



# DIET FACTOR

Journal of Nutritional & Food Sciences

<https://www.dietfactor.com.pk/index.php/df>

ISSN (E): 2789-8105, (P): 2789-8091

Volume 5, Issue 1 (Jan-Mar 2024)



## Original Article

# Tailoring the Use of Proso Millet in Preparation of Gluten Free Cupcakes

Nighat Raza<sup>1\*</sup>, Naheed Bano<sup>2</sup>, Ali Hamza<sup>1</sup>, Ahmed Mujtaba<sup>3</sup>, Umar Farooq<sup>1</sup>, Amar Matloob<sup>4</sup>, Mirza Abid Mehmood<sup>5</sup>, Qurat ul Ain<sup>1</sup> and Muhammad Munir<sup>6</sup>

<sup>1</sup>Department of Food Science and Technology, Muhammad Nawaz Shareef University of Agriculture, Multan, Pakistan

<sup>2</sup>Faculty of Veterinary and Animal Sciences, Muhammad Nawaz Shareef University of Agriculture, Multan, Pakistan

<sup>3</sup>Department of Food Science and Technology, Faculty of Engineering Sciences and Technology, Hamdard University, Islamabad Campus, Islamabad, Pakistan

<sup>4</sup>Department of Agronomy, Muhammad Nawaz Shareef University of Agriculture, Multan, Pakistan

<sup>5</sup>Institute of Plant Protection, Muhammad Nawaz Shareef University of Agriculture, Multan, Pakistan

<sup>6</sup>Department of Management and Administrative Sciences, University of Narowal, Narowal, Pakistan

## ARTICLE INFO

### Keywords:

Celiac Disease, Gluten-Free Cupcakes, Proso Millet, Rice Flour, Product Development

### How to Cite:

Raza, N., Bano, N., Hamza, A., Mujtaba, A., Farooq, U., Matloob, A., Mahmood, M. A., Ain, Q. ul, & Munir, M. (2024). Tailoring the Use of Proso Millet in Preparation of Gluten Free Cupcakes: Tailoring Proso Millet in Gluten-Free Cupcakes. DIET FACTOR (Journal of Nutritional and Food Sciences), 5(01). <https://doi.org/10.54393/df.v5i01.123>

### \*Corresponding Author:

Nighat Raza  
Department of Food Science and Technology,  
Muhammad Nawaz Shareef University of  
Agriculture, Multan, Pakistan  
[nighat.raza@mnsuam.edu.pk](mailto:nighat.raza@mnsuam.edu.pk)

Received Date: 30<sup>th</sup> January, 2024

Acceptance Date: 12<sup>th</sup> March, 2024

Published Date: 31<sup>st</sup> March, 2024

## ABSTRACT

Celiac disease is the disorder of small intestine. It affects about 1% of the population. To meet dietary requirements of the affected population, the food industry must develop new food items with special health-improving properties. For people who are allergic to gluten, Proso millet is the ideal cereal owing to its gluten-free nature. **Objective:** To make gluten-free cupcakes using varying concentrations of Proso millet and rice flour. **Methods:** The gluten content, total phenolic content, and particle size distribution of the raw material were all measured. Next, 100% wheat flour, 80%, 85%, and 90% Proso millet flour, and 20%, 15%, and 10% rice flour were used to make cupcakes. The nutritional makeup of the cupcakes, including their moisture content, ash content, crude fiber, crude fat, crude protein, and mineral (Fe, Zn, Ca, and P) contents, was examined. **Results:** Based on the results, the optimal ratio of protein and fiber was found to be 90% Proso millet and 10% rice flour. The result for the sensory score of the cupcakes showed that all the treatments were acceptable by the consumer. **Conclusions:** Although the treatment having high concentration of Proso millet recorded the highest acceptability score. Therefore, Proso millet is useful cereal for any product development.

