



ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(8): 2029-2032
© 2022 TPI
www.thepharmajournal.com
Received: 13-06-2022
Accepted: 27-07-2022

Nongmaithem Roshia
Sam Higginbottom University of
Agriculture, Technology and
Sciences, Prayagraj, Uttar
Pradesh, India

Shanta Peter
Sam Higginbottom University of
Agriculture, Technology and
Sciences, Prayagraj, Uttar
Pradesh, India

Shanker Suwan Singh
Sam Higginbottom University of
Agriculture, Technology and
Sciences, Prayagraj, Uttar
Pradesh, India

Krishna Kumar Patel
Sam Higginbottom University of
Agriculture, Technology and
Sciences, Prayagraj, Uttar
Pradesh, India

Corresponding Author:
Nongmaithem Roshia
Sam Higginbottom University of
Agriculture, Technology and
Sciences, Prayagraj, Uttar
Pradesh, India

Development and quality assessment of gluten free muffins from black rice (*Oryza sativa* L.) flour and coconut (*Cocos nucifera* L.) flour

Nongmaithem Roshia, Shanta Peter, Shanker Suwan Singh and Krishna Kumar Patel

DOI: <https://doi.org/10.22271/tpi.2022.v11.i8y.15131>

Abstract

Today's consumers are more conscious of their diet and many prefer eating healthy food. This study was carried out to use blends of black rice flour, coconut flour and cocoa powder for production of gluten free muffins suitable for patients with celiac disease. The gluten-free were prepared from black rice flour, coconut flour and cocoa powder at different levels of concentration (T₀, T₁, T₂ & T₃). The concentration of black rice flour, coconut flour and cocoa powder in experimental samples were T₁ [BRF:CF:CP (80:15:5)], T₂ [BRF:CF:CP (75:20:5)] and for T₃ [BRF:CF:CP (70:20:5)]. While control sample were prepared from 100% black rice flour. The data collected on different aspects were tabulated & analysed statistically using the methods of analysis of variance & critical differences. Physico - chemical analysis (carbohydrate, protein, fat, ash, total solids), other constituents like antioxidant, crude fiber was done for estimating its nutritional content and for sensory evaluation (flavour and taste, body and texture, colour and appearance & overall acceptability) were judged by the panel on 9-point hedonic scale. Overall acceptability score for treatment T₀, T₁, T₂ & T₃ were 8.34, 7.40, 7.71 & 8.71 respectively. The cost of production of final product for treatment T₀, T₁, T₂ & T₃ were 13.66, 16.79, 17.14 & 17.47 INR / 100 g respectively. The muffins prepared from treatment T₃ [BRF:CF:CP (70:20:5)] was found to be the best among all. Therefore, the acceptability of the product assessed by sensory evaluation can be assessed as T₃>T₀>T₂>T₁.

Keywords: Gluten free muffins, black rice flour, coconut flour, cocoa powder, celiac diseases, sensory evaluation

Introduction

Today's consumers are more concerned about their diet, and many prefer a healthy diet. In recent years, consumers interest in wheat (*Triticum-aestivum*) free products has grown slowly and steadily to minimize the risk of a relatively unfamiliar condition known as celiac disease. CD is not only disease associated with gluten intake. In fact, gluten also causes other pathologies classified under the term "gluten-related disorders." To date, the only treatment for CD is strictly following a gluten-free (GF) diet.

Muffins

Are one of the bakery products highly appreciated by consumers due to their sweet taste, moist texture and convenience? The composition of the muffins is fat in water obtained from the egg- sugar -water-fat mixture in a continuous phase, and the air bubbles represent a discontinuous phase where the flour is dispersed. Traditionally, muffins recipes are made with wheat flour, vegetable oils, eggs and milk. For this reason, many people with celiac disease cannot consume this type of product because it is made with wheat flour.

Black rice: Is native to the common rice species (*Oryza sativa*). Other common names for black rice are purple rice, forbidden rice, imperial rice, royal rice and precious rice. In Manipur, it is known as Chakhao Amubi (Chakhao means "delicious" and Amubi means "black"), so it means delicious black rice. Black rice is more nutritious.

The various health benefits of black rice and the presence of black rice "anthocyanins" make it an amazing ingredient in the food industry. The use of black rice in the food industry may improve the nutritional profile of foods made from black rice, and may even be converted into functional foods targeted to specific groups of people such as people with diabetes, obesity or high blood pressure and heart condition disease.

Many consider this rice to be a panacea for many culinary ailments due to its high nutritional value and medicinal properties.

