*D. Andronic, et all. Journal of Agroalimentary Processes and Technologies, Volume XIII, No.2 (2007), 373-380*
*Full Paper – Natural Food Extract and Additives*

# RESEARCHES CONCERNING THE INFLUENCE OF SOME AUXILIARY MATERIAL OVER FROZEN SHEET DOUGH QUALITY

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## Abstract

*The quality of pastry products from frozen sheet dough is conditioned, besides obtainment technology, by the establishment of an optimum recipe which contains those ingredients which can remove the negative effects of frosting and defrosting. In order to optimize the gluten, ascorbic acid and sodium stearoyl-2-lactylate additions in the manufacturing recipe of frozen sheet dough a type $3^3$ factorial optimization model was used. The finished products were sensorial analyzed regarding aspect, texture and friability.*
***Keywords:*** *frozen pastry dough, factorial model optimization*

## Introduction

Frozen dough market has been constantly growing because of consumers' demand for practicability and high quality baking products. The use of frozen dough has developed increasingly, especially in bakeries, restaurants, because they permit a relative easy obtainment of products and have great economical efficiency (Kulp, 1995).

For an assortment diversification of baking and pastry products, accompanied by their selling in a fresh state, an optimum solution for using cold has been developed. The methods which include the use of cold are based on the inhibition of microbiological processes in the frozen dough and consist of dough preparation, frosting, storage at subzero temperatures and defrosting (Neyreneuf, 1991; Inoue, 1992). On the other hand, cold in bakery requires major investments and expenses: energy consumption is considerably greater, cooling and defrosting requires heat, a large quantity of additives which enlarge gluten activity, forming capacity and starch hydration capacity.

Frozen dough obtainment technology is influenced by a series of factors, like: flour quality; yeast quantity and quality in the dough; ingredients and additives adding; dough fermentation and kneading conditions; frosting, storage and defrosting conditions (Bordei, 2004).

For improving frozen sheet dough quality, the researches made introduced different ingredients and additives in the manufacturing recipe.

The paper shows a factorial optimization model of type $3^3$ with three independent variables, gluten, ascorbic acid and sodium steroyl-2-lactylate (SSL) quantities, in order to show the influence of these ingredients over frozen sheet dough quality (Azzouz, 1998).

## Experimental

The researches were made at the bakery-milling firm S.C. Pambac S.A Bacau on a technological line of sheet dough obtainment for pastry. The raw materials and manufacturing recipe used in the experiments were flour 480-1 kg; margarine-35%; salt-16%; water-57%; vinegar-0.6%.

For improving frozen sheet dough quality we tested the addition of three ingredients: gluten, ascorbic acid and sodium steroyl- 2-lactylate.

Comparing to classic technology, the sheet dough obtained was frozen at a temperature of -30°C for 30 minutes, and then stored in that state at a temperature of -18°C over periods varied between 10 days, 20 and 30 days.

At the end of each storage period the samples were defrosted slowly: defrosting time 35-45 minutes; defrosting temperature 28-30°C. For quality verification of frozen sheet dough the pastry products were baked at the end in a rotational type oven. The baking was made following these technological parameters: baking time 12-13 minutes and baking temperature 210-220°C. The pastry products obtained were analyzed from an organoleptical point of view. Members of the tasting committee were instructed concerning the criteria for grading the samples, so that every product was appreciated with grades from 0 to 10 as following: between 0 and 2.5

unsatisfactory, between 2.5 and 5 insufficient, between 5 and 7 acceptable, between 7 and 9 good, between 9 and 10 very good.

## Results and Discussions

In the first step we applied a three independent variable moulding programme, gluten quantity ($x_1$), ascorbic acid quantity ($x_2$), sodium steroyl-2-lactylate (SSL) quantity ($x_3$), in order to show the influence of these ingredients over the quality of frozen sheet dough.

The components considered and the variation levels of their concentration in the environment are shown in table 1.

**Table1**. Concentration limits and coding of ingredients added in frozen sheet dough's manufacturing recipe

| Independent variable | Reduced variable | Variation level | | | $\Delta x_i$ | $x_{i\ med}$ |
|---|---|---|---|---|---|---|
| | | -1 | 0 | +1 | | |
| Gluten quantity, (%) | $x_1$ | 0.5 | 1 | 2 | 0.75 | 1.25 |
| Ascorbic acid quantity (ppm) | $x_2$ | 20 | 50 | 100 | 40 | 60 |
| SSL quantity, (%) | $x_3$ | 0.3 | 0.5 | 0.6 | 0.15 | 0.45 |