## INTRODUCTION

Most celiac disease patients have clinical, serological, and histological remission after completely eliminating gluten from their diet. Following a gluten-free diet for celiac disease, growth and development in children return to normal, and in adults, many of the condition's problems are avoided [1]. Celiac sickness is a special immune system problem where in the natural precipitant, gluten, is known [2]. The cereals are common annual grasses that belong to the Poaceae family, which is sometimes referred to as the

Gramineae at times [3]. The two most important crops in the world, wheat and rice, provide more than half of the world's grain [4]. Proso millet (*Panicum miliaceum*), a grass, with a warm growth season that lasts 60 to 100 days. Around 10,000 years ago, Proso millet was probably domesticated in China. When ingested as food for people, Proso millet offers several advantages [5]. Minerals, dietary fibre, polyphenols, vitamins, and proteins are all abundant in Proso millet. It is gluten-free and hence

perfect for those who cannot tolerate gluten. High levels of lecithin in Proso millet help the neurological health system. Niacin, B-complex vitamins, Ca, Fe, folic acid, P and Zn are among the vitamins, minerals, and important amino acids that are abundant in it (methionine and cysteine). It lowers the risk of type 2 diabetes and has a low glycemic index [6]. Baked goods come in different difficulty levels, such as cakes, muffins, and cookies (cookies and crackers) [7]. Cupcakes are a kind of cake that can be utilized as a pastry or a tidbit. Cupcakes are made with mixture produced using margarine, sugar, eggs, and wheat flour, and afterward finished off with different fixings like as whip cream, spread cream, icing, cooking chocolate, and eatable pictures. This gives cupcakes a particular character and draws clients by giving heavenly flavors and item variations, making it basic to their development [8].

Therefore, the objectives of the current study were to prepare gluten-free cupcakes and perform the compositional and sensory analysis of gluten free product

## METHODS

The current study's analysis was completed at the Department of Food Science and Technology (FF&HS) at MNS-University of Agriculture Multan during the months of April to July in 2023. Proso millet (Figure 1) and Basmati rice (*Oryza sativa*) was obtained from the Department of Agronomy MNS-University of Agriculture Multan. All reagents as per specifications, standards were obtained from standardized sellers. Proso millet flour, basmati rice flour, sugar, butter, vanilla was used according to the standard recipe for the formulation of gluten-free cupcakes.



**Figure 1:** Proso Millet

### Analysis of Raw Material

#### Gluten Test

Flours were examined for gluten using standardized method by American Association of Cereal Chemists [9].

#### Total Phenolic Contents

Total polyphenol content and total antioxidant capacity were calculated from grain flour as methods described by Kassim et al [10].

#### Particle Size Distribution

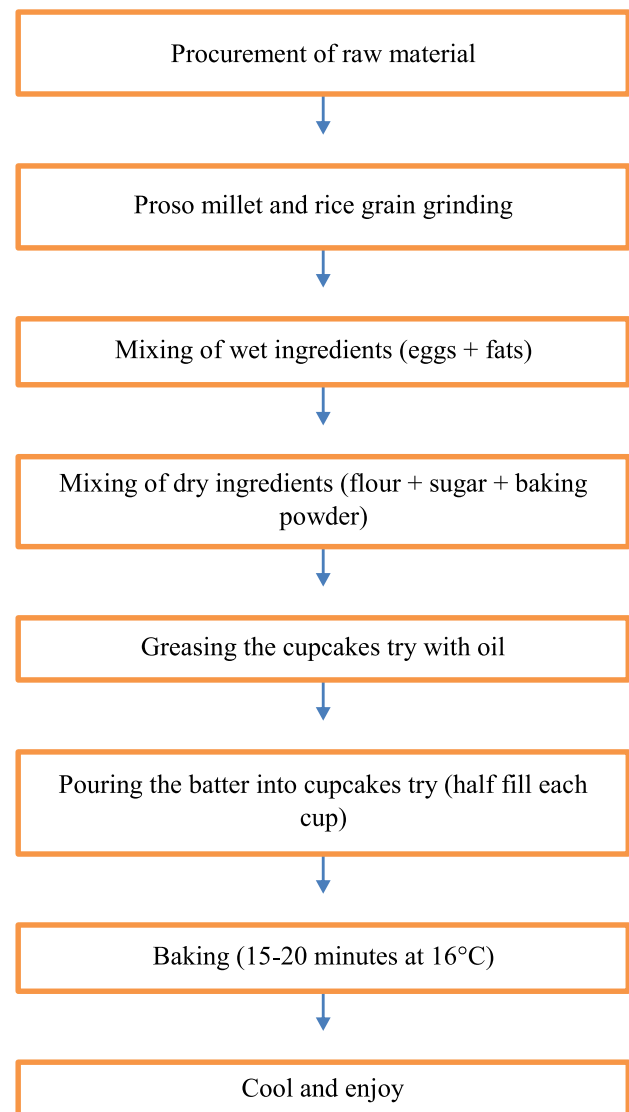
The particle size index of all the flour was determined using the set method described by American Association of

