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Effect of millet milk powdre on the physico-chemical properties of gluten-free cake based on rice flour

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ABSTRACT

In recent years, the production of gluten-free products with good quality is one of the priorities of the food industry to meet the needs of celiac patients. The aim of this research work was to study the effects of MMP on some physico-chemical properties of rice flour-based gluten free batter and cake. MMP was prepared from common millet grain (Pishahang variety) and its physical and functional characteristics were evaluated. Gluten-free batters and low-ratio cakes based on rice flour with three levels of xanthan gum (0, 0.15, 0.3%) and four levels of MMP (0, 5, 10, 15 %) were produced then evaluated for their physico-chemical and sensory characteristics. The results of physical and functional properties of millet milk powder including bulk density, water absorption and oil absorption respectively 0.652±0.09, 0.615±0.1, and 0.696±0.05 was obtained. Increasing levels of MMP along with xanthan gum increased the viscosity of the batter. The highest viscosity (20 pa.s) was observed in the sample with 0.3% xanthan gum and 15% MMP, which led to a decrease in the volume and porosity of the resulting cakes. Evaluation of the color indices showed the significant effect of MMP on L*, a* and b*. In general, with the increase of MMP, L* and b* decreased and a* increased. The results of sensory analysis for the cake samples showed that with the increase of MMP and xanthan gum, due to the increase in viscosity and decrease in volume, the texture score of the samples decreased, and the highest score was related to the sample with 0.15% gum. It was concluded that the cake sample prepared with 10% MMP with 0.15% xanthan gum was the best treatment in terms of sensory and quality characteristics.

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1- Introduction

It is very important to consume gluten-free foods as an alternative to gluten-containing foods in the diet and nutrition of celiac patients. Therefore, the production of gluten-free products is one of the priorities of the food industry to help this group of people. Celiac disease is an autoimmune digestive disease that occurs due to the intolerance of a certain sequence of amino acids found in prolamin (a part of gluten proteins) of wheat, rye, barley and possibly oats [1]. The only way to treat this disease is to follow a gluten-free diet throughout the patient's life. Among cereal products, cake has been noticed due to its good taste, variety of appearance and taste, and long shelf life. The main raw material in its preparation is wheat flour, which is not suitable for celiac patients and should be made from cereals.Use without gluten. Rice is one of the grains that is used as a substitute for wheat in gluten-free products due to its gluten-free, mild taste, low amounts of sodium, protein, fat and fiber and high amounts of carbohydrates with high digestibility [2].

Millet is the sixth most important grain in the world in terms of global production. Millet is important due to its resistance to drought, disease and pests and short growing season, as well as due to its high nutritional value.]3[. Today, along with its nutritional benefits, millet has been noticed due to its gluten-free, mild taste and bright color. With the increase of the world population and the decrease of water resources, this agricultural product becomes very important for human use in the future [4]. The white extract extracted from plant sources such as grains, legumes, nuts and oil seeds is called vegetable milk. Plant milks are similar to dairy milks in terms of color and appearance, but they are different in terms of nutritional value and flavor [5]. Today, the consumption of vegetable milk is increasing with the increase in the number of patients suffering from lactose intolerance and due to having less calories and cholesterol [6,7]. Millet is a suitable grain for preparing herbal milk. Millet milk has high protein and low calories, so it is an ideal alternative to dairy milk, especially in the current situation where a low-calorie diet is preferred [8]. Millet milk powder has many quality and health benefits that make it suitable for use in gluten-free products. In a research that investigated the effect of xanthan gum on gluten-free cakes, the results showed that xanthan gum improves the quality of gluten-free cakes and adding gum at levels of 0.3 and 0.4% in terms of sensory and physicochemical characteristics are similar to the control sample. The sample was prepared with wheat flour) [9]. Devi and Sangeta (2013) used millet milk powder obtained from a mixture of finger millet flour and pearl millet flour in the production of extruded products and stated that the resulting millet milk powder has good physical and functional properties (including volume density, swelling index, capacity water retention) for use in the production of extruded products. Also, the results of organoleptic evaluation showed that the formulation containing millet milk powder and control at the rate of 50:50 had the highest acceptability in terms of nutritional content, color, texture, cooking quality and sensory acceptance [10].Karmi et al. (2019) investigated the functional characteristics of millet flour for use in gluten-free cookie formulations based on rice flour, and the results showed that with the increase of millet flour, water absorption and extensibility increased and lightness decreased. Cookies containing higher amounts of millet flour had firmer texture, higher baking loss and lower water activity [11]. In the study of the effect of replacing barnyard millet flour with wheat flour in the

