

## EFFECTS OF SOY FLOUR AND SOY GRITS ADDITION ON PSYCHIC-CHEMICAL AND SENSORY QUALITY OF TWO TYPES OF PASTRIES

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### Abstract

*The influence of the soy blends addition, obtained by lecithinated soy flour and defatted soy grits in different ratios, on the physico-chemical and sensory characteristics of two types of pastries (croissant and choux pastry) was investigated. The type and the amount of the blends affected the chemical parameters and especially the key characteristics (volume, shape, crust, surface, texture, color, taste, flavour etc) of the pastries. The statistical analysis of the sensory parameters showed significant differences between control samples and samples with different ratios of soy blend. The ratios between lecithinated soy flour: defatted soy grits about of 2:3 in the case of croissant and 2:4 for choux pastry did not negatively affect the sensorial parameters ; furthermore an improvement of the key characteristics of the pastries was obtained.*

**Keywords:** soy flour, grits, pastries, quality

### INTRODUCTION

Soybean (*Glycine max*) a self-pollinated crop is one of the most important oil and protein crops of the world (Tariqul Islam et al., 2007). Soybeans contain 30 to 45% protein being a good source of all indispensable amino acids (Serrem et al., 2011). The addition of soy protein to wheat flour increases the protein content and improves the amino acid balance in the food, providing a more nutritious product. The protein content of soybean is higher than the one found in other pulses (about 2 times), wheat and eggs (4 times), rice grain (6 times), and milk (12 times). Most applications for soy flours and grits involve their combination with cereals. Their addition raises both the quantity and quality of the protein in cereal products. The quality of the protein is improved in soy-cereal mixtures because soy protein is a rich source of lysine, the first limiting essential amino-acid in most cereal proteins. Soybean has 3% lecithin, is also rich in calcium, phosphorous and vitamins A, B, C and D (Tariqul Islam et al., 2007).

Several types of soy products have been successfully incorporated in various products including chicken-meat analogs, cereals, pasta etc. (Vittadini and Vodovotz, 2003). Among the soybean products that can be used in baking are enzyme-active soy flour, full-fat flour, defatted soy flour,

soy protein concentrates, soy protein isolates, soy fiber, soy lecithin, and lecithinated soy flour (Stauffer, 2006). Soy flours and grits are made by grinding and screening soybean flakes either before or after removal of the oil. Their protein content is in the range of 40 to 54%. Soy flours and grits are the least refined forms of soy protein products used for human consumption and may vary in fat content, particle size, and degree of heat treatment. They are also produced in lecithinated or refatted forms. The degree of heat treatment creates varying levels of water dispersibility and enzyme activity qualities that can be useful in tailoring functionality in many food applications (Endres, 2001).

Defatted soy flour and grits are the most economical sources of soy protein available. It was reported that defatted, lightly heat-treated soy flour was used in bread and rolls to improve texture, dough conditioning, crumb properties, toasting characteristics, and crust color. Because soy flour can bind and hold large amounts of water through cooking processes, addition of soy flour increases dough's water absorption and, as a result of the improved moisture retention, its machinability is also improved. On average, each 1% increase in soy flour leads to an increase in bread moisture between 0.3 and 0.5%. The moisture of the dough may also help reduce the rate of staling after baking. The flavor of soy flour depends on its heat processing. Addition of more than 1% soy flour, which has a 90% protein dispersibility index (90 PDI) (untoasted), gives an off- flavor to bread. Soy flour with 70 PDI (slightly toasted) generally has a cereal taste and does not affect flavor. Soy flour with a 20 PDI (fully toasted) has a slightly nutty flavor that may be suitable for baking (Endres, 2001)

Grits are coarsely ground flakes; coarse grits can pass through a #10 sieve but remain on a #20 mesh, while medium grits can pass through a #20 sieve but remain on a #40 mesh. Grits for bakery applications are usually toasted (with low PDI) and are used to increase the protein content of breads and biscuits, as well as to impart a nutty flavor.

Lecithinated flour is specialty soy flour made by spraying a mixture of soy lecithin and soy oil onto defatted soy flour. The lecithin/oil ratio is 1/1, and a popular product comprises 15% of the lipid and 85% of soy flour. This product has excellent emulsifying properties and finds applications in products where eggs are used as emulsifiers (Lusas and Riaz, 1995).