Cereal Chemists [9]. Weighed about 10g of flour sample to nearest 0.01g. Fitted pan under the U.S. standard testing sieve No. 200 and transferred sample to it. Covered sieve and gave accurately 10 minutes to it on sieve shaker for proper sieving. Then brushed the bottom of sieve to remove and collect adhering fines in receiving pan. Finally weighed throughs (W) to nearest 0.01g.

$$\text{PSI (\%)} = \frac{\text{Weight of throughs (W)}}{\text{Sample Weight}} \times 100$$

### Preparation of Cupcakes

The Cupcakes were prepared according to standard recipe but wheat Proso millet and rice flour was varied by adopting the treatment plan as shown in table 1. Flow Line of Cupcakes Preparation is shown in figure 2.



**Figure 2:** Flow Line of Cupcakes Preparation

## Treatment Plan

**Table 1:** Concentration of Proso Millet Flour, Wheat Flour and Rice Flour to Prepare Cupcakes

Treatment	Wheat (%)	Proso millet (%)	Rice flour (%)
T <sub>0</sub>	100	-	-
T <sub>1</sub>	-	80	20
T <sub>2</sub>	-	85	15
T <sub>3</sub>	-	90	10

## Analysis of Cupcakes

Determination of proximate composition like crude protein (method no. 46-10), crude fat (method no. 30-10), crude fiber (method no. 32-10), moisture (method no. 44-15A), ash (method no. 08-01) and nitrogen free extract (NFE) of Proso millet's cupcake were performed in compliance with the method followed by Aboshora [12]. Copper, magnesium, phosphorus, and iron were measured using an atomic absorption spectrophotometer, while potassium and sodium and calcium were measured using a flame-photometer [13].

## Mineral Content Analysis

The mineral profile of cupcakes was measured using an atomic absorption spectrophotometer and flame photometer according to the method of Düzgün and Karaman [13]. Wet digestion of cupcakes samples was carried out on a hot plate for two hours using a 7:3 combinations of HNO<sub>3</sub>:HClO<sub>4</sub>. To make the sample volume 100 ml, distilled water was used to dilute the wet digested samples. An atomic absorption spectrophotometer was used to quantify the Fe, P and Zn contents in the digested samples. While a flame photometer was used to quantify Ca content in digested samples.

## Color Analysis of Cupcakes

Color analysis was performed using a Chroma meter (Chroma Meter CR-400 by Konica Minolta) [14]. The Chroma meter gave three variety boundaries: I\*, a\* and b\*. The colorimeter was aligned by involving a white standard plate so that readings of "I" were gotten in the scope of 0 to 100, which exhibits the obscurity and splendor of the examples. Readings of "a" with negative (green tone) values and positive (red tone) were kept in the scope of 0 to 60. Like "a" esteem, "b" values demonstrate negative and positive qualities for the blue and yellow overshadowing, individually.

