EFFECTS OF INCREASING SOURNESS OF BREAD DOUGH ON BREAD QUALITY

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ABSTRACT

Preconditions for production of good quality bread are adequate mixing, longer fermentation, optimal dough consistency and a sourdough starter. Returning to traditional production of a natural and good quality bakery product of a desired and standardized quality, application of sourdough starter in bread production becomes increasingly important, especially in production of rye-based products because the rye flour dough is supposed to be soured. Modern technology applied in bakery plants makes the application of sourdough easier in contrast to past, hours-long preparations of pre-ferment, i.e. straight dough procedures and application of emulsions and powders.

In this Paper, emulsion and powder (*Backaldrin*), in recommended concentration (emulsion 5% and powder 3%), and reduced concentration (emulsion 2.5% and powder 1.5% were used for increasing the sourness of dough. In order to be able to make a comparison, we used the standard without adding emulsion or powder.Analyses made on bread samples were focused on the following parameters: specific volume, shape of loaf (bread form), acidity degree, pH value and sensory evaluation of aroma profile.

The largest specific volume has been noted in standard bread samples, while with an increased concentration of emulsion and powder the values of specific volume were decreasing. Bread form of all samples was mildly flattened. There is established very strong correlation between acidity level and bread form of samples (r = 0.92). As expected, the sourdoughs added significantly decreased pH value and increased the acidity level of bread. In breads made with reduced concentration of emulsion and powder, pH value and acidity level are also satisfactory. All breads produced have improved structure of the crumb, which is softer, fresher and moist. They have good cutting properties and very specific aroma and flavour. Correlation between the acidity level and evaluated sensory elements varied in wide rang (from r = 0.64 for aroma intensity to r = -0.81 for preferences).Prepared starters enable production of good quality bread without application of any additives, and from the aspect of cost-effectiveness it is important to know that good quality bread can be made with 50% less starter than recommended.

Key words: prepared sourdough starter, acidity level, pH value, bread specific volume, bread sensory evaluation

INTRODUCTION

In production of a natural and good quality bakery product of a desired and standardized quality application of sourdough starter in bread production becomes increasingly important, especially in production of rye-based products. Modern technology applied in bakery plants makes the application of sourdough easier in contrast to past, hours-long preparations of pre-ferment, i.e. straight dough procedures and application of emulsions and powders. Advantages of the sourdough application are reflected in improved flavor and aroma, extended shelf life and deceleration of the aging process [1]. According to [2] the percentage ratio of lactic and acetic acids is 80:20 and it affects the quality of bread. The higher the percentage of acetic acid, the more sour is the bread. Due to higher acidity, pH value of the bread declines to 4.0-4.3. In such conditions the enzyme processes become activated, affecting the flavor and aroma of the bread, while at the same time *Maillard* reaction occurs resulting in a more intensive flavour and aroma. Besides, in a dough containing 5-20% of the sourdough, the volume of bread significantly increases [3]. According to [4] there is a significant correlation (r=0.94) between pH and glichemical index. The more significant decline of pH value, the higher is the glichemical index (GI) in blood. According to [5] formation of certain temporary components in pre-ferments is considered very important for sensory profile of bread, and flavor is one of the most valued sensory attributes of bread. According to [5] inconsistent elements are products of lactic acid bacteria (LAB) and yeast fermentation. All variable components produced during the process make no effect on the ultimate flavor of bread. Generally, components with high factor of flavor dilution make impact on ultimate aroma. Acetic, butyric, phenylacetic acids and 2- and 3-methyl butyric and pentanoic acids are considered to be the elements that make most significant impact on the flavour of bread made by sourdough fermentation. By adjusting the conditions of fermentation, duration, temperature, level of flour extraction and consistency of dough it is possible to control the production of variable components. General opinion is that longer fermentation improves the flavour of a final product.

Since sourdough fermentation is a long and demanding process, the need occurred for finding more appropriate ways to make bakery products. At first the acids – lactic, acetic and citric, and compounds thereof were used. They were used directly, with or without sourdough. However, the aroma and flavour of bread produced this way were not satisfactory. Based on modified and improved traditional processes, developed was the production of dry, liquid and sour dough in the form of paste [6].

