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EFFECT OF SWEET YEAST BREAD FORMULA ON EVALUATING RAPID MIX TEST

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Abstract

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The aim of this work was to detect how different sweet yeast bread formulas influence results of rapid mix test and by the help of sensory analysis to discover consumer preferences and possible benefit and use in bakery industry. Applied raw materials (ground wheat flour T 530, yeast, sugar, salt, oil, egg, improver Hit) along with basic formula were taken from the Varmužova bakery in Boršice by Buchlovice. The basic formula served as a standard (I), other six formulas were then determined (II–VII). In each formula, the rate of yeast, sugar or oil was altered in the range of ± 10% compared with the standard. Flour bread-making quality – Hagberg Falling number [s], Sedimentation index [ml], wet gluten [%], ash [%], moisture [%], binding capacity [%], granulation [%], alveographic energy [10^{-4}J] and alveographic rate P/L – was measured. Rapid mix test and parameters like pastry weight, volume, shape, dough yield, pastry yield, baking loss, penetration and sensory analysis were determined. To establish yeast fermentation activity, Engelke fermentation test was applied. The most evident differences among the samples appeared in the volume and shape. The results of sensory analysis showed that the samples with higher rate of altered raw materials were evaluated as the best.

rapid mix test, sensory analysis, pastry formula

Flour is a basic raw material for bread production, forming 60 and more percent of weight in most types of dough. It is obtained by grinding cereals and subsequent modification of meal and grits. In bakeries and confectioneries, mostly wheat and rye flours are manufactured. Other types of flour (maize, barley, soy-bean) are used predominately for special purposes (Skoupil, 1994).

Wheat producers, bakers and millers have been trying to find an easy method for evaluating the wheat quality since the discovery of gluten in the 18th century. The majority of the predictions is based on endosperm proteins. In the beginning, the rate of gliadin:glutenin fractions was investigated, later each fraction was examined. Although the dependence between wheat quality and these fractions was proved, there is a need of further research to state higher correlation (Lászity *et al.*, 2007).

The primary effect on the flour quality have the seed quality, inclusion of wheat in crop rotation, soil cultivation before seeding, seeding process, support, fertilization, diseases, pest protection and harvest have Zimolka *et al.* (2005). Other factor is weather and its instability. The development of weather during vegetation affects almost all parameters of technological quality of the wheat kernel. Quality requirements then are: moisture maximum 14%, bulk weight at least 76 kg/hl, content of nitrogenous substance at least 11.5%, impurities maximum 6% (Burešová and Palík, 2008). Thus high-quality grain is ready for milling, in which the endosperm is processed. The endosperm structure belongs among the criteria which affect the technological parameters of grain (Hrušková and Švec, 2009).

Concerning chemical composition of flour, it depends on the quality of the raw material and changes during storage according to the conditions. After milling, many biochemical modifications, which are identified as maturing, occur. If the flour is well-matured, it has a higher binding capacity, the dough is less sticky and has better ability to exclude fermentative gas. These properties reflect in better workability of the dough and higher volume of bread (Hrušková and Machová, 2002).

One of the most important chemical components of flour are polysaccharides. Storage polysaccharide is starch in the form of granules, which absorb about 46% of water. Starch granules swell under increased temperature, moisture and time within baking and form coherent network of the crumb after cooling. During storing, bread looses freshness and parches – the crust hardens, stiffens and looses elasticity, generally, the bread looses taste. This is mostly caused by migration of the water from starch - retrogradation (Goesaert *et al*., 2005).

Similarly to starch, proteins play a considerable role too. They are biopolymers which consist of amino acids connected with peptide structure (Příhoda *et al*., 2003a) and in terms of bakery, two groups of proteins are important – prolamins and glutelins. Prolamins (gliadins) are single-stranded macromolecules while glutelins (glutenin) are described as macromolecules composed of more strands (Hrušková, 2001). Prolamins and glutelins swell due to mechanical stress and atmospheric oxygen and they form a solid gel called gluten. Gluten is a mould of dough and it is a reason of the unique properties of the dough – extensibility and elasticity (Příhoda *et al*., 2003b).

When discussing the properties of dough, fats have to be mentioned. Müllerová and Chroust (1993) explain that fat content in light flour is about 1.5%, and approximately 2% in the dark types of flour and they are regularly added into breads, sweet yeast bread and confectioneries. Fats have a number of favourable technological properties, but the disadvantage is their high energy value. A number of them (for example shortening, margarine, butter, lard, plant oils) according to the purpose are used in bakery. In the kneading phase, fat creates a film between the protein fibers and starch grains, thereby reducing the swelling of the flour particles. Predominantly phospholipids and unsaturated fatty acids apply in dough maturing. In the phase of baking, fat retards starch gelation, thus prolonging the baking time. The function of the fat is to improve the structure, aroma, taste and shelf life of the product (Švec and Hrušková, 2004).