It was reported that the incorporation of a soy flour, or a mildly lecithinated soy flour, in a pancake formulation at the 3 % level will result in a golden brown product with improved light and fluffy texture, with a reduced tendency to stick to the griddle. In sweet goods, 2-4 % defatted soy flour improves water-holding capacity, sheeting characteristics, and finished product quality. In hard (snap) cookies, the use of 2-5 % defatted soy flour improves machining and produces cookies with a crisp bite. "Short" pastry

items such as pie crusts, fried pie crusts, and puff pastry can be machined more easily and will retain freshness longer when lecithinated soy flour is used at a concentration of 2-4 % (Sipos, 1994).

This study aimed to assess the influence of the blends obtained by lecithinated soy flour and defatted soy grits at different ratios, on the physico-chemical and sensory characteristics of two types of pastries (croissant and choux pastry).

## **MATERIAL AND METHODS**

### ***Raw Materials, formulations and processing***

A commercial wheat flour type 000 (according to ash content 0.48% by the Romanian classification), with 14.5 % moisture and 13.5 % protein was used. Lecithinated soy flour (LSF, 70 PDI, # 200 mesh, 4% lecithin content) and defatted soy grits (DSG, 30 PDI, and medium size) were purchased from a local producer. All the raw materials (as seen in Table 1) were purchased from the local market. Four treatments (w/w, % on flour) were conducted for each type of pastries dough (croissant or choux pastry) as following:

- a. For croissant dough
  - AT1: 2% LSF
  - AT2: 2% LSF + 2% DSG
  - AT3: 2% LSF + 3% DSG
  - AT4: 2% LSF + 4% DSG
- b. For choux pastry dough
  - BT1: 2% LSF
  - BT2: 2% DSG
  - BT3: 2% LSF+ 2% DSG
  - BT4: 2% LSF + 4% DSG

The croissant dough was obtained in a laboratory mixer by kneading the raw materials ca. 18 min, dough temperature 20°C. After lamination the roll-in-fat was spread and the dough was folded. Two rest periods, about 15 min each, were used by putting the dough in a retarder. The layered dough was then sheeted to a uniformed thickness of 1.5-2 cm, make-up and proofed at 29°C, with a relative humidity of 65-70% for 60 min. The baking period was 15 min at 200°C (for 50 g cold croissant). All the croissant samples were made without filling. In the case of the choux pastry dough, the fat and the water were brought to the boil, removed from the heat and then the flour was quickly added all in once. All ingredients were mixed until the dough structure was formed and after 2-3 minutes of cooling the eggs were gradually added and mixed in order to obtain a smooth, shiny paste. A pastry bag was used to form balls with 1.5 cm diameter which were

then baked at 180°C for 15 min. Formulations for croissant and choux pastry dough are presented in Table 1.

#### Physico-chemical analyses

The determination of the chemical parameters: moisture content, protein content, fat content, ash content were determined by methods described by *Romanian settlement STAS 91-83 „Bread, loaf products and bakery specialties”*. Also, the pastry quality score sheet (Stanley Cauvain) was applied in order to compare the external (volume, uniformity shape, crust, surface appearance) and the internal (cell structure, texture characteristics, flavor/aroma) characteristics of the samples.

Table 1

Dough's formulation for croissant and choux pastry obtained without soy blend addition (control samples A, B)

Ingredients, %	Croissant (A)	Choux pastry (B)
Wheat flour	100	100
Water	52	160
Yeast	5.5	-
Fat	6	67
Laminating margarine	40	-
Granulated Sugar	6	-
Whole eggs	3	160
Salt	1.8	0.9

\*Fat content (%) of margarine 70

#### Sensory analysis

Sensory evaluation of the composite bread samples was carried out by 20 panelists on a 9 point hedonic scale for different parameters such as colour, aroma, taste, texture and overall acceptability as described by Ihekoronye and Ngoddy (1985).

#### Statistical analysis

The sensory evaluation data was statistically analyzed using the analysis of variance (ANOVA) and the Dunnett's Multiple Comparison Test.

## RESULTS AND DISCUSSION

The results obtained from the chemical parameters investigated are shown in Table 2. The type and the amount of the blends obtained from different soy products affected the chemical parameters and especially the key characteristics (volume, shape, crust, surface, texture, color, taste, flavour etc) of the pastries. For the both types of pastries, croissant and choux pastry, the values for the protein, moisture, fat and ash content are lowest in the control samples (A, B) made without soy blend addition.

