IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Development Of Gluten Free and Dietary Fiber Rich Multigrain Muffins

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Abstract

The current project focuses on the development, sensory evaluation, and production of multigrain muffins. Sorghum Flour, Pearl Millet Flour, Finger Millet Flour, Coconut Flour, Sesame Flour, Flax Seed Flour and Fox-nut Flour were all used and formulated in different quantities. Sensory assessment was carried out by a semi-trained panel using the 9-point hedonic scale system, and the first formulation received the highest score. The final formulation was taken a step further and chemically tested. Protein content is 7.05 percent, iron is 3.45 mg/100gm, dietary fibre is 6.19gm/100gm, and the energy value is 304.41 Kcal/100gm. Multigrain muffins contain nutritious ingredients that have been shown to have health benefits, such as dietary fibre contained in sorghum and pear millet, which lowers the risk of heart disease and LDL cholesterol and beet root fibre, which is high in iron and suitable for people with gluten allergies and celiac disease.

Keywords: Multigrain muffins, Sorghum Flour, Pearl Millet Flour, Gluten free formulations.

1. Introduction

Muffin is the single-serving cake, which is get raised by using a combination of baking soda and baking powder or by using egg instead of using yeast (*Saccharomyces Cerevisiae*). It is a sweet dessert. According to some 19th-century sources, the term “muffin” may come from the Greek bread “Maphula” or old French “mou-pain” which means soft bread. Muffins are also known as “Quickbread muffins” or “American muffins” individual-sized, cupcake-shaped dessert. These muffins are made by cake batter and American muffins were invented in the 18th century. British muffins discovered by Welsh in the 10th century and English muffins arrived in 19th century (Coracana L. 2014).

Muffins are rich in carbohydrates and protein mainly gluten which is harmful to the human body if consumed excessively. It also contains fats (saturated, monounsaturated, polyunsaturated) and fibres into it but they are significantly lower than other nutritional factors (Malia, 2020). Muffins are commonly made by mixing dry and wet ingredients to form a batter. Multi-purpose flour or white flour is frequently used for the preparation of muffin batter and it also includes a source of fat i.e. butter, sugar as a source of carbohydrate, egg or baking soda and powder for the leavening and milk as a source of moisture. All these ingredients are getting mixed thoroughly to form a consistent and lump-free batter. All-purpose flour is rich in protein (8-10%) mainly known as gluten which gives the chewy texture to the muffin and it also provides the strength to the muffin (Sally L., Peter K. and Robert J. 2011). It is the blend of hard and soft wheat flour. Sugar not only provides sweetness to product but also enhance the final colour of the product and this happens due to the "caramelisation reaction" also known as "browning reaction". Egg used as an emulsifier in muffin making and it consists of two main parts egg white and egg yolk, egg white is responsible for giving the foam-like appearance to the muffins and egg yolk is a good source of protein results the protein-rich final product. But according to information mention before, these types of muffins contain gluten in it, excess consumption of gluten can cause many health issues regarding heart (Malia F. 2020**)**. The disease is known as "Celiac disease" means the intolerance of gluten, other than this disease, excess consumption of gluten also causes the bloating, abdominal discomfort and pain, altered bowel habits, flatulence, rash, fatigue, headaches, mental disturbances, irritability, depression, bone and joint pain, and even attention deficit disorder in people who are not suffering from celiac disease (Aziz I., Lewis N. and Hadjivassiliou M. 2014).

The requirement for low gluten or gluten-free food products is increasing day by day because almost 1% population of the world is affected by this disease and it is a lifelong disease (Gujral N, Freeman and Thomson, 2012.) The reaction of gluten indigestion for those who are suffering from celiac disease is inflammation of small intestine accompanied by stomach pain, heartburn causes malabsorption of nutrients (Feighery, 1999). According to the recent demands of the consumers, they also want the food enriched with functional nutrients like dietary fibre. The bakery sector is one of the dominant sectors in processed food. The purpose of the present study was to introduce innovative, gluten free and fibre enriched baked goods and muffins are from those bakery products which had a wide scope of modification and the final developed product is name as Fibre Enriched Gluten-free Muffins (DeRoosM. 2004). The foremost part of this recipe is, it is made up of combination of seven flours named as "Seven Heaven Flour" which makes it 100% gluten-free. This combination of flour includes, first, Sorghum flour (*Sorghum Bicolor*) which is rich in