The response functions pursued are aspect ($y_1$), texture ($y_2$), friability ($y_3$). The factorial model type $3^3$'s coefficients were determined and the following polynomial equations were obtained:

$$y_1=7.88 - 0.079x_1 + 0.095x_2 + 0.214x_3 + 0.178x_1x_2 - 0.024x_1x_3 - 0.142x_2x_3 - 0.24x_1^2 + 0.048x_2^2 + 0.31x_3^2 - 0.035x_1x_2x_3 \quad (1)$$

$$y_2=7.61 + 0.0005x_1 + 0.277x_2 + 0.165x_3 + 0.51x_1x_2 + 0.118x_2x_3 - 0.41x_1^2 + 0.47x_2^2 + 0.08x_3^2 + 0.195x_1x_2x_3 \quad (2)$$

$$y_3=7.9 + 0.068x_1 + 0.268x_2 + 0.068x_3 - 0.186x_1x_2 - 0.18x_1x_3 - 0.118x_2x_3 + 0.032x_1^2 - 0.009x_2^2 + 0.372x_3^2 + 0.01x_1x_2x_3 \quad (3)$$

In order to simplify the models and also to eliminate the terms with minimal influence, the t-student test was made by repeating the experiment three times in the central coordination point (0, 0, 0). The values obtained from the supplementary tests are shown in table 2.

Finally, after neglecting insignificant coefficients, the models obtained were the following:

$$y_1 = 7.88 + 0.214x_3 + 0.178x_1x_2 - 0.24x_1^2 + 0.31x_3^2 \quad (4)$$
$$y_2 = 7.61 + 0.277x_2 + 0.51x_1x_2 - 0.41x_1^2 + 0.47x_2^2 \quad (5)$$
$$y_3 = 7.9 + 0.268x_2 - 0.186x_1x_2 - 0.18x_1x_3 - 0.118x_2x_3 + 0.372x_3^2 \quad (6)$$

**Table 2**. Values obtained at supplementary tests

| Response function | $y_1^o$ | $y_2^o$ | $y_3^o$ | $y_{med}$ |
|---|---|---|---|---|
| Aspect ($y_1$) | 7.66 | 8 | 7.59 | 7.75 |
| Texture ($y_2$) | 8 | 8 | 8.22 | 8.07 |
| Friabilitaty ($y_3$) | 8 | 7.9 | 8 | 7.96 |

In order to visualize these effects, a graphic representation in a three-dimensional space is used (figures 1 - 9).

From the analysis of model $y_1$ it can be observed that gluten and ascorbic acid addition in frozen sheet dough has no direct influence over the finished product's aspect (figures 1 - 3). A favorable effect over aspect can be made by SSL addition, as well as the combined effect of gluten and ascorbic acid addition.

The intensity of ingredient addition over the finished product's aspect varies in the following order: $x_2$ $x_1x_2 > x_1$.

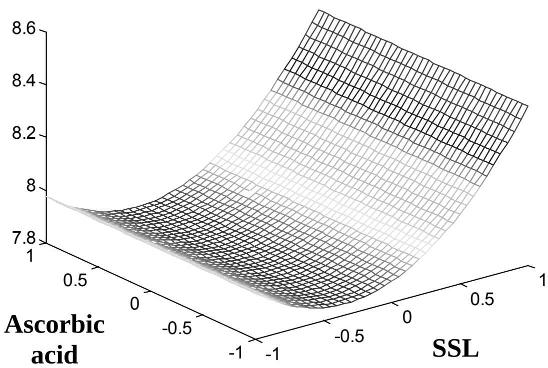


**Figure 1**. Combined effect of ascorbic acid and SSL quantities over pastry products aspect

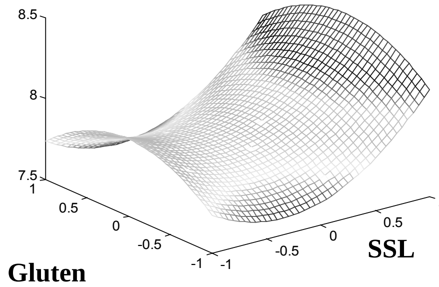


**Figure 2**.Combined effect of gluten and SSL quantities over pastry products aspect

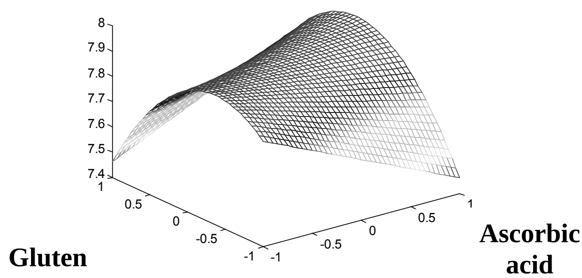


**Figure 3**. Combined effect of gluten and ascorbic acid quantities over pastry products aspect

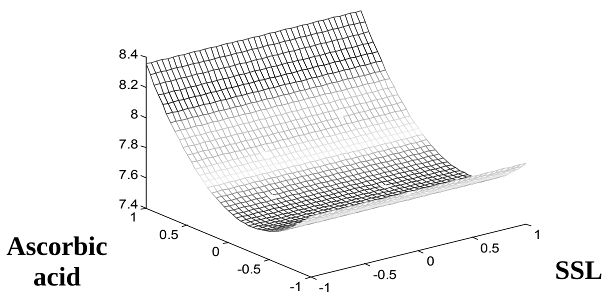


**Figure 4**. Combined effect of ascorbic acid and SSL quantities over pastry products texture

From the analysis of model $y_2$ it can be ascertained that the combined effect of gluten and ascorbic acid addition and the individual addition of ascorbic acid in frozen sheet dough have a positive effect over the finished product's texture (figure 4 - 6). Gluten and SSL addition do not show a direct, individual influence over texture.

