CONTRIBUTIONS REGARDING THE USE OF BARLEY FLOUR AND ZARA IN THE BAKERY PRODUCTS INDUSTRY

Lăcrămioara Păduraru[*], Domnica Ciobanu[*], Mihai Leonte[**], Luminița Grosu[*]

[*]*University of Bacau, Environmental Protection Chemistry Laboratory, Calea Marasesti 157, 600115, Bacau, Romania*
[**]*University of Bacau, Food Technology and Biochemistry Laboratory, Calea Marasesti 157, 600115, Bacau, Romania*

ABSTRACT: The results of research program praised the conditions used to obtain dough through the capitalization of cereals resources with poor gluten content (barley flour) and zara, secondary product resulted from technological process of milk industrialization.
Barley flour adding of 6 – 9 % and 40 % zara can be considered sufficient quantities for our goal: dietetic bakery products with reduced gluten content and increased proteins content because of zara adding.

KEY WORDS: *barley flour, zara, dietetic bakery products*

THEORETICAL CONSIDERATIONS

To obtain the dietetic bakery products with reduced gluten content through use of barley flour requires the supplementing of food fibers and increasing of nutritional value because of zara adding that has a 3.4 % proteins content [1].
Zara can be considered a raw material of bakery products because of its chemical composition wealthy in glucides (3.6 % lactose), proteins (3.4%), vitamins, and essential aminoacids [3].

The barley flour adding influences positively the dietetic bakery features through the gluten complex (glyadina and glutenine) [2].
The chemical composition of barley flour has the following quantitative limits: glucides 74.3 %, proteins 9.5 %, lipids 1.4 %, mineral substances 1.6 % [4].
The research achieved in the first stage of dough obtaining has the purpose to reproduce the necessary conditions for achievement of bakery dough with a mixture of wheat flour and barley flour and zara adding, secondary product of milk industrialization [5].

MATERIALS AND METHODS

The research program of centered compound system by second degree, with four independent variables is reproduced in table 1.

Table 1. Experimental conditions

Independent variables	$\mathbf{X_i}$	**Codified values**					
		-2	-1	0	1	2	Δx
		Actual values					
Barley flour, (%) reported to mixture flour	X_1	0	3	6	9	12	3
Zara , (%) reported to mixture flour	X_2	20	25	30	35	40	5
Duration of fermentation, (minutes)	X_3	56	58	60	62	64	2
Temperature of fermentation, (°C)	X_4	26	28	30	32	34	2

The independent parameters have influence in the technological process of dough obtaining necessary to dietetic bakery products.
The raw materials used in the program were:

- ✓ Wheat flour type 650 with the following features:
  - hydration capacity, 60.8 %;
  - growth, 2 minutes;
  - stability, 6 minutes;
  - extensibility, 120 UB;
  - power, 56.
- ✓ Water and zara 50 % reported to entire mixture of wheat and barley flour;
- ✓ NaCl 1.5 %;
- ✓ Bakery dregs 3 %.

The quantities of NaCl and bakery dregs are constantly for experimental program (table 2). The kneading duration of dough was 10 minutes.

RESULTS AND DISCUSSION

The influence of independent parameters about dough quality was established through graphic representation of dependent variables (table 3) and regression equations particularized form general equation:

