acid bacteria were added to each 100 g flour and mixed at 60 rpm for 20–25 min. The amount of water was adjusted according to the water absorption determined by a farinograph. The dough was left for bulk fermentation for 1 h at 30 ± 1 °C and 75% relative humidity. At the end of the fermentation time, the dough was divided in to 100 g pieces and each piece was rounded before moulded by hand. The moulded dough pieces were proofed for 1 h at 30±1 °C and 85% relative humidity before baking at 240–250 °C for 35–40 min in a firewood-heated oven. The seven bread groups were produced and coded as T1, T2, T3, T4, T5, T6 and T7 (control). The experimental breads were produced at Degirmenci Bakery Plant in Isparta, Turkey.

2.3. Physicochemical analyses

The pH values of the sourdough samples were determined electrometrically with a WTW 526 pH meter (WTW Instruments, Germany). Titratable acidity (% lactic acid) was measured as suggested by Uluöz [18]. Fermentation time (FT) was experimentally applied by bakeries and is shown in Table 2. Moisture and total solid contents were determined by heating the sample in an oven at 105 °C until a constant weight was obtained. The yields of dough, yields of bread and volume of bread and specific volume of bread were determined according to Elgün et al. [16] and Anon. [19]. The penetrometer (FT-327, USA) values of breads were measured after 24, 48 and 72 h of bread production. All analyses were performed in duplicate.

Table 1
Combination, acid production ability and ratios of starters used in bread making

Codes of breads	Combined starters	Acid production ability (pH)	Ratios (%) (LAB + yeast)
T1	*Lb. amylophilus* E_L1	3.23	1.5 + 1.5
	S. cerevisiae E_M2		
T2	*Lb. brevis* E_L2	3.74	1.5 + 1.5
	S. cerevisiae E_M2		
T3	*Lb. plantarum* B_L2	3.25	1.5 + 1.5
	S. cerevisiae E_M2		
T4	*Lb. sake* Y_L2	3.63	1.5 + 1.5
	S. cerevisiae E_M2		
T5	*Lb. acetotolerans* T_L1	3.38	1.5 + 1.5
	S. cerevisiae E_M2		
T6	*Lb. amylophilus* E_L1	3.23	1.5 (LAB) + 1.5 (yeast)
	Lb. brevis E_L2	3.74	
	Lb. plantarum B_L2	3.25	
	Lb. sake E_M2	3.63	
	Lb. acetotolerans T_L1	3.38	
	S. cerevisiae E_M2		
T7 (control)	*S. cerevisiae*		1.5 (commercial yeast culture)