The final quality of flour is affected by minerals, which are expressed as ash, which consists mainly of carbon, phosphorus, magnesium, potassium, calcium and ferrum. Uneven distribution of minerals in the grain became the basis for assessing the flour quality (Kučerová, 2004), and on the basis of chemical composition and physical properties of flour Hrušková *et al*. (2008) provide flour quality requirements – ash content 0.60% in dry matter, granulation at least 96% (siftings of 257 µm mesh size) and 75% maximum (mesh size 162 µm), wet gluten content at least 28% in dry matter, Hagberg falling number minimum 220 s and sedimentation index at least 30 ml.

Another part of formulas for bread-making then is *Saccharomyces cerevisiae Hansen*, which is used as baker's yeast, and it is able to ferment sugar into ethanol and carbon dioxide. Released carbon dioxide causes dough loosening and affects the product within baking. Good baker's yeast should contain at least 26% of dry matter and 35% of proteins in dry matter (Beneš, 1979). The usual addition of 1–5% of yeast causes changes in the structure of the dough, the dough volume increases and the typical sensory properties of leavened bread develop. As yeast is osmosensitive, greater addition of salt and sugar affects the rate of fermentation. It is reported that 1.5% of salt decreases production of carbon dioxide generation by 20% compared with the dough without salt, while the addition of sugar increases gas production by 5%. For fermentation, the optimum pH of 4–6 and temperature around 32 °C are required (Švec and Hrušková, 2004).

According to Skoupil (2002a), salt is present in a vast range of bakery products as a flavour component except for some kinds of sweet pastry. In bakery production salt with iodine – finely ground – which contains at least 98% NaCl, compounds of calcium, magnesium and small amounts of trace elements essential for human beings, is used.

Salt affects the rheological properties of dough by reducing water binding capacity, strengthening gluten structure and extending the time of dough development. The effect depends on the addition and the properties of the flour (Švec and Hrušková, 2004).

Another important component of dough is substance called "improver" which refers to a broad group of materials that can be added to flour or dough to improve some properties of the dough and quality of final products (Cauvain and Young, 2001).

As regards water, Skoupil (2002b), Příhoda *et al*. (2003b) claim that only fresh water can be used for food processing. The basic quality indicator of water is hardness (calcium and magnesium salts). Soft water gives sticky dough and reduces water binding capacity. Hard water, on the other hand, slows down fermentation of the dough and strengthens gluten. The basic requirement on water used in food processing is health safety. In the baking process, water addition to the dough and also its loss during baking is monitored, because there is an evident influence on rheological properties of the dough. In the storage process its decrease depends on the time and conditions (Cauvain and Young, 2007).

Properties of the wheat dough and its behaviour during baking process are determined by two main factors:

- rheological behaviour of the dough based on the balance between elastic and viscosity properties on the molecular level given by the representation of different molecular weight glutenin and gliadin in flour,
- distribution and stability of air bubbles primarily rising during the formation of dough and then expanding by the influence of fermentation.

Both of these factors are related to the formula and basic components – wheat flour, water, yeast, salt, sugar and fat, which also influence each other (Cauvain and Young, 2007).

For the formation of homogeneous dough, addition of 45% water is expected. This amount gives a good consistency. It is the liquid component of the dough that seems to be essential for the formation and stability of air bubbles. These arise primarily at the mixing stage, in which the dough has the optimum viscoelastic parameters. Fermentation gases during subsequent fermentation first dissolve in the liquid phase of the dough, and then evaporate and enlarge the generated bubbles (Švec and Hrušková, 2004).

Taking these factors into account, we conducted this experiment in cooperation with Varmužova bakery in Boršice by Buchlovice. The main goal was to verify the effect of raw materials ratio in the formula of sweet yeast bread on the results of the rapid mix test. A further aim was to determine consumer preferences and potential benefits for use in the bakery industry.

MATERIALS AND METHODS

The material for rapid mix test was obtained from bakery in Boršice by Buchlovice. Three charges of flour T 530, yeast Vivo (Lesaffre Czech Republic, Olomouc), oil, sugar, salt, eggs and improver Hit were used.

