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USE OF A NATURAL LOW Na^+ SALT IN DURUM WHEAT BREAD

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ABSTRACT

Processed foods are the main source of sodium in the diet and bread is one of the main contributors to dietary sodium intake, especially in countries where the bread has an important role in the daily menu. The aim of this work was the evaluation of the effects of the reduction of sodium content and its replacement with a natural low Na^+ salt on the quality parameters of durum wheat [*Triticumturgidum* (L.) subsp.*turgidum* (L.) convar. *durum* (Desf.)] bread. Breads were produced in an industrial company, packaged under MAP conditions and stored at 25 °C for 90 days. The physicochemical characteristics of the bread samples and the sensory changes were evaluated to highlight the products evolution during the shelf life. The loaf volume and height, the crumb porosity, the moisture content and the pH were determined in bread samples at different time of storage. Sensory changes were also studied to understand the effect of the Na^+ reduction on the major bread attributes. Loaf volume and height showed, as expected, a decrease of these parameters correlated with the reduction of salt concentration. The moisture content did not show differences during storage, while HMF showed the typical fluctuating trend independently from the salt level of the bread samples. The results of the sensory data showed that breads differed in salt attribute, as expected, and had similar trends during storage.

Keywords: durum wheat bread, potassium chloride, shelf-life, sensory evaluation

1. INTRODUCTION

The negative effects of an excessive salt intake with the diet, today, are well known. EFSA (2006) recommended an intake of 3-4 g salt/day, but generally, among European population the daily salt intake is more than double. One of the several initiatives undertaken for the reduction of the salt intake with breads was from the Italian Ministry of Health in 2007, who signed with various bakery associations a progressive reduction of the salt content in bread. NaCl plays an important role in bread-making. Decreasing salt addition causes a reduced dough resistance to extension, changes in gas holding capacity of the dough, influence on crumb structure and hardness during storage (LYNCH *et al*., 2009). A partial replacement of NaCl with KCl and yeast extract in durum wheat bread as a possible strategy to reduce salt intake, was proposed by SPINA *et al*. (2015). The NaCl replacement with KCl higher than 30% gives metallic and astringent taste (SALOVAARA, 1982). The aim of this work was the evaluation of the effects of the sodium chloride reduction, from 1.7% to 0.15%, and its replacement with a natural low Na^+ salt on the quality parameters of durum wheat bread. Loaf height and weight, porosity, moisture content and sensory changes were determined during shelf life.

2. MATERIALS AND METHODS

2.1. Bread making process

Breads were produced in an industrial company (Valle del Dittaino Società Cooperativa Agricola, Assoro, Enna, Italy), according to a consolidated industrial process and packaged under MAP conditions and stored at 25°C up to 90 days. For each dough 50 kg of durum wheat semolina was used and mixed with water, compressed yeast and added with different level of NaCl (1.7, 0.15%) or natural low Na^+ salt (1.7, 0.15%). Code for samples and the composition of the salts of dough were reported in Table 1.

Table 1: Code for samples and composition of the salts of the dough.

Sample code	NaCl (g/100 g)	Low natural Na+ salt (g/100 g)
1.7% NaCl	1.7	-
1.7% Lns	-	1.7
0.15% NaCl	0.15	-
0.15% Lns	-	0.15

2.2. Bread quality parameters

The volume was determined according to the rapeseed displacement in a loaf volume meter. The internal structure was visually estimated using the Mohs scale. Moisture content was determined on grounded samples by gravimetric method. HMF extraction and HPLC conditions were according to SPINA *et al*. (2015).

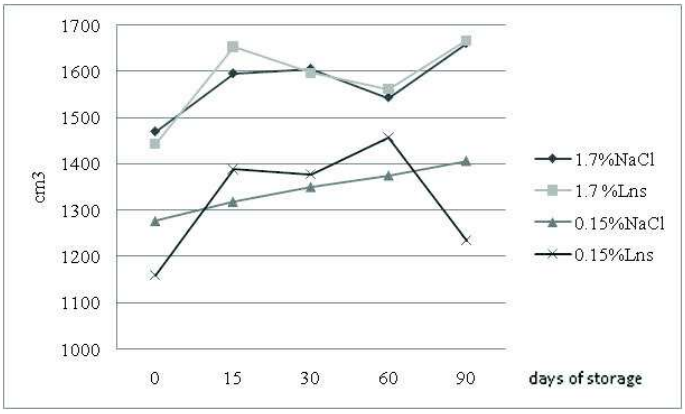
2.3. Sensory evaluation

The sensory profile was determined by applying the methods UNI 10957 2003 and UNI EN ISO 8586 2008 according to LANZA *et al*. (2011). The judges, using a scale between 1 (absence of the sensation) and 9 (extremely intense), have evaluated the intensity of the selected sensory attributes.

