The Annals of the University *Dunarea de Jos* of Galati
Fascicle VI – Food Technology, New Series Year III (XXXII)
Paper presented at the International Symposium *Euro - aliment 2009*, 9th – 10th of October 2009, Galati – ROMANIA

RESEARCHES REGARDING THE DEPENDENCE OF CERTAIN SENSORIAL COMPETENCES OF BREAD UPON THE RAW MATERIAL AND THE PROCESSING PARAMETERS

JIANU CĂLIN, DOGARU DIANA, MIŞCĂ CORINA, STOIN DANA, RINOVETZ ALEXANDRU, JIANU IONEL

Agricultural Sciences and Veterinary Medicine University, Calea Aradului, no. 119, 300645, Timisoara, Romania
calin.jianu@gmail.com

Received 3 July 2009
Revised 12 October 2009

The organization (structuring) of a sensorial (taste) assessment program with all the derived implications and recommandations is a decisive step in promoting a new kind of food.
The paper presents the experiments of sensorial evaluation for two panification assortments (graham and whole-meal bread) by using specific wheat obtained from raw material cultivated in the West Planes of Romania, improved with enzymes, glucides and proteins (fermentation bran extract). The special taste and odour of the bread is due to the over 200 flavoured vectors (partially identified).
In this paper, by using the three-phase proceeding, we, gradually, modified the main influence factors of taste and flavor in the two major technological phases: the preparation of the leaven and dough (consistency, duration, fermentation temperature) and baking (duration, temperature). We analyzed, by chromatography, the major compounds of taste and flavor (ppm) (hydroxy-methyl-furfural, furfural-acetoine, diacetyl) in the crumb, in the inferior and superior crust, for the mentioned specialties and the flavor index, by knowing, from the literature, the sensitivity threshold for the four flavor "vectors". Each of them was described and it appreciated by three/four different points of the global sensorial evaluation of the panification product.
The PCA (Principal Component Analysis) allowed us to evaluate the experimental data that we collected. The diagrams of the trials and the recordings sustain that the main sensorial characteristic remains the taste, then the odour, the superior and the inferior appeareance of the crust, of the crumb, consistency and shape.

Keywords: sensorial vector, bread aroma, food flavor, Maillard browning, sensorial evaluation.

1. Introduction

The systematic study of bread and other breadstuff flavor has begun after *1953*. The pleasant odour of fresh bread savor depends on some factors such as: ingredients, fermentation process and baking. Its improvement is possible in different ways: using some additives, aromatizants and precursors by enhancing the other ingredients.

Bread flavor compounds are about 200 and they belong to further organic functional categories:

- ✓ carboxylic acids: with linear and branched chain, hydroxy and keto acids, etc.;
- ✓ alcohols [(C_2 – C_8 linear and branched) from ethanol until to octanol, 2,3-butandiol; benzyl alcohol, 2- phenylethanol];
- ✓ aldehyde: normal aliphatic and branched, from the formic aldehide until dodecanal;
- ✓ cetone: acetone, butanone, acetoin, diacethyl, pentanone, 2-hexanone şi 3-hexanone, 2~heptanone şi 3-heptanone, 2-octanone, 2-heptadecanone et al.;
- ✓ esthers: ethyl and furfuryl formiates, acetates, laureares, myristates, furanic and pirole different constitution compounds substituted;
- ✓ compounds on sulphur: dimethyl sulphide, *methanethiol*, thiophenic compounds;
- ✓ lactone: thiophenic lactone with chain from zero to five carbons;
- ✓ pyrazine: methyl and ethyl substituted;
- ✓ various compounds: maltol, acetal, naphtalene compounds, phenol, ethylphenol, guaiacol,

cresol, eugenol.

