

Nutritional and sensory quality evaluation of gluten free cake with Pecan nuts

D. Gurbina¹, Nicoleta-Andrada Fruja¹, Paula-Roxana Mot¹, Antoanela Cozma¹,
D. Stoin^{1*}

¹Banat's University of Agricultural Sciences And Veterinary Medicine „King Michael of Romania” from Timișoara, Faculty of Food Products Engineering, 119, Calea Aradului, 300645, Timișoara, Romania

Abstract

The present study was based on the development and sensory and chemical evaluation of gluten free cake, specially designed for people with celiac disease or for diabetic ones, made with millet flour (MF), rice flour (RF) and Pecan nuts (PN). Stevia extract was used as a sweetener. Three cake samples were prepared with MF and RF, added in different proportion (20%, 40%, 60% MF), mixed with other ingredients and compared with control sample (100% RF).

According to the results obtained, the flour blends: 20% RF: 80% MF, 40% RF: 60% MF and 60% RF: 40% MF are suitable to be incorporated in the gluten free cake, obtaining products with improved sensory and nutritional characteristics than those obtained solely from RF. The results showed that the addition of 40% MF to the dough has improved the sensory and chemical characteristics of the samples of the cake obtained, and consequently increased their nutritional value

Keywords: gluten free cake, Pecan nuts, sensory evaluation, nutritional quality.

1. Introduction

Studies performed in recent years show that the evolution of human society is largely determined by the quantity and quality of food used for daily nutrition [1]. In this respect, modern science of food and nutrition shows increasing importance to both preventative role of nutrition in disease onset and production of food for people with increased sensitivity to certain foods. Thus, due to the reactions they produce, food intolerances have become a major problem for the population [2, 3]. Currently, both nationally and internationally, there is a growing concern regarding celiac disease, both in its medical aspects and to ensure adequate nutrition and food, gluten-free offering for this category of the population [4].

A gluten-free diet is made for a celiac disease person or for a person who is trying to fuel his body with healthiest ingredients. Celiac disease is a permanent intolerance to certain proteins which are found in wheat, barley, rye or in some bakery products such as pasta or bread, which are called

“gluten”. The only treatment that exists right now is a strict life-long gluten free diet [1, 3].

This study aimed to produce a healthy gluten free cake with higher nutritional value specially designed for people intolerant to gluten or for diabetic ones, made with millet flour, rice flour and Pecan nuts.

Millet flour is gluten free and has been found to be a healthy choice for people with celiac disease. Millets are small seeds, widely grown around the world as cereals or grain and they contain about 75% complex carbohydrate and 10% fat and fibre [5]. Millets can be excellent cereals which can potentially replace wheat in gluten-free bakery products as they lack gluten forming protein fractions. They are a good source of energy, protein, minerals and vitamins. Millet proteins are a good source of most essential amino acids except lysine and threonine but contain a higher amount of methionine. Millets contain abundant phytochemicals and micronutrients and due to these nutritional benefits millets are termed as “nutri-cereals” [6].

Rice flour is a key ingredient in most gluten free recipes. White rice flour is flavored flour which works very well in almost all delicate baked goods [2].

Pecan nuts have the highest fat content of any nut, are full of healthy monounsaturated fats and contain just a few saturated ones. Pecan nuts are rich in minerals critical for growth and metabolism, source of thiamin and protein and contain vitamin E which has antioxidant effects and may boost immune activity [7].

They contain many phyto-chemical substances that may contribute to their overall antioxidant activity (E vitamin, β -carotene, lutein) and several important B-complex vitamins (riboflavin, niacin, thiamin, pantothenic acid, vitamin B-6, folates), minerals (manganese, potassium, calcium, iron, magnesium, zinc, selenium), and phytosterols [8].

Based on these observations, this study aimed at creating a gluten free product: gluten free cake, nutritionally optimized type that would not exhibit the allergen factor, but would contain the nutrients necessary for correcting malabsorption deficiencies created by illness, aimed to be consumed by children and adults who suffer from celiac disease.