Coconut: Is naturally low in digestible carbohydrates, gluten-free, cheaper than most of the other nuts, and are rich in healthy fiber and important nutrients. Coconut flour (CF) is a by-product of the Virgin Coconut Oil (VCO). Coconut flour can be added to baked goods such as cookies, candy bars, quick breads, desserts and muffins. When cooking or roasting food, it enhances the taste of chocolate and vanilla and improves the texture of baked goods. It has also gained importance due to its benefits against cardiovascular disease, gastrointestinal cancer, and other conditions.

Therefore, this study was conducted with the aim of using coconut flour and cocoa powder

- To develop muffins from black rice flour and coconut flour.
- To assess physicochemical, sensory and microbial attributes of the developed product.
- To determine the antioxidant activity and crude fiber content.
- To evaluate the cost of developed product.

Materials and Methods

The experiment was carried out in the research lab of “Warner College of Dairy Technology” SHUATS, Prayagraj (Allahabad)-211007.

Black rice of good quality was purchased from Manipur. The variety of black rice used for preparation of this muffins is Poireiton Chakhao and the other ingredients like coconut flour, sugar, baking powder, cocoa powder, milk, eggs and butters were procured from the local market of Prayagraj.

Treatment combinations of this study were as follows

Muffins prepared by blending of Black Rice Flour (BRF), Coconut Flour (CF) and Cocoa Powder (CP) in the ratio of T₀ [100:00 (BRF)], T₁ [80:15:05 (BRF:CF:CP)], [T₂ 75:20:05 (BRF:CF:CP)] & T₃ [70:25:05(BRF:CF: CP)].

Preparation of muffins: For the preparation of muffins, A control (T₀) sample of the formulation of muffins are black rice flour, sugar (45 g), baking powder (3 g), milk (50 ml), butter (30 g) and egg (45g). T₁ containing 80% black rice flour, 15% coconut four, 5% cocoa powder, T₂ containing 75% black rice flour, 20% coconut flour, 5% cocoa powder, T₃ containing 70% black rice flour, 25% cocoa powder and 5% cocoa powder. Baking powder and other ingredients were added for each muffin were weighed accurately and the sugar, milk and melted butter were beating for 2 minutes to produce a batter. In later stage flours and other ingredients were mixed using a mixer at low speed (145 rpm) for 10 minutes to ensure even distribution of the components. The bowl was scrapped and batter was mixed for an additional 2 minutes at medium speed. The batter was placed into mould plate, previously oiled and covered with a butter paper and baked in a hot – air oven heated to 180 °C for 20 minutes. After cooling the muffins was packed into LDPE bags and kept in a refrigerator at 5 °C for further Sensory evaluation, physico-chemical & microbial analysis.

Chemical analysis: The nutritive value of the ingredients were analyzed by standard AOAC methods. The control and formulated muffin samples i, e moisture content was estimated by AOAC 2010 method. Protein, ash, fat, total solids and crude fiber were determined using AOAC method.

Antioxidant was determined by DPPH method and total carbohydrate content of the sample was determined as total difference

Sensory Analysis: The control sample and samples of muffins prepared with coconut flour and cocoa powder were evaluated by the sensory panelists for the sensory qualities of colour and appearance, body & texture and overall acceptability using a 9-point hedonic scale. The sample with the highest acceptability received a score of 9 and the sample with the lowest acceptability received a score of 1. The mean value of the scores from sensory panelists was then calculated.

Microbial analysis: Microbiological analysis i.e., Standard Plate Count (SPC), coliforms and yeast & mould tests were performed using standards methods described in IS (1981). Nutrient agar, Mac Conkey agar, Potato dextrose agar (HiMedia, HiMedia Laboratories Pvt. Ltd., Mumbai) media were used for estimating SPC, coliform and Yeast and Mould.

Statistical analysis: Each treatment was replicated 5 times and data was statistically analysed using Microsoft excel spread sheet. The data analysis was done by application of ANOVA at 5% level of significance.

Cost analysis: The endeavor has been made to assess the cost of production of muffins from black rice flour, coconut flour & cocoa powder. The cost of production of muffins was calculated on the basis of the cost of the ingredients used (Black rice flour, coconut flour, cocoa powder, sugar, baking powder, milk, butter and eggs).