## Cupcake's Sensory Assessment

The sensory characteristics of cupcakes were scored. A panel of 17 people (Male=10, Female=7) from the Department of Food Science and Technology, MNS-University of Agriculture, Multan. The sensory examination took place in a room that was silent, unscented, and well-ventilated. The panelists ranged in age from 23 to 42 years old, and they were in good health with strong sensory discernment (Figure 3).

## Cupcake's Statistical Assessment

All analysis was carried out in triplicate and collected data w subjected to statistical analysis. The one-way ANOVA under CRD (completely randomized design) was calculated using JMP v10 (Statistics 8.1. Software) from SAS, and the mean ± standard deviation was calculated using Microsoft Excel Spreadsheet Software Microsoft-365. Then pair wise comparison was done by Tuckey HSD test.

## RESULTS

### Analysis of Raw Material

#### Gluten

The table 2 indicates that, on average, wheat flour contains 29.2% wet gluten. The standard deviation suggests a slight amount of variability around the mean value. On the other hand, both rice flour and Proso millet flour show wet gluten content of 0%.

#### Flour's Antioxidants

The table 2 provides information about the mean values of Total Phenolic Contents for different types of flour. It suggests the presence of antioxidants in each flour sample and offers insights into the potential antioxidant activity of these flours.

**Table 2:** Gluten and Total Phenolic Content Analysis

Sample	Wet Gluten (%)	TPC (mg/g)
Wheat Flour	29.20±1.20 <sub>a</sub>	222±0.10 <sub>a</sub>
Rice Flour	00 <sub>a</sub>	2.45±0.01 <sub>b</sub>
Proso Millet Flour	00 <sub>a</sub>	2.44±0.45 <sub>c</sub>

#### Particle Size Index

The table 3 displays the mean values of the particle size index for different types of flour: Wheat flour, Rice flour, and Proso millet flour. The particle size index is measured in grams per kilogram (gm/kg) and provides information about the distribution of particle sizes in each flour sample.

**Table 3:** Mean Value of Flour's Particle Size Index

Particle Retained	Wheat Flour	Rice Flour	Proso Millet Flour
90µm	33.33±2.35 <sub>a</sub>	123.33±20.5 <sub>b</sub>	80±14.7 <sub>c</sub>
75µm	31.67±2.35 <sub>a</sub>	98.33±2.35 <sub>b</sub>	31.67±0 <sub>a</sub>
45µm	13.3±2.35 <sub>b</sub>	76.67±11.7 <sub>c</sub>	12.33±2.35 <sub>a</sub>

(Mean±SD) Represent A Statistically Significant Difference (P=0.05)

### Analysis of Product

#### Proximate Analysis of Cupcakes

The analysis of variance of moisture content of cupcakes showed that variety, treatment and interaction of both treatment and variety imposed highly significant difference (p < 0.01) within cupcakes, as it can be seen from table 4. The moisture content among the treatment ranged from 10.27 to 19.86%. The treatment T<sub>3</sub> had the highest moisture level, 19.77±0.07 while treatment T<sub>1</sub> had the lowest moisture content, 11.06±0.31 (table 4). The ash content of

gluten free cupcakes made from Proso millet and rice flour revealed a highly significant variation between treatments. The mean value of ash content of cupcakes ranged from 1.31 to 1.93% among treatments. The treatment T<sub>3</sub> had the highest ash level, 1.78±0.16%, (90% Proso millet flour and 10 % rice flour)(Table 4) According to results, the mean value of protein content of cupcakes ranged from 7.77 to 13.21% among treatments. The treatment T<sub>0</sub> had the highest protein level, 13.09±0.11, while the treatment T<sub>1</sub> had the lowest protein content, 8.10±0.25% while the protein content of remaining treatments was 0.34±0.42% (T<sub>2</sub>) and 8.53±0.08% (T<sub>3</sub>) can be seen in table 4. Highly significantly results showed in mean value table of fat content of gluten free cupcakes. Mean value of fat content of T<sub>0</sub>, T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> of cupcakes were 22.16±0.24%, 22.99±0.67%, 22.27±0.38%, 22.57±0.51% respectively. According to the results, the treatment T<sub>3</sub> had the highest fiber level, 4.24±0.098%, while the treatment T<sub>0</sub> had the lowest fiber content, 0.33±0.049%. The mean value of fiber content of cupcakes ranged from 0.33 to 3.24% among treatments while the fiber content of remaining treatments was 3.73±0.224% (T<sub>1</sub>) 4.24±0.04% (T<sub>2</sub>) confirm form table 4. Mean value of fiber content of gluten free cupcakes indicated that fiber varies highly significantly between different treatments. Similarly mean value of NFE content of gluten free cupcakes indicated that NFE varies highly significantly between different treatments and is quite obvious form table 4.