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preparation of muffins, the results showed that if the levels of millet flour in the formulation were increased, the volume, firmness and weight of the muffin samples decreased. The results of the sensory analysis showed that all the prepared muffin samples, even the sample containing 100% millet flour, were sensory acceptable [12].in ReviewThe effect of adding millet malt flour and xanthan gum on the physical properties of gluten-free dough and the resulting cake, the results showed that the addition of millet malt flour to the formulation caused the production of a weak dough due to the high enzyme activity and the lack of gluten protein, in which the increase The level of millet malt led to a significant decrease in viscosity and an increase in the specific weight of the dough compared to the control sample. However, xanthan gum improved the physical parameters of the dough by trapping water and increasing the storage capacity [13].

Considering that no studies have been done on the production of millet milk powder and its use in cake formulation, the aim of this research is to prepare millet milk powder and investigate its effect at levels of 0, 5, 10 and 15% along with xanthan gum in The three levels are 0, 0.15 and 0.3% on the physicochemical characteristics of gluten-free cake.

2- Materials and methods

1-2- raw materials: The millet used in this research is ordinary millet of Peshahang variety[1] was obtained from the seed breeding center of Khomein city. Half-grain rice of Fajr variety was purchased from Shalikobi Zumard Gorgan. After soaking and draining, the rice was milled and sieved with an 80 sieve (pore size 180 microns). Then the rice flour was dried and kept in the refrigerator until it reached a moisture content of about 10%. Other ingredients required for the cake are purchased from reputable stores and brand name xanthan gumRodia Gel (Xanthan Gel, E415)from companyRodia Food it was prepared.

2-2- Preparation of millet milk powder: In order to produce millet milk powder, millet grains were first cleaned and soaked in water for 12 hours, then rinsed and washed. Washed millet seeds were wet ground and then mixed with equal ratio of water for 8 hours. Finally, the resulting mixture was dried using a smooth and liquid filter cloth obtained by a dryer at a temperature of 42 degrees Celsius for 15 hours, then milled and packed in plastic bags and stored in a refrigerator until consumption [14].

3-2- Preparation of dough and production of cakes: The cakes prepared in this research are low ratio oil cakes that were produced using the method of Abbaszadeh et al. (2018) with some changes in the raw materials [15]. The basic ingredients for making the cake include: 100 grams of rice flour, 72 grams of powdered sugar, 57 grams of oil, 0.5 grams of vanilla, 72 grams of eggs, 2 grams of baking powder, and 30 grams of water and xanthan gum in 3 levels (0, 0.15, 0.3 0) and Shirarzan powder were at 4 levels (zero, 5, 10, 15%) (the amount of ingredients was considered based on 100 grams of rice flour). In order to prepare the cake, first, sugar powder and oil are stirred for 3 minutes at a medium speed until it turns into a cream-colored liquid. In the next step, the beaten egg was added to the mixture and stirred for 2 minutes. Half of the water was added and stirred for 1 minute at a medium speed, and then the powdered ingredients were stirred for 1 minute at a slow speed. Finally, the other half of water was added and mixed for 1 minute at medium speed. 30 grams of the prepared cake batter was poured into the molds. Then cooking was

[1] -Panicum miliaceum Var. Pishahang

done in an electric oven at a temperature of 170 degrees Celsius for 25 minutes. After cooling, the cakes were packed and kept at ambient temperature in polythene bags in order to evaluate the quantitative and qualitative characteristics.

4-2- Physicochemical characteristics of rice flour and millet milk powder: Moisture, ash, protein and fat values of the samples according to the standardAACC, 2000-44-16، AACC, 2000-08-01، AACC, 2000-46-12 AndAACC, 2000-30-10 was measured [16].