$$y = b_0 \pm b_i x_i \pm b_{ij} x_i x_j \pm b_{ii} x_i^2$$

Table 2. Experimental program for dough fermentation

No.	X_1= barley flour %		X_2 = zara ml		X_3 = duration minutes		X_4 = temperature °C	
	Codi-fied	Real	Codi-fied	Real	Codi-fied	Real	Codi-fied	Real
1	-1	3	-1	25	-1	58	-1	28
2	1	9	-1	25	-1	58	-1	28
3	-1	3	1	35	-1	58	-1	28
4	1	9	1	35	-1	58	-1	28
5	-1	3	-1	25	1	62	-1	28
6	1	9	-1	25	1	62	-1	28
7	-1	3	1	35	1	62	-1	28
8	1	9	1	35	1	62	-1	28
9	-1	3	-1	25	-1	58	1	32
10	1	9	-1	25	-1	58	1	32
11	-1	3	1	35	-1	58	1	32
12	1	9	1	35	-1	58	1	32
13	-1	3	-1	25	1	62	1	32
14	1	9	-1	25	1	62	1	32
15	-1	3	1	35	1	62	1	32
16	1	9	1	35	1	62	1	32
17	-2	0	0	30	0	60	0	30
18	2	12	0	30	0	60	0	30
19	0	6	-2	20	0	60	0	30
20	0	6	2	40	0	60	0	30
21	0	6	0	30	-2	56	0	30
22	0	6	0	30	2	64	0	30
23	0	6	0	30	0	60	-2	26
24	0	6	0	30	0	60	2	34
25	0	6	0	30	0	60	0	30
26	0	6	0	30	0	60	0	30
27	0	6	0	30	0	60	0	30
28	0	6	0	30	0	60	0	30
29	0	6	0	30	0	60	0	30
30	0	6	0	30	0	60	0	30
31	0	6	0	30	0	60	0	30

The acidity degree of dough can be 3.5 for 6 – 9 % barley flour adding if the fermentation duration is 62 – 64 minutes and zara adding is 35 – 40 % (figures 1, 2).
In this conditions the dough growth register an increase of 24.8 – 25.2 %, with positive influence about process (figures 3, 4).
Minimal values for dough quality: humidity, final temperature of fermentation, appearance, was registered when the barley flour adding, zara and fermentation duration was placed in the field of codified programmed system: - 1 and –2 (figures 5 - 7).
In these conditions the results of research program can't be recommended to the extension and use for industrial level.

Table 3. Regression equations for dependent variables at dough fermentation

Dependent variable, y_i	**Regression equation**
Acidity degree, ml NaOH N/1	$Y = 3.74 + 0.114x_1 + 0.024x_2 + 0.099x_3 + 0.141x_4 + 0.0625x_1x_2 + 0.025x_1x_3 + 0.0375x_1x_4 - 0.05x_3x_4 - 0.20x^2_1 - 0.006x_2^2 + 0.10x_3^2$
Dough deformation, %	$Y = 27.71 - 1.39x_1 + 0.49x_2 - 0.16x_3 + 2.57x_4 - 0.25x_1x_2 - 0.75x_1x_3 - 0.25x_1x_4 + 0.37x_2x_4 - 1.03x_1^2 - 0.40x_2^2 - 1.53x_4^2$
Final temperature of fermentation, °C	$Y = 31.78 + 0.061x_1 + 0.10x_2 + 0.18x_3 + 1.73x_4 + 0.062x_1x_2 + 0.093x_1x_3 - 0.093x_1x_4 - 0.21x_2x_3 - 1.007x_1^2 - 1.13x_2^2 - 1.31x_3^2$
Humidity, %	$Y = 42.71 - 0.328x_1 - 0.24x_2 + 0.328x_3 - 0.166x_4 + 0.37x_1x_2 - 0.5x_1x_3 + 0.125x_1x_4 - 0.25x_2x_3 + 0.55x^2_1 + 0.80x_2^2 + 0.55x_3^2$
Appearance, marks by 1 to 5	$Y = 3.85 - 0.41x_1 - 0.082x_2 + 0.32x_3 - 0.082x_4 - 0.125x_1x_4 - 0.125x_2x_4 + 0.125x_3x_4 - 0.16x^2_1 - 0.16x_2^2 - 0.003x_3^2 - 0.71x_4^2$

