RESEARCH REGARDING THE BAKING CONDITIONS FOR DOUGH WITH ASH BONE FLOUR SUPPLEMENT

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The diversification of assortment from the bakery industry is possible by natural addition of nutritional elements. One of the solutions is an economic rendering of the by-products throughout meat processing industry; higher recovery of the pig bones through calcination process. The resulting ash is representative as a rich source of mineral ingredients used for good human body development. The achieved research revealed the necessary conditions for the obtaining of bakery products with an amount of 1.5-3% bone flour ash: baking time 33-39 minutes, baking temperature 200°C.

Keywords: minerals, bakery, baking, bone flour ash, rendering.

The organic products has been used as auxiliary materials Bread is a basic foodstuff, that's why, for decades, in many countries of the world, it has been practiced the enrichment of wheat flour with mineral elements, vitamins, proteins to supply human body deficiency of nutrients, its harmonious development and the prevention of diseases that may endanger national health.

The use of bone flour ash in bakery products brings a natural supplement of calcium and magnesium but it also requires the analysis of the problems concerning the ash amount during baking process [1].

The over adding of certain doses of calcium and magnesium for dough composition alter the taste and quality of bread, which can be checked up after the baking stage, the optimal doses of minerals, reported to the wheat flour content, that can be added to the dough are determined by successive tests [2].

MATERIAL AND METHOD

The research has considered the optimum parameters of baking dough with the following recipe: wheat flour type 800 - 94%, bone flour ash 1.5-3% and NaCl 1.5%.

For the achievement of the scientific research, it was used a program, based on a second degree rotator centered system with 2 independent variables, regarded as essential parameters for baking.

There were maintained constantly, in the experimental system, for each type of recipe, the next components:

• Water: 50 ml to a 100 g mixture of wheat flour;

- Bakery dregs: 5 g to a 100 g mixture of wheat flour;
- NaCl: 1.5% to a 100 g mixture of wheat flour.

The variation of independents parameters during of baking stage are presented in table 1.

Table 1

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			Codified values			
Independent variables		Xi	-1	0	1	
			Actual values			
Baking °C	temperatures,	X ₁	180	200	220	
Baking minutes	duration,	X ₂	33	36	39	

For determinations, there were used standardized methods specific to bakery department.

The average square deviation $\sigma = 0.38$ justifies the accuracy of the research program and the accuracy of the results obtained through research.

The experimental program is reproduced in table 2 [3].

Table 2

Nr	X ₁	X ₂	Acidity	Ratio	Ratio	Ratio
crt	Temp,	Duration,	degree,	H/D	core/	core/
	°C	minutes	ml		crust	bread
			NaOH			
			N/10			
1	180	33	3.9	0.34	1.7	0.22
2	180	36	4.1	0.42	1.9	0.38
3	180	39	4.3	0.37	1.6	0.29
4	200	33	4	0.47	2.1	0.42
5	200	36	4.2	0.48	2	0.30
6	200	39	4.5	0.39	2.4	0.35
7	220	33	4	0.31	2	0.29
8	220	36	4.2	0.27	1.8	0.27
9	220	39	4.7	0.25	1.5	0.28

Experimental program for baking proces

RESULTS AND DISCUSSIONS

The interpretation of the independent variables was accomplished by the particularization of the general regression equation 1 [4]:

$$Y = a_0 + a_1 x_1 + a_2 x_2 + a_{12} x_1 x_2 + a_{11} x_1^2 + a_{22} x_2^2$$
(1)

The mathematical model that describes the response for the variable Y_1 , Y_2 and Y_3 is presented in table 3:

Table 3

Regression equations for dependent variables during baking process

Dependent variable, Yi	Regression equation
Dough acidity, ml NaOH N/10	$Y_1 = 4.2 + 0.1x_1 + 0.26x_2 + 0.075x_1x_2 - 0.27x_1^2 - 0.071x_2^2$
Ratio H/D	$Y_2 = 0.36 - 0.05x_1 - 0.01x_2 + 0.034x_1x_2 - 0.12x_1^2 - 0.0014x_2^2$
Ratio core/crust	$Y_3 = 1,8 + 0,016x_1 - 0,05x_2 - 0,11x_1x_2 - 0,41x_1^2 - 0,0065x_2^2$

An optimal baking process is obtained for the dough containing 1.5-3.0% bone flour ash.

The reason of this is that for an amount of 3% bone flour ash, it can be obtained the maximum acidity value for the core, the positive influence being represented by the composition of wheat flour. To obtain a product with an increased quantity of the core, it is recommended a baking time of about 33-36 minutes when the baking temperature is 180-200°C.

An increase of the baking duration to 42 minutes affects in a negative way the product's quality and the porosity of the bread is minimum.

A maximum ratio height/diameter is obtained with an added amount of 3.0% bone flour ash, when the baking temperature is 220°C and duration is 36 minutes.

Ratio core/crust is about 1.3% when baking temperature is 180°C and baking duration is 33 minutes. The highest quantity of core is registered for the baking temperature of 200-220°C and baking duration of 36 minutes.

The increasing of baking temperature over 220°C and baking duration over 39 minutes influenced in a negative way the bread baking by the development of a high quantity of crust that has slowed the dough growth.

Concerning the variation of ratio core/bread with baking temperature and duration, there was found that a baking temperature of 200°C and baking duration between 36-39 minutes has increased the ratio up to a value of 0.27 with a decrease when the temperature exceeds 200°C, and baking duration exceeds 39 minutes.

In this research, heve been established optimal values of the independent variables of system, specific to each parameter: acidity, ratio H/D, ratio core/crust, which are presented in table 4.

Table 4

		Acidity, Y ₁	Ratio	Ratio
Independent	X_i	(ml NaOH	H/D,	core/
variable		N/10 / 100	Y ₂ ,	crust,Y ₃ ,
		g bread)	%	%
Baking duration, minutes	X ₁	35.2	33.8	36.3
Baking	X ₂	215	209	218
temperature, C				

Optimal values of independent variable of research program

The addition of the mineral composition of bread is presented in table 5 [5].

	Ihe	amount of t	he mineral	added of br	read	
Label	Ca, %	Mg, %	P, %	Zn, μg/g	Cu, μg/g	Fe, μg/g
Minimal quantity*	1.08	1.8	0.51	3.55	1.07	1.75

* The percentage composition reported to a dry matter of bread

CONCLUSIONS

The use of minerals from bone flour ash in bakery products can be one of the solutions to supplement the deficiency of macro/microelements in human nutrition through the enrichment of bakery products with essential elements as: calcium, phosphorus, magnesium, copper, manganese.

A small amount of 3.0% bone flour ash added to the dough does not produce significant changes to the consistency, granulation, color or fineness from the classic bread (without addition of bone flour ash).

For the manufacturing of bread with functional qualities, can be considered the following technological conditions:

- Wheat flour: 94-97%;
- Bone flour ash: 3.0%
- Baking temperatures: 200-220°C;
- Baking duration: 33-36 minutes;
- Water: 50 ml to a 100 g of mixture of wheat flour and bone flour ash;
- NaCl: 0.75–1.5% :
- Bakery dregs: 5 g to a 100 g of a mixture of wheat flour and bone flour ash:

The quality of the finished product is equivalent to adding an additional mineral to 12% [5].

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Table 5