5-2- Physical and functional characteristics of millet milk powder

1-5-2- Mass education: To measure bulk density, millet milk powder was slowly poured into a pre-weighed 10 ml graduated cylinder. Then the end of the cylinder is gently hit on the work table several times until the empty space between the powders disappears and the sample of millet milk powder inside the cylinder is filled uniformly. Then 10 samples were poured into the cylinder until reaching the line. At the end, the bulk density was calculated from the following equation [17].

$$\frac{gr}{ml} It's\ mass\ density = \frac{(gr)\ Cylinder\ in\ stock\ sample\ weight}{(ml) cylinder\ in\ stock\ sample\ volume} \times 100$$

2-5-2- water absorption: In order to measure this quantity, Bouchet's method (1977) was used with some changes. 3 grams of sample was poured into a 50 ml centrifuge tube with 18 ml of distilled water and mixed for 30 seconds. Then it was kept at room temperature for 30 minutes and finally centrifuged for 30 minutes at 5000 rpm. The supernatant separated from the sediment was removed from the centrifuge tube by a completely dry paper towel and its weight was measured [18]. (Water absorption capacity was expressed as the amount of water absorbed by 1 gram of sample).

3-5-2- oil absorption: In order to measure this quantity, Bouchet's method (1977) was used with some changes. 3 grams of sample along with 18 ml of corn oil were poured into a 50 ml centrifuge tube. Then it was mixed for 30 seconds and kept at room temperature for 30 minutes. After that, it was centrifuged at 5000 rpm for 30 minutes. The samples were slowly removed from the centrifuge and the amount of oil in the upper part of the sediment was separated. The weight of the samples and centrifuge tube was recorded again. The difference between the final and initial weight was calculated and the oil absorption capacity was obtained from the gram of oil absorbed by 1 gram of the sample [18].

2-6- Measurement of batter viscosity: direction Investigating the changes in the viscosity of cake batter using a rheometerAnton Paar (Austria modelMCR 301)، using two parallel plates at a temperature of 25 degrees Celsius and a distance between the plates of 1 mm and a shear rateS^{-1} 60/5 was used [19].

7-2- Measuring the physicochemical characteristics of the cake

1-7-2- Measurement of specific volume: The rapeseed displacement method was used to measure the volume of the cake. First, the bulk density of rapeseed was calculated using a specific weight and volume of seeds. Then, in a container with specific dimensions, the cake sample was placed with rapeseed and weighed. Finally, the volume was calculated based on the following relationships [16].

$$IN_{dish} - IN_{Cake} - IN_{Total} = IN_{canola}$$

$$V\ canola = \frac{w\ canola}{\rho\ canola}$$

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$_{canola}IN - {}_{dish}IN = {}_{Cake}IN$

2-7-2- Porosity measurement: In order to evaluate the amount of porosity, first the actual volume of the cake was determined. The cake sample was pressed inside the graduated cylinder until there were no voids left. Then the percentage of porosity was calculated according to the following relationship [20].

$$Percent\ Porosity = \left[1 - \frac{V\ true}{V\ bulk}\right] \times 100$$

V True: actual volume

V bulk: The total volume of the cake measured by the displacement method of rapeseed

3-7-2- Evaluation of shell and brain color: Color analysis at a time interval of 2 hours after baking by determining 3 indicators L*، a* Andb* done. IndicatorL* It represents the lightness of the sample color in the range of 0 (absolute black) to 100 (absolute white). Indicatora* It shows how close the color of the sample is to green and red, and its range varies from -120 (pure green) to +120 (pure red). Indicatorb* It shows the closeness of the color of the sample to blue and yellow colors and its range varies from -120 (pure blue) to +120 (pure yellow). The color comparison was done with the help of Huntlab device and the above parameters were measured [21].

2-8- Sensory characteristics: In order to compare different treatments in terms of desired sensory characteristics, evaluation was done by 10 semi-trained people familiar with sensory evaluation techniques. The cake samples were provided to the evaluators 2 hours after baking, and the characteristics of color, texture firmness, aroma and taste, sample appearance and overall acceptance were evaluated using a 5-point hedonic method (1 = unfavorable, 5 = favorable) [22] [.

2-9- Statistical analysis: In this research, the obtained data were analyzed using a factorial test based on a completely random design and using SAS software. All tests were performed in three repetitions, and comparison of averages was done with Duncan's test at 95% confidence level.

3. Results and Discussion

1-3- Physicochemical characteristics of rice flour, millet grain and millet milk powder: The results of chemical tests of rice flour, millet milk powder and millet grain are given in Table 1.

