

INFLUENCE OF PACKAGING MATERIAL CHARACTERISTICS ON THE SHELF-LIFE AND QUALITY OF MIXED CORN BREAD

Nada Filipović¹, Vera Lazić¹, Jelena Filipović^{2*}, Dragana Simović-Šoronja¹

¹ Faculty of Technology, University of Novi Sad,
Bul. cara Lazara 1, Novi Sad, Serbia

² Institute for Food Technology, University of Novi Sad,
Bul. cara Lazara 1, Novi Sad, Serbia

ABSTRACT: The influence of different packaging materials on mixed corn bread was investigated. Combination of wheat flour and heat treated corn resulted in new characteristics of bread varieties. Heat treatment of corn is positively contributing to certain biochemical, nutritional and use changes. Pertinent data show that packaging material has strong influence on shelf-life and quality of this type of bread. The combination of multilayer PET/PE material was the best combination concerning the bread crumb quality and shelf-life.

Keywords: *bread, extruded corn, packaging, modified atmosphere, quality*

INTRODUCTION

Over the last sixty years there has been a major step in the development of bakery equipment in this country. New technological processes, which contributed to improving the quality of bread, shortening the production time and the substantial increase in labor productivity, but a range of products is not very extended, especially in the category of so-called mixed breads (1).

In comparison to wheat bread, corn bread is aging more rapidly (2). Mixed corn bread (70% wheat and 30% extruded maize flour) has a specific sweet taste and aroma of corn. Disadvantages of mixed corn bread can be seen at the stage of dough handling and fermentation thus contributing to poor

sensory characteristics of the finished product. These can be partly corrected by the addition of commercial gluten and specific additives. For the purpose of baking, in order to obtain better characteristics of bread, corn can be thermally processed in different ways, like micronization (IR treatment) and extrusion (hydrothermal treatment).

Packaging materials, due to their physical-mechanical properties particularly barrier characteristics, significantly affect the quality and sustainability of packaged food products (3, 4). Bread is packed to maintain prolonged freshness and to prevent rapid drying out. In order to achieve a better protective effect of packaging material great

*Corresponding author

e-mail: jelena.filipovic@fins.uns.ac.rs:

Tel: +381 21 485 3779; Fax: +381 21 450725

advantages were realized by applying new materials with improved properties, as well as introducing different conditions within the packaging unit like modified atmosphere (MAP), vacuum, and aseptically intelligent package (7).

Objective of this paper is to investigate the shelf-life and freshness of mixed corn bread in relation with the packaging materials. These tests include quality control of bread (sensory analysis of bread crumb quality and crumbliness), depending on the type of packaging materials and composition of gases within the packaging unit.

MATERIAL AND METHODS

In the experiment the following materials were used: flour T-400, produced by "Žitko" from Backa Topola, extruded corn, produced by "Metal-Matik from Beocin, and commercial products: fresh yeast, Budafok from Budapest, Hungary, salt, "The product" from Belgrade and Ca-propionate, and Na-diacetate, by ICN Galenika Zemun.

Bread loaves were packed in containers of:

- polypropylene foil (PP), produced by "Tipoplastika from Gornji Milanovac, declared thickness 30 mm and
- multilayer foil (PET / PE), a manufacturer of "Sipex" from Ada, declared thickness 70 μm . Modified (MAP) included the following combination of gas 40% CO_2 and 60% N_2 , by MAP Tehnogas AD Belgrade.

The permeability of gases CO_2 , O_2 and N_2 packaging materials was tested by the LYSSY-in, according to DIN 53 380 on the

device Lyssy GPM-200 with the associated gas chromatograph GASUKURO Kogyo GC-320 and HP 3396 integrator, and air permeability was obtained by calculation. Bread was baked according to the standard AACC methods. The following formula was applied: wheat flour 70%, extruded corn 30%, salt 2.0%, 2.5% baker's yeast, 0.7% Ca propionate and 0.7% Na/diacetate (based on flour). Bread loaves were packed in a packaging material under atmospheric conditions (ATM) and modified atmosphere (MAP). The quality of bread was periodically evaluated by five trained panelists. The quality of crumb was expressed by numerical scores, the maximum is 7 and the minimum 0 (5).

Crumbliness was determined by sieving 9 crumb cubes dimensions 25x25x25 mm, for 15 min through wire mesh size 1.4 mm (6).