2. Material and methods

2.1. Materials

All raw materials used for gluten free cake preparation have been purchased from hypermarkets and specialized stores.

2.2. Methods

Proximate composition of RF, MF and PN: For determining the average chemical composition of RF, MF and PN the following chemical characteristics were determined: moisture, fat content, ash content, crude fiber content and carbohydrate content, according to standard method A.O.A.C. 1995 [9]; protein content by the Kjeldahl method according to standard method A.A.C.C. 2000, No. 46-10 [10].

Technological process for obtaining gluten free cake with PN: In this study we have obtained 4 assortments of gluten free cake, as follows: a control sample – (100% RF: 0%MF), cake with 20% MF addition (80% RF: 20%MF), cake with 40% MF addition (60% RF: 40%MF) and cake with 60% MF addition (40% RF: 60%MF).

The gluten free cake formulations are presented in Table 1. Butter and eggs were mixed together for 2 min at medium speed with an electric hand mixer. RF, MF and PN, stevia extract and baking powder were mixed together in a separate bowl, and then added over wet ingredients at high speed for 10 seconds. The four cake samples were baked 20-25 minutes at 170°C in a preheated oven. After baking, the gluten free cake samples were cooled at room temperature, then packed in cardboard boxes and stored at temperatures of 12°C [11, 12].

Sensory evaluation of gluten free cake with PN: The cake samples obtained according to the method described in paragraph: *Technological process for obtaining gluten free cake with PN*, were submitted to sensory indices evaluation. A panel of 25 semi-trained judges of both genders aged 20 - 35 years, students of Food Processing Technology evaluated the gluten free on a 9-point hedonic scale (1=dislike extremely, 5=neither like nor dislike, 9=like extremely). Gluten free cake were sliced into half and offered to the judges on a white plate at room temperature. Panellists were given water at room temperature to cleanse the mouth before tasting the samples from each formulation. All four cake samples were served, one at a time, to each taster. General appearance, flavour, texture, taste and overall acceptability were evaluated [11, 13].

Chemical evaluation of gluten free cake with PN: The cake samples obtained according to the method described in paragraph: *Proximate composition of RF, MF and PN*, were submitted to chemical evaluation aiming: moisture, fat content, protein content, ash content, crude fiber content, carbohydrate content according to A.O.A.C. and A.A.C.C. standard method [9, 10].

Results and discussion

Proximate composition of RF, MF and PN: In Table 2 are shown the results obtained from the proximate analysis of flours and PN. The results obtained with regard to the chemical composition of RF, MF and PN highlight their functional potential. According to these results, MF and PN can be considered important "protein sources" and "fiber sources", as the protein content ranges between 14.36% in MF and 9.89% in PN, the fiber between 6.82% in PN and 3.26% in MF, results that are consistent with those obtained by Moodley R. *et al.* (2007), Poongodi V.T. *et al.* (2009) and Tharise, N. *et al.* (2014) [14, 15, 16].

Table 1. Formulas for gluten free cake with PN

Ingredients (%)	Control sample 100RF:0MF	Cake with 20% MF 80RF:20MF	Cake with 40% MF 60RF:40MF	Cake with 60% MF 40RF:60MF
Rice flour (RF)	100	80	60	40
Millet flour (MF)	0	20	40	60
Pecan nuts (PN)	100	100	100	100
Butter	100	100	100	100
Stevia extract sweetener	22.5	22.5	22.5	22.5
Baking powder	5	5	5	5
Egg	150	150	150	150

Table 2. Chemical composition of RF, MF and PN

Chemical composition (%)	Flour samples		Pecan nuts (PN)
	Rice flour (RF)	Millet flour (MF)	
Moisture	14.48±0.11	13.36±0.11	3.90±0.23
Fat	1.88±0.24	8.42±0.07	63.78±0.09
Protein	12.14±0.26	14.36±0.09	9.86±0.42
Crude fiber	3.58±0.03	3.26±0.22	6.82±0.09
Carbohydrates	65.78±0.19	59.06±0.06	14.14±0.23
Ash	2.14±0.05	1.54±0.08	1.50±0.13

All determinations were done in triplicate and the results were reported as average value ± standard deviation (SD).