Applying the achievements of modern biotechnology, the ratio of lactic and acetic acids depends on the selection of LAB, and nowadays there is a large application of instant preparations of sourdough, dry or liquid. Sourdough in this form is much easier to manipulate, and shortcomings following sourdough application in bread production are in this way avoided.

This paper is aimed at production of a mixed rye bread with addition of an instant preparation of sourdough in the form of emulsion and powder in order to examine the

impact of these preparations on sensory quality of bread as to different levels of acidity and pH value.

MATERIALS AND METHODS

Preparation of dough and test baking took place at the facilities of Pekara Visoko DD "Klas". Laboratory tests of bread samples were run in the laboratory of the Faculty of Agriculture and Food Science.

Ingredients used in the process were: whole rye flour (up to 1.9% ash, acidity level up to 5) semi-white wheat flour T – 710 (ash up to 0.79%, acidity level up to 3.2), water, salt, yeast *Sil – Fala Lesaffre*, emulsion and powder starters *Backaldrin*: *Bas Light*, liquid, multi-component starter and sourdough aroma (Ingredients: starter and acetic acid, recommended dose is 5%) – emulsion; and *Anifarin light*, dry and sour pre-mix for rye-flour products (Ingredients: fried rye and wheat flour, sour material, citronic and acetic acids, soya flour, emulgator, soy lecithin, stabilizer solution, recommended dose is 3%) – powder.

Five different mixtures were made: a mix for standard rye bread, two mixes with emulsion additives (producer recommended dose of 5%, and double less dose of 2.5%) and two mixes with powder additives (producer recommended dose of 3%, and double less dose of 1.5%).

Table 1. Formula of bread samples

	(S)[1]	(E5)[2]	(E2,5)[3]	(P3)[4]	(P1,5)[5]
Wheat flour T-750 (kg)	7	7	7	7	7
Rye flour (kg)	3	3	3	3	3
Salt (kg)	0.18	0.18	0.18	0.18	0.18
Leaven (kg)	0.25	0.25	0.25	0.25	0.25
Emulsion (kg)	-	0.5	0.25	-	-
Powder (kg)	-	-	-	0.3	0.15
Water (L) according water absorption	5.6	5.4	5.5	5.7	5.6

[1]Standard sample; [2]Sample with addition of 5% emulsion; [3]Sample with addition of 2.5% emulsion; [4]Sample with addition of 3% powder; [5]Sample with addition of 1,5% powder

Lower water-absorbing power with emulsion mix is understandable given the liquid that is brought in with the emulsion. The situation is completely opposite with the powder mix because the powder has the ability to absorb an additional amount of water.

Bread sampling process comprised the following phases: preparing and weighing the ingredients, kneading the dough with a speed spiral mixer (12 minutes), dough resting (35 minutes, dough temperature 28 °C), manual shaping and weighing (350 g), fermentation (temperature 37 °C, humidity 75%, 50 min) and baking (temperature 230 °C, 28 min). The product was cooled naturally, under the conditions present in the plant.

Physical and chemical parameters of the bread samples tested were: volume and specific volume (a seed change method), shape, crumb elasticity [7], acidity level and pH values (*Hamna Instruments*, HI 8314 membrane) [8]. In this paper the means from the three measurements are presented

Sensory testing was carried out by 34 judges, trained laymen. They applied a discrimination method – the Ranking method [9]. The following features of the samples were evaluated on 5-point scale: typical flavor, aroma intensity, aroma duration and preferences. The maximum score was 20.

Correlation between the acidity level and specific volume and shape of samples tested, as well as acidity level and evaluation of sensory parameters (n=5) were carried out in the „*Biostatistik*" programme [10].

Intensity of correlations was determined by following classification [8]: 0.0 ± 0.50 - weak correlation, ± 0.50 ± 0.75 - medium strong correlation, ± 0.75 ± 0.90 - strong correlation, ± 0.90 ± 0.999 - very strong correlation.

RESULTS AND DISCUSSION

Specific volume happened to be the highest with bread samples made with 2.5% of added emulsion. Specific volume is lower where there is higher percentage of emulsion and powder. Comparing the emulsion and powder, the lower values were noted in the bread samples made with powder.

