

Effect of Storage Time on Hardness and Water Activity of Pastry Biscuits with Thyme, Oregano and Sage

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Abstract — The study investigates the effect of storage time on hardness and water activity of pastry biscuits with thyme, oregano and sage. There was a significant effect of the herbs on the hardness of pastry biscuits. Herbs accelerate staling while added separately, whereas added in combination they slow down the staling. The water activity of biscuits with herbs is higher compared to control sample. Addition of herbs keeps high water activity in storage.

Keywords— Pastry biscuits, thyme, oregano, sage, staling.

I. INTRODUCTION

The story of biscuits dates back to the time of Ancient Rome, and today the manufacturers of these products face the challenge to offer on the market a wide variety of biscuits with sustainable quality (Pyler et al., 2008, Stefanova et al., 2017). The consumer preferences to these products are associated with their taste and high nutritional value determined by the content of sugar and fat (Stefanova et al., 2017, Tarancón et al., 2013).

Nowadays, research on the application of herbs to human nutrition and in particular their use in pastry as an addition to obtaining healthy semi-finished products and finished products is a particular interest. The Bulgarian herbs oregano, thyme and sage are one of the most common and widely used. They have an exceptional healing effect proven over the years (Dhillon et al., 2013).

It has established that most culinary herbs exhibit bactericidal, fungicidal, and antiviral and can decrease the level of blood sugar (Dimov et al., 2013, Popular culinary herbs and their effects upon health, Sharon Palmer, 2008, Small, 2006).

The sage extract can be used as a natural antioxidant in food industry. It has been found that adding *Salvia officinalis* to ethanol extract it gives an excellent antioxidant effect on the stability of mayonnaise (Paucean et al., 2012).

The positive antioxidant and antimicrobial effect of cinnamon use (*Cinnamomum verum*) and extract of *Echinacea purpurea* for the production of traditional biscuits (Kolompe) in Iran is described. The test samples biscuits obtained with cinnamon (0.15 %) and the extract (0.75 %) are characterized by higher antioxidant stability, greater resistance to microbial spoilage and longer shelf life, compared to the control sample (Nair, 2006).

The addition of thyme (up to 0.2 %) and rosemary (up to 0.02 %) to biscuits increases their antioxidant stability by increasing the shelf life. The taste of biscuits with herbs is very well appreciated by consumers (Krasteva et al., 2011).

The products shelf life is especially important for their consumer properties. Significant changes in elasticity,

softness, and consequence of their chewing characteristics are observed. The hardness of pastry biscuits is one of the indicators which determine the degree of storage time. It is generally defined as the force required compressing the sample (Paucean et al., 2012).

The aim of the presented study is to determine the effect of herbs: thyme, oregano and sage on hardness and water activity of pastry biscuits during their storage.

II. MATERIALS AND METHODS

Materials

A standard commercial grade wheat flour type 500 (moisture – 13.0 %, acidity content 2.2 °H), cow cheese, butter and eggs were used for pastry biscuits formulation.

Methods (Baking test)

Pastry biscuits are made from wheat flour type 500 (100 %), cow cheese (75 %), cow butter (58 %), egg yolk (25 %). The control sample of biscuit is (C) and the other test samples biscuits were examined with 0.5; 1.0 and 1.5 % thyme, 0.5; 1.0 and 1.5 % oregano, 0.5; 0.8 and 1.0 % sage. The biscuits with a combination of herbs were made with 1.5 % thyme, 1.5 % oregano and 1.0 % sage. The flour and herbs are pre-mixed to the even distribution of herbs in the flour. The previously grated cheese is added and mixed again. To the mixture thus obtained it is added the pre-broken butter and egg yolk and everything is involved until a homogeneous mass. The dough is laminated to a thickness of 5 mm from the dough it was cutting out circular shapes with a diameter of 40 mm. The biscuits are baked at 200 °C for 14 minutes.

Determination of Hardness

The change in hardness and water activity was followed over a period of 14 days (336 h). The biscuits were stored at a temperature of 20 ± 1 °C and a relative humidity of 75 % (maintained with a saturated solution of NaCl). The hardness of pastry biscuits was measured with Stevens-LFRA Texture-Analyzer (Brookfield Engineering Lab., Inc, Massachusetts, USA). The biscuits are pierced with a 2 mm diameter with cylindrical working body and a flat top. The puncture rate is 0.5 mm/sec and the penetration distance is 3 mm. The biscuit's reaction to destruction (reverse force) is recorded on the graph. Hardness is the highest value of the reaction, expressed in grams (g) (Brookfield LFRA, 2008).

Determination of Water Activity

The water activity (a_w) is determined by an electronic device type ER – 84 (Novasina, Switzerland) with a RTD – 42 Sensor Block (Dimitrov et al., 2011).

The effect of storage time and the type of added herbs on hardness was established by the two-factor ANOVA procedure. The effect of storage time on water activity is determined by linear regression, in which the hypothesis (H_0) is verified by the Fisher F-criterion: the coefficients before the variables are statistically equal to zero. The results presentation and all statistical processing were performed with “R: Programming Language and Development Environment for Statistical and Mathematical Data Processing” (R Core Team, 2013).

III. RESULTS AND DISCUSSION

Figure 1 shows the change in hardness of pastry biscuits during storage.