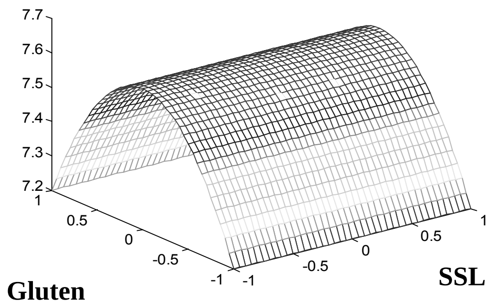


**Figure 5**. Combined effect of gluten and SSL quantities over pastry products texture

The intensity of effects over the finished product's texture varies in the following order: $x_1x_2 > x_2 > x_1$.

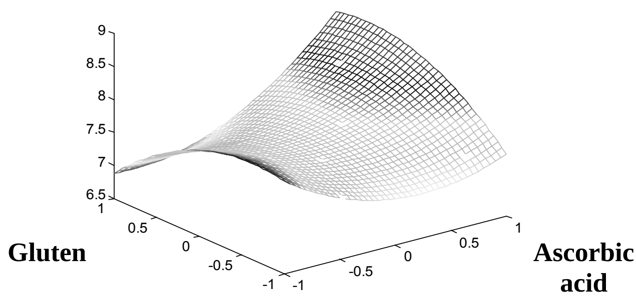


**Figure 6**. Combined effect of gluten and ascorbic acid quantities over pastry products texture

From the analysis of model $y_3$ it can be observed that the addition of ascorbic acid in frozen sheet dough has a favourable effect over the finished product's friability (figures 7 - 9). The combined effect of gluten and ascorbic acid addition, of gluten and SSL addition or of ascorbic acid and SSL addition decreases the finished product's friability.

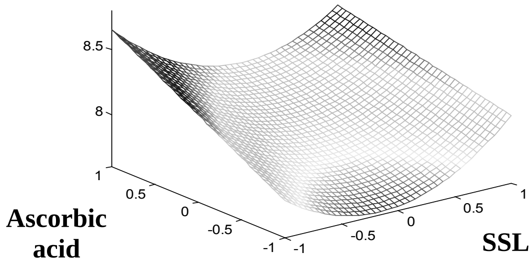


**Figure 7**. Combined effect of ascorbic acid and SSL quantities over pastry products friability

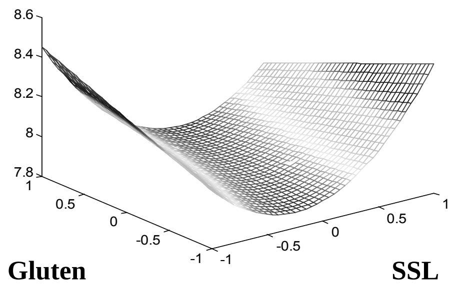


**Figure 8**. Combined effect of gluten and SSL quantities over pastry products friability

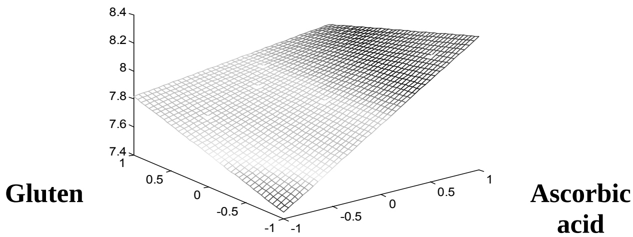


**Figure 9**. Combined effect of gluten and ascorbic acid quantities over pastry products friability

The intensity of effects over the finished product's texture varies in the following order: $x_2 > x_3$. The optimization of developed models was made through derivate annulment method.

Table 3 shows the optimum values of the three parameters used in the experiments.

**Table 3**. Optimum values of the three organoleptic parameters of the finished product

| Response function | Reduced values | | | Real values | | |
|---|---|---|---|---|---|---|
| | $x_1$ | $x_2$ | $x_3$ | Gluten (%) | Ascorbic acid (ppm) | SSL (%) |
| Aspect | 0 | 0 | -0.35 | 1.25 | 60 | 0.4 |
| Texture | 0.14 | - 0.22 | V | 1.35 | 51.2 | - |
| Friabilitaty | 0.125 | -0.024 | 0.024 | 1.34 | 59.04 | 0.45 |

## Conclusions

The optimization models used through a factorial program of 27 experiments have led to the establishment of the following components which optimize the finished product's sensorial quality:

- for aspect: gluten – 1.25%, ascorbic acid – 60 ppm, SSL – 0.4%;
- for texture: gluten – 1.35%, ascorbic acid – 51.2 ppm;
- for friability: gluten – 1.34, ascorbic acid -59.04 ppm, SSL- 0.45%.

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