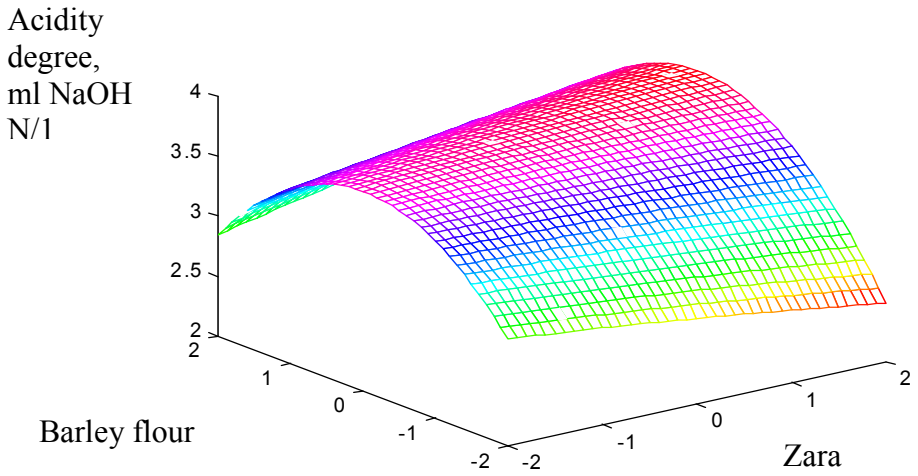

Fig.1. Acidity degree variation of dough made of wheat flour and barley flour mixture and zara, when the temperature and duration are constantly in central domain (30 ℃, 60 minutes)

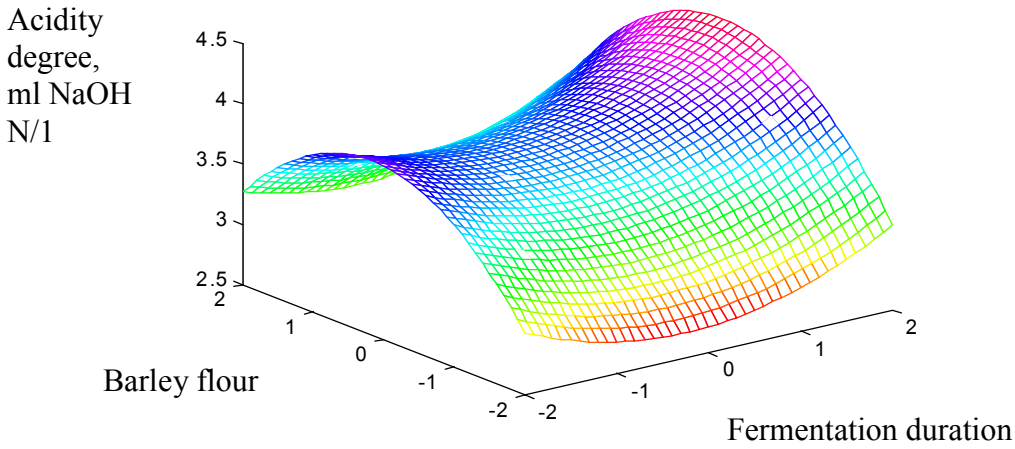

Fig.2. Acidity degree variation of dough made of wheat flour and barley flour mixture and zara, when the zara adding and temperature are constantly in central domain (30 %, 30 ℃)

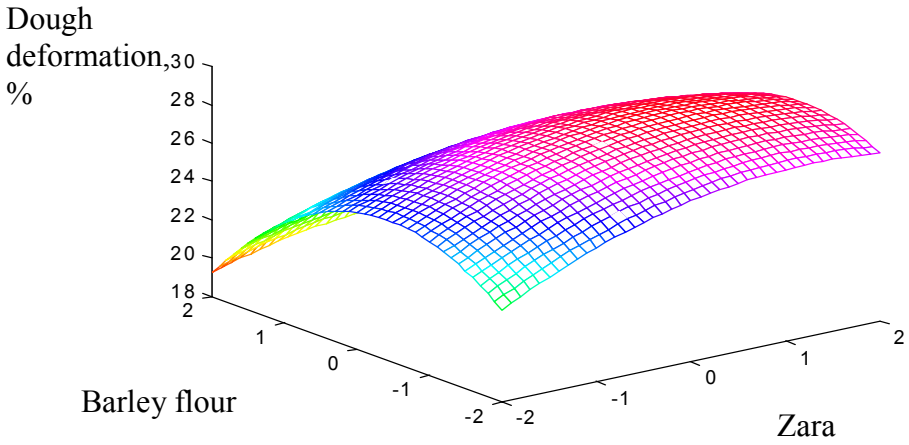

Fig.3. Dough deformation variation of dough made of wheat flour and barley flour mixture and zara, when the temperature and duration are constantly in central domain (30 ℃, 60 minutes)