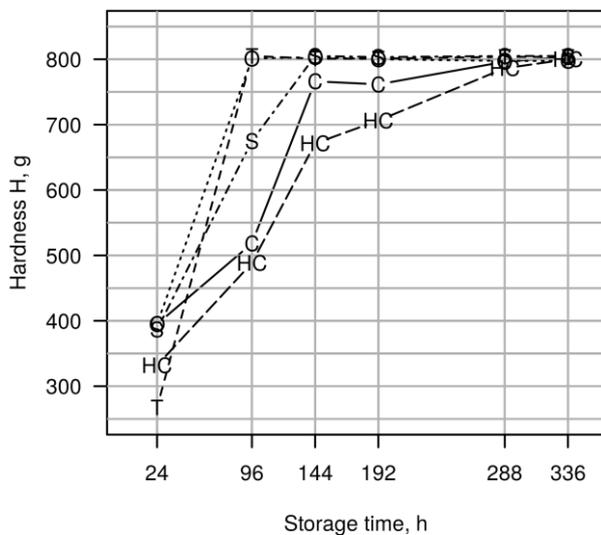


Fig. 1. Changes in the hardness of biscuits with thyme (T), oregano (O), sage (S) and herbal combination (HC) during storage. The graph shows the mean values and the hardness of the control sample without herbs (C)

Different herbs ($F=29.0$; $df=4.85$; $P<0.001$) and storage time ($F=301.5$; $df=5.85$; $P<0.001$) have a statistically significant effect on hardness. We also found a mutual effect of both factors ($F=8.43$; $df=20.85$; $P<0.001$).

At the beginning of the test (at 24 h) five test samples have a low hardness between 250 and 400 g. The lowest is the hardness of the sample with thyme (267.5 g), followed by HC (332 g), and in the other three samples – with sage, oregano and control sample their initial hardness is statistically indistinguishable – on average 391 g ($SD = 2.2$).

The hardness of the pastry biscuits increases to a certain value, and then remains relatively constant during storage. Maximum hardness is reached most rapidly in samples with thyme and oregano at 96 h of storage, followed by samples with sage at 144 h. The shelf life control sample and the herbal combination are reaching their maximum most slowly – at 288 h of storage. Biscuits with herbal combination (HC) preserve their freshness for the longest time.

Figure 2 shows changes in water activity (a_w) during storage.

The addition of herbs to pastry biscuits, has a statistically significant effect on water activity ($F=56.75$; $df=4.25$; $P<0.001$). The combination of herbs has the highest water activity, followed by the sample with sage, oregano and thyme alone. Their water activities are in the range of 0.734 to 0.842. The lowest water activity is that of the control sample, which is different from the other test samples and ranges from 0.554 to 0.715. Generally, the water activity of pastry biscuit with herbs is high – over 0.750, which implies the development of microorganisms and short shelf life.

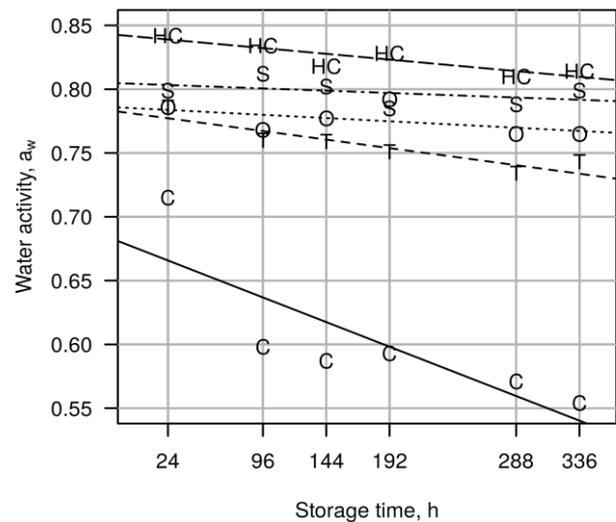


Fig. 2. Changes in the water activity (a_w) of biscuits with thyme (T), oregano (O), sage (S) and herbal combination (HC) during storage. The control sample without herbs is (C)

Water activity decreased with increasing the storage time in all five test samples. Linear-correlation analysis showed a significant decrease in the control sample ($F=8.56$; $df=1.4$; $P=0.043$, $R^2=0.65$); test sample with thyme ($F=20.09$; $df=1.4$; $P=0.011$, $R^2=0.83$) and biscuits with herbal combination ($F=14.61$; $df=1.4$; $P=0.019$; $R^2=0.78$). The storage time does not significantly effect on water activity of test samples with sage ($F=0.98$, $df=1.4$, $P=0.38$, $R^2=0.20$) and test sample with oregano ($F=1.64$, $df=1.4$, $P=0.27$, $R^2=0.29$).

Decrease in water activity of control sample is most significant during storage. The biscuits with herbs retain the water activity relatively constant and generally high. All this implies a pronounced moisture-retaining effect of herbs, which can be explained by the presence of coarse cellulose in their composition.

IV. CONCLUSION

Significant effect on hardness of pastry biscuits with herbs has been established. Individually introduced herbs accelerate storage while their addition in combination – slow down shelf life.

The effect of the herbs on the water activity of pastry biscuits was also found. The water activity of biscuits with

herbs is higher than those without herbs. The addition of herbs keeps high the water activity during the storage.

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