3. RESULTS AND CONCLUSIONS

Bread samples (1.7% NaCl and 1.7% Lns) reported similar values of loaves volume (Fig. 1a), independently from the type and content of salt used. On the contrary, bread samples (0.15% NaCl and 0.15% Lns) reported a reduction of about 300 cc. After 60 days of storage, a decrease in loaves volume was reported only in 0.15% Lns samples.
As regards to the bread weight, loaves samples (1.7% NaCl and Lns) showed an average weight between 450 and 500 g, maintaining it until the end of storage (Fig. 1b). Concerning the internal structure bread samples showed a variable trend during the 90 days of storage (Fig. 1c).

a)



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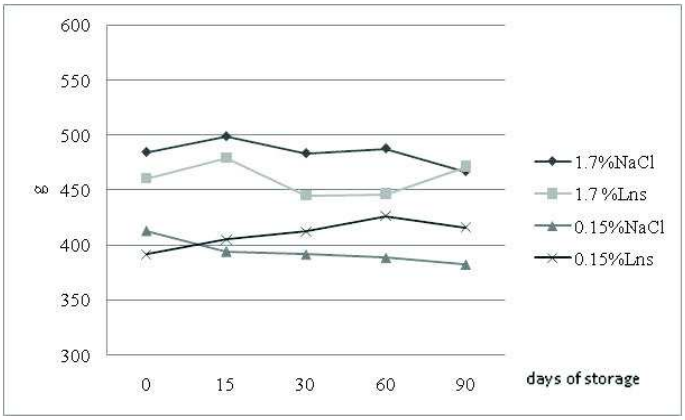

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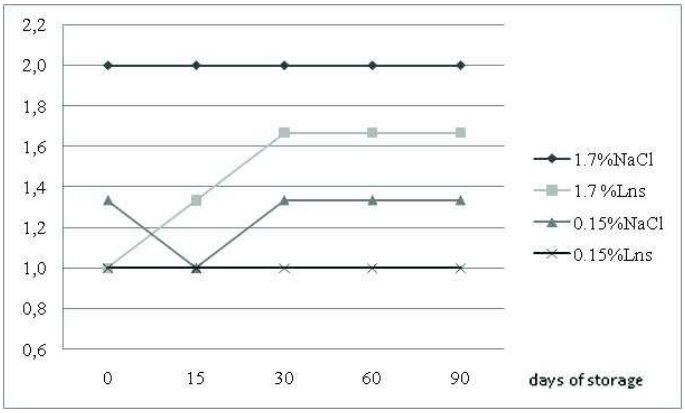


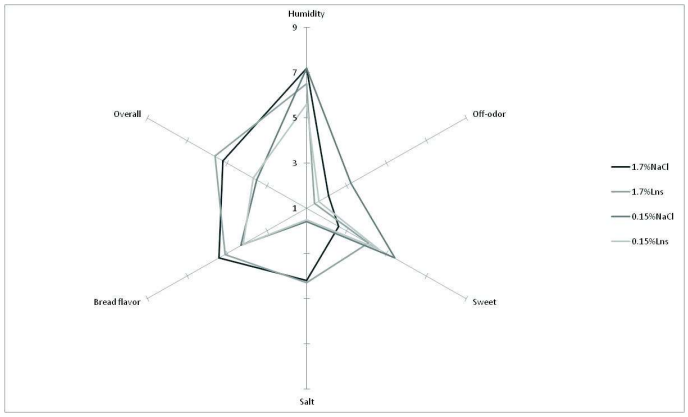
Figure 1: Effect of different salt concentration on physical properties of bread during 90 days of storage. a) Loaf volume (cm^3); b) Weight (g); c) Crumb structure (1: irregular, 2: regular).

Moisture content was about 34% in bread samples with 1.7% of salts, while bread samples with 0.15% of salts had the lowest moisture content (about 32%). During storage the moisture content remained constant in all samples, suggesting a good performance of the packaging materials.

HMF is a well-known index of thermal treatments and its formation is related to the presence of sugars in the dough and time and temperature of the oven baking (RAMÍREZ-JIMÉNEZ *et al*., 2000). The HMF levels in freshly baked bread samples ranged from approximately 23 mg/kg to approximately 39 mg/kg, but it is not possible to attribute these differences in the HMF levels between samples nor to salts content neither to NaCl replacement. Probably other factors such as slight differences in the oven baking time influences more the HMF content respect to the different salt levels in the dough. After three months of storage the HMF level in all bread samples was lower than the concentration determined before storage.

Sensory evaluation performed on the freshly baked bread samples highlight a comparable overall judgment of breads having the same levels of salts, indicating no off-odour development in bread produced with the natural low Na^+ salt (Fig 2a.).

a)



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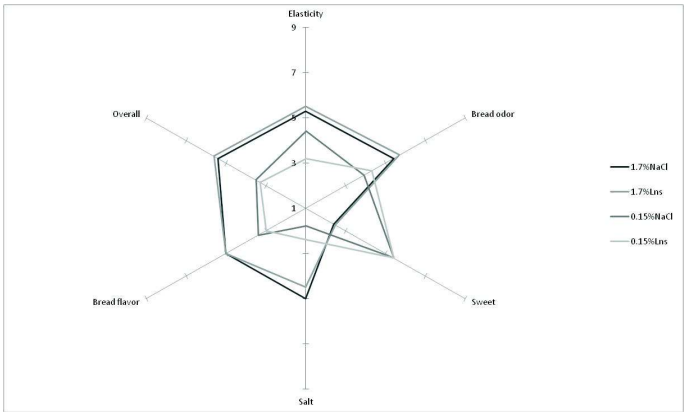

Figure 2: Evaluation of the sensory attributes in freshly baked bread samples (a) and after three months of storage (b).

Bread samples with the highest salt level (1.7%) had the highest intensity of bread flavor while bread samples with the 0.15% of salts had the lowest intensity of the same attribute. After 90 days of storage the overall judgment, the bread flavor, the bread odor and the elasticity were similar between bread samples having the same salt level (Fig. 2b).

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