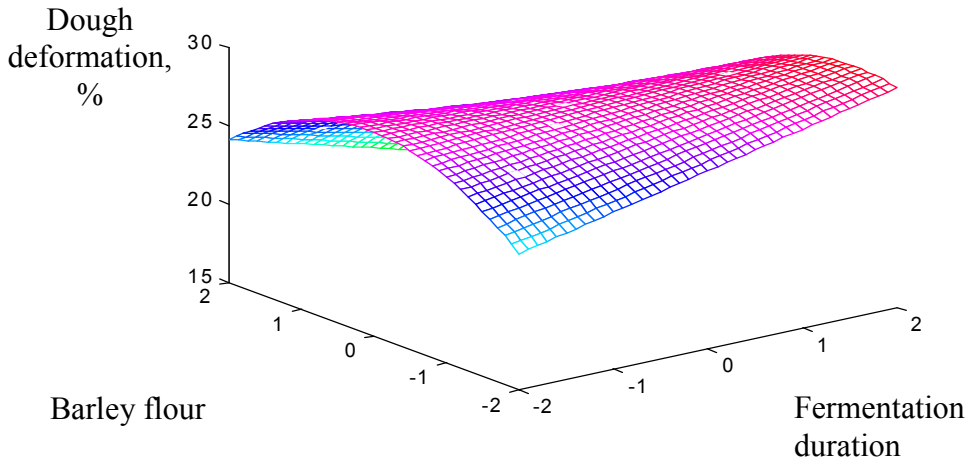

Fig.4. Dough deformation variation of dough made of wheat flour and barley flour mixture and zara, when the zara adding and temperature are constantly in central domain (30 %, 30 ℃)

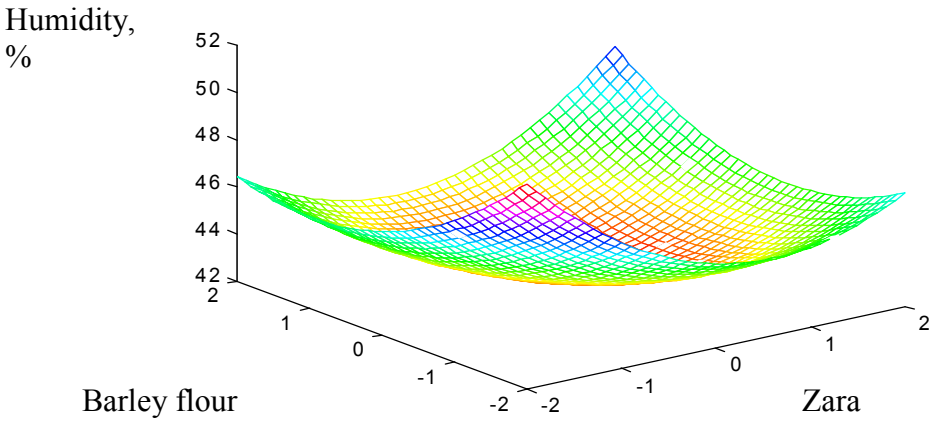

Fig.5. Humidity variation of dough made of wheat flour and barley flour mixture and zara, when duration and temperature are constantly in central domain (60 minutes, 30℃)

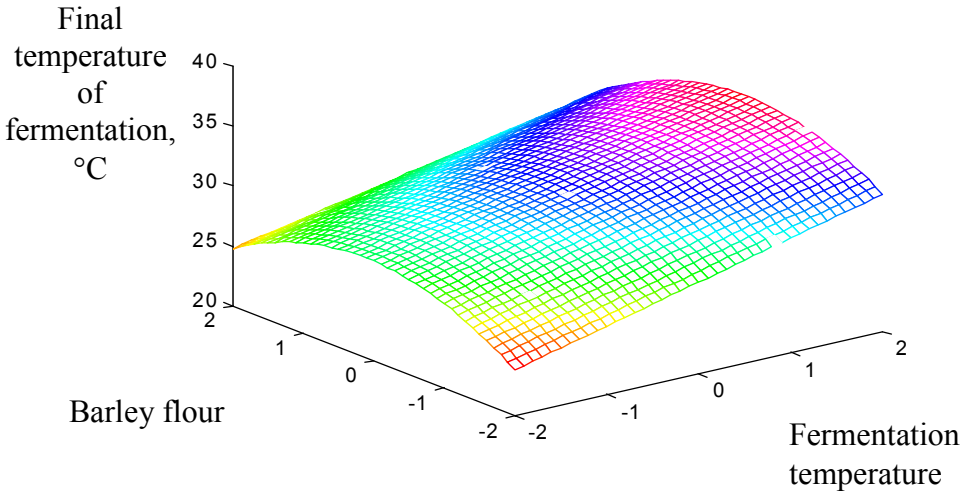

Fig.6. Final temperature variation of dough made of wheat flour and barley flour mixture and zara, when the duration and zara adding are constantly in central domain (60 minute, 30 %)