Protein content of the croissants with added soy product ranged from 8.63 to 12.73 %. The minimum value of the protein content was recorded in the case of AT1 containing the smallest amount of LSF, while the maximum value is due to an increased amount of blend (soy flour and grits) in sample AT4.

Table 2

Protein, moisture, fat and ash content (%) for the pastries samples obtained without soy product addition (A, B) and with different ratios of soy product (AT1-AT4, BT1-BT4). For codification see *Materials and Methods*.

Pastries Samples	Parameters			
	Protein content (g %)	Moisture content (%)	Fat content (%)	Ash(%)
A	7.03±0.13	20.09±0.9	20.05±0.3	1.12±0.1
AT1	8.63±0.2	25.28±0.3	24.89±0.1	1.19±0.2
AT2	10.23±0.1	29.78±0.12	25.71±0.2	1.28±0.12
AT3	11.3±0.14	32.28±0.2	26.19±0.2	1.31±0.1
AT4	12.73±0.2	34.98±0.13	26.96±0.12	1.36±0.24
B	8.53±0.4	24.49±0.32	24.32±0.2	1.09±0.2
BT1	9.04±0.3	25.77±0.2	28.32±0.15	1.15±0.13
BT2	8.99±0.2	26.01±0.15	25.04±0.3	1.19±0.09
BT3	9.56±0.12	27.05±0.32	30.09±0.1	1.29±0.12
BT4	10.2±0.13	28.96±0.2	32.89±0.3	1.34±0.3

\*Data represent means values± SD for three independent trials

Same pattern was recorded in the case of choux pastry, with a maximum value for protein content around 10.2%. The increased protein content in this type of pastries is related to the high protein content of the soy products. Similarly, the fat content increased with the increasing ratio of soy blend and it is related to the fat content of the added soy products. It is known that LSF has an increased fat content than DSG. The fat content ranged from 20.05% in the control sample A to 32.89% in the sample BT4. The ash content increased with the increasing level of soy product, both in the croissant and choux pastries samples. Soy products addition in pastries formulations increased also the moisture content of the final products; an increased amount of soy blend contributing to a higher moisture content. Similar results were reported by Ndife et al., 2011, Tariqul Islam et al., 2007, Sanful and Darko, 2010 in baking products containing different amounts of soy flour.

As seen in figure 1, samples AT3 and BT4 recorded the highest values for external characteristics score and internal characteristics score, respectively. The total score calculated for these samples was 93 in the case of sample AT3 and 97 for BT4. In terms of quality descriptors this high score level could be explained by high volume, regular and uniform shape,

light brown even crust, even cell structure with thick cell walls and soft silky texture, all this parameters being characteristic for samples AT3 and BT4.

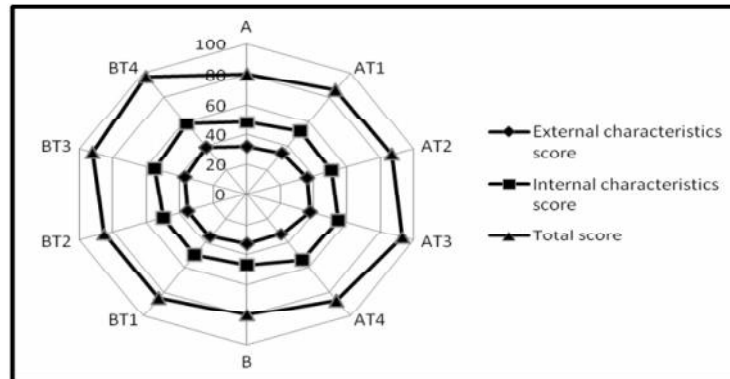


Fig.1 Quality scores for external and internal characteristics of the pastries samples obtained without soy product addition (A, B) and with different level of soy product (AT1-AT4, BT1-BT4). For codification see Materials and Methods.