For determination of flour baking quality, moisture ČSN ISO 461014 (2010a), falling number ČSN ISO 3093 (2010b), Zeleny test ČSN ISO 5529 (2000b), ash ČSN ISO 2171 (2008), gluten quantity ČSN ISO 56 0512-10 (1995) and alveographic values AACC 54-30A (2000a) were determined.

The rapid mix test was then done and evaluated – first, loose components were homogenized and solutions of sugar, salt and yeast suspension were prepared. Thus prepared material was kneaded on Zelmer profi for one minute. The dough then rose at the optimum temperature 30–32 °C and relative humidity 80–85% for 20 minutes, next it was divided into clones of 80 g weight. These clones were put into the proofer and rose for 25 minutes and finally were baked for 20 minutes at the temperature of 220 °C.

In the next step, sensory analysis and penetration at penetrometer TIRA test 27025 with flat adapter of 5 mm diameter were done. The whole experiment was conducted twice.

To establish yeast fermentation activity, Engelke fermentation in 10% sucrose solution test was applied. Loaf volume, shape and penetration were analysed using analysis of variance (ANOVA) (Statistica 9) with subsequent Tukey test. ANOVA provides a statistical test, which shows whether the means of several groups are equal or not. Tukey test, which is commonly used in conjunction with ANOVA, finds which means are significantly different. These tests had proven to be the most appropriate for the results evaluation.

To determine the differences between the products with varying formulas, the following prescriptions were used (see Tab. I). Sample I (the basic formula from the bakery) was considered as the standard. Then, the sensory analysis was done. Five trained assessors evaluated the final product and following descriptors were established as the

I: *Formulas of sweet yeast bread*

charge	sample	g							
		flour	water	salt	Hit	yeast	sugar	oil	egg
	I (standard)					28.50	5.00	37.50	
	II					25.65	5.00	37.50	
A–16032010	III					31.35	5.00	37.50	
B–6042010	IV	500	175	5	30	28.50	4.50	37.50	15.00
C–13042010	V					28.50	5.50	37.50	
	VI					28.50	5.00	33.75	
	VII					28.50	5.00	41.25	

II: *Results of evaluating flour baking quality*

Charge	A	B	C
Hagberg Falling number [s]	299	306	286
Sedimentation index [ml]	45.1	45.6	44.6
Wet gluten [%]	33.2	33.0	33.2
Granulation [%]	99.9	99.9	99.9
Ash [%]	0.52	0.53	0.52
Moisture [%]	14.1	14.2	14.2
Binding capacity [%]	55.0	56.5	56.0
Alveographic energy [10^{-4} J]	254	265	262
Alveographic rate P/L	0.71	0.82	0.80

most important: overall appearance and shape, crust smell, crust strength, crust parcelling, crumb softness, crumb elasticity, porosity and regularity of pores, overall smell and taste and sweet taste. For the sample evaluation a point system was chosen (1–5 points) and results were obtained by the method of weighted mean and noted into the graphs.

RESULTS AND DISCUSSION

Flour quality

Tab. II shows the results of baking quality evaluation of all flour charges. As can be seen, all of them pertain to high quality flours and correspond to public notice standards (110/1997).

Yeast fermentation test

Yeast was assessed by Engelke test in sucrose solution for 13 days (until the expiration date). The measured data are presented in Fig. 1, which shows changes in fermenting power of yeast during storage. The sample keeps good power in the first week of evaluation in accordance with the literature (Müller, 1986). The amount of carbon dioxide produced in the first two measured half hours is the indicator of yeast fermenting power in the initiatory period of proofing. The third half hour demonstrates the main phase of proofing. The decline of fermentation activity in the first period of testing occurred in the next week of examination. Despite this decrease the yeast did not influence the result of rapid mix test.

Rapid mix test

All charges of flour produced dough with smooth surface. The dough yield was on the average of 173% and the pastry yield 160%. The baking loss ranged from 5 to 7%. With regard to the same baking conditions, the crust colour was determined as brown and typical of this type of pastry. The appearance of all samples was evaluated as regular and high arched.

As no big differences were recorded among the flour charges, the results of all charges are commented together.

Statistically confirmative differences for pastry volume were detected for samples with diverse amount of all altered raw materials – yeast, sugar and oil, because all these raw materials affect pastry volume as mentioned by Švec and Hrušková (2004). The minor difference was seen for pastry penetration and shape. These changes were caused by the increase/decrease of the raw materials amount. The effect of pastry formula more on the volume and less on the penetration and shape was statistically proved at almost all cases (data not shown).

