STUDIES REGARDING BAKERY PRODUCTS OBTAINING WITH BARLEY BRAN SUPPLEMENT

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Abstract

The production of bakery products with high content of fiber by adding barley bran is an important objective through a healthy nourishing process. This paper presents researches about establishing technological parameters for bakery products with barley bran. The researches regime developed has revealed the posibilities for obtaining products by following limits: supplement of barley bran 3-9%; fermenting temperature of dough 35ºC; time of fermenting 33-35 min.; NaCl content 2%; bakery yeast was in constant proportion, respectively 5%. Results of experiments effectuated looks like: a quantity of barley bran of 12% has negative influence through reduced content of gluten; a supplement of barley bran 6-9% may be considered positive solution for nourishing and bakery products digestion.
Keywords*: bakery products, barley bran, fiber, mathematical modeling, food products, healthy.*

Introduction

The nowadays tendency in food industry is the increase of the nutrient value of food products. The production of bakery products with high content of fiber by adding barley bran is an important objective through a healthy nourishing process.

Consumption of diets high in barley bran has been recommended in the 2005 Dietary Guidelines for Americans and are reported to have a number of beneficial health effects including reduced risk of cancer (Jacobs, 1998), cardiovascular disease (Truswell, 2002; Rimm, 1996), and type 2 diabetes (Fung, 2002; Liu, 2000), which are leading causes of death in the USA. These results have been attributed to the effects of the soluble and insoluble fiber content of barley bran foods on risk factors for

these diseases including blood glucose (Hallfrisch, 2000), insulin (Willett, 2002), and cholesterol (Behall, 1997; Leinonen, 2000). Other more general beneficial physiological effects of consumption of barley bran include reduced transit time which may reduce risk of colon cancer (Lupton, 1993), and reduced rate of absorption of energy containing nutrients which may reduce glucose and insulin responses and risk of obesity (Wisker, 1992). Numerous studies have demonstrated that barley bran is high in soluble fibers, such as beta-glucan, lowering blood cholesterol.

This paper presents researches about establishing technological parameters for bakery products with barley bran. The barley bran addition is limited by technological conditions, especially those concerning the obtaining of the dough. Using mathematical modeling, this paper aims to establish technological parameters for bakery products with barley bran addition.

Experimental

The experimental program was conceived with the utilization of programming model of experiences in the centered system by second degree, having four independent variables (table 1) and 31 experiments. The experimental conditions are presented also in table 1. During the determinations it was maintain constant the following technological parameters:

- the water quantity, 50 ml at 100 g mixture of barley bran and wheat flour mixture;
- the bakery yeast quantity of 5%;
- kneading duration, 10 minutes.

The wheat flour used in the determinations was of type 900, the quantity for each determination varying function of barley bran supplement, knowing that the total quantity of the bran-flour mixture must be 100 g.

The values of the independent parameters were determined taken in a count the followings:

- the barley bran addition is limited, a 12% supplement being the maximum value which can be added; over this value, due to the increase of gluten content, the dough made process is affected;
- the dough water content varies function of the barley bran – wheat flour hydrate capacity.

Table 1. Experimental conditions

Experimental conditions						
Independent variables	X_i	Codified values				
		-2	-1	0	1	2
		Actual values				
Barley bran, %	X_1	0	3	6	9	12
NaCl, %	X_2	0.75	1.50	2.25	3.0	3.75
Fermenting duration, min.	X_3	31	33	35	37	39
Fermenting temperature, °C	X_4	30	35	40	45	50

The chemical composition of barley bran is:
- glucides content 74.3 %
- proteins content 8.3 %
- fat content 2.00 %
- cellulose content 26.6 %
- mineral substances content 1.5 %.

Results and Discussions

The influence determination of the independent variables was accomplished by particularization of the general regression equation:

$$Y = b_0 + b_i x_i + b_{ij} x_i x_j + b_{ii}x_i^2$$

The dependent variables that characterized the dough fermentation process are:
- dough acidity, expressed as acidity degree;
- dough deformation (D), defined as:

$$D = \frac{D_f - D_i}{D_i} \cdot 100\%$$

In above relation D_i represents dough ball medium diameter at the beginning of the fermentation process, and D_f is dough ball medium diameter at the ending of the fermentation process

The regressions equations particularized for the dependent variable of the dough fermentation process are presented in table 2.