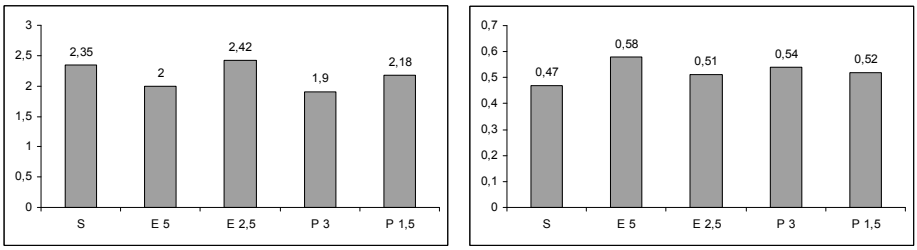

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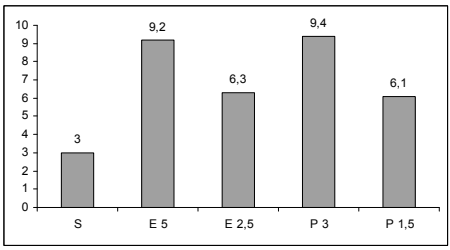
Figure 1. and 2. Means of specific volume (mL/g) and bread form of samples

The results show that good volume bread can be produced with the use of 50% less starters than recommended, while recommended quantity of sourdough starters result in a somewhat poorer volume of bread.

In all samples, the bread form was mildly flattened. Standard bread without any additives happened to be of the most flattened shape (0.47). Samples with added powder retained almost the same shape, regardless of whether the recommended or lesser amount of powder used. In samples with emulsion, breads with 5% emulsion turned out to have somewhat better shape. Increased level of lactic acid positively affect the features of gluten, resulting in a more desirable shape of bread made of "sourer" samples.

Calculated difference (Δh) in all samples was 0, meaning that all samples have excellent elasticity.



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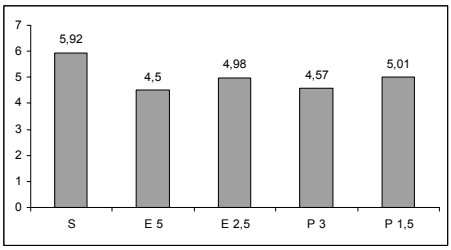

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Figure 3. and 4. Means of acidity level and pH value of bread samples

In samples with addition of sourdough higher acidity levels were reported. Similarly high values were reported in the samples with recommended dose of emulsion and powder (9.2 and 9.4). Similar values were also reported in samples with 50% lesser dose of emulsion and powder (6.3 and 6.1).

Value of acidity level in samples with double lesser dose of emulsion and powder are closer to lower recommended threshold [11] for mixed rye breads (7-9). Acidity level in samples with recommended dose of emulsion and powder (5% and 3% respectively) is higher than recommended [11], and breads are sourer, of a very intensive odour and flavour.

According to [12] the reported pH value of industrial bread made of wheat flour T-710 with the dough-resting time of 30 minutes was 5.95 – 5.98. The pH value in standard bread without additives is 5.92 and it is slightly lower than these values. In straight breadmaking process the pH value slightly changes, and even the improvers, if used, make no significant change in pH value [13].

Use of sourdough considerably reduced the pH value in bread samples. These values in breads with recommended dose of emulsion and powder are fairly balanced (4.50 and 4.57). Samples with half a dose of emulsion and powder tend to be less sour, while pH values are close, too (4.98 and 5.01).

Recommended values for mixed rye bread according to [14] are 4.3 – 4.8. Bread samples with recommended dose of emulsion and powder have a satisfactory pH value within these limits. Somewhat higher pH value the recommended are found in samples with 2.5% emulsion and 1,5 % powder, but since in these samples required half a dose of emulsion and powder and relatively short time of fermentation, this value can be considered favourable. Recommended values of 4.3 to 4.8 refer to the rye bread produced according to different fermentation processes, which sometimes implied over 30 hours and different schemes of sourdough preparation [14].

Higher pH value in bread samples is followed by a lower titratable acidity (TA).

There is a very strong correlation between acidity level and shape of bread (r = 0.92), while a negative medium strong correlation was found between acidity level and specific volume (r = -0.62).