Table 1. The results of chemical composition analysis of rice flour, millet milk powder and millet grain (wb,%)

	Moisture (%)	Ash (%)	Protein (%)	Lipid (%)	pH
Rice flour	10.41±0.1^{a}	0.45±0.02^{a}	8.87±0.05^{a}	1.23±0.01^{b}	6.14±0.11^{a}
Millet milk powder	5.2±0.11^{b}	2.75±0.12^{b}	13.33±0.14^{b}	3.12±0.1^{a}	6.29±0.05^{a}
Millet grain	9.48±0.08^{c}	2.88±0.15^{b}	15.18±0.05^{c}	3.94±0.1^{a}	6.70±0.14^{a}

Different superscripts indicate significant differences among samples (p< 0.05).

2-3- Physical and functional characteristics of millet milk powder: The functional properties of food depend on various factors, including the amount of carbohydrates, protein, fat, fiber, or other additives. Mass density values 0.09±0.652 g/ml and water and oil absorption respectively 0.10±0.651 and 0.05±0.696 percent was calculated. To determine the functional quality of millet milk powder, the results were compared with soy protein isolate. Water and oil absorption values for soybean protein isolate are 0.12 respectively±6/12 and

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09/0±1.46% was reported, which indicates the lower ability of millet milk powder to absorb water and oil. In the study conducted on different methods of drying the functional properties of millet milk powder, the bulk density was in the range of 0.003.±0.533 to 0.017±0.68 g/ml and water absorption in the range of 0.005±0.9 to 0.034±0.98% was reported [10].

3-3- Viscosity of cake batter: The rheological behavior of the cake batter plays a key role in the sensory and qualitative characteristics of the samples. As a result, the viscosity of the samples were compared at the medium shear rate in order to study the sensory characteristics and mouthfeel. Viscosity values of samples at shear rate $^{1}S^{-}$ 5.60 is given in Figure 1. As can be seen, with the increase in the percentage of xanthan gum and millet milk powder, the viscosity of the cake batter increased. The lowest viscosity was related to the sample of rice flour without adding gum and millet milk powder. The sample with 15% millet milk powder and 0.3% gum had the highest viscosity. The reason for the increase in viscosity with the addition of ozone milk powder can be attributed to protein, fiber and also the increase of dry matter. Also, due to their water holding capacity, the existing proteins absorb water and thus increase viscosity [23]. Kim and Yoo (2006) and Salehi et al. (2018) reported an increase in consistency coefficient and apparent viscosity with increasing gum concentration, which is in line with the results of this research [24, 25]. These compounds have high water retention capacity [26].

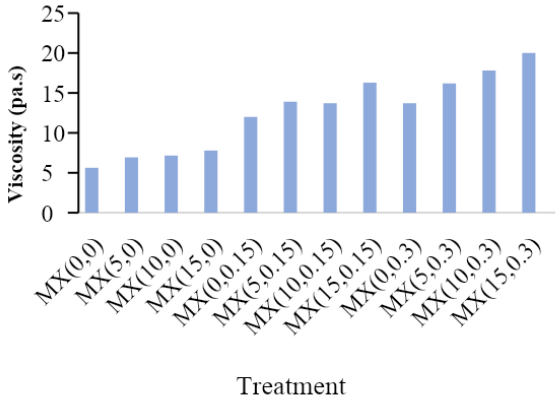

Figure 1. The effect of xanthan gum and millet milk powder on the viscosity batter cake. Xanthan gum (X), Millet milk powder (M)

4-3- Cake volume and porosity: The results of the volume and porosity of cake samples are given in Table 2. According to the results, the addition of xanthan gum and millet milk powder caused a significant decrease in the volume and porosity of the samples, which is due to the increase in viscosity and the decrease in the ability of air to enter the dough and the enlargement of gas cells during the baking process. According to the results, both compounds caused a significant decrease in volume and porosity compared to the control sample ($p<0.05$). The volume of different samples was determined in the range of 57.89 to 70.20 cubic centimeters, the largest volume was related to the control sample and the lowest was related to the sample of 0.3% gum and 15% millet milk powder. The levels of 0.15 and 0.3 xanthan gum were not significantly different from each other. With the increase of xanthan gum, due to its ability to absorb water, the viscosity of the dough increases, and as a result, it does not have the ability to include the created gases, so it prevents the increase in volume [2]. The effect of adding millet milk powder on the samples also showed a decrease in volume. The levels of 10 and 15% millet milk powder without xanthan gum were not significantly different from each other. The