In the case of croissant samples, treatments AT1, AT2, AT3 led to products whose external and internal scores had an upward trend, while treatment AT4 (containing the highest amount of DSG, namely 4%) decreased these scores. In the case of choux pastry, by increasing the soy blend amount (and the DSG ratio) the above mentioned scores were the highest. In all choux pastries samples, the soy blend contributed to the increase of the quality scores compared with the control samples. In this case, the treatment containing 2% LSF and 4% DSG recorded the highest quality scores. By analyzing the results of the sensory analysis (table 3) with Dunnett's Multiple Comparison Test, significant differences (\*\*\*,  $p < 0.05$ ) were found between the control sample A and AT2, AT3, AT4 samples. Instead, no significant differences were found between control sample A and AT1 sample -containing 2% LSF. It was found a good linear correlation ( $r^2 = 0.86$ ) between soy blend level and the overall acceptability of the croissant samples (AT1- AT4). In the case of choux pastry samples, the Dunnett's Multiple Comparison Test showed significant differences (\*\*\*,  $p < 0.05$ ) between the control sample B and BT2, BT3 and BT4 samples, but no significant differences between the control B and BT1 sample. Finally, the addition level of the defatted soy grits was compared with the overall acceptability of the choux pastry samples and a good linear correlation ( $r^2 = 0.89$ ) was found. We can conclude that for the croissant, the treatment containing 2% LSF and 3% DSG led to an optimal sensory acceptability, while for the choux pastry we found the blend containing 2% LSF and 4%

DSG being the best one. Also, we observed an enhancement of the dough's rheological properties during the manufacturing of the pastries samples.

Table 3

Sensory mean scores of the pastries samples obtained without soy blend addition (A, B-control samples) and with different ratios of soy blend (AT1-AT4, BT1-BT4). For codification see *Materials and Methods*.

Pastries Samples	Parameters				
	Crust color	Crumb appearance	Texture	Flavour	Overall acceptability
A	7.30	7.10	7.25	7.45	7.25
AT1	7.45	7.30	7.45	7.30	7.30
AT2	7.75	8.00	7.75	7.75	7.80
AT3	8.10	8.15	8.15	8.10	8.15
AT4	8.00	8.10	8.00	8.00	8.00
B	7.40	7.30	7.80	7.10	7.50
BT1	7.60	7.50	8.00	7.45	7.60
BT2	7.75	7.60	8.10	7.60	7.80
BT3	8.00	8.00	8.15	8.10	8.00
BT4	8.15	8.20	8.15	8.20	8.15

Even if some authors (Brewer et al., 1992, Ndife et al., 2011) reported that soy product addition in wheat flour negatively affect the sensorial parameters of baked goods, our results show that by combining 2% LSF with 3-4% DSG in pastries formulations, the sensory quality was improved comparing with the control samples. It may be due to the nutty flavour of the DSG and also to the emulsifying properties of the lecithinated soy flour. Based on the results obtained in the first part of our study, we selected the treatments AT3 (2% LSF +3% DSG) in the case of croissant and BT4 (2%LSF +4% DGS) in the case of choux pastry, as the best treatments for these types of pastries. In the second part of the study we aimed to reduce the egg amount in pastries formulation (as presented in Table 1) with selected treatments. Thereby, we totally reduced the egg content in croissant formulation and we supplemented the water content at the ratio of 55% (sample AT3.1). In the case of choux pastry formulation we replaced 20% of the egg content with 6% soy blend (2% LSF +4% DGS) and 12% water (sample BT4.1) in.

The samples AT3.1 and BT4.1 were submitted to the sensorial exam and the quality score sheet was accomplished in similar conditions as for the first part of the study. No significant differences ( $p>0.05$ ) were found between the samples AT3.1 and AT3, BT4.1 and BT4, respectively. Also, in these samples an enhanced dough yield was obtained by increasing the water content and the water holding capacity. By reducing the egg content in pastries not only costs saving (Porter and Skarra, 1999) are important but also the extend freshness.

## CONCLUSIONS

In this study we used soy blends obtained by combination of lecithinated soy flour (LSF) and defatted soy grits (DSG) at different ratios in order to improve the overall baking characteristics of two types of pastries: croissant and choux pastry. The ratios between LSF: DSG about of 2:3 and 2:4 were selected as the best for croissant and choux pastry quality, respectively. This level of addition did not negatively affect the sensorial parameters; furthermore an improvement of the key characteristics of the pastries being achieved. Also, these soy products blends allow to reduce the egg content in pastries formulations (both for croissant and for choux pastry) and thus to prolong the freshness of the final product.

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