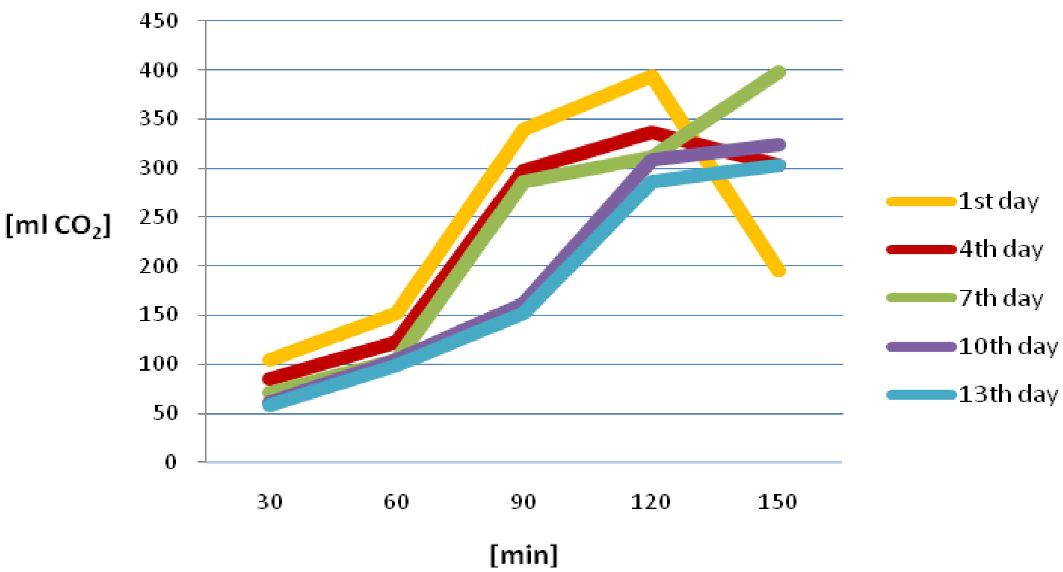
Sensory analysis

Concerning the overall appearance and shape, no big differences were recorded (except from sample II with lesser amount of yeast), because all the samples were formed into small loaves and baked at standard conditions (Fig. 2).

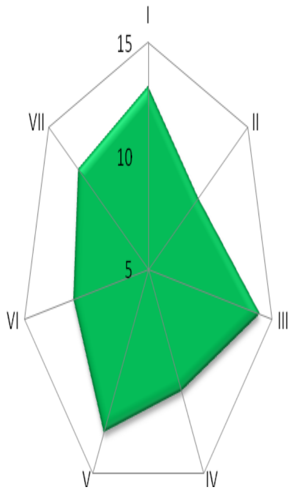
Crust smell was evaluated as the best for the samples with higher portion of yeast and vice versa – the odour of samples with lesser amount of yeast in comparison with the standard were assessed as the weakest (Müllerová and Chroust, 1993), as can be seen in Fig. 3.

Concerning the crust strength, samples with higher portion of yeast, sugar and oil were detected as the best (see Fig. 4).

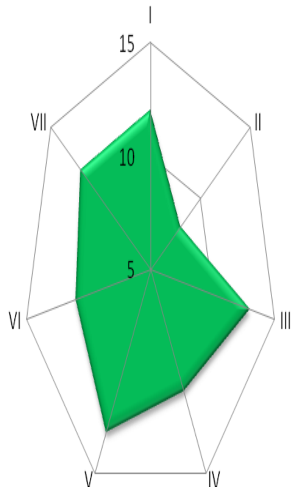
Crumb softness was slightly affected by small differences in flour quality – the dough of charge "A" was jerky and inelastic and adversely influenced the