**Table 4:** Mean Value of Proximate Analysis (%) of Cupcakes Prepared from Proso Millet and Rice Flour

Parameters	T <sub>0</sub>	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>
Moisture (%)	18.47±0.15 <sub>b</sub>	11.06±0.31 <sub>c</sub>	18.55±0.16 <sub>b</sub>	19.77±0.07 <sub>a</sub>
Ash (%)	1.56±0.01 <sub>a</sub>	1.55±0.07 <sub>a</sub>	1.55±0.18 <sub>a</sub>	1.78±0.16 <sub>a</sub>
Crude protein (%)	13.09±0.10 <sub>a</sub>	8.10±0.23 <sub>b</sub>	8.340±0.23 <sub>b</sub>	8.53±0.08 <sub>b</sub>
Crude fiber (%)	0.33±0.05 <sub>c</sub>	3.73±0.22 <sub>b</sub>	4.24±0.22 <sub>a</sub>	4.24±0.09 <sub>a</sub>
Crude fat (%)	22.16±0.09 <sub>a</sub>	22.99±0.67 <sub>a</sub>	22.27±0.38 <sub>a</sub>	22.57±0.51 <sub>a</sub>
Nfe (%)	81.19±0.25 <sub>b</sub>	85.20±0.47 <sub>a</sub>	77.20±1.01 <sub>c</sub>	75.99±0.32 <sub>d</sub>

(Mean±SD) Represents a Statistically Significant Difference(P=0.05)

#### Mineral Analysis

Mean value of iron content ranged from 1.13±0.076 to 1.75±0.261mg/100g observed in different cupcakes. Highest value of iron is 1.96mg/100g observed in (T<sub>0</sub>) while lowest value 1.08mg/100g observed in (T<sub>0</sub>) (Table 5). The same trend is followed by other minerals.

**Table 5:** Mean Values Minerals Analysis (mg/100g) of Cupcakes Prepared from Proso Millet and Rice Flour

Parameters	T <sub>0</sub>	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>
Zinc (mg/100g)	1.271±0.12 <sub>a</sub>	0.81±0.02 <sub>b</sub>	0.76±0.07 <sub>b</sub>	0.748±0.11 <sub>b</sub>
Iron (mg/100g)	1.32±0.24 <sub>a</sub>	1.14±0.07 <sub>a</sub>	1.36±0.26 <sub>a</sub>	1.75±0.22 <sub>a</sub>
Phosphorus (mg/100g)	305.67±0.47 <sub>a</sub>	181.67±2.36 <sub>d</sub>	200.67±0.47 <sub>c</sub>	205.67±0.47 <sub>b</sub>
Calcium (mg/100g)	14.67±0.47 <sub>a</sub>	12.33±0.47 <sub>c</sub>	12.67±0.47 <sub>c</sub>	13.33±0.94 <sub>ab</sub>

#### Color Analysis

Color analysis of gluten free cupcakes showed highly significant results. Mean value of crumb I\* content of T<sub>0</sub>, T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> of cupcakes were 70.88±1.08, 68.97±0.571, 70.437±0.857, 68.75±0.127 respectively. The treatment T<sub>0</sub> had the highest I\* level, 70.88±1.08, while the treatment T<sub>3</sub> had the lowest I\* content 68.75±0.127 (Table 6).