Relaying only on the already identified compounds it is not yet possible to re-construct similar bread flavors, proving thus not all the compounds are totally identified, among them the most relevant are the flavor-compounds so-called "flavor-vectors". Much more important than bread flavor reconstruction is to explain away the dependence between flavors, the concentration of some flavor compounds and technological factors. A great number of correlations followed up:

- ✓ Flour, as a main natural ingredient, is not easy to define qualitatively with a few parameters. Regarding bread flavor, it is known that there are very important compounds present in small quantities (free aminoacids, free superior acids, monoglucides, phenolic compounds, etc.). Among these, the first three are precursors of aromatic compounds. Also, the peroxydic additives that improve the dough quality have favorable influences upon flavor.
- ✓ Salt addition influences flavor formation. Studies upon yeast and bacteria influence (Lactobacillus bulgaricus) were conducted on bread flavor.
- ✓ Water quantity influences the time/temperature graphic for baking and, as it follows, the flavor.

The time and the technological variant of kneading decisively influence the concentration of carbonylic compounds. The use of oxygen and of some lipoxydases has as result the growth of their concentration.

The literature also mentions some correlations between temperature, fermentation time and concentration of some compounds such as acetoine, organic acids, and carbonylic compounds important for flavor.

The preference for normally-fermented bread is recorded prior to the quick variant or excessive one, because as it affects the alcohols, acids and carbonylic compound concentration.

Bread dimension is important for the baking temperature system, for the ratio between surface and volume, crust and core. All these are important for flavor-forming and loss of volatile substances that define the flavor.

The type of oven and the way of warming up bear their influence upon the content of carbonylic compounds and upon the results of sensorial tests. Of the same nature is also the baking time and temperature influence.

Bread flavor is modified rapidly after baking. Sensorial properties change negatively with the storage time; the content of aldehydes being preferentially reduced. This is a reason why the producers want to obtain bakery products on a classic recipe with sensorial qualities as stable as possible.

2. Materials and methods

2.1. Materials

- Whole – meal from *Triticum durum* (Didactic Station of Banat's University of Agriculture Sciences and Veterinary Medicine Timisoara, harvest 2008);
- Ingredients;
- Tomato seed oil (Food Additive Department of Faculty Food Technology Product, Banat's University of Agriculture Sciences and Veterinary Medicine Timişoara).

2.2. Methods

- Tri-phase process to obtain bakery products on a classic recipe (standard): 2.0 kg of whole-meal *Triticum durum*; yeast bread (2.5%), salt (2%), tomato seeds oil (3%), water (57%)] .
- Principal Component Analysis (PCA).
- Five points scale (STR 3196 – 83) respectively 20 points.

2.3. Apparatus

- Micropilot baking equipment (Didactica Italia) with standard appendix.
- Solid/liquid extraction plant for tomato seeds oil (Soxhlet);

- Distilling plant (recovery) solvents extraction connected to vacuum ($10^{-2} \div 10^{-3}$ mm col. Hg).

2.3. Working approach (selective presentation)

Evaluation of the sensorial competence of graham roll and whole – meal bread samples.

Taste group coordinator (selected according to standard methodology) prepares the middle sample of processed breadstuffs, homogenizing carefully to maintain their integrity. The operations are realized in a different sense space than that of taste. The quantity of the sample allocated to each taster is not over 100g. After sample allocation to each taster, they fill an evaluation form and start by installment evaluation of samples. Sensorial evaluation was realized on only one batch consisting in one assortment of the two breadstuffs with a panelist of 15 persons (Table 4).

3. Results and discussions

The recipe for the processing of bakery products (graham rolls) previously presented, recorded: 20% global technological loss of: 0.5% (preparation of raw materials); 1.5% (fermentation); 1,5% (proofing); 0,75% (dividing – forming); 12% (baking); 2,8% (cooling).

Main sensorial characteristics are presented in table 1. Main organoleptic characteristics (evaluated according to STAS 91–83) (Table 2).

Table 1. Sensorial characteristics of graham roll and whole–meal bread with 3% tomato seed oil

Weight [g]	Sensitive properties			
	Crust appearence	Core appearence	Odour	Taste
100	Uniform product with resistant thin crust without cracks or air embedded yellow gold uniform throughout the product, without any trace of meal or partial calcination.	Loose, white, elastic core, with uniform pores assigned which cannot be detached from the crust without holes or traces of non – ridden whole – meal, burning or impurities.	Pleasant characteristic of specialties graham and whole - meal bread, free of foreign fermented, mold or rancid smell [2.0 kg of whole-meal Triticum durum; yeast bread (2.5%), salt (2%), tomato seeds oil (3%), water (57%)] with specific ripe tomatoes flavor (tomato soup).	Pleasant, slightly sweetish, characteristic of graham and whole - meal bread specialties, with vegetable oil appendix, without the sour, mold taste, [2.0 kg of whole-meal Triticum durum; yeast bread (2.5%), salt (2%), tomatoes seed oil (3%), water (57%)] or rank [2.0 kg of whole-meal Triticum durum; yeast bread (2.5%), salt (2%), tomato seed oil (3%), water (57%)]

Table 2. Sensory characteristics for graham roll and whole–meal bread

Sensory characteristics	Examination nature
Form	Form, volume proportional with the mass and the presence of some possible defects (deformed, oblate or crowned, crushed, broken products)
Crust aspect appearance	Appearance, thickness, color and any cracks, wavy, splice, thick crust, burnt or beady. Cracks are evaluated on the length and width, with a rule, and results are expressed in mm. Color is examined on the surface and assessed if it bears the standard characteristics for the specialities under study.
Core (appearance in section) color consistency	Core section (uniformity, form and fine pores). Color, compared core with characteristic of assortment analysis. Consistency by spare compression with fingers, once in the place of the core, noting the degree of elasticity. The core detached to the crust, baked, dense, crumbly, non-elastic with compact layers and traces of whole-meal, sticky and/or tearing the thin silver wire.
Odour	The product its cuts, and pressed several times, inhaling the odour of liberal (sour, rancid, mold or other odor non-characteristic of the product).
Taste	Tasting the portions of the product (core and crust) and assessing if the taste bears a characteristic flavor in the range and if defects are detected (taste, sour, bitter or overly salty).

The freshness degree depending on the specific time of normal consume range is appreciated in Table 3.

Table 3. Freshness degree of graham rolls and whole-meal bread with 3% tomato seeds oils after two and three days

Characteristics	Graham rolls / whole-meal bread
	Freshness degree after 2 days
Form	Uniform, non-oblate, non-deformed;
Crust	Shiny, sligtly oily, blushful, non-burnt, with yellow gold color;
Core	White, elastic, with fine pores, uniforms, wet to touch, no congestion or traces of non – kneader, after a slight push returns immediately to the initial
Odour	Pleasant of fresh graham roll and whole – meal bread, well cooked, no foreign odour of stale or mould;
Taste	Tasteful, specifically to fresh graham rolls and whole – meal bread, without sour or bitter taste.
	Freshness degree after 3 days:
Form	Unchanged;
Crust	Appearance and color unchanged;
Core	Fine pores, irregular, white;
Odour	Unchanged, free from foreign odours
Taste	Unchanged, free from foreign tastes

Table 4. Results of sensory evaluation of graham rolls and whole – meal bread, 3% tomatoe seeds oil additive added