Table 3. Sensory evaluation of gluten free cake by 9-point hedonic scales

Samples	Appearance	Flavor	Texture	Taste	Overall acceptance
P1	6.86 ± 0.24	7.05 ± 0.04	7.62 ± 0.14	7.24 ± 0.32	7.41 ± 0.24
P2	6.62 ± 0.09	7.34 ± 0.24	7.38 ± 0.42	7.86 ± 0.44	7.92 ± 0.44
P3	6.48 ± 0.26	7.65 ± 0.32	7.19 ± 0.09	8.24 ± 0.27	8.16 ± 0.62
P4	6.26 ± 0.16	7.48 ± 0.06	6.88 ± 0.08	8.08 ± 0.08	7.86 ± 0.34

All determinations were done in triplicate and the results were reported as average value ± standard deviation (SD).

The results obtained regarding the chemical composition of MF compared to RF highlight its nutritional potential, as a result of the higher protein and fat content. MF showed high levels of protein - 14.36% compared to 12.14% in RF and fat - 8.42% compared to 1.88% in RF and lower fiber levels - 3.26% compared to 3.58% in RF, ash - 1.54% compared to 2.14% in RF, and carbohydrates - 59.06% compared to 65.78% in RF, results that are consistent with the obtained results by Moodley R. *et al.* (2007), Poongodi V. T. *et al.* (2009), Tharise N. *et al.* (2014) and Amir G. *et al.* (2015) [14, 15, 16, 17]. In contrast, PN showed high levels of fiber - 6.82% and fat - 63.78% and lower levels of protein - 9.86% and ash - 1.50%, results which are comparable to those obtained by Moodley R., *et al.* (2007) and Medina-Juárez L.A. (2018) [14, 18]. The carbohydrate content was lower in the case of MF and PN compared to RF, which ranged from 14.14% in PN to 59.06% in MF compared to 65.78% in RF, which leads to obtaining gluten free cake samples with low glycemic index.

Regarding the moisture of the analyzed samples, this was lower in the case of PN (3.90%) and of MF (13.36%) compared to that of RF (14.48%) [14, 15, 16].

Sensory evaluation of gluten free cake with PN: Sensory characteristics of gluten free cake obtained in this study were influenced mainly by the raw materials (RF, MF and PN) and proportions used in the formulation, the results being presented in the Table 3. Experiments conducted in the laboratory belonging to Faculty of Food Engineering at the Banat's University of Agricultural Sciences and Veterinary Medicine "King Michael I of Romania" from Timisoara, showed a direct correlation between the dough composition, working technological parameters and qualitative properties of these cake assortments.

The cake with MF and PN were marked as:

- P1** – Control sample;
- P2** – Cake with 20% MF;
- P3** – Cake with 40% MF;
- P4** – Cake with 60% MF.

The four assortments of gluten free cake obtained were sensory evaluated using 9-point hedonic scales by a number of 25 tasters. Hedonic ratings for product attributes and overall likeability are presented in *Table 3*.

The analyzed gluten free cake samples showed changes in taste and odor depending on the proportion of MF added, thus, the lowest score was obtained by the P1 sample (flavor - 7.05, and taste - 7.24), and the highest score by sample P3 (flavor - 7.65, and taste - 8.24), the sample in which the proportions of flour were as follows: 60% RF and 40% MF.

The attribution for texture was considerably lower, comparing control sample P1 with samples containing different proportions of MF (P2-P4), the hedonic rate for texture decreasing as follows: P1(7.62) > P2(7.38) > P3(7.19) > P4(6.88).

