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LIST OF ABBREVIATION

%	Percentage
AACC	American Association of Cereal Chemists
AOAC	Association of Official Analytical Chemists
Avg	Average
AWRC	Alkaline Water Retention Capacity
B.U	Brabender unit
BY	Commercial baker's yeast
CFU	Colony forming unit
Cm	Centimeter
Co.	Company
d.f.	Stationary phase thickness
E	Extensibility
Ed	Editor
et al	And others
Fig.	Figure
g	gram
GC	Gas chromatography
h	Hour
i.e	That is
J	Journal
K	*Kluyveromyces marxianus*
LAB	Lactic acid bacteria
Lb	*Lactobacillus plantarum*
Min	Minute
MIRCEN	Microbiological Resource Center
ml	Milliliter
mm	Millimeter
MRS	deMan-Rogosa-Sharpe

N	Nitrogen
$NaHCO_3$	Sodium bicarbonate
NFE	Nitrogen free extract
No	Number
ºC	Centigrade degree
P.U	Penetrometer unit
Ped	*Pediococcus cerevisiae*
ppm	Parts per million
P-value	Statistical significance of difference between samples
R	Resistant to extension
RI	Retention Index
rpm	Revolutions Per Minute
S	*Saccharomyces cerevisiae*
Sci.	Science
SD	Standard deviation
Sec.	Second
SK	*Saccharomyces cerevisiae* + *Kluyveromyces marxianus*
TBC	Total bacteria count
TPA	Texture profile analysis
TTA	Total titrateble acidity
xg	relative centrifugal force
YM	Yeast Malt Extract

1-INTRODUCTION

Bread is one of the most important products of wheat flour in many parts of the world, especially in the developing countries **(Anjum *et al.*, 2008)**.

The flavor of wheat bread has suffered greatly from intensive, shorter bread-making methods and the flavor of bread made with traditional longer processes is considered superior in comparison to short processes. The overall flavor of bread is typically process-induced, and formed from relatively tasteless raw materials during processing. Bread flavor is formed from hundreds of different compounds, which themselves originate from the different stages of the bread-making process such as raw materials, fermentation and baking. Due to the complex nature of bread flavor, it still remains a challenge for researchers after many years of intensive research. The means to enhance the desired flavor attributes of bread would be highly appreciated by the baking industry **(Katina, 2005)**.

The extension of shelf-life is one of the biggest challenges for the baking industry today **(Plessas *et al.*, 2008)**. The shelf-life of bread is relatively short, mainly due to number of physicochemical alterations that occur after baking and during storage. These alterations known as bread staling, which responsible for the disposal of large quantities of bread, therefore resulting in economical losses **(Katina *et al.*, 2006).** Staling is characterized by crumb firming mainly due to retrogradation of the starch polymers and interactions between starch and proteins, crust softening due to transfer of moisture from the crumb to crust and finally loss of flavor components **(Maga, 1974; Inagaki and Seib, 1992; Corsetti *et al.*, 2000; Katina *et al.*, 2006)**. The staling phenomenon has been

intensively studied for decades, but a scientific and technological understanding of the mechanism of staling, however, is far from clear **(Chinachoti, 2003)** .

Fermentation is mostly done by the commercial baker's yeast but it does not produce appreciable amounts of organic acids, which are required to enhance the flavor, texture and the shelf-life of bread. Therefore, there is a need for innovations in bread making to increase its shelf-life and consumer's attraction **(Corsetti *et al.*, 2000; Guarda *et al.*, 2004; Katina *et al.*, 2006)**. Use of dough improvers such as emulsifiers and hydrocolloids, etc was the main approach for delaying staling and extending shelf-life of bread **(Corsetti *et al.*, 2000).** However, sourdough has a natural, additive-free image and lactic acid bacteria have been used in food for thousands of years and are "generally regarded as safe". Recently, the traditional processes like sourdough bread making and using lactic acid bacteria (LAB), has been suggested for improving the taste, texture, aroma and increasing shelf-life of bread **(Messens and De Vuyst, 2002; Hansen and Schieberle, 2005; Rehman *et al.*, 2006)**.

The dominating microbes in spontaneously fermented dough are homofermentative lactobacilli and *Pediococci,* which are found both in wheat and rye sourdoughs at the level of 3 $x10^8$- 3 $x10^9$ CFU/g. Typical homofermentative LAB in spontaneous sourdoughs are *Lb. casei, Lb. delbrueckii, Lb. farciminis, Lb. plantarum, Pc. pentosaceus*. Typical heterofermentative LAB are *Lb. brevis, Lb. buchneri,* and *Lb. fermentum* (**Stolz, 2003)**.

The technological benefits of the use of sourdough in wheat bread making include enhancing loaf volumes, decreasing rate of bread firming (**Corsetti *et al.*, 1998)**, delaying of starch retrogradation

(**Corsetti *et al.*, 2000)** and improving bread flavor (**Rehman *et al.*, 2006**). Furthermore, **Korakli *et al.*, (2003)** demonstrated the ability of certain sourdough originated LAB of producing exopolysaccharides, many of which are potential anti-staling substances. Also, the solubilisation of arabinoxylans during sourdough fermentation might reduce bread staling as pentosans have been postulated to prevent starch-gluten interactions responsible for staling (**Gray and Bemiller, 2003**). Moreover, recent papers demonstrated the effectiveness of sourdough fermentation in improving the nutritional value of cereal products (**Liukkonen *et al.*, 2003; Kariluoto *et al.*, 2004**).

Traditional sourdough fermentation is troublesome and economically ineffective. However, negligence in the completion of the process results in serious bread failures, namely, leathery crust, atypical flavor, crumbling or dull taste (**Hui *et al.*, 2006**). Therefore, using pure cultures of lactic acid bacteria in combination with yeast, has been suggested for improving the physical and organolyptic properties of bread (**Hansen and Schieberle, 2005; Rehman *et al.*, 2006**). On the other hand, many flat types of bread such as balady, rye and sangak bread are still prepared according to the traditional procedures. Although rye sourdough bread production has been extensively studied in Europe, only a limited number of references are available with respect of function of sourdough in balady and other types of flat breads (**Qarooni, 1996; Ereifej *et al.*, 2006**).

Therefore, the aim of the current study was to improve the quality of bread and delay staling using sourdough fermentation. To achieve this aim, microbial mixed cultures of yeast and lactic acid bacteria were optimized for preparation of sourdough starters which could be used as starters for production of sour pan and balady. For this purpose the following tasks were considered: