TOYOTARITY

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The Identification of Value Stream Factors in Different Branches

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Chapter 14

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APPLICATION OF THE RITES SOURDOUGH AND ITS' INFLUENCE ON THE QUALITY OF THE READY-MADE PRODUCT IN THE TECHNOLOGICAL PROCESS OF PRODUCING THE WHOLE-GRAIN, RYE BREAD WITH SHELLED SUNFLOWER-SEEDS

Abstract: Improvement of the technological processes in the baking industry is an important element in the rivalry between producers, which can give companies significant advantages as bread plays crucial role in our daily diet. Nowadays a conscious consumer demands the producer to supply him with bread that is not only fresh but also rich in fiber, mineral nutrients such as calcium, zinc, magnesium, iodine, iron or fluorine, all of which are crucial to human body's functioning. Taking the above into consideration, the study on the wet Rites sourdough was conducted in the technological process of producing the whole-grain rye bread with the addition of the shelled sunflower-seeds weighting 0,750g. After the trial batch was baked the analysis of the product quality was conducted. Among others the physical and chemical parameters were marked which was followed with the organoleptic test in compliance with the PN-A-74108:1996 norm. The results of the tests are featured in form of tables and graphs.

Key words: improving technological processes, bread, PN-A-74108:1996 norm.

14.1. Theoretical foundations

Whole-grain rye bread is produced using whole-grain rye flour type 1400, 1850, 2000, which undergoes a multi -phase acid fermentation. During the process of bread preparation we can use various technological

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additives originating from both plants and animals. They influence the stabilization as well as the improvement of quality and nutritional value of bread. The products that can be considered as additives are as follows: salt, potato syrup, sugar, artificial honey, malt extract, baking oil, powdered milk, potato flakes or potato grit, seeds of oily plants such as sunflower, dairy products, dry yeast and others. During the process of producing rye bread there can be up to 10 per cent of the wheat flour added (SWIDERSKI 1999, FLACZYK 2006, KOWNACKI, LUBCZYNSKA 2001). Physical and chemical requirements for rye bread production according to the PN-92 A-74101 are as follows: acidity should not be higher than 11[°], Bread should not to reach humidity level higher than 50% after 8 hours since the bread was baked, The size of 100g of bread should not be less than 140cm^3, contents of arsenic should not be higher than 0,2 mg, of lead 0,4mg, of copper 5mg, of zinc 40mg and of cadmium 0,1mg.

Whereas the nutrients for 100g of bread can be found in the table no. 14.1.

Table 14.1. Quantity of nutrients in 100g of bread.

No.	Ingredient		Contents
1	Water, [%]		41,1
2	Protein, [g]		5
3	Fats, [g]		2
4	Carbohydrates, [g]	together	49
		fibre	1
5	Mineral nutrients, [mg]	calcium	26
		phosphor	200
		iron	2,5
		magnesium	61
6	Vitamins, [mg]	B_1	0,16
		B_2	0,12
		PP	0,7

Source: (AMBROZIAK 1998, KUNACHOWICZ 2005)

Nutritional value of whole-grain rye bread can vary and depends on the type of flour and additives used in its' production. The important thing in this type of bread is the content of fiber. Fiber is helpful with the following: regulation of the gastrointestinal tract, counteracting constipation, preventing the occurrence of the large intestine cancer, moreover it produces the feeling of fullness. It is also proven that eating whole-grain bread reduces the level of cholesterol in the blood as it allows its' partial excretion from the gastrointestinal tract. The PN-92 A-74101 norm sets the organoleptic requirements rye bread has to fulfill. They are illustrated in table no.14.2.

Table 14.2. Organoleptic requirements for rye whole-grain bread.

No.	Characteristic		Requirements
1	Shape		Elongated
2	Crust	surface	Coarse
		colour	Brown to dark-brown
		thickness	Thickness of the top crust – not less than 3mm; crust tightly connected to the crumb
3	Bread crumb	porosity	Quite even
		elasticity	Under light pressure it bounces back to its' original state
		other features	Crumb should be evenly coloured, dry to touch and of good quality
4	Smell		aromatic, typical for this type of bread
5	Taste		Typical for this type of bread

Source: (PN-92 A-74101).

14.2. Description and outline of the technological process of the whole-grain rye bread

Technological process of whole-grain rye bread production consists of many stages. Most important ones are as follows:

- Preparation of flour and other raw materials:
    - Flour has to be sieved which helps to separate the possible pollutants as well as aerate the flour (FLACZYK 2006).

- Water at the suitable temperature should be dosed according to the amount that was determined for the particular amount of dough we want to obtain (FLACZYK 2006).
- Yeast is added in the form of aqueous suspension (FLACZYK 2006).
- Salt is usually added in the form of aqueous solution NaCl. The amount of the salt added depends on the recipe and good production practice (FLACZYK 2006).

- Dough production:

Rye bread is produced from rye flour and additives. The dough is produced basing on the acid, in result of yeast activation and lactic acid fermentation bacteria, which come mostly from flour. Fermentation of rye dough occurs in stages with each stage being called fermentation phase. Conducting the process of the five-phase dough production complies of the following stages (FLACZYK 2006, LUBCZYNSKA 1996):

- Pre-ferment is the beginning phase of fermentation of rye dough, it characterizes in even layout of micro-flora bacteria without the yeast (FALCZYK 2006, LUBCZYNSKA 1996).
- starter after refreshment is a middle phase of fermentation which is prepared by adding water to flour (AMBROZIAK 1998; FALCZYK 2006, LUBCZYNSKA 1996).
- Semi-sourdough is the next stage of fermentation, which should last for about 5 to 7 hours (AMBROZIAK 1998; FALCZYK 2006, LUBCZYNSKA 1996).
- acid is the phase in which yeast undergoes the most of its' development. Acid fermentation should last about 3 hours and the temperature should range between 28 and 30 degrees (AMBROZIAK 1998, FALCZYK 2006, LUBCZYNSKA 1996).
- dough produced from whole-grain flour should be less acidic. The suitable amount of water is added to the prepared acid. Water temperature is counted out in a way to make the dough temperature between 29 and 31 degrees Celsius. Salt as well as other additives (that are capable of dissolving in water) is

dissolved in part of the water. After adding the flour and other ingredients the dough is knead and then undergoes another fermentation which lasts 20-30 minutes or undergoes direct division into morsels (AMBROZIAK 1998, FALCZYK 2006, LUBCZYNSKA 1996).

Getting each of the phases ready should proceed in the same way and the differences should derive from change of temperature, amount of the water and flour, the time of fermentation or application of the ready-made sourdough (such as Rites sourdough). During the kneading stage there can be various additives added to the dough such as shelled sunflower-seeds (FALCZYK 2006, LUBCZYNSKA 1996).

- Forming of the dough morsels:

It is the division of the dough into morsels, shaping and fermentation that is biological aeration of the bread crumb. Thanks to those actions morsels of dough even before being baked gain shape and structure. This process influences the quality of the crumb and the correct exterior appearance of the bread (FALCZYK 2006).

- Final growth of the dough and baking preparation:

Final growth of the dough is called final fermentation, this phase is essential as its' aim is to achieve an appropriate aeration of the dough. The full biological maturity of the dough is determined sensorially on the basis of the visual grading: The volume of the dough morsel, Shape of the morsel, Exterior appearance of the morsel's surface: through touch (the degree of elasticity and aeration that are the structural qualities of the bread morsel.). Before putting the fully grown dough into the oven it undergoes ennobling steps e.g.

-moistening the morsels
-incising and puncturing the dough
-applying the seeds (LUBCZYNSKA 1996).

- Baking the bread:

After the process of full growth, the morsels are baked in the baking chamber in the temperatures ranging from 200 to 289 degrees Celsius in time between 40 and 60 minutes depending on the recipe and weight of the dough morsel. During the baking process there are several physical and biochemical processes affecting the dough and giving it its' appropriate taste, smell and appearance (AMBROZIAK 1996, FALCZYK 2006).

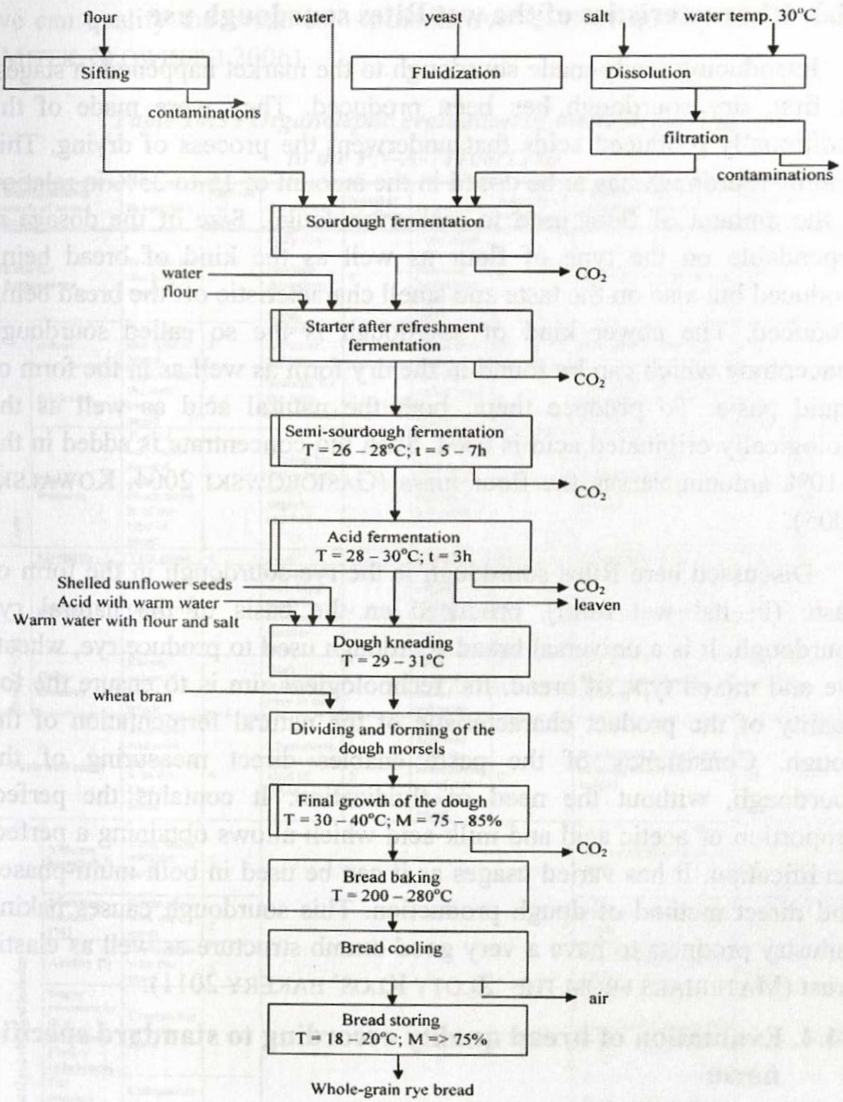
- Cooling and storing:

After being baked bread has to be sorted for the reason of eliminating the imperfect items and directly after this stage is over, bread should be cooled. The process of cooling of bread until it reaches room temperature can be conducted in one of two ways: naturally that is through natural cooling of the bread or mechanically through the use of the cooling machines e.g. air-conditioners (Falczyk 2006).

- Prepackaging and presenting:

This stage complies of appropriate cutting and packaging techniques. Pre-cut bread is for its' potential consumers a big simplification at the consumption stage, pre-packing gives the bread a steady sanitary conditions during the transport, sales as well as storing of the ready-made product.

Below on the graph no14.1 you can see the simplified scheme of production of the rye whole-grain bread with shelled sunflower.



Pic. 14.1. Idea scheme of the technological process of production of rye whole grain bread made with shelled sunflower.

Source: PERSONAL STUDY BASED ON TECHNOLOGICAL DESCRIPTION AND MATERIALS SUPLIED BY COMPANIES.

14.3. Characteristics of the wet Rites sourdough use

Introducing ready-made sourdough to the market happened in stages. At first, dry sourdough has been produced. They were made of the traditionally produced acids that underwent the process of drying. This kind of sourdough has to be dosed in the amount of 15 to 25% in relation to the amount of flour used to make the dough. Size of the dosage is dependable on the type of flour as well as the kind of bread being produced but also on the taste and smell characteristic off the bread being produced. The newer kind of sourdough is the so called sourdough concentrate which can be found in the dry form as well as in the form of liquid paste. To produce them, both the natural acid as well as the biologically originated acid is used. Such bio-concentrate is added in the 5-10% amount versus the flour mass (GASIOROWSKI 2004, KOWALSKI 2005).

Discussed here Rites sourdough is the rye sourdough in the form of paste (in its' wet form), produced on the basis of the natural rye sourdough. It is a universal bread sourdough used to produce rye, wheat-rye and mixed type of bread. Its' technological aim is to ensure the top quality of the product characteristic of the natural fermentation of the dough. Consistency of the paste enables direct measuring of the sourdough, without the need of fluidization. It contains the perfect proportion of acetic acid and milk acid which allows obtaining a perfect acidification. It has varied usages as it can be used in both multi-phased and direct method of dough production. This sourdough causes baking industry products to have a very good crumb structure as well as elastic crust (MATERIALS FROM THE 'ZLOTY KLOS' BAKERY 2011).

14.4. Evaluation of bread quality according to standard specific norm

Evaluation of bread is based on conducting the organoleptic tests, deciding its' physical features as well as chemical composition. Every distinguishing mark of quality can be judged based on the point scale (table 14.3). On the basis of the amount of points received by the product

we can qualify the bread into a distinctive level of quality (table 14.4) (MITEK, SLOWINSKI 2006).

Table 14.3 . Organoleptic evaluation of bread according to the PN-A-74108:1996

Distinguishing mark of bread quality		Properties	Amount of points	Properties	Number of points	Properties	Number of points	Properties not consistent with the norm	Number of points
Exterior Appearance		Specific for this kind of bread	5	Fully risen with minimal deviations from the norm	4	Fully risen with minimal deviations from the norm	0	Not well risen, deformed.	-35
Crust	colour	Typical for this type of bread	3	Slightly darker or lighter	2	Slightly uneaven or darker	0	Very dark or very light	-35
	thickness	Typical for the well baked bread	4	Suitable for the fully baked bread	3	Suitable for sufficiently baked bread	0	Very thin characteristic of not properly baked bread	-35
	Other features	Typical very well formed crust characteristic of this type of bread	4	Typical for this type of bread, slightly cracked	3	Deviations that do not disqualify the product	0	With dark blisters, peeling away and cracked	-35
Bread Crumb	Elasticity	Very good	4	good	3	suitable	0	Not suitable	-35
	porosity	Good, even	3	Quite even, with bigger pores in-between smaller ones	2	Slightly uneven with thin walls	0	Pores dense or very big	-35
	Other features	Evenly coloured, dry to touch	3	Well coloured, easy to cut	2	With slightly varied colouring	0	Slightly slack-baked, crumbly	-35
Taste and smell		Aromatic and mild characteristic to this kind of bread	6	Characteristic for this kind of bread	5	Slightly different from the characteristics of this kind of bread	0	Not typical for this kind of bread, bitter and insipid	-35
Physical and chemical indicators	Volume 100g [cm^3]	Compatible with the norm	3					Not compatible with the norm	-35
	Moisture content [%]	Compatible with the norm	2					Not compatible with the norm	-35
	Acidity [°]	Compatible with the norm	3					Not compatible with the norm	-35
	Sugar contents in dry substance [%dry substance]	Compatible with the norm	-					Not compatible with the norm	-35
	Fat content [%dry substance]	Compatible with the norm	-					Not compatible with the norm	-35
Mass of the bread		Compatible with the norm	-					Not compatible with the norm	-35

Source: (PN-A-74108:1996)

The following table illustrates the quality level of bread according to the PN-A-74108:1996 norm.

Table 14.4. Level of bread quality according to PN-A-74108:1996 norm.

Level of bread quality	Number of points
I	40-36
II	35-31
III	30-26
IV	25-8
Bread that received less than 8 points should be disqualified	

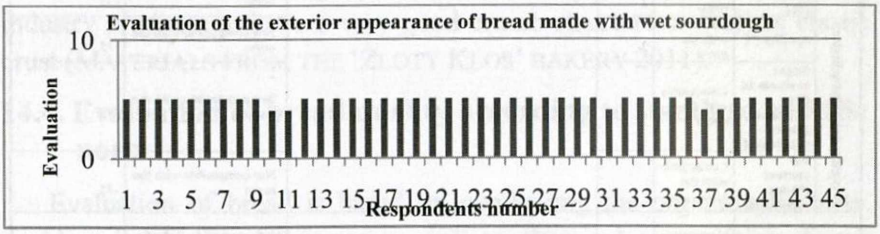
Source: (PN-A-74108:1996)

Table 14.4 shows us that the first level of quality can be reached by products that received the between 36 and 40 points from the organoleptic and physical tests, the second quality level received between 31 and 35 points. The total of points from 26 to 30 classifies the product in the third quality level. If the amount of the allocated points ranges from 8 to 25 it classifies the bread product in the fourth category.

14.5. The results of the tests conducted on the basis of o PN-A-74108:1996 norm

Evaluation of the exterior appearance:

In the graph number 14.2 you can see the evaluation of the exterior appearance of the examined bread.



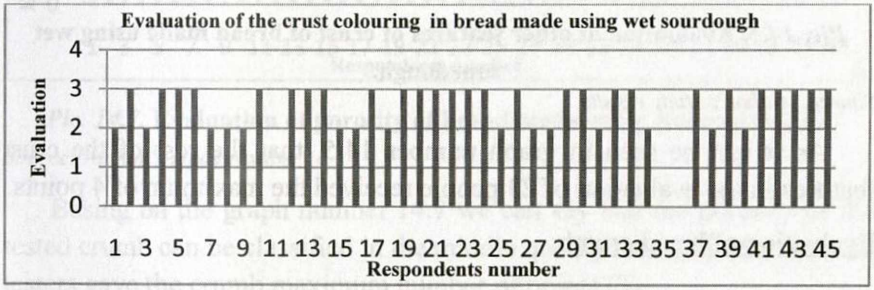
Pic. 14.2. Evaluation of the exterior appearance of the bread made using dry sourdough.

Source: Author's study results

Looking at the graph number 14.2 we can see that the exterior appearance of the bread produced using wet sourdough was very well received by the respondents. The maximum amount of points, that is 5 , was allocated by as many as 40 testers which is circa 89%of them.

Evaluation of the crust:

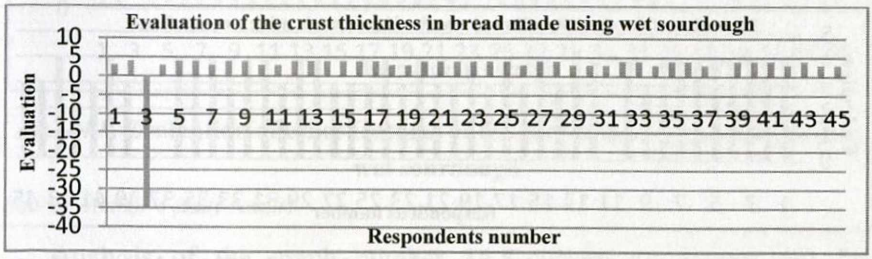
It encompassed defining of the colour, thickness and other features such as the appearance of the surface, elasticity and crispiness. On the graphs number 14.3, 14.4, 14.5 you can see the evaluation of those particular qualities of the crust of the researched bread.



Pic. 14.3. Evaluation of the crust colouring in bread made using wet sourdough.

Source: Author's study results

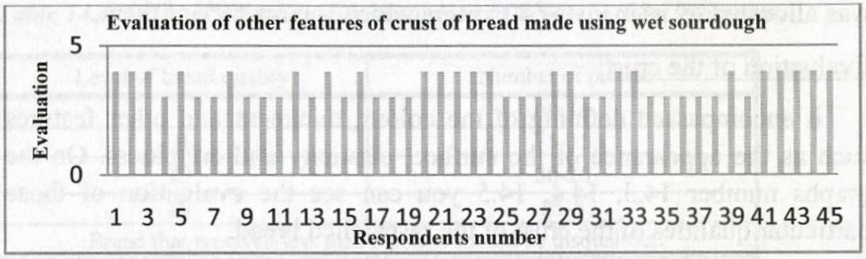
As Graph number 14.3 shows us that as many as 27 testers gave the evaluated bread maximum number of points. At the same time 3 people considered the colour of the crust to qualify for 0 points.



Pic. 14.4. Evaluation of the crust thickness in bread made using wet sourdough.

Source: Author's study results

Graph 14.4 illustrates the evaluation of the crust's thickness. As many as 27 respondents gave it the maximum amount of points (4). However one negative evaluation occurred.



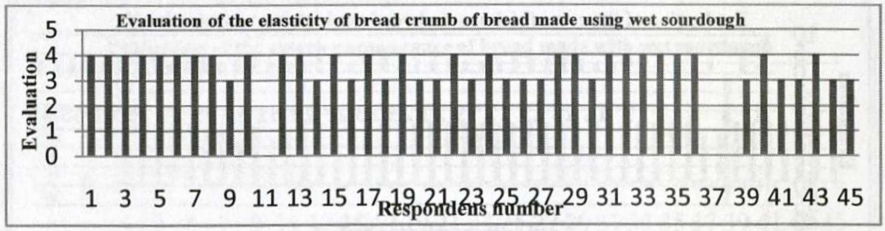
***Pic. 14.5.* Evaluation of other features of crust of bread made using wet sourdough.**

Source: Author's study results

As it can be seen in graph number 14.5, that the rest of the crust features in the evaluation of 23 people received the maximum of 4 points.

Evaluation of bread crumb:

It was conducted considering the elasticity and porosity as well as other features defining the crumb such as its' colour. Porosity and colour was tested through visual evaluation of the slice of bread cut in half. Elasticity was tested by pressing fingers simultaneously on the top and bottom part of it. The results of the research are presented on the graphs 14.6, 14.7 and 14.8.

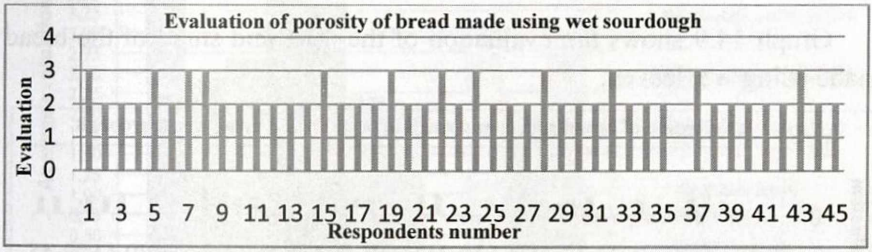


***Pic. 14.6.* Evaluation of the elasticity of bread crumb of bread made using wet sourdough.**

Source: Author's study results

Analysing the above graph presented in picture number 14.6 we can see that the crumb of the tested bread shows a very good elasticity as 26 of the testers gave it a maximum number(4) of points and the other respondents gave it a good evaluation (3).

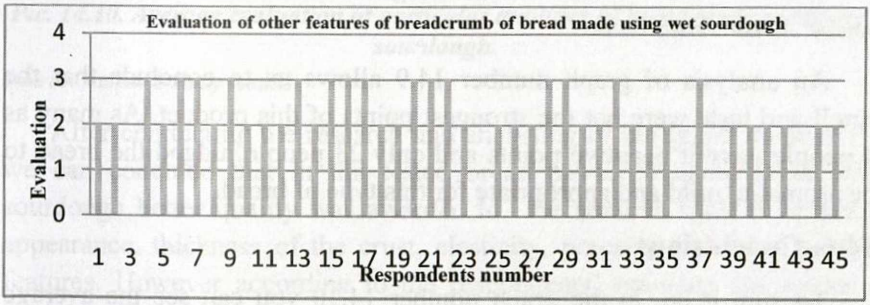
Evaluation of porosity of the bread produced using wet sourdough.



***Pic. 14.7.* Evaluation of porosity of bread made using wet sourdough.**

Source: Author's study results

Basing on the graph number 14.7 we can say that the porosity of the tested crumb can be classified in the middle quality level (2). However 12 testers gave the crumb maximum number of points (3).