Previous product attributes influenced the overall acceptability of the gluten free cake, the rate increasing in P2 - 7.92 and P3 - 8.16 samples compared with control sample (7.41) but to P4 sample the hedonic rate decreased to 7.86.

By centralizing the results obtained regarding the sensory analysis of gluten free samples, it can be observed that the cake sample with 60% RF and 40% MF was the most appreciated by the evaluators (**overall acceptance 8.16**) (*Table 3*) [19, 20, 21].

Chemical evaluation of gluten free cake with PN: Results showed in *Figure 1 ÷ 6* are the chemical composition of gluten free cake substituted with different levels of MF.

From the data presented in *Figure 1* it can be observed that the moisture of gluten free cake with PN samples were without exception lower than in P1 sample (27.86%), ranging between 25.62% in sample P2 and 22.36% in P4 sample. The values for moisture recorded in the case of the gluten-free cake are within the range of values indicated in the literature for cake-like precooked products (22-32%) [19, 20, 21].

In *Figure 2*, the fat content variations of the gluten-free cake samples with PN are shown. Thus, an increase in the fat content is observed as the proportion of added MF increases, from 20.92% in P2 to 24.48% in P4 compared to 16.87% in P1. MF being richer in fat (8.42%) compared to RF (1.88%) influences the amount of fat of the finished product.

The fat content of the analyzed cake samples falls within the values provided in the literature [19, 20].

