

## Studies regarding the obtaining and sensory analysis of gluten-free muffins with buckwheat flour addition

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### Abstract

The celiac disease or gluten sensitive enteropathy is an autoimmune disorder, that affects the small intestine which can not metabolize gluten. Since celiac disease affects approximately 1% of world's population, the demand for gluten free products is constantly increasing and manufacturing bakery products from cereals, without harming these people is a great challenge for bakers nowadays. Starting from these considerations, this paper, part of a more complex study, aims the obtaining of some gluten free muffins based on rice flour, with high nutritional value, by adding buckwheat flour in different amounts and the influence of buckwheat flour on the final product. Gluten free muffins were prepared by the same recipe, in three trials, in which rice flour and buckwheat flour varied: T1- RF:BWF(90:10), T2- RF:BWF(80:20), T3- RF:BWF(70:30). A blank sample of the gluten free muffins was prepared by using only rice flour as basis.

It was concluded that, the optimum amount of buckwheat flour addition in gluten free muffins, would be that of 20%, in order for a final product with a high acceptability by the consumer to be obtained.

**Keywords:** Gluten-free, muffins, buckwheat, sensory analysis.

### 1. Introduction

Gluten sensitive enteropathy known as celiac disease, is a chronic disorder of the small intestine caused by the exposure to gluten, to genetically predisposed individuals [1]. In susceptible individuals, the ingestion of gluten leads to the damage of the mucosal surface of the small intestine [1]. In spite of the advances made in its diagnosis, celiac disease remains largely unrecognized, affecting 1% of most populations [2]. Once diagnosed, a celiac disease patients directed to a life-long gluten-free diet, that prevents morbidity and reduces the incidence of the associated gastrointestinal affections [3].

As the bakery industry and floury products sector occupies an important place in the framework of

consumer goods manufacturing, due to the fact that bread is a daily consumed staple food [4], it results an emerging need for the development of new gluten-free bakery products suitable to consumer's needs, in order to increase his dietary choices and improve quality of life in general [5].

The manufacture of bakery products without gluten is a great challenge for science people and a major problem for bakers nowadays. In recent years, the interest on gluten-free bakery products has been increasing. Thus, science people have searched an alternative to classic wheat or other gluten containing flours, by using *pseudocereals* or legume flours that are gluten-free and rich in proteins, for the nutritional quality of the product, and gums or enzymes, in order to mimic viscoelastic properties of

lacking gluten and to increase the overall acceptability of the final product [6,7].

Rice flour is among the most used raw material for gluten-free bakery products manufacturing. Exhibiting hypoallergenic properties [8], low in fat (0.4%) [9], it is recommended for soft, delicate doughs for muffins, cakes or biscuits.

Buckwheat is a pseudocereal with a high quality nutritional profile, being an important source of protein and amino acids, vitamins, starch and fibre [10]. Buckwheat flour exhibits a grey color and a characteristic taste.

Starting from these considerations, this paper aims to obtain some gluten-free sweet bakery products, that is, muffins, with high nutritional properties given by the addition of buckwheat flour and a high overall acceptance by the consumer.

## 2. Material and Methods

### 2.1. Materials.

All raw materials used in these experiments have been purchased from specialized stores.

### 2.2. Methods

#### 2.2.1. Analytical methods applied to flours.

The analytical methods used in experiments for determining the quality indices of rice and buckwheat flour have been the following: Moisture content (%) SR-877-1996; Protein content (%) STAS 90-2007; Lipids (%) STAS -90-2007; Water absorption (%) and Ash content (%) STAS-90-2007, respectively.

#### 2.2.2. Technological process for obtaining gluten-free muffins

The common technological process was used for gluten-free muffins manufacture. The recipe used was the following one: gluten free flour 400 g, corn starch 100 g, xanthan gum 10 g, milk 450 mL, oil 350 mL, eggs 300 g, sugar 250 g, baking soda 10 g and salt 5 g.

Three trials were performed, in which various blends of gluten-free flours were used, that is: (RF:BWF): T1-90:10, T2-80:20, T3-70:30. Similarly, control gluten-free muffins samples were prepared from rice flour only.

After being kneaded, the dough was placed in small paper cups for baking. The optimum parameters of the technological process were: kneading – 15 minutes at high speed, baking for 20 minutes/180°C. After baking, the muffins were cooled at room temperature, and put into paper bags.

#### 2.2.3. Sensory and physical-chemical evaluation of gluten-free muffins

Gluten-free muffins samples prepared according to the protocol described in paragraph 2.2.2., were subjected to sensory and physico-chemical evaluation, aiming: aspect and shape, color, taste, flavor and softness (according to STAS 91-2007: “Bread, loaf products and bakery specialities. Analysis methods”). The sensory analysis was performed by using the Romanian scoring scheme.

## 3. Results and Discussion

### 3.1. Quality of rice flour, buckwheat flour and their blends

The nutritional parameters of gluten-free flours and their mixtures, used in the experiments, are shown in Table 1.

