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Microbiological aspects of wheat sour-dough

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Although sour-dough bread represents only a fraction of the Dutch bread market, there is an increasing interest for this product which has led to the establishment of a growing number of sour-dough bakeries. In contrast to Central European sour-dough baking, Dutch sour-dough manufacturers do not use rye-based starters but sour-doughs maintained on wheat flour. The aim of this investigation was to analyse the microflora of commercially used Dutch sour-doughs which have been maintained for several years.

The microbiological components of two representative sour-doughs A and B, and of the flours on which they are maintained, is given in Table 1. Sour-doughs A and B differ considerably in composition: A, 100 g whole wheat flour + 80 ml water; B, 100 g whole wheat flour + 65 ml water + 1.5 g NaCl.

Table 1. Microbial counts (in log units) per g of sour-doughs and the corresponding wheat flours

Microorganisms	A ¹		B ²	
	Flour	Sour-dough	Flour	Sour-dough
Total aerobic	5.3	7.2	5.9	<4
Total anaerobic	5.2	7.1	5.7	<4
Endospores	3	<1	2	<1
<i>Lactobacillus</i> sp.	<1	7.7	<1	9
Yeasts	2.6	7	<2	1.5
Moulds	2.5	<4	2.4	2.1
<i>Streptococcus</i> sp.	<2	<1	<1	<1
<i>Leuconostoc</i> sp.	<2	1.3	<1	<1
<i>Staphylococcus epidermidis</i>	3.6	<1	2.9	<1
<i>Micrococcus</i> sp.	2.9	<1	<1	<1
Enterobacteriaceae	4.4	<1	5.6	<1
Coliforms	<1	<1	<2	<1
<i>Escherichia coli</i>	<1	<1	<2	<1

¹ Composition 100 g whole wheat flour + 80 ml water.

² Composition 100 g whole wheat flour + 65 ml water + 1.5 g NaCl.

Sour-dough A contained high numbers of yeasts and lactobacilli. The majority of isolated yeasts were identified as *Saccharomyces exiguus*, whereas two species of *Lactobacillus* were found, viz. *L. sanfrancisco* and *L. brevis* var. *lindnerii* II (35% and 65% of all isolates, respectively). Sour-dough B contained very high numbers of lactobacilli, all identified as *L. brevis* var. *lindnerii* II, but only low numbers of yeasts, identified as *Sacch. exiguus* and *Sacch. cerevisiae* (83% and 17% of all isolates, respectively). The above organisms are characterized by a restricted assimilation of carbohydrates (API 50 CHL system): *L. sanfrancisco* only assimilates maltose, whereas *L. brevis* var. *lindnerii* II assimilates maltose and glucose only. The major yeast, *Sacch. exiguus*, can not assimilate maltose, but only glucose, sucrose, raffinose and trehalose, and resists $10 \mu\text{g} \cdot \text{ml}^{-1}$ actidione. The isolated *Sacch. cerevisiae* strain had a very weak maltose assimilation and did not resist $10 \mu\text{g} \cdot \text{ml}^{-1}$ actidione.

Our findings are similar to those of Sugihara et al. (1970) and Kline and Sugihara (1970) who found only *Torulopsis holmii* (imperfect stage of *Sacch. exiguus*) and *L. sanfrancisco* in San Francisco sour-doughs maintained for several decades. However, Spicher and Schröder (1978) reported a large variety of yeasts and homo- and heterofermentative lactobacilli to be found in relatively young rye sour-doughs.

KLINE, L. and SUGIHARA, T. F. 1970. Microorganisms of the San Francisco sour dough bread process II. Isolation and characterization of undescribed bacterial species responsible for the souring activity. — *Appl. Microbiol.* **21**: 459–465.

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