***Pic. 14.8.* Evaluation of other features of breadcrumb of bread made using wet sourdough**

Source: Author's study results

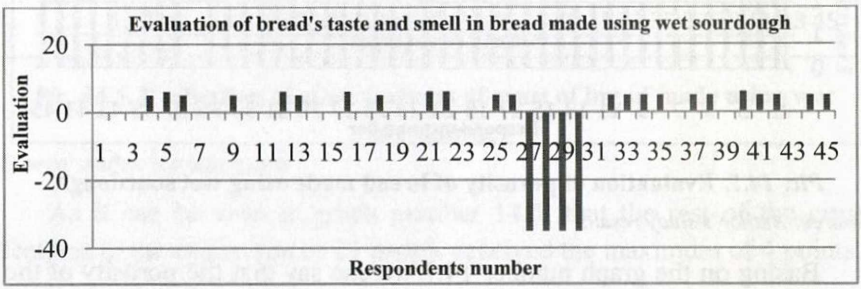
Analysis of the graph number 14.8 allows us to see that the respondents judged other features of the crumb as follows: 15 people

awarded it 3 points, 25 people gave it 2 points and 5 people gave it 0 points.

Taste and smell evaluation:

Taste was evaluated through slow chewing of the crumb that was taken out of the middle of the bread slice.

Graph 14.9 shows the evaluation of the taste and smell of the bread made using wet leaven.



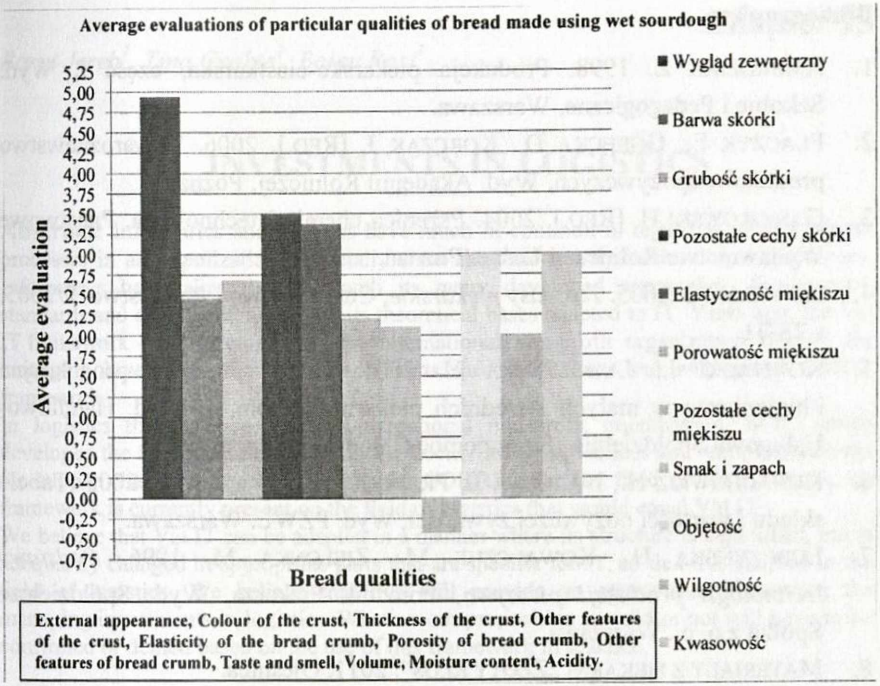
Pic. 14.9. **Evaluation of bread's taste and smell in bread made using wet sourdough**

Source: Author's study results

An analysis of graph number 14.9 allows us to conclude that the smell and taste were not the strongest points of this product. As many as 4 people gave it negative points and only 23 people judged the bread to be aromatic, mild and appropriate for this type of bread.

14.6. Conclusions

To sum it up, in the graph number 14.10 you can see the average grade awarded to specific qualities of the tested bread such as: exterior appearance, colour, thickness and other crust features, elasticity, porosity and other crumb features, taste, smell and volume, moisture and acidity. The research was conducted in compliance with the PN-A-74108:1996 (table 14.3 and 14.4) norm.



Pic. 14.10. Average evaluation of particular qualities of bread made using dry sourdough.

Source: Author's study results

After conducting the research and analysing of the graph number 10 we can conclude that in the tested bread produced using Rites wet sourdough better quality was awarded to the features such as exterior appearance, thickness of the crust, elasticity, porosity and other crumb features. However according to the respondents' opinions the features such as smell and taste definitely imply that the technological process of production should be modified. It should be concerned with bettering the taste and smell qualities.

The physical and chemical indicators such as volume, moist and acidity are compatible with set standards and that is why they were awarded the maximum number of points.

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