By comparing the values obtained for the analysed samples (**RF 100%**, **RF90% BWF10%**, **RF80% BWF20%**, **RF70% BWF30%**, **BWF100%**) it can be stated that these flours can be used in gluten-free baking, due to the fact that they are gluten-free mainly, but also for their nutritional value.

Summarizing the data presented in Table 1, regarding the quality indices and chemical composition of rice and buckwheat flour and their blends, the following assessments can be made:

- The water absorption of the flour blends increased with increasing protein contents;
- The moisture content of flour blends decreased with rice flour proportion increasing
- Buckwheat flour, due to its nutritive value is highly recommended for use in gluten-free baking

### 3.2. Sensory evaluation of gluten-free muffins

The use of well-proportioned blends of gluten-free flours (rice flour and buckwheat flour, respectively)

led to the obtaining of a final product with optimum sensory characteristics, in accordance with STAS 1227-3/1990. Sensory evaluation of the assortments of gluten-free muffins obtained in the “Milling and Baking Technology” Laboratory, was

performed using the points scale method, which accordingly, they have obtained the following qualifications, presented in Table 2. The evaluation was carried out by 13 tasters, untrained and not celiac people.

**Table 1.** Quality indices of gluten-free flours and their blends used in gluten-free muffins manufacture

Quality indices	Experimental values				
	RF100%	RF90%BWF10%	RF80%BWF20%	RF70%BWF30%	BWF100%
Moisture (%)	12.88	12.37	12.47	12.50	11.77
Lipids (%)	2.46	2.24	2.39	2.45	2.4
Protein (%)	5.29	6.05	6.11	7.4	11.21
Ash (%)	1.48	1.58	1.59	1.71	1.89
Water absorption (%)	100	90.9	83.33	76.92	111.11

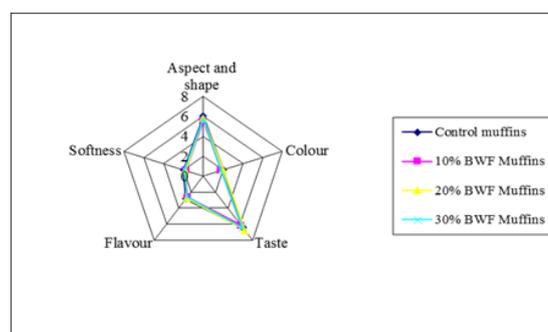
**Table 2.** Scores assigned to gluten free buckwheat added muffins

Sample	Maximum score	Scores obtained			
		Control muffins	BWF10% Muffins	BWF20% Muffins	BWF30% Muffins
Aspect and shape	6	6	5.53	5.81	5.77
Colour	2	2	1.77	2	1.77
Taste	7	6.46	6.15	6.77	6.46
Flavour	3	2.85	2.62	2.77	2.62
Softness	2	2	1.77	1.81	1.92
Maximum score average	20	19.53	17.92	19.15	18.54

**Table 3.** Gluten-free muffins with buckwheat flour added physical-chemical features

Analysed physical-chemical features	Control muffins	10% BWF muffins	10% BWF muffins)	10% BWF muffins
Product moist (%)	24.69	24.85	24.98	25.49
Product acidity (acidity degrees/100g product)	0.8	1	1.3	1.7
Protein (%)	7.05	7.85	8.15	8.89
Lipids (%)	21.24	21.45	21.87	22.14

Summarizing the data presented in Table 2, it can be said that the samples sensory evaluated (the four assortments of gluten-free muffins) fit in the first two categories of quality (“very good” and “good”), but in terms of sensory analysis, the 20% buckwheat flour muffins and 30% buckwheat flour muffins, respectively, are best, by reaching a score of 19,15 (the 20% buckwheat flour gluten free muffins) and 18,54 (the 30% buckwheat flour gluten free muffins).



**Figure 1.** Spider diagram for sensory evaluation of gluten-free BWF added muffins

Gluten-free muffins with 30% buckwheat flour added reached a total score of 18.54, while the control gluten-free muffins samples reached a total score of 19.53 (Table 2). The gluten-free muffins with 20% buckwheat flour had a maximum score regarding the colour (2 points) and the highest score for taste (6.77 out of 7) (Figure 1).

### 3.3. Physical-chemical evaluation of gluten-free muffins with buckwheat flour added

After the sensory evaluation, the gluten free muffins with BWF added samples, were subjected to physico-chemical analysis. The experimental results obtained in this study, are given in table 3.