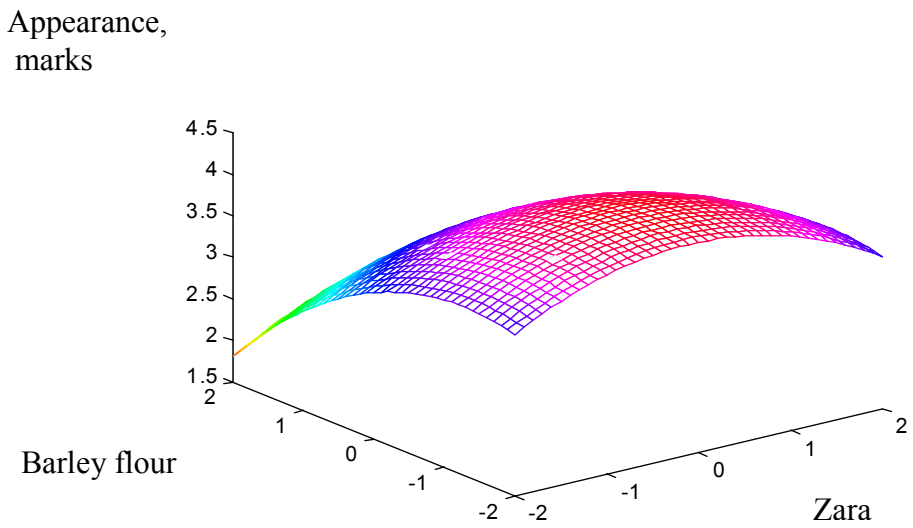

Fig.7. Appearance variation of dough made of wheat flour and barley flour mixture and zara, when the duration and temperature are constantly in central domain (60 minute, 30 ℃)

CONCLUSIONS

The requirements of dietetic bakery products characterized through reduced gluten content and increased food fibers content, can be achieved through dough formed by:

- ✓ 6 – 9 % mixture of wheat and barley flour;
- ✓ 35 – 40 % zara.

Fermentation duration is 62 – 64 minutes and fermentation temperature is 32 – 34 °C.
Zara adding has positive influence about technical, economical and ecological features, because of decrease of technological water consumption and the superior utilization of zara, secondary product of milk industrialization.

REFERENCES

1. Ciobanu, D., *Chimia produselor alimentare*, Ed. Tehnica-Info Chişinău, ISBN 9975-63-036-7, **2001**;
2. Ciobanu, D., *Chimia produselor alimentare – investigaţii analitice*, Ed. Tehnica-Info Chişinău, ISBN 9975-63-156-8, **2002**;
3. Leonte, M., *Tehnologii şi utilaje în Industria Morăritului*, Ed. Millenium, Piatra-Neamţ, **2001**;
4. Leonte, M., - *Tehnologii, utilaje, reţete şi controlul calităţii în industria de panificaţie, patiserie, cofetărie, biscuiţi şi paste făinoase*, Ed. Millenium, Piatra-Neamţ, **2003**;
5. Moldoveanu, Gh., *Tehnologia Panificaţiei*, Editura Didactică şi Pedagogică, Bucureşti, **1978;**
6. Zaharia Traian, *Tehnologia pâinii în unităţile de capacitate mică*, Editura Tehnică, Bucureşti, **1985**;
7. Banu, C., *Manualul inginerului din industria alimentară*, Bucureşti, Ed. Tehnică, **1998**;
8. Sandru, A., Tucu, D., *Panificaţia. Sisteme tehnologice şi structuri productive*, Editura Orizonturi Universitare, Timişoara, **1997**;
9. Huber, H., *Corelaţia dintre procedeul de preparare al aluatului şi calitatea făinii*, nr. 18, septembrie, **1981**;