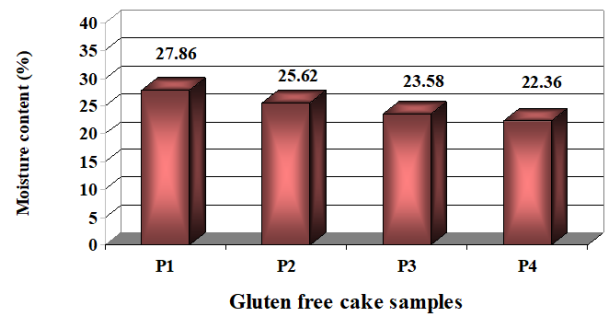


Figure 1. Moisture content of gluten free cake samples

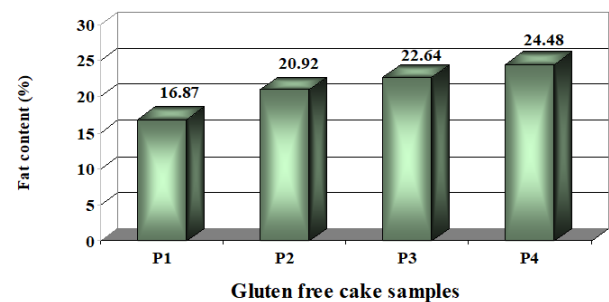


Figure 2. Fat content of gluten free cake samples

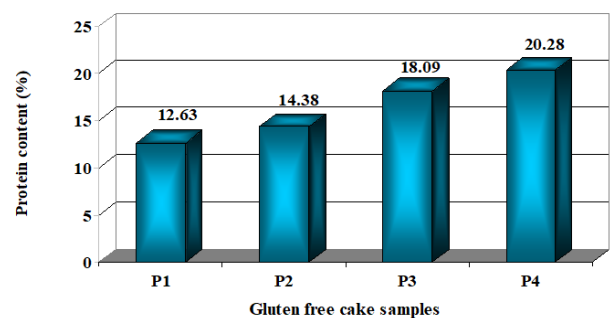


Figure 3. Protein content of gluten free cake samples

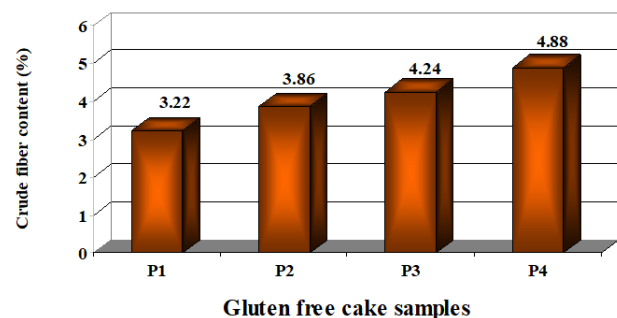


Figure 4. Crude fiber content of gluten free cake samples

Analyzing the chart in which the protein content of the studied gluten-free cake samples is represented (*Figure 3*), it can be observed the increase of the protein content proportional to the percentage of MF added, since MF is richer in protein (14.36%) compared to RF (12.14%). Sample P1 has a protein

content of 12.63% compared to sample P4 which has a protein content of 20.28%. The protein content of the analyzed samples is within the limits existing in the literature data [19, 20].

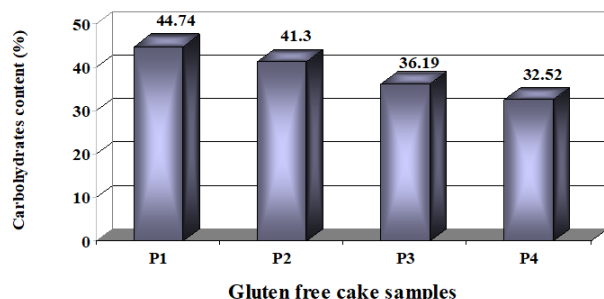


Figure 5. Carbohydrates content of gluten free cake samples

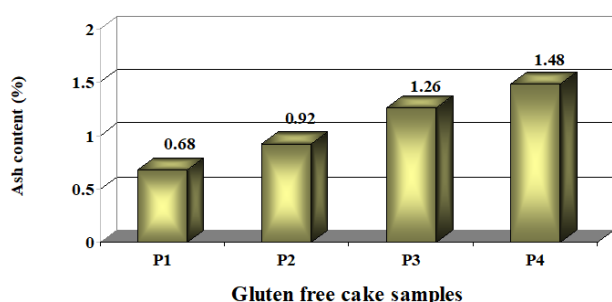


Figure 6. Ash content of gluten free cake samples

The fiber content of the analyzed samples (Figure 4) falls within the limits of allowable values provided in the standards, as well as the values existing in the literature data [19, 20, 21]. Regarding the fiber content of the studied gluten-free cake samples, in Figure 4 it can be observed that it increases proportionally with the amount of MF added, up to 4.88% in the P4 sample, compared to 3.22% in the P1 sample. Among the three samples of gluten-free cake with PN with 20%, 40% and 60% added MF, the highest value of the fiber content was registered in sample P4 (4.88%), followed by sample P3 (4.24%) and sample P2 (3.86%). In the case of studied cake samples, the value of the fiber content increases with the increase of the percentage of MF added in the manufacturing recipe.

The carbohydrate content of the analyzed gluten-free cake samples (Figure 5) decreases as the percentage of MF increases [19, 20], thus the highest value of the carbohydrate content was recorded in sample P1 (44.74%), followed by sample P2 (41.30%), sample P3 (36.19%), and the lowest value of the carbohydrate content was registered in P4 sample (32.52%). Thus, the

obtained gluten-free cake samples with MF added, will have a low glycemic index

The ash content of the analyzed cake samples (Figure 6) reflects the level of mineral substances in PN cake, and falls within the limits of allowable values provided in the standards, as well as the values existing in the literature data [19, 21]. The ash content of the three gluten-free cake samples increases with the addition of MF, from 0.92% in sample P2 to 1.48% in sample P4, compared to 0.68% in sample P1.

Compliance with Ethics Requirements. Authors declare that they respect the journal's ethics requirements. Authors declare that they have no conflict of interest and all procedures involving human / or animal subjects (if exist) respect the specific regulation and standards.

Acknowledgement: The present paper was funded by the Research Project "Research on the use of biologically active substances in order to obtain high-nutrition foods", No 1545/28.02.2019.

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