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percentage of porosity in baking products is directly related to the volume of the product, and the smaller the volume, the lower the porosity. In this research, a direct relationship was observed between the results of volume and porosity. The results of the interaction between xanthan and millet milk powder showed that the highest porosity was related to the control sample and the lowest was found in the sample with 15% millet milk powder and 0.3% gum. The results of Lazarido et al. (2007) and Shuber et al. (2005) were in line with the results of this research in reducing the volume of gluten-free bread with the increase of xanthan gum [2, 27]. In the study of the effect of sweet almond protein concentrate in gluten-free cake, the results showed that with the addition of gum and protein, the volume and porosity of the samples decreased, which was attributed to the increase in the amount of protein, which, along with xanthan, led to an increase in the viscosity of the dough and, as a result, it became more compact. It is woven [15]. In the research conducted on muffins with millet flour, a decrease in volume and porosity was also reported [12,28].

Table 2. Results of volume and porosity of cake samples containing xanthan gum and millet milk powder

Porosity (%)	Volume (Cm3)	Treatments
66.50±0.53^{a}	70.20±0.19^{a}	MX(0,0)
64.17±0.67^{c}	68.87±0.39^{b}	MX(5,0)
61.83±0.42$^{It is}$	67.20±0.14^{d}	MX(10,0)
59.53±0.50^{g}	67.03±0.47^{d}	MX(15,0)
65.70±0.46^{ab}	67.88±0.22^{c}	MX(0,0.15)
63.43±0.57^{cd}	65.43±0.26$^{It is}$	MX(5,0.15)
60.37±0.49^{f}	62.82±0.20^{f}	MX(10,0.15)
58.70±0.44^{h}	60.66±0.18^{g}	MX(15,0.15)
65.17±0.38^{b}	67.53±0.30^{cd}	MX(0,0.3)
62.77±0.21^{d}	62.38±0.09^{f}	MX(5,0.3)
60.97±0.57^{f}	60.37±0.33^{g}	MX(10,0.3)
57.77±0.35^{i}	57.89±0.48^{h}	MX(15,0.3)

Different superscripts indicate significant differences among samples (p<0.05). Xanthan gum (X), Millet milk powder (M)

5-3- Evaluation of shell and brain color: Color is an important parameter in product acceptance by consumers. The color of the shell of the product is the result of caramelization and Maillard reactions, which are created during the cooking process, while the color of the core of the product is influenced by its constituent compounds [29]. In addition, the physical state of the product surface is also effective on its color components. If the surface of the cake is smooth and without wrinkles, the amount of light reflection is higher, as a result, the L* component increases [30]. The results of the analysis of the L* index of the crust and core of the cake samples are shown in Figure 2. The results showed that xanthan gum increased the L* index of cake samples. This increase in cake brain showed a statistically significant difference at the level of 0.3% ($p < 0.05$). The amount of this index for the sample containing millet milk powder decreased significantly compared to the control sample. The results of the interaction between xanthan gum and millet milk powder show a decrease in the L* index in both the crust and the core of the cake samples. As it is clear from table 3, millet milk powder has a low L* index, so by adding it to rice flour cake, this index decreases, and another reason for this decrease can be attributed to the higher protein content of millet milk powder compared to rice flour, and as a result, it intensifies Millard knew the reaction. In examining the independent and mutual effect of gum and millet milk powder on the a* index of the shell and brain (Figure 3), the results showed that xanthan gum decreased the redness index and millet milk powder increased the redness index of the samples ($p<0.05$). Their interaction increased the reddening index. However, this index did not show a statistically significant difference in the shell and brain at the level of zero percent millet milk powder at all gum levels. The results of the b* index of the crust and core of the cake samples in Figure 4 showed that xanthan gum reduced this index in the crust and core of the cake, but in the core of the cake, only the level of 0.3% was significantly different from the control. The mutual effect of gum and millet milk powder reduced this index. Due to the ability of hydrocolloids to absorb water, the amount of water activity of the samples is affected, thus causing a change in the color parameters of the samples. Generally, xanthan gum causes The increase in the L* index and the decrease in the a* and b* indices are seen due to the decrease in the speed of the Maillard browning reaction compared to the sample.

In the study of the effect of kathira gum and xanthan on gluten-free cake, an increase in the L* index and a decrease in the b* index were reported [31]. Patel and Torat (2019) reported a decrease in L* and b* index and an increase in a* in a sponge cake made with finger millet flour and Naghipour (2016) in a gluten-free cake made with soy milk powder [32,33].

