The Influence of Storage Temperature on the Bread Quality

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Abstract. The main purpose of this paper is the study of sensory and physicochemical changes occurring in bread, preserved at ambient temperature and refrigeration temperature for 7 days. The study has been achieved using bread commercialized in a supermarket, sliced and packaged in polyethylene foil. Monitoring the quality parameters has been achieved daily so be as visible changes. The quality parameters monitored was elasticity, porosity, acidity, humidity and sensory characteristics, indicators which reflect the freshness of bread. The analytical methods used are those of standards and values are within the limits of quality standards.

Keywords: bread, quality, temperature, time.

INTRODUCTION

Bread is one of the food at the basis of food pyramid as a result is consumed daily by most peoples. The question is how we store the bread so that they may keep better sensory and physicochemical characteristics.

Bread stored at ambient temperature (temperature having values between 18 and 25 °C) in a refrigerator (at temperatures of 2-4 °C) or freezer (temperature range -18 to -22 °C).

The question is which of the methods of storage lets you keep bread so that the organoleptic and physico-chemical characteristics to change as little as possible.

The purpose of this study is to answer to the question set out in the previous paragraph.

MATERIALS AND METHODS

To achieve the experimental research have studied three kinds of bread (white bread, black bread and semi bread) and quality parameters was monitored for 7 days. The bread used was bought from the supermarket, according to the label it not contain additives.

The parameters monitored to all three varieties of bread stored at room temperature, the refrigeration temperature and refrigeration temperature was: organoleptic characteristics (appearance, crust appearance, crumb appearance, smell and taste) and physicochemical characteristics (elasticity, porosity, acidity and humidity).

Sensorial characteristics was monitored daily during the experimental research, the method of analysis is the points appreciation method, according to SR 91/2003.

Physicochemical characteristics were monitored daily for moisture content of crumb, porosity, acidity and elasticity analysis methods are according to SR 878/96.

Porosity is pores volume found in 100 g of crumb. The method is based on determining the specific non-porous crumb (Tucu, 2007).
Determination is as follows: 3 cylinder crumb is cut with 2 cm height and with internal diameter drill 41.5 ± 0.03 mm, weigh of the crumb cylinder cut out and note the mass (m), calculate the volume of cylinders crumb pore (Vp) using the following formula:

\[ V_p = h \cdot \pi \frac{d^2}{4} \]

where: \(d=41.5\text{mm} \pm 0.03\) ; \(h=2\text{cm}\)

- Calculate the volume of non-porous core cylinders (V) on the compact core density as follows the next formula:

\[ \rho = \frac{m}{V}, \quad \Rightarrow \quad V = \frac{m}{\rho} \]

where the compact crumb density for bread is 1.31 g/cm\(^3\)

**Calculation and expression of results**

The difference between crumb cylinder volume and volume crumb without pores, expressed as a percentage, is the porosity of the sample:

\[ \text{Porosity} = \left( \frac{V_p - V}{V_p} \right) \cdot 100 \quad [\%] \]

where: \(V_p\) – volume of pore crumb cylinders cut out, in cm\(^3\); \(V\) - volume of free pores crumb from cut cylinders, in cm\(^3\).

Minimum porosity white bread has to be 73%.[5]

**The elasticity determination** - the method consists in pressing a particular form of pieces of crumb as a limit specified of time and measuring the return to original shape after the pressing end.

**Operation Mode**: a cylindrical crumb cuts with a hole punch from a slice thickness of 60 mm, cylinder crumb is put on board camera, mobile card is descent by turning the crank until the cylinder crumb, avoiding pressing it. Read the initial height of the crumb cylinder ruler, cylinder crumb is pressed down half of its height and remains 1 minute stands the movable plate and leave space for the return of the crumb is returned and read height.

**Calculation and expression of results**

Crumb elasticity is the ratio of height after rebound (H) and initial height (Hi) core cylinder, expressed as a percentage.

\[ \text{Elasticitatea} = \left( \frac{H}{H_i} \right) \cdot 100 \quad [\%] \]

Have been made two determinations in parallel, and as a result has taken the average of the two determinations. The difference between the two determinations was within the 2% by volume in absolute value.[6]

**Bread humidity** is the water content of its crumb. Humidity is to determine the weight loss by heating to 130 °C ± 2 °C.

**Operation mode**: a capsule weighing, previously brought to constant weight, 0.001 g analytical balance weigh about 5g of the prepared sample. Capsule with sample is insert in the oven previously heated to 140-145 °C. Set the oven at 130 °C and continue heating the capsule containing for 45 minutes at this temperature. Then the capsule is removed from the oven, cover with lid and place in a ecssicator containing anhydrous calcium chloride. After cooling to room temperature, the capsul is weighed to the analitical balance.

There were two parallel determinations carried out on the same sample for analysis.
Calculation and expression of results:

\[ U = \left( \frac{m_1 - m_2}{m_1 - m_0} \right) \times 100 \% \]  

(5)

where: 
- \( m_1 \) - capsule with the products weight before drying, g;
- \( m_2 \) - capsule with the products weight after drying g;
- \( m_0 \) - capsule mass, in g.