RESULTS AND DISCUSSION

GAS PERMEABILITY

The insight of packaging materials, particularly for polymer barrier properties is illustrated by determining the gas permeability. These characteristics influence their use for packaging of certain food products where it is important to preserve the contents from the effects of gases from the environment. The permeability of gases depends on the nature of the material and gas is directly proportional to the difference of concentration on the surface of packaging materials and temperature, and inversely proportional to the thickness of the packaging material (4, 7).

Table 1.
Gas permeability of packaging materials used

number of samples	CO_2	O_2	N_2	air
PP	3.843,60	1.415,60	263,00	507,60
PET/PE	631,50	113,60	14,80	35,80

Data from Table 1 show that the multilayer PET / PE packaging material on the whole has a much smaller gas permeability compared to the polypropylene film.

The values of gas permeability of packaging materials used are different depending on the type of gas which is in accordance with published data (7).

THE QUALITY OF BREAD

The quality of mixed corn bread was analyzed as a function of length and storage packaging conditions. It is noticeable that the quality of the bread deteriorates with time regardless the packaging but it is evident that packaging material is positively

contributing to prolong the quality of packed product (Table 2). Due to sensory changes of unpacked bread its shelf-life is only three

days but for comparison changes were traced seven days.

Table 2.

Sensory evaluation of mixed corn bread crumb- expressed as number of crumb quality (VBS)

days	Packaging material				
	unpacked	ATM-PP	ATM-PET/PE	MAP-PP	MAP-PET/PE
1	3,3	3,3	3,3	3,3	3,3
3	1,5	2,4	2,4	2,4	2,4
5	1,5	1,4	1,4	1,6	1,4
7	1,2	1,4	1,4	1,4	1,4
14	/	*	1,4	*	1,4
21	/		*		*

*the occurrence of molds

Mixed corn bread packaged stales slower than unpacked. Regardless the quality of packaging material and the atmosphere inside the packaging unit, data from Table 2 show that the time of occurrence of fungi depends on the quality of packaging materials and on the gas permeability of those materials (Table 1), thus pointing at pronounced effect of packaging conditions. When mixed corn bread was packed in the packaging material attributed with higher and lower gas permeability (Table 1) mold appeared after 14 and 21 days, respectively (Table 2).

The study of crumb crumbliness confirmed that it initially increases, but after 5 to 7 days depending on the type of packages it began to decline (Table 3).

Crumbliness point at crumb staling. Concerning the same type of bread, crumbliness is increasing with the time but the rate of increase depends on bread storing conditions, particularly on the characteristics of packaging material. In general, crumbliness of unpacked mixed corn bread was lower than in packaged products which are related to moisture loss of product and stiff crumb. Better barrier attributes of packaging material are positively contributing to the characteristics of bread crumb. The declination of values is in accordance with bread crumb quality, Table 2. When bread crumb quality was evaluated with the lowest values, crumbliness began to decline pointing at crumb firmness accompanied with not appealing mastication.

Table 3.

Crumbliness (%) of mixed corn bread

Days	Packaging material				
	unpacked	ATM-PP	ATM-PET/PE	MAP-PP	MAP-PET/PE
1	4,16	4,05	3,17	3,33	2,08
3	5,10	9,01	5,44	8,91	5,22
5	5,94	12,60	15,56	9,73	7,66
7	6,25	11,69	7,05	4,37	4,28
14	/	/	3,15	/	4,21
21	/	/	/	/	/

Crumbliness of packed mixed corn bread increased until the fifth day of storage after which it began to decline. Crumb in this kind of bread after the fifth day was very hard and compact, and not elastic. Increased

crumbliness, as a consequence of crumb staling is resulting from known mechanism of forming a thin air layer round gelatinized starch (8). Hydrogen or other associative bonds are formed with hydroxyl groups from

amylose nearby chains, which influences the change of hydrophilic properties of the environment, thus contributing to staling.

CONCLUSION

Based on the investigation of freshness and shelf life of mixed corn bread according to the packaging and packing requirements following can be concluded:

- The packaging of mixed corn bread positively contributes to the elasticity and fineness of crumb.
- Due to shelf-life, crumb crumbliness initially increased, but after 5 to 7 days depending on the type of packages it began to decline.
- Packaging material characteristics had a greater impact on the shelf-life of mixed corn bread than the packaging conditions. Multilayer PET / PE packaging material prolonged the use-value of mixed corn bread.
- Concerning the crumb quality of mixed corn bread, the best proved to be the combination of multilayer PET / PE packaging materials and modified atmosphere within the packaging unit. While taking into account the sensory evaluation of breads, it can be concluded that under these conditions mixed corn bread is viable fourteen days.

- Testing should proceed in finding an optimal composition of gases depending on the type of packaging materials.

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