RENDERING OF MEAT INDUSTRY BYPRODUCTS WITH A END USE IN THE BAKERY INDUSTRY

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The purpose of this paper is to bring into focus the uses of the bone flour ash in bakery products with compatible ratios betwen bone flour ash, wheat flour and poor gluten content, enriched with mineral elements: calcium, phosphorus, magnesium, copper, iron, magnesium. The best recipe for dough with bone flour ash can be considered the following: wheat flour 94-97%; bone flour ash 3%; dough fermentation time 31-35 minutes; fermentation temperature 30-35°C; water 50% reported to the entire wheat flour mixture; NaCl 0,75 – 1,5% reported to the entire mixture; bakery dregs 5% reported to the entire mixture.

Keywords*: bone flour ash, rendering, bakery, mineral elements, kneading.*

The bone flour ash presents a chemical composition that justifies its use in food products. The mineral composition of the bone flour ash is rich in nutrients: calcium 36,1 - 37,2 %, magnesium 58,6 - 62,7%, phosphorus 17,02 - 17,08% and other components in smaller quantities but with a significant role in human metabolism: copper (9,5 - 10,7 μg/g bone flour), zinc (346 - 556 μg/g bone flour), manganese (3,2 - 3,4 μg/g bone flour).

People who exercise intensively – have an intense metabolism, lose salts and mineral elements by sweating and they need mineral supplements. The bakery products with bone flour ash addition compensate mineral deficiencies due to some nutritional elements. The current researches proved the necessity of mineral supplements generated by the lack of certain types of food or by the high, refined food degree consumption [1]. Thus, according to the USA National Academy of Science, the amount of calcium that must be added in flour is of 900 mg/kg, magnesium of 200 mg/kg, taking into consideration that bread contains only 40 mg of magnesium per 100 grams wheat flour, for example [2].

MATERIAL AND METHOD

For the achievement of this research study, it was used a IInd rotated centered system program with 31 experiments and 4 independent variables, as can be seen in table 1.

Table 1

Experimental parameters and areas of variation regarding dough training and fermentation

Independent variables, X_i	Codified values				
	-2	-1	0	1	2
	Actual values				
Bone flour ash, %	0	1.5	3	4.5	6
NaCl, %	0.75	1.5	2.25	3	3.75
Duration of fermentation, minutes	31	33	35	37	39
Temperature of fermentation, °C	30	35	40	45	50

There were maintained constants for each recipe in the experimental system. The following results have been obtained:

- Water: 50 ml to a 100 gr mixture of wheat flour;
- Bakery dregs: 5 g to a 100 g mixture of wheat flour;
- Kneading duration of dough, 10 minutes.

The quality indicators of wheat flour type 800 are presented in table 2 [2].

Table 2

Quality indicators of wheat flour type 800

Characteristics		Chemical and biochemical characteristics	
Hydration capacity, %	60.7	Proteins, %	11.5
Growth, minutes	1.5	Umidity, %	13.78
Stability dough, minutes	11	Finesse,	77
Extensibility, UF	120	Gluten, %	31
Solubility, UB	30	Crust, %	35
Power, UB	56	Acidity, degree	2.97

The characteristics presented in table 2 allow the following conclusion: flour type 800 is of optimal quality and has been obtained from optimal bakery wheat. The mineral composition of bone flour ash is presented in table 3 [3].

Table 3

Mineral composition of bone flour ash

	Ca, %	Mg, %	P, %	Zn, μg/g	Cu, μg/g	Fe, μg/g	Mn, μg/g
minim	36.4	58.6	17.02	346	9.5	61.2	3.2
maxim	37.2	62.7	17.08	556	10.7	65.6	3.4

RESULTS AND DISCUSSIONS

In order to establish the necessary conditions to complete the technology for obtaining specific bread dough with addition of bone flour ash, there were chosen particularly dependent and representative variables Y_i, that provide information during the fermentation process:

- Y_1 - dough acidity, ml NaOH N/10;
- Y_2 - dough growth, by determining dough deformation, expressed by ratio $100(D_f-D_i)/D_i$;

D_i şi D_f = the analysed sample diameter in the initial and final phase of the fermentation process [4].

The value of the average square deviation justifies the accuracy of the research program and is presented in table 4.

Table 4

The value of average square deviation for dependent variable y_1 and y_2

Dependent variable, Y_i	Average square deviation, σ
Dough deformation	$2.18 \cdot 10^{-3}$
Dough acidity	$3.06 \cdot 10^{-3}$

The interpretation of the independent variables was accomplished by the general regression equation 1 [5]:

$$Y = a_0 \pm a_i x_i + a_{ij} x_i x_j + a_{ii} x_i^2 \quad (1)$$

For the interpretation of the results, there was chosen a graphic method to express the customized regression equations, based on the IInd order rotary system.

An added amount of 1.5% bone flour ash at 35 minutes dough fermentation time and 35-40°C fermentation temperature is regarded as a minimum condition to form a dough from which can be obtained a products with identical properties to baking products without the addition of bone flour ash minerals.

Dough's acidity degree can be of 4.2 degrees for an amount of 0.75-1.5% NaCl if the fermentation time takes about 33 minutes and in this case, dough's acidity degree with bone flour addition is positively influenced.

In the centered domain with the amount of 3% bone flour ash added, a minimum amount of 0.75-1.5% NaCl is enough for dough's to growth and development in normal conditions like those of a normal dough with no bone flour ash addition.

Dough deformation increases for an amount of 1.5-4.5 bone flour ash, when a maximum deformation degree is achieved. In this case, the amount of NaCl added is 1.5 – 2.25%. An amount of bone flour ash greater then 4.5% and an amount of NaCl greater then 3.0-3.75% cause a significant reduction in dough deformation.

A 20% growth dough can be optimal, if we take into account an amount of 3% bone flour ash, when dough's fermentation duration is about 33-35 minutes (fig. 5).

A fermentation temperature of 30-35°C contributes to the dough's growth in normal conditions, when the amount of bone flour ash is 1.5-3.0%.

The determination of the optimal values of the independent parameters

Based on calculations made, there have been established the following optimal values for the system's independent parameters, required to obtain optimal acidity and deformation to achieve a dough with a maximum degree of development, as presented in table 6.

Table 6

Optimal values of the independent parameters during the research program

Independent Variables	X_i	Dough acidity, Y_1, (ml NaOH N/10),	Dough deformation, Y_2, %
Bone flour ash, %	X_1	1.52	2.68
NaCl, %	X_2	1.27	1.56
Duration, minutes	X_3	34.2	32.7
Temperature, °C	X_4	33.8	34.1

CONCLUSIONS

Bone flour ash by compositional qualities, can be considered an optimum solution for the population with gaps in minerals in particular calcium, phosphorus, magnesium, but especially people who make an intense physical effort.

For the manufacturing of bread with the required nutritional qualities, it may be applicable for the fromation of dough the following technological recipe per 100 kg product presented in table 7.

Table 7

The recipe for bakery products enriched with mineral elements from bone flour

Assortment	Quantity
Wheat flour type 800	94-97
Ash of bone flour	1.5 -3
NaCl	1.5

The recipe is valid when dough's fermentation temperature is 35°C and fermentation time is about 31-35 minutes.

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