carbohydrates, protein (Kafirin) (Castro., Alcantara and Tovar, 2020.) and it is also rich in vitamins and minerals like B vitamins, magnesium, potassium, phosphorus, iron, and zinc. It's likewise an excellent source of fibre, antioxidants, and protein. (Xiong et al.,2019). Second, Pearl millet (*PennisetumGlaccumm*) is also the descent source of protein and carbohydrates and a good source of fibres, vitamins and minerals (Bora, Ragaee and Marcone, 2019).Third, Finger millet (*EleusineCoracana*) flour Which contains a better amount of Phenolic compounds (0.3–3%) and dietary fibre (18%) and are also rich in calcium (0.38%) also acclaimed for various health benefits like anti-diabetic, anti-tumerogenic, atherosclerogenic effects, and antioxidant and antimicrobial properties (Bastola R. and other.2015).Forth, Fox nut (*Euryale Ferox*) flour which is rich in protein and fiber and less in fat and it is great source of calcium They also contain magnesium, potassium and phosphorus in good amount (Sangtae and Kae, 2015). The health benefits are weight loss, anti-aging, control blood sugar level and improves bone strength and heart health (PuriR. 2020). Fifth, sesame flour (*Sesamum indicum*) it has some properties like antioxidant, antimicrobial, antiinflammatory, antidiabetic, anticancer (S.O. Amoo,2017). The sixth one is coconut (*Cocos Nucifera*) flour (Pearsall J.1999) and it is a rich source of carbs, fibres, fat and it also contains protein and B vitamins and minerals (Laurel, 2013). It is beneficial for heart health and may promote blood sugar control (Albert, 2016). The last but not least type of flour is Flax seed (*Linum Usitatissimum*) flour (Allaby, Peterson and Merriwether, 2005) which is excellent source of omega-3 fatty acid and also rich source of alpha-linolenic acid (Joseph, 2014). It prevents deposition of cholesterol in the blood vessels of the heart and reduces inflammation in the arteries (Am J.2013).

The rich source of dietary fibres is, first, Beetroot (*Beta Vulgaris*) (Gledhill, and David, 2008) which is not only rich in dietary fiber but also contains folate (Vitamin B9), manganese, potassium, iron and vitamin C. Various health benefits are improves blood flow and enhance physical performance by increasing stamina (Acta S.2014) and second is Purple carrot (*DaucusCarota*) which are loaded with nutrients like fiber, potassium and antioxidants called anthocyanins which acts as inflammatory agent and reduce risk of heart disease (Bredmond L. 2018). It also has caner fighting properties. These are some major ingredients other than these it also includes sugar for sweetness and it keeps muffins moist, vegetable oil which is responsible for tenderness of muffins and it also effective for maintaining springiness of muffins (2014). Egg is used as a leavening agent and it also enhance colour and flavour of the final product. Salt is added for strengthen the structure and it also enhances flavour of final product (Boskou, D. 2010).Joseph L. 2014). Egg is used as a leavening agent and it also enhance colour and flavour of the final product.

The aim of the study was to investigate added nutritional value and impact on sensory properties and physical parameters of increased dietary fibre, protein, carbohydrates based on gluten-free seven heaven flour combined muffin based on additional beetroot and purple carrot.

2. Material Method

2.1 Materials

All ingredients of basic muffin including Sorghum Flour, Pearl Millet Flour, Finger Millet Flour, Coconut Flour, Sesame Flour, Flax Seed Flour, Fox-nut Flour (Table 2) Egg, milk, oil, Fiber (Beetroot + black carrot), sugar, baking soda, Baking Powder, Vanilla Essence (Anchor) were bought from a supermarket in Jaipur, Rajasthan.

2.2 Processing of raw material

Sieving of all flours along with baking soda and baking powder was done to remove suspended impurities and oil milk stored at refrigeration temperature.

2.3 Muffin production

The muffin recipe was adapted from RomeroLopez et al (2011). A control muffin was made with butter, while the other seven muffins were made with different percentages of flour. The seven muffin recipes were shown in (Table 1). Initially, oil and sugar were combined in a mixer bowl using an electric mixer. Then 99 g of whole eggs were added to the mixture and thoroughly mixed in. Before applying to the mixer bowl, flour, baking powder (1.25 g), baking soda (2.50g) sugar (75 g), were combined and sifted. Then, when combining the ingredients until they were homogeneous, milk (75 mL) was progressively added to the mixture. Finally, the muffins were baked for 30-40 minutes at 180°C in a preheated oven. Until testing, the muffins were allowed to cool to room temperature (25° C).