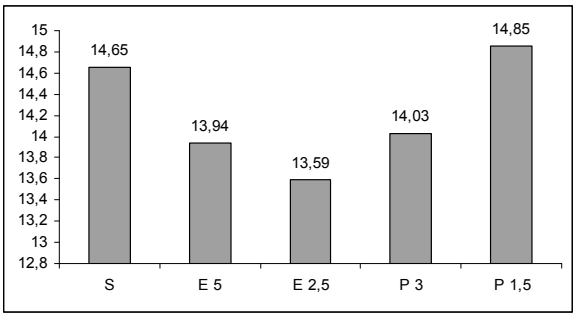

Figure 5. Mean of overall sensory evaluation

None of the samples scored maximum number of points. The lowest score was found in bread with 2.5% emulsion (13.59 points), while bread with 1.5 % of powder has best score (14.85 points). The total score in all bread samples is low, when compared against the maximum score (20 points).

Aroma intensity and duration are different in different samples of bread. Highest scores for these attributes were reported in breads with 5% emulsion and 3% powder. However, when it comes to preferences and typical flavour, these breads had the lowest

score. Samples with a higher percentage of sourdough are aromatic, of a very strong scent and flavour, but according to these rates the judges found them less acceptable and likeable.

Best scores in terms of preferences and typical flavour had the bread with 1.5% powder. Somewhat lower score won the standard bread without additives.

Negative correlation was found between acidity level and typical flavor (r=-0.72) and preferences (r=-0.81). Samples with high TA (recommended dose of emulsion and powder) scored low on preferences; therefore it can be assumed that they would not be well accepted by consumers. However, aroma intensity and duration are in positive correlation with acidity level, where medium strong correlation was found.

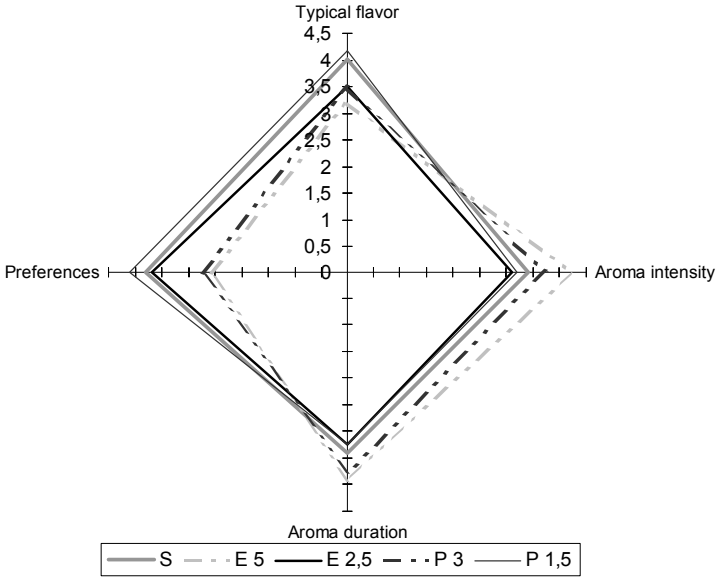

Figure 6. Means of scores by individual attributes of samples tested

Table 2. Correlation between acidity level and individual sensory attributes

Sensory attributes	r	Correlation intensity
Typical flavor	-0,72	Medium strong
Aroma duration	0,71	Medium strong
Preferences	-0,81	Strong
Aroma intensity	0,64	Medium strong

Correlation coefficient was the strongly negative only in case of evaluation of preferences. This result can be explained by the fact that a preference of a product is highly subjective, as opposed to evaluation of other sensory parameters. Having in mind that the analysis was carried out by a group of trained laymen, the possibility of subjective evaluation becomes even more likely. All bread samples with added preparations have improved structure of the crumb, which is softer, fresher and moist. They have good cutting properties and very specific aroma and flavour.

CONCLUSIONS

Prepared starters used enable production of good quality bread without application of any additives. More favourable sensory attributes in terms of typical flavour and preferences are found in bread samples with half a dose of recommended mix (emulsion and powder). Specific volume also tends to be more favourable with a lesser dose of mix, while the bread forma is better in samples made with the recommended dose.

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