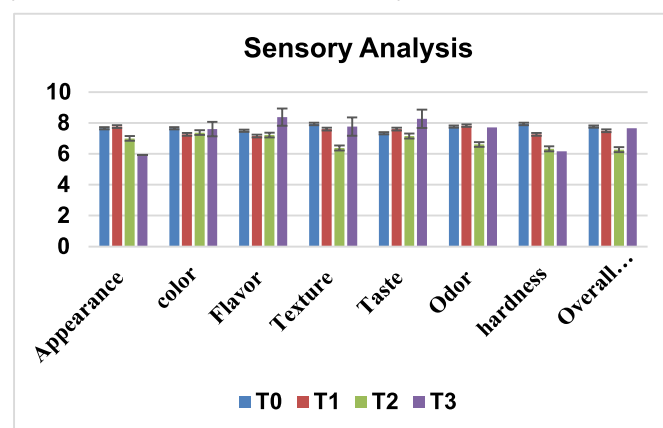
**Table 6:** Mean Value of Color Analysis of Cupcakes Prepared from Proso Millet and Rice Flour

Parameters	T <sub>0</sub>	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>
I value	70.88±1.080 <sub>a</sub>	68.97±0.570 <sub>a</sub>	70.436±0.857 <sub>a</sub>	68.75±0.127 <sub>a</sub>
a value	5.1±0.482 <sub>a</sub>	5.31±0.512 <sub>a</sub>	5.536±0.424 <sub>a</sub>	5.66±0.519 <sub>a</sub>
b value	24.25±0.330 <sub>a</sub>	23.79±0.507 <sub>a</sub>	24.22±1.187 <sub>a</sub>	24.43±0.661 <sub>a</sub>

(Mean±SD) Represents a Statistically Significant Difference(P=0.05)

#### Sensory Analysis

Figure 3 shows the findings of sensory analysis of parameters in different treatment plans.



**Figure 3:** Data of Sensory Analysis

## DISCUSSION

The analysis for present study was done at MNS-UAM of Agriculture, Multan's laboratory. According to the result of raw material Proso millet flour contain highest TPC (Total Phenolic Content). Similar results were determined with the study of [15], who found the total phenolic content (TPC) in Proso millet ranged from 2.4–2.51 (mg/g) and all of these differences caused by differences in environmental circumstances, genetics and diversity. As the purpose of the study was to prepare gluten free product. The gluten



content in the Proso millet flour and rice flour is zero according to the result as shown in table 2. This was similar to the other findings [16], who reported gluten content ranged from 27.5–30.1. Different environmental factors, such as temperature, air and humidity, cause all of these differences. The rice flour had highest particle retention as compared to wheat and flour and Proso millet, when sieved, keeping the sieve size at 90 $\mu$ m, 75 $\mu$ m and 45 $\mu$ m showing the largest particle size among all (Table 4). While wheat flour showed lowest number of particles having a size of 90 $\mu$ m as shown in the table 2. The particle size index of wheat flour match with the study [17]. The overall quality of the cupcake, the hardness and softness of the texture, and the look of the crumbs were all influenced by the particle size distributions of the rice flours. According to results, T<sub>3</sub> was having highest moisture content, ash crude protein, crude fiber (Table 4) as well as in iron content (Table 5) as compared to other treatments. T<sub>0</sub> was highest in zinc, phosphorus and calcium. The highest NFE content was shown in T<sub>1</sub>. While in color analysis T<sub>3</sub> had the highest a and b values. The fat content of cupcakes calculated in this study is similar to that reported in another study [18], who found 20.02 % to 23.12 % fat content in Ragi supplemented cupcakes. Fat content in all treatments were increased because the Proso millet used in this research which is a good source of fat comparatively. The moisture content of cupcakes calculated in this study is similar to that reported by other researchers [19], who found 10.63% to 19.86% moisture content in gluten free cupcakes. The overall moisture content was increased because when the percentage usage of Proso millet flour is increased. The effect of baking factors (forced or natural airflow condition, oven temperature, baking time) on texture characteristics, volume development and moisture content of a conventional butter cake [20]. The findings of the current study's ash content of cupcakes were similar to the findings of others [21], who reported 1.1 to 3.1% ash content in wheat flour supplemented with some seed sprouts flours cupcakes. The protein content of cupcakes calculated in this study is similar to that reported in another study [22], who found 7.1 % to 8.17 % protein content. Different Proso millet flour concentration caused protein content variations because they contain different amount of protein. The fiber content of cupcakes observed in this study was similar to another study [23], who found fiber content ranged from 3.67 to 4.37% in cupcakes made with cereals and pulses. Based on the findings of the sensory analysis, Treatment 3 (T<sub>3</sub>) was found to have the best taste, flavor, and color out of the four treatments that were evaluated for cupcake creation. 10% rice flour and 90% Proso millet were used in this therapy. The preference for T<sub>3</sub> indicated that the cupcakes' sensory qualities were