Table 3. Rice flour and millet milk powder color index value

Samples	L*	a*	b*
Rice Flour	94.1±0.33	2.4±0.15	4.7±0.28
Millet Milk Powder	74.9±0.20	7.1±0.10	11±0.45

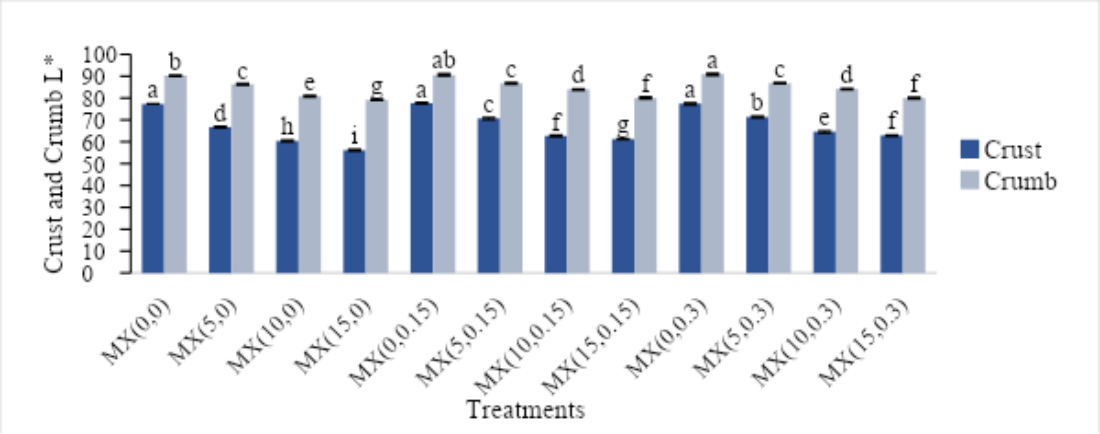

Figure 2. The effect of xanthan gum and millet milk powder on the color index L* of crust and crumb cake Different superscripts indicate significant differences among samples (p< 0.05).

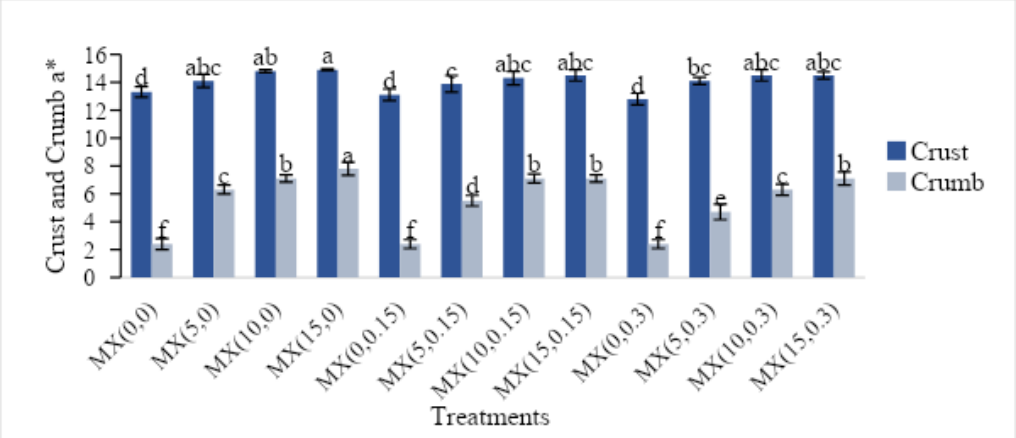

Figure 3. The effect of xanthan gum and millet milk powder on the color index a* of crust and crumb cake Different superscripts indicate significant differences among samples (p< 0.05).