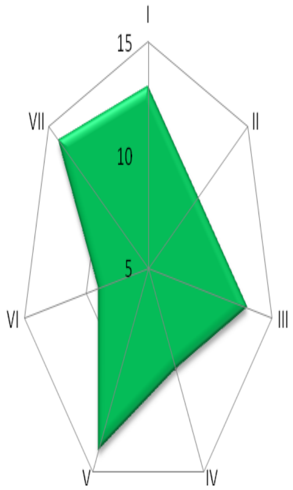
1: *Fermenting power of yeast*



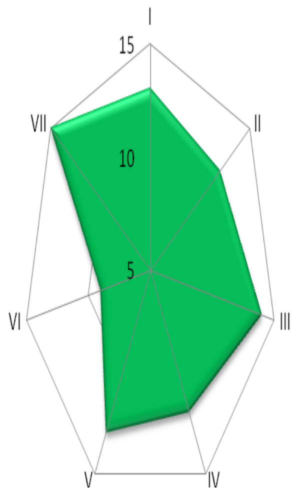
2: *Overall appearance and shape*



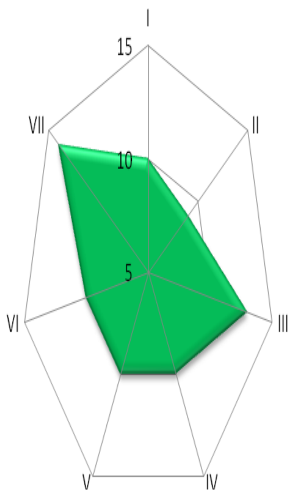
3: *Crust smell*



4: *Crust strength*



5: *Crumb softness*



6: *Porosity and regularity of pores*

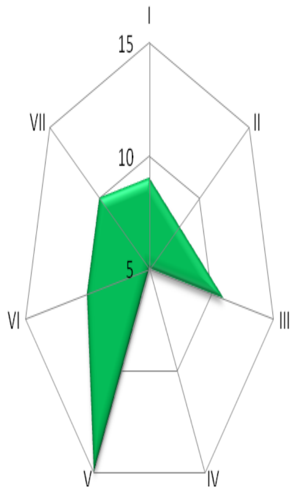
crumb softness. On the contrary, the addition of oil, sugar and yeast had a positive effect on the crumb softness (Švec and Hrušková, 2004) in comparison with standard (Fig. 5).

As can be seen in Fig. 6, another descriptor – porosity and regularity of pores – was rather substandard for all samples. The addition of oil and yeast had quite a positive effect.

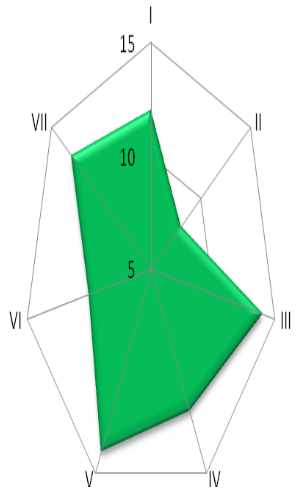
Sweet taste was recorded as strongest for the sample with higher portion of sugar and yeast (Fig. 7).

A positive impact of addition of raw materials – oil, yeast and sugar – on the overall smell and taste was also discovered as proved by Příhoda *et al.* (2003b). These samples were evaluated better than the standard and vice versa, as can be seen in Fig. 8.

Figures of other descriptors – crust parcelling and crumb elasticity are not shown, because no big differences were recorded between the samples.



7: *Sweet taste*



8: *Overall smell and taste*

CONCLUSIONS

The obtained results show that all flour charges belong among flours of high bread-making quality with only small differences between them. Despite the change in the yeast fermentation activity during storage, no significant decrease of gas production was recorded hence this did not affect the quality of examined bread.

The research showed differences between bread with various formulas. The contrasts, however, were not influenced by the flour, but other raw materials, which were altered.

For the bakery, these small changes in formula mean higher costs in bread production. But from a consumer perspective the samples with higher portion of varied raw materials were evaluated better than the standard.

SUMMARY

This work deals with effect of different sweet yeast bread formulas on evaluating rapid mix test. In addition, consumer preferences and possible benefit and use in bakery industry were determined with the help of sensory analysis. Applied raw materials (ground wheat flour T 530, yeast, sugar, salt, oil, egg, improver Hit) along with basic formula were taken from the Varmužova bakery in Boršice by Buchlovice. The basic formula served as a standard (I), other six formulas were then calculated (II–VII). In each formula, the rate of yeast, sugar and oil was altered in the range of ± 10% compared with the standard. Flour bread-making quality – Hagberg Falling number [s], Sedimentation index [ml], wet gluten [%], ash [%], moisture [%], binding capacity [%], granulation [%], alveographic energy [10^{-4}J] and alveographic rate P/L – was determined. Rapid mix test and parameters like pastry weight, volume, shape, dough yield, pastry yield, baking loss, penetration and sensory analysis were assessed. To establish yeast fermentation activity, Engelke fermentation test was applied. The yeast was tested for 13 days (until the expiration date) and the measured data showed a decline of produced gas, however this decline did not influence the results of rapid mix test. The most evident differences among the samples appeared in the volume and shape, which were evaluated using analysis of variance and subsequent Tukey test. The results of sensory analysis showed differences between the samples and finally proved that the samples with higher rate of altered raw materials were evaluated as the best, but for the bakery, these small changes in formula mean higher costs in bread production.

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