Results and Discussion

Table 1: Chemical composition of control & experimental muffins

Parameters	Samples (BRF: CF: CP)			
	T ₀ (100:00)	T ₁ (80:15:05)	T ₂ (75:20:05)	T ₃ (70:25:05)
Carbohydrate %	29.254	22.198	18.508	16.848
Protein %	15.642	15.812	15.708	15.55
Fat %	33.022	36.798	38.264	39.42
Ash %	2.522	2.632	2.74	2.82
TSS %	80.44	77.44	75.22	74.64
Moisture %	19.56	22.56	24.78	25.36
Antioxidant % RSA	89.762	81.7	80.506	79.016
Crude fiber %	1.182	4.206	5.132	6.054

Table 2: Microbial analysis of muffins

Parameters	Samples (BRF: CF: CP)			
	T ₀ (100:00)	T ₁ (80:15:05)	T ₂ (75:20:05)	T ₃ (70:25:05)
SPC × 10 ⁻³ (colony forming unit/gm)	1.264	1.328	1.33	1.354
Coliform count (cfu/gm)	Nil	Nil	Nil	Nil
Yeast & Moulds count (cfu/gm)	2.4	2.4	3.0	3.2

Table 3: Sensory analysis of muffins

Parameters	Samples (BRF: CF: CP)			
	T ₀ (100:00)	T ₁ (80:15:05)	T ₂ (75:20:05)	T ₃ (70:25:05)
Color and Appearance	8.382	7.642	7.982	8.664
Flavour and taste	8.288	7.448	7.694	8.688
Body and Texture	8.342	7.11	7.526	8.806
Overall acceptability	8.34	7.402	7.714	8.718

Table 4: Calculated cost of control and experimental samples

Cost in Rs/100 g	T ₀	T ₁	T ₂	T ₃
	13.66	16.79	17.14	17.47

Chemical analysis of muffins

A control (T₀) sample of the formulation of muffins are black rice flour, T₂ containing 75% black rice flour, 20% coconut flour, 5% cocoa powder, T₃ containing 70% black rice flour, 25% coconut flour and 5% cocoa powder. Were analyzed for carbohydrate, moisture, protein, fat, ash, total solids, crude fiber and antioxidant by the methods of AOAC. The results of analysis are shown in Table 1. The sample T₃ was found to have a higher moisture content, which is probably due to higher crude fiber content that binds more water in the muffins. The protein content was significantly higher in T₁ because of the added 80% black rice flour, 15% coconut flour and 5% cocoa powder. Increase in fat, ash, crude fiber as gradually increase in addition of coconut flour & cocoa powder to the product in the treatment T₃. Carbohydrate, Total solids, and antioxidant are highest in T₀ because of highest content in black rice flour to the product.

The use of coconut flour & cocoa powder affects the nutritive value of the product. The partial substitution of coconut flour and cocoa powder slightly increase the protein content. Therefore, incorporation of coconut flour, cocoa powder into black rice flour improves the protein content and thus improves the nutritional status of muffins.

Microbial Analysis: Moisture is increasing therefore SPC & yeast and mould growth is in increasing order due to increase in moisture in the treatment while coliform count was found nil in all the treatment because it shows the absence of gram-negative bacteria which means the strict hygienic practice was maintained during the procedure preparation. All the results

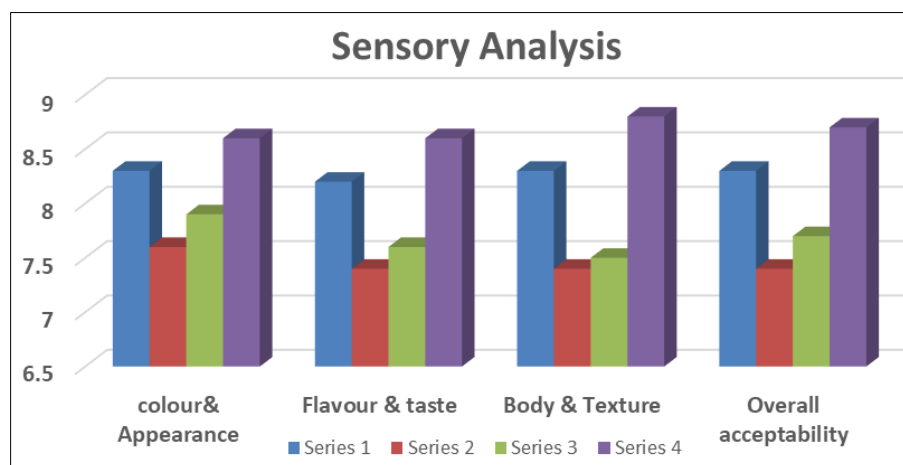
of microbial analysis are shown in Table 2.

Sensory Analysis

The average sensory scores for samples T₀, T₁, T₂ & T₃ are shown in Table 3. Sample T₃ containing 70% black rice flour, 25% coconut flour and 5% cocoa powder scored the highest in colour & appearance, body & texture, flavour & taste and overall acceptability. The increased fat content by adding coconut flour seemed to improve colour, aroma and taste. The addition of coconut flour and cocoa powder plays an important role in the porosity and overall acceptability of the finished product.