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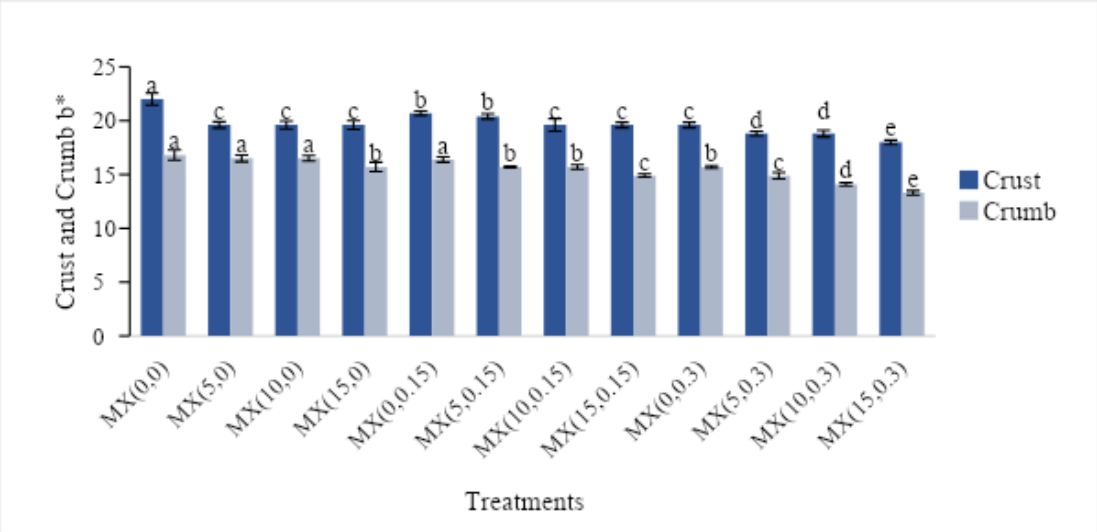

Figure 4. The effect of xanthan gum and millet milk powder on the color index b* of crust and crumb cake Different superscripts indicate significant differences among samples (p< 0.05).

Sensory evaluation: The results of sensory evaluation analysis of the effect of adding xanthan gum and millet milk powder are given in Table 4. Based on the results, the addition of millet milk powder and xanthan gum at 10% levels with 0.15% gum improved the color index. Due to its darker color and low L* index, millet milk powder, when added in high levels to the rice flour cake sample, darkens the color of the product and reduces consumer acceptance. The texture scores of the samples showed that xanthan gum did not make a significant difference ($p<0.05$). In general, in all samples, with the increase of gum and millet milk powder, the texture score decreased, which is due to the increase in viscosity and non-uniform distribution of gas cells. Also, the addition of millet milk powder reduced the aroma and taste scores, and the sample with 0.3% gum and 15% millet milk powder had the lowest sensory score. The evaluation of the appearance of the cake samples also showed that the addition of xanthan gum and millet milk powder decreased the sensory score by the panelists. The highest overall acceptance score was related to the cake sample with the addition of 0.15% gum and 10% millet milk powder.

Table 4. Intraction effect of xanthan gum and millet milk powder on sensory evaluation of cake

Total acceptability	Appearance	Odor and Taste	Hardness	Color	Treatment
4.00 ± 0.70^{abc}	4.20 ± 0.92^{ab}	3.90 ± 0.57^{a}	4.50 ± 0.53^{a}	2.60 ± 0.70^{f}	MX(0,0)
4.00 ± 0.52^{abc}	4.30 ± 0.82^{ab}	3.70 ± 0.67^{a}	4.30 ± 0.48^{a}	3.70 ± 0.67^{abcde}	MX(5,0)
4.00 ± 0.70^{abc}	4.40 ± 0.70^{a}	3.90 ± 0.74^{a}	3.90 ± 0.74^{abc}	4.20 ± 0.92^{ab}	MX(10,0)
3.30 ± 0.95^{cdef}	3.50 ± 0.71^{bc}	4.10 ± 0.99^{a}	3.90 ± 1.10^{abc}	3.30 ± 0.95^{cdef}	MX(15,0)
3.90 ± 0.88^{abcd}	3.90 ± 0.74^{ab}	4.30 ± 0.82^{a}	4.50 ± 0.71^{a}	3.00 ± 0.94^{if}	MX(0,0.15)
4.00 ± 0.82^{abc}	3.70 ± 0.67^{ab}	4.20 ± 0.63^{a}	4.00 ± 0.67^{ab}	3.90 ± 0.99^{abcd}	MX(5,0.15)
4.10 ± 0.57^{ab}	3.80 ± 0.92^{ab}	3.60 ± 1.07^{ab}	3.30 ± 0.67^{cd}	4.00 ± 0.82^{abc}	MX(10,0.15)
3.00 ± 0.82^{if}	3.80 ± 0.79^{ab}	3.90 ± 0.74^{a}	3.20 ± 0.63^{of}	4.40 ± 0.52^{a}	MX(15,0.15)
3.60 ± 1.07^{bcde}	4.00 ± 1.05^{ab}	4.10 ± 0.99^{b}	4.30 ± 0.67^{a}	3.40 ± 1.07^{bcdef}	MX(0,0.3)
3.20 ± 0.63^{def}	3.70 ± 0.95^{ab}	3.50 ± 0.85^{ab}	3.50 ± 0.97^{bcd}	4.40 ± 0.97^{a}	MX(5,0.3)
3.10 ± 0.74^{if}	2.90 ± 0.74^{c}	2.50 ± 1.08^{c}	2.60 ± 0.52^{if}	3.70 ± 0.67^{abcde}	MX(10,0.3)