Figure 2. Gluten-free BWF added muffins aspect in section

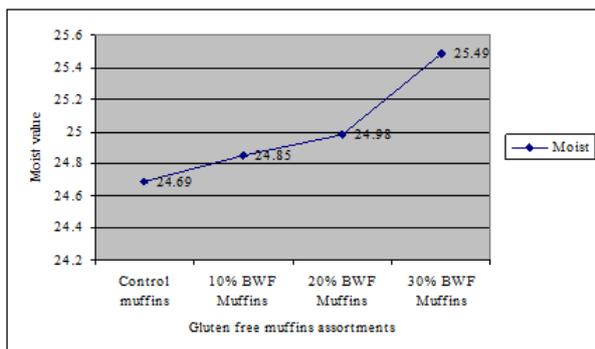


Figure 3. Moist variation to gluten-free BWF added muffins

From data presented in Figure 3, it can be seen that moist is lower in the control sample (24.69%) and it increases with the increasing of the buckwheat flour amount addition 24.85% (10%BWF Muffins), 24.98% (20%BWF Muffins) and 25.49% (30%BWF Muffins), respectively.

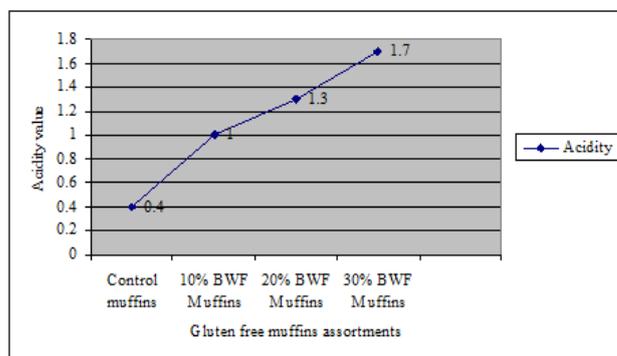


Figure 4. Acidity variation to gluten-free BWF added muffins

20%BWF Muffins and 30%BWF Muffins exhibit an acidity of 1.3 grades and 1.7grades, respectively, due to the fact the buckwheat flour contained has an acidic character. This increased acidity in gluten free BWF added muffins, leads to a higher instability to storage comparative to the other assortments of gluten free muffins (Figure 4).

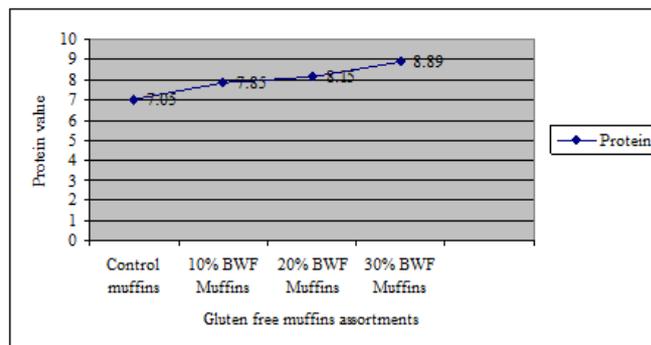


Figure 5. Protein variation to gluten-free BWF added muffins

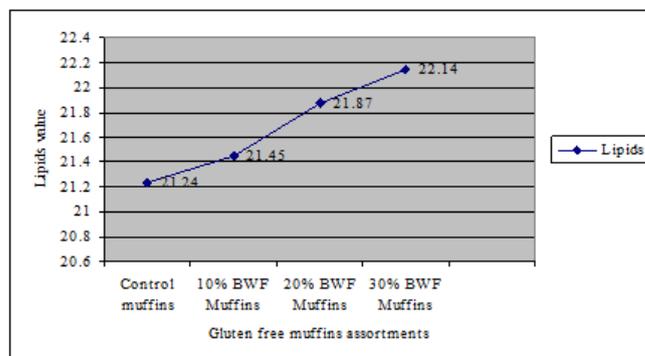


Figure 6. Lipids variation to gluten-free BWF added muffins

The protein content of the analysed samples fit in the limits provided by the standards, and ranges between 7.05% for the control sample and 8.89% for the 30% BWF Muffins (Figure 5), confirming that the protein content of the gluten free studied muffins increases along with the increasing amount of buckwheat flour added.

Figure 6 reveals that all three samples of gluten free BWF added muffins exhibited a higher lipids content than the control muffins sample. Comparing the gluten free muffins analysed, it can be seen that the 30%BWF Muffins exhibit the highest lipids content (22.14%), followed by the 20%BWF Muffins (21.87%) and 10%BWF Muffins (21.45%), respectively.

#### 4. Conclusions

The results obtained in this study indicate that the addition of 20% buckwheat flour can be successfully used in gluten free baking, in order to obtain an end product – gluten free muffins in this case, with a high acceptance by the consumer. Thus, by this amount of buckwheat flour addition, the sensory characteristics and physicochemical properties of gluten free muffins are improved.

The recommended recipe, following the results obtained in this study, is: rice flour 320 g, buckwheat flour 80 g, corn starch 100 g, xanthan gum 10 g, milk 450 mL, oil 350 mL, eggs 300 g, sugar 250 g, baking soda 10 g and salt 5 g; kneading – 15 minutes at high speed, baking for 20 minutes/180°C.

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