2.4 Sensory analysis

According to Meilgaard et al., the Hedonic test was used to determine market acceptability (2007). This test used a 9-point scale ranging from 1 (extremely dislike) to 9 (extremely like) (extremely like). Each panellist rated the appearance, colour, texture, taste, and overall acceptance of the product. To avoid bias, each muffin sample was cut into a rectangle shape and served to panellists with a random three-digit number.

3. Result and discussion:

3.1 Sensory Evaluation

For finding the appropriate sample which has a good texture, acceptable colour, and taste we prepared seven different samples with varying quantities of seven heaven flours show in figure 1. Sample 1 has a tacky taste with a sticky texture and it was having reddish-brown colour. Sample 2 has a dominating taste of single-ingredient with a brittle structure which doesn't suit the physical properties of a muffin and it was also having reddish-brown colour. Sample 4 has a balanced taste of each ingredient but it has a fudgy structure which is not acceptable and it also had the same colour as samples 1 and 2. Sample 5 has a bitter taste and soft, and moist texture, colour was similar to other samples. Sample 6 has a dominating oil taste with a sticky and moist structure and in this sample also the colour was the same as other samples. Sample 7 has a bitter burnt taste with a soft and moist texture and has a reddish-brown colour. Now, sample 3 which was an appropriate sample decided based on sensory evaluation has a balanced taste with acceptable soft and moist texture with a reddish-brown colour. The sample consisted of 20 grams of finger millet flour 5gram of fox-nut and 10 grams of other mentioned flour on the table.

Figure 1. Sensory evaluation of multigrain muffin prepared from seven flour

3.2 Optimization of muffins

The optimized sample was mainly chosen because of its overall acceptance for the texture and taste; it also contains the major nutrients which are discussed before. The optimized sample is rich in colour as it contains the source of fibre which also enhances the colour of the final product. The colour of sample S1 is dark brown while the colour of the optimized sample is reddish brown because of the red colour pigments known as betacyanins and beta carotene present in the source of the fibre. The combination of seven flours and fibre source are get bind with each other with the help of egg which is known for its property of emulsification.

3.3 Chemical analysis

The nutritional analysis of muffins prepared from a blend of seven different flours optimized sample had higher amounts of dietary fibre which is almost 24.76% of the daily value (6.19 gm./ 100gm of the sample) as compared to control sample which contains ordinary ingredients (all-purpose flour, egg, sugar/sugar solution) show in Table 3. Control contains 234.12 kcal., while optimized sample contains 304.41 kcal. Optimized sample contains 7.05 gm. of protein (i.e., 14.10% of daily value) while control contains 5.02

gm/100gm. An optimized sample is an iron-rich sample that contains almost 3.45 mg of iron per 100 gm. of the sample while sample control contains 1.23 mg of iron. An optimized sample contains 8.60 gm. of sugar/100 gm. sample while control contains 6.56gm./100gm of sugar. The pH of the optimized sample is 7.75 and its acidity is almost 0.203%. Jadhao et al. (2018) have been also reported that the multigrain muffins were good source of energy, carbohydrates also provide protein and fiber in certain amounts.

4. Conclusion

Muffins are made with this recipe. Sorghum Flour, Finger Millet Flour, Coconut Flour, Sesame Flour, Flax Seed Flour, Fox-nut Flour and pearl millet flour in the right a proportion adds nutrition to a food and improves its overall acceptability. The flour mixtures could be used to make high-quality multigrain muffins with excellent sensory properties. Multigrain muffins are a good source of fibre, starch, protein, energy and iron, all of which are necessary for good health and provide unique health benefits.

Disclosure

The author reports no conflicts of interest in this work.

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Table 1 Ingredient for preparation of muffins

Serial number.	Ingredients	Quantity
1.	Sorghum Flour	10 gm
2.	Pearl Millet Flour	10 gm
3.	Finger Millet Flour	20 gm
4.	Coconut Flour	10 gm
5.	Sesame Flour	10 gm
6.	Flax Seed Flour	10 gm
7.	Fox-nut Flour	05 gm
8.	Egg	99 gm
9.	Milk	75 gm
10.	Oil	20 gm
11.	Fiber (Beetroot + black carrot)	75 gm (50 gm+25 gm)
12.	Sugar	75gm
13.	Baking soda	2.5 gm
14.	Baking Powder	1.25 gm
15.	Vanilla Essence	5 ml

Table 2. Formulations of multiflours proportion