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2.70±0.82^{f}	2.80±0.63^{c}	2.80±1.14^{bc}	2.30±0.48^{f}	3.10±0.74^{def}	MX(15,0.3)

Different superscripts indicate significant difference among samples (p<0.05).
Xanthan gum (X), Millet milk powder (M)

4 - Conclusion

Nowadays, due to the increase in the identification of celiac patients, the production of gluten-free bakery products is increasing all over the world. Therefore, food industry experts are trying to produce and improve the quality of these products. In this research, xanthan gum along with millet milk powder was used in the preparation of gluten-free cake based on rice flour and their physicochemical and sensory characteristics were investigated. The physicochemical properties of the cake are influenced by the interaction of xanthan gum with millet milk powder. Increasing or decreasing the volume and porosity of the samples depends on the characteristics of the batter. Due to the increase in batter viscosity, xanthan gum and millet milk powder had a negative effect on the volume and porosity of the cake samples. But it can be used at low levels due to the increase in nutritional value and the amount of protein, color and taste. In the sensory evaluation results, the sample containing 0.15% xanthan gum and 10% millet milk powder had the highest sensory score and can be suitable for preparing cakes with desirable characteristics.

5- Resources

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مقاله علمی_پژوهشی

تأثیر پودر شیر ارزن بر ویژگی‌های فیزیکوشیمیایی کیک بدون گلوتن بر پایه آرد برنج

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چکیده

امروزه تهیه محصولات بدون گلوتن با کیفیت مطلوب یکی از اولویت‌های بخش صنعت غذا جهت تغذیه بیماران سلیاکی می‌باشد. لذا هدف از این پژوهش در ابتدا تهیه پودر شیر ارزن (MMP) از دانه ارزن معمولی رقم پیشاهنگ و بررسی ویژگی‌های فیزیکی و عملکردی آن و سپس تهیه کیک بدون گلوتن بر پایه آرد برنج با سه سطح صمغ زانتان (صفر، ۰/۱۵، ۰/۳ درصد) و چهار سطح پودر شیر ارزن (صفر، ۵، ۱۰، ۱۵ درصد) و بررسی ویژگی‌های فیزیکوشیمیایی خمیرابه و کیک بدون گلوتن می‌باشد. نتایج خواص فیزیکی و عملکردی پودر شیر ارزن شامل دانسیته توده‌ای، جذب آب و جذب روغن به ترتیب ۰/۶۵۲±۰/۰۹، ۰/۶۱۵±۰/۱، ۶۹۶/۰۵±۰/۰ بدست آمد. افزایش پودر شیر ارزن و اثر متقابل آن با صمغ زانتان باعث افزایش ویسکوزیته خمیرابه شد. بیشترین ویسکوزیته (pa.s ۲۰) در نمونه با ۰/۳ درصد صمغ و ۱۵ درصد پودر شیر ارزن دیده شد. بدلیل افزایش ویسکوزیته حجم و تخلخل نمونه‌ها کاهش یافت. ارزیابی شاخص رنگ نیز نشان دهنده‌ی اثر معنادار پودر شیر ارزن بر پارامترهای L*، a* و b* بود. بطورکلی با افزایش پودر شیر ارزن، L* و b* کاهش و a* افزایش یافت. نتایج آنالیز حسی برای نمونه‌های کیک نشان داد که با افزایش پودر شیر ارزن و صمغ زانتان بدلیل افزایش ویسکوزیته و کاهش حجم امتیاز بافت نمونه‌ها کاهش یافت، بیشترین امتیاز مربوط به نمونه با ۰/۱۵ درصد صمغ بود. در نهایت کیک تهیه شده با ۱۰ درصد پودر شیر ارزن به همراه ۰/۱۵ درصد صمغ زانتان بهترین تیمار از لحاظ ویژگی‌های حسی و کیفی بود.