In conclusion, this study confirms that incorporating different levels of coconut flour, cocoa powder into muffin recipes improved the quality attributes of muffins in terms of nutrition in terms of fat, protein, ash, crude fiber and physically flavour and taste, body & texture, colour & appearance and overall acceptability. The present study confirmed that muffins can be successfully prepared by using black rice flour, coconut flour and cocoa powder. These results indicates that gluten free muffins obtained with black rice flour, coconut flour and cocoa powder could be an alternative for people suffering from gluten intolerance.

Based on the results of the studies, it was concluded that addition of 70% black rice flour, 25% coconut flour and 5% cocoa powder T₃ (70:25:05) has improved the sensory and physico-chemical characteristics of the samples of the muffins obtained and consequently increased- their nutritional value with the cost of production of INR 17.47 per 100 g. Furthermore, by comparing the results obtained, it can be appreciated that the recipes established from this study can be successfully applied on an industrial scale. Therefore, it can be concluded that adding up to 25% coconut flour and 5% cocoa powder gives organoleptically acceptable muffins.

**Fig 1:** Sensory Analysis

References

- Arifin N, Siti Nur Izyan MA, Huda-Faujan N. Physical properties and consumer acceptability of basic muffin made from pumpkin puree as butter replacer. *Food Research*. 2019;3(6):840-845.
- Chiang AN, Wu HL, Yeh HI, Chu CS, Lin HC, Lee WC. Antioxidant effects of black rice extract through the induction of superoxide dismutase and catalase activities. *Lipids*. 2006;41(8):797-803.
- Daniela Stoin, Calin Jianu, Corina Misca, Gabriel Bujanca, Laura Radulescu. Effect of almond flour on nutritional, sensory and bakery characteristics of gluten-free muffins; 2020.
- Ichikawa H, Ichinagi T, Xu B, Yoshii Y, Nakajima M, Konishi T. Antioxidant activity of Anthocyanin Extract from purple Black rice, *Journal of Medicinal Food*. 2001;4(4):211-218.
- Kang MY, Kim JH, Rico CW, Nam SH. A comparative study on the physicochemical characteristics of black rice varieties. *International Journal of Food Properties*.

- 2011;14(6):1241-1254.
6. Laura T, Rodriguez Furlán, Antonio Perez Padilla, Mercedes E, Campderros. Improvement of gluten-free bread properties by the incorporation of bovine plasma proteins and different saccharides into the matrix. *Food Chemistry*. 2015;170:257-264.
 7. Lee BR, Kim KY, Jung WJ, Avice JC, Ourry A, Kim TH. Peroxidases and lignification in relation to the intensity of water-deficit stress in white clover (*Trifolium repens* L.). *Journal of experimental Botany*. 2007;58(6):1271-1279.
 8. Lee HJ, Oh SK, Choi HC, Kim SU. Identification of anthocyanins from pigmented rice seed. *Applied Biological Chemistry*. 1998;41(40):257-260.
 9. Maria E Matosa, Cristina M Rosell. Understanding gluten-free dough for reaching breads with physical quality and nutritional balance. *Journal of the Science of Food and Agriculture*. 2014;95(4):653-661.
 10. Nurul Ain O, Marina AM, Sakinah H. The effect of avocado puree as fat replacer on the physical quality of muffin. *Malaysian Applied Biology*. 2016;45(2):11-16.
 11. Saikia S, Dutta H, Saikia D, Mahanta CL. Quality characterisation and estimation of phytochemicals content and antioxidant capacity of aromatic pigmented and non-pigmented rice varieties. *Food research International*. 2012;46(1):334-340.
 12. Sampong R, Ehn SS, Martin GL, Berghofer E. Physicochemical and antioxidant properties of red and black rice varieties from Thailand, China and Sri Lanka. *Food Chemistry*. 2011;124(1):132-140.
 13. Shevkani Khetan, Kaur Amritpal, Kumar Shresth, Singh Narpinder. Cowpea protein isolates: Functional properties and application in gluten-free rice muffins. *LWT - Food Science and Technology*. 2015;63(2):927-933.
 14. Simona Man, Adriana Paucean, Sevastița Muste, Anamaria Pop. Studies on the formulation and quality characteristics of gluten free muffins. *Journal of Agro alimentary Processes and Technologies*. 2014;20(2):122-127.
 15. Sofyan Maghaydah, Selma Abdul-Hussain, Radwan Ajo, Yousef Tawalbeh, Noor Elshahoryi. Effect of Lupine Flour on Baking Characteristics of Gluten Free Cookies. *Advance Journal of Food Science and Technology*. 2013;5(5):600-605.
 16. Yodmanee S, Karrila TT, Pakdeechanuan P. Physical, chemical and antioxidant properties of pigmented rice grown in Southern Thailand. *International Food Research Journal*. 2011;18(3):901-906.