Table 2. Regression equation for dependent variables of the dough fermentation

Regression equation for dependent variables of the dough fermentation process	
Independent variable, Y_i	Regression equation
Dough acidity, degree	$Y_1 = 2.85 - 0.07x_1 + 0.11x_2 + 0.03x_3 + 0.066x_4 + 0.395x_3x_4 + 0.78x_1^2 + 0.048\ x_2^2 + 0.22x_3^2 + 0.15x_4^2$
Dough deformation, %	$Y_2 = 0.332 - 0.0024x_1 + 0.023x_2 + 0.005x_3 + 0.16x_4 + 0.012x_1^2 + 0.44x_2^2 - 0.25x_3^2 + 0.67x_4^2$

The graphical representations of the regression equations depending on the correlation between dependent variables and independent variables will be presented in figures 1, 2, 3 for the acidity and in figures 4, 5, 6 for the dough deformation.
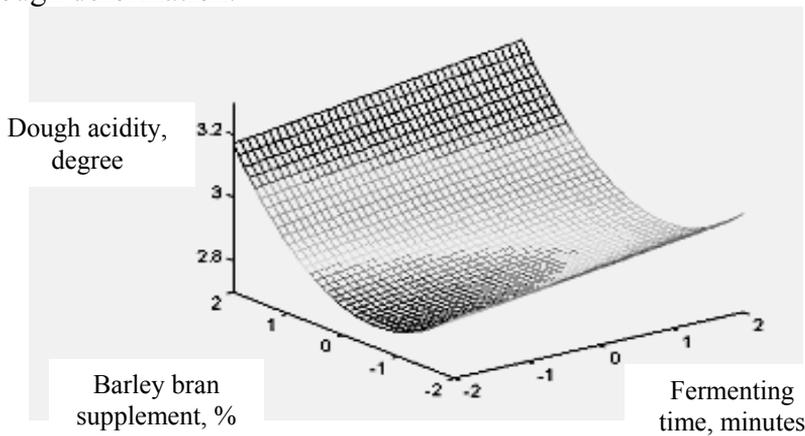

Figure 1. The dough acidity variation function of barley bran content and fermenting time

The barley bran has a low gluten content thus having a negative influence over the dough fermentation process. The maximum 3.2-3.6 acidity degree is obtained when barley bran supplement is between 3-9% and the fermenting time is 33-35 minutes. Actually, the highest acidity is obtained for the lowest barley bran supplement. The porosity and the dough gases retaining capacity have maximum values for a barley bran supplement of 6% and a fermenting temperature of 35°C.
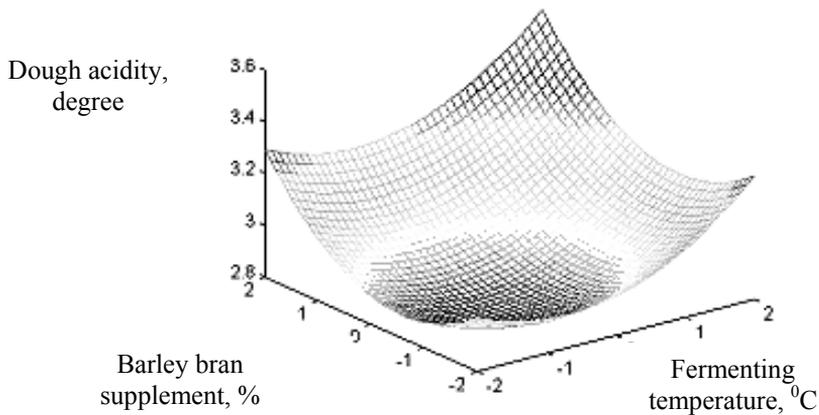

Figure 2. The dough acidity variation function of barley bran content and fermenting temperature
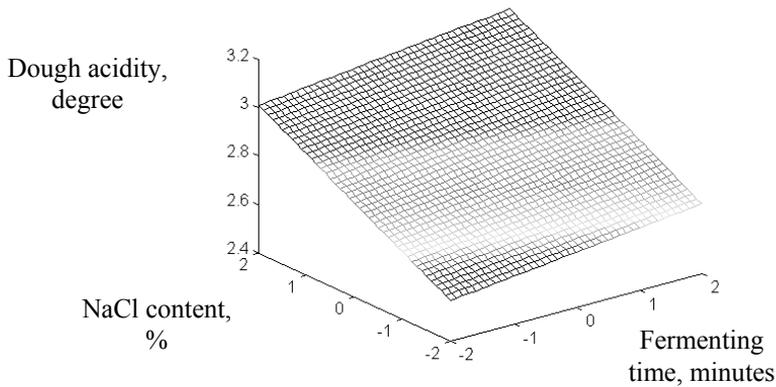