improved and their overall appeal was increased by the greater Proso millet and lower rice flour proportions. Furthermore, T<sub>3</sub> showed lower hardness in comparison to the other treatments, suggesting a more preferred texture, maybe because of the particular component combination. Overall, T<sub>3</sub>'s high acceptance highlights how well it balanced flavor, texture, and appearance, suggesting that it may be a good substitute for conventional wheat-based cupcakes.

## CONCLUSIONS

Based on the findings of current study we can conclude that Proso millet is an adaptable cereal grain to replace wheat in cupcakes. The nutritional and sensorial characteristics of cupcakes were observed best in treatment where 90% Proso millet and 10% rice flour used by completely replacing with wheat flour. Owing to gluten free nature, celiac disease patients could use it as good options. It is an indigenous crop therefore can help local industry to invest in Proso millet to make gluten free products range which could be economical for locals.

## Authors Contribution

Conceptualization: NR, NB

Methodology: NR, AM

Formal analysis: NR, AM, MAM, MM

Writing, review and editing: AH, UF, QA

All authors have read and agreed to the published version of the manuscript.

## Conflicts of Interest

The authors declare no conflict of interest.

## Source of Funding

The authors received no financial support for the research, authorship and/or publication of this article.

## REFERENCES

- [1] Niewinski MM. Advances in celiac disease and gluten-free diet. *Journal of the American Dietetic Association*. 2008 Apr; 108(4): 661-72. doi: 10.1016/j.jada.2008.01.011.
- [2] Nadhem ON, Azeez G, Smalligan RD, Urban S. Review and practice guidelines for celiac disease in 2014. *Postgraduate Medicine*. 2015 May; 127(3): 259-65. doi:10.1080/00325481.2015.1015926.
- [3] Sarwar MH, Sarwar MF, Sarwar M, Qadri NA, Moghal S. The importance of cereals (Poaceae: Gramineae) nutrition in human health: A Review. *Journal of Cereals and Oilseeds*. 2013 Jun; 4(3): 32-5. doi: 10.5897/JCO12.023.
- [4] McKevith B. Nutritional aspects of cereals. *Nutrition Bulletin*. 2004 Jun; 29(2): 111-42. doi:10.1111/j.1467-3010.2004.00418.x.