No. taster	Bakery product	Aspect		Smell[1)]	Taste[1)] (aroma)	Texture[1)]
		exterior	section			
1.	Graham roll	4	5	4 (3)	5 (4)	4 (2)
2.		5	4	5 (2)	4 (3)	4 (3)
3.		4	4	4 (3)	4 (3)	4 (3)
4.		5	4	4 (3)	4 (2)	5 (3)
5.		4	5	4 (2)	5 (3)	4 (3)
6.		4	4	5 (4)	4 (3)	4 (4)
7.		3	4	5 (4)	4 (4)	5 (3)
8.		4	4	4 (3)	5 (3)	5 (4)
9.		3	4	5 (3)	4 (3)	4 (3)
10.		5	4	5 (3)	5 (2)	4 (3)
11.		5	4	4 (3)	5 (3)	4 (3)
12.		3	4	4 (4)	5 (4)	5 (3)
13.		4	5	5 (3)	4 (3)	5 (4)
14.		5	4	5 (4)	5 (3)	4 (3)
15.		4	5	4 (3)	5 (3)	4 (3)
1.	Whole – meal bread	4	5	4 (3)	5 (3)	4 (3)
2.		4	5	5 (3)	4 (4)	4 (2)
3.		5	4	5 (3)	4 (3)	4 (3)
4.		5	5	5 (3)	4 (2)	4 (4)
5.		4	4	4 (4)	4 (3)	5 (3)
6.		5	4	4 (3)	5 (4)	4 (4)
7.		4	5	4 (2)	5 (3)	5 (3)
8.		4	5	5 (3)	4 (3)	4 (3)
9.		5	4	4 (3)	4 (3)	5 (3)
10.		5	4	5 (3)	4 (4)	4 (3)
11.		3	4	4 (3)	5 (4)	4 (4)
12.		4	5	5 (4)	4 (3)	3 (3)
13.		5	4	5 (5)	5 (3)	4 (3)
14.		4	5	4 (4)	4 (4)	4 (3)
15.		5	4	4 (3)	5 (3)	5 (4)

[1)] Value from parenthesis represents the sensory appreciation of the same samples in the absence of tomato seeds oil.

Multivariate analysis (evaluation) of registered experimental data (Table 4) has benefited from the statistical processing method of principal components (PCA).

From the tests chart results that the most important characteristics for the quality of crackers under study are the sense of smelling and appearance in section (which are explained especially for the main component, (PC_1); respectively, the appearance for the second main component (PC_2); of average importance is taste, flavor and texture. The first three principal components largely explaining in the overall variant of experimental values (91%) distributed as follows: 47% PC1; 27% PC_2; 17% PC_3.

From the chart records, a relatively uniform distribution of samples is noticed in the space for the principal components, in a relatively narrow field PC_1 U PC_2 = (-2; 2) U (-1; 1.5), so an effective characterization of both bakery types is studied.

Evaluation of individual sensorial scale was achieved using a five-point scale, further multiplying the average score of each feature with the weighting factors and adding the weighted average to the global score (assessment). The sensorial competence for graham roll and / or whole-meal bread has benefited from the scale of 20 points.

Conclusions that can be drawn from numerous studies on the aroma of bread have found applications in an impressive number of patents that claimed flavoring optimization.

It is a wide range of products based on whole – meal and other ingredients, including flavoring which have a defining role.

4. Conclusions

Accessing tomato seeds oil in processing of two bakery products is beneficial firstly because it provides a further variant of integrated ecological recovery of some processing by-products, secondly, it gives the basic sensory optimized competences (appearance, odour, taste, texture). The methods of statistical processing are circumscribed within good overall aim pursued.

Acknowledgements

We wish to thank the *Banat's University of Agriculture Sciences and Veterinary Medicine Timişoara, Faculty of Food Technology Products*, for a generous help of different kinds and for their financial support.

References

ASTM, 1968. *Manual on Sensory Testing Methods*, STP 434, Am. Soc. Test. Makr., Philadelphia, Pennsylvania.

Amerine, M.A., Pangborn, R.M. and Roessler, E.B., 1965. *Principles of Sensory Evaluation of Food*, New York: Academic Press.

Bartoshuk, L.M, 1993. The biological basis of food perception and acceptance, *Food Quality & Preference*, **4**, 21-32.

Chi-Tang Ho, Manley, C.H., 1993. *Flavor Measurement*, Marcel Dekker, Inc.

Gacula, M.C., 1993. *Design and analysis of Sensory Optimization*, Food & Nutrition Press.

Lawless, H.T. and Heymann, H., 1998. *Sensory Evaluation of Food: Principles and Practices*, Chapman & Hall, New York.

Lyon, D.H., Francombe, M.A., Hasdell, T.A. and Lawson, K., 1992. *Guidelines for Sensory Analysis in Food Product Development and Quality Control*, Chapmann and Hall, London, UK.

McBride, R.L., 1990. *The Bliss Point Factor*, Sun Books, Australia.