Figure 3. The dough acidity variation function of NaCl content and fermenting time
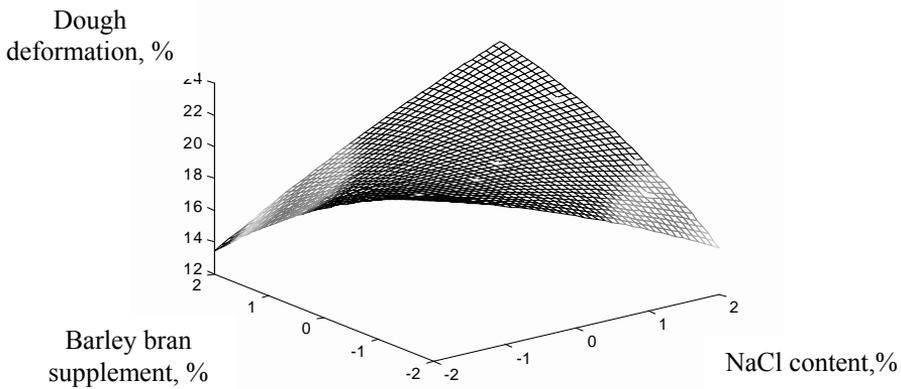
Dough
deformation, %

Figure 4. The dough deformation variation function of barley bran content and
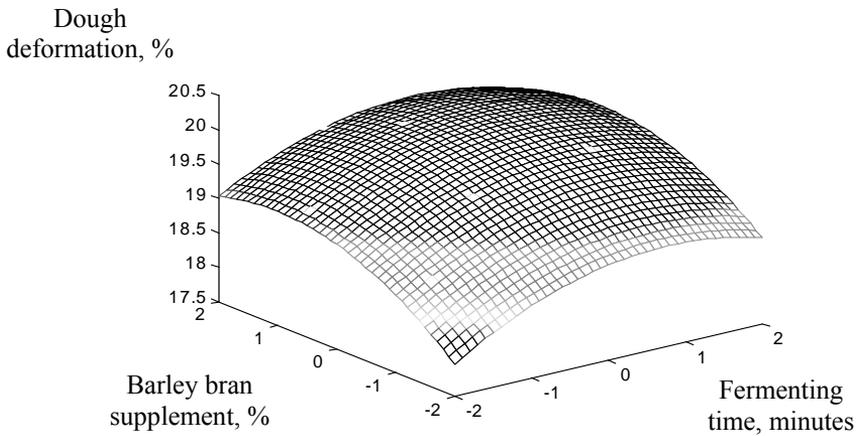NaCl content

Dough
deformation, %

Figure 5. The dough deformation variation function of barley bran content and
fermenting time

The dough growing capacity increases tougher with the decrease of
the barley bran supplement. A barley bran supplement of 3-9% leads to a
dough deformation between 15-20%.

The maximum dough deformation is obtained for a barley bran
supplement between 0-3% and a fermenting time of 31-33 minutes; the
minimum dough deformation conditions are barley bran supplement of

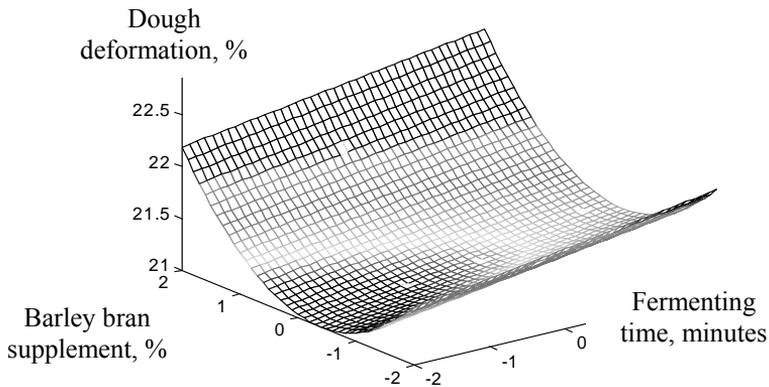12% and a fermenting temperature of 40°C. Over these values, the dough growing process couldn't take place.

Figure 6. The dough deformation variation function of barley bran content and fermenting time

Normal dough grow takes place in the following conditions: a barley bran supplement between 3-6% and a fermenting temperature of 30-35°C.

Conclusions

The mathematical models obtained can be used for simulating and optimizing the bakery products with barley bran supplement obtaining process. The technological parameters established for the obtaining process of the bakery products with barley bran supplement are: supplement of barley bran 3-9%; fermenting temperature of the dough 35°C; time of fermentation 33-35 min; NaCl content 2%; bakery yeast added in a constant proportion of 5%. Outcome this experimental research one can come to the following conclusions: a quantity of barley bran of 12% has negative influence through reduced content of gluten; supplement of barley bran 6-9% may be considered positive effect solution for nourishing and bakery products digestion.

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