- [5] McSweeney MB, Seetharaman K, Dan Ramdath D, Duizer LM. Chemical and physical characteristics of Proso millet (*Panicum miliaceum*) -based products. *Cereal Chemistry*. 2017 Mar; 94(2): 357-62. doi:10.1094/CCHEM-07-16-0185-R.
- [6] Das S, Khound R, Santra M, Santra DK. Beyond bird feed: Proso millet for human health and environment. *Agriculture*. 2019 Mar; 9(3): 64. doi: 10.3390/agriculture9030064.
- [7] Caleja C, Barros L, Antonio AL, Oliveira MB, Ferreira IC. A comparative study between natural and synthetic antioxidants: Evaluation of their performance after incorporation into biscuits. *Food Chemistry*. 2017 Feb; 216: 342-6. doi: 10.1016/j.foodchem.2016.08.075.
- [8] Oktriandi E, Nurminah M, Lubis Z. Cupcake from composite flour based on natural local resources (modified breadfruit, purple sweet potato, mocaf, saga seed). In *IOP Conference Series: Earth and Environmental Science*. 2021 Nov; 912(1): 012036. IOP Publishing. doi: 10.1088/1755-1315/912/1/012036.
- [9] American Association of Cereal Chemists. Approved Methods Committee. Approved methods of the American association of cereal chemists. American Association of Cereal Chemists; 2000.
- [10] Kassim NK, Rahmani M, Ismail A, Sukari MA, Ee GC, Nasir NM et al. Antioxidant activity-guided separation of coumarins and lignan from *Melicope glabra* (Rutaceae). *Food Chemistry*. 2013 Aug; 139(1-4): 87-92. doi: 10.1016/j.foodchem.2013.01.108.
- [11] Rebecca LJ, Seshiah C, Sharmila D. Fortification of cupcakes with cereals and pulses. *International Journal of Novel Research in Life Sciences*. 2016; 3(3): 1-6.
- [12] Aboshora W. Association of Official Analytical Chemists. *Official Methods of Analysis*. 1990.
- [13] Düzgün M and Karaman M. Determination and evaluation of quality parameters in cool climate cereals. *Theoretical and practical new approaches in cereal science and technology*. Ankara: IKSAD Publishing House. 2021: 147-223.
- [14] Chandrasekara A, Naczki M, Shahidi F. Effect of processing on the antioxidant activity of millet grains. *Food Chemistry*. 2012 Jul; 133(1): 1-9. doi: 10.1016/j.foodchem.2011.09.043.
- [15] Ionescu V, Stoenescu G, Vasilean I, Aprodu I, Banu I. Comparative evaluation of wet gluten quantity and quality through different methods. *The Annals of the University Dunarea de Jos of Galati. Fascicle VI-Food Technology*. 2010 Nov; 34(2): 49-53.
- [16] Sonaye SY and Baxi RN. Particle size measurement and analysis of flour. *lung*. 2012 May; 2(3).
- [17] Mane K and Kadam M. Development and Quality Evaluation of Ragi Supplemented Cupcakes. *International Journal of Environment, Agriculture and Biotechnology*. 2021; 6(2). doi.org/10.22161/ijeab.62.8.
- [18] Aleman RS, Paz G, Morris A, Prinyawiwatkul W, Moncada M, King JM et al. High protein brown rice flour, tapioca starch & potato starch in the development of gluten-free cupcakes. *Lebensmittel-Wissenschaft & Technologie*. 2021 Dec; 152: 112326. doi: 10.1016/j.lwt.2021.112326.
- [19] c NA, Taip FS, Kamal SM, Aziz N. Effects of temperature and airflow on volume development during baking and its influence on quality of cake. *Journal of Engineering Science and Technology*. 2014 Jun; 9(3): 303-13.
- [20] Abdallah MM, Ghanem KM, Abo El-Naga MM, El-Sheshtawy AA, Abd El-Gany TS. Effect of wheat flour supplemented with some seed sprouts flours on cake qualities. *Journal of Biological Chemistry and Environmental Sciences*. 2017; 12(3): 113-30.
- [21] Kim JM, Shin M. Effects of particle size distributions of rice flour on the quality of gluten-free rice cupcakes. *Lebensmittel-Wissenschaft & Technologie-Food Science and Technology*. 2014 Nov; 59(1): 526-32. doi.org/10.1016/j.lwt.2014.04.042.
- [22] Rebecca LJ, Seshiah C, Sharmila D. Fortification of cupcakes with cereals and pulses. *International Journal of Novel Research in Life Sciences*. 2016; 3(3): 1-6.