As a result, it got the arithmetic average of the two determinations carried out in parallel. The difference between the results of two parallel determinations carried out was within the limit of 0.5 g water per 100 g sample.[6]

**Bread acidity** is the sum of acids and acid reaction of the sample compounds.

**Principle** - aqueous extract of the sample to be analyzed is titrated with sodium hydroxide solution 0.1 n in prophesy phenolphthalein as indicator, until the appearance of pink coloration that persists for a minute.

**Operation mode**: weigh 25 g crumb product or crumbled, in a weighed beaker is placed crumb and 250 cm³ distilled water, shake and filter 50 cm³ filtered into an Erlenmeyer, add three drops of phenolphthalein; titrate with 0.1 n NaOH solution until a pink color that persists a minit, to read the volume of NaOH used in the titration.

**Calculation and expression of results**

Acidity is expressed in acidity degrees (1 degree of acidity is the acidity of 100g sample is neutralized with 1n NaOH 1 cm³) and is given by:

\[ A = \frac{V \cdot n}{m} \times 100 \]  

(6)

where: 
- \( V \) - volume of sodium hydroxide solution used in titration 0,1 n, in cm³;
- \( m \) - mass of the sample taken for determination, in g;
- \( n \) - normality of sodium hydroxide (0.1 n).

There have been two determinations and is considered as a result their arithmetical average, expressed to one decimal place (SR 878/96).

**RESULTS AND DISCUSSIONS**

In case of sensory characteristics rating scale was 20 points, 5 points for each sensory characteristic monitored (Apostu, S., Naghiu, Al., 2008). Sensory characteristics monitored were looking at bread are: crust appearance, crumb appearance, taste and smell.

As can be seen in figure 1 staling rate is influential but storage temperature and shelf life of bread, regardless of the assortment considered.

In the graphs in figure 1 in the early days of storage, whether we refer to white bread, semi-white bread and black bread sensory characteristics better stored at room temperature, a situation that changed after 48-72 hours, when stored at room temperature characteristics of bread is deteriorating with higher speed.

As shown in Figure 1, in terms of organoleptic bread stored at refrigeration temperature keeps more features to the end of storage and is good for the consumer and on the seventh day.
Fig. 1. Sensory characteristics of bread stored at different temperatures
a - white bread, b – black bread, c - semi-withe bread.
Characteristics of physicochemical studied for three types of bread are: elasticity, porosity, humidity and acidity.

The percentage elasticity is shown in figure 2, where it can be seen that in the first 24 to 48 hours elasticity is better kept at room temperature, after which the rate of obsolescence is very high in bread stored at room temperature. As regards of elasticity values stored at room temperature bread may be consumed 3 to 4 days, while the better preserved by refrigeration for proper use and at the end of the seven days of storage.

Comparing the elasticity values with the minimum value from STAS (minimum 86 %) are found at the end of the seven days of storage the only one sort who has this parameter below the regulatory limit is semi-white bread stored at room temperature (SR91/2003).

Porosity is another parameter that gives information concerning the quality of bread. As can be seen in Figure 3, for all three types of bread considered by this study in the first 48 hours porosity is reduced significantly less when stored at room temperature. The third day of preservation porosity is significant changes occur in the bread stored at room temperature (fig. 3). According SR 878/96 minimum acceptable value for porosity is 72% and the minimum value obtained in the study is 79%, for semi-white bread, stored at room temperature.
Another important parameter which gives information on the quality of bread is acidity. The maximum value allowed in SR878/96 is a 4.5 °A for white bread. As can be seen in figure 4, the maximum value obtained in experiment was 4.1 °A at a white bread stored at room temperature, a value that fits into the quality, even if preservation was done for 7 days. Acidity values have been very low, and although on the package does not specify that the bread is not food additives raises the suspicion that they were used.

Humidity is a decisive parameter influencing the rate of staling and also influences the organoleptic characteristics. The maximum amount of moisture the crumb, according SR878/96 is 47 %. With as humidity of crumb decreases more, the bread becoming more crumbly, and cutting of slices will be harder. Humidity increases above the limit admitted increase the risk of developing microorganisms, and if it is above The maximum value allowed for fresh bread baked means that it was insufficient.

Humidity value during the storage changes according to existing air parameters in storage room.

Humidity value during the storage changes according to value of air parameters existing in the storage room.

CONCLUSION

Physico-chemical and organoleptic characteristics of bread no matter sort, the first two days of storage at refrigerator temperature changes faster than bread stored at room temperature. This occurs because the bread at refrigerator temperature (below 4 °C) the starch structure changing occurs that has the effect of modifying elasticity and porosity crumb. This change is accentuated due to moisture change no matter sort of bread and covered storage temperature.

On the third day the bread stored at room temperature changes are carried out faster than the bread stored by refrigeration. This can be seen in the graphics of all parameters studied.

After performing experimental research found that the bread, no matter sort, is better preserved at room temperature in the first 24-48 hours. Based on this finding it is recommended that if immediate consumption bread to be preserved at room temperature, it
will be stored in the refrigeration room only if the bread will be consumed after a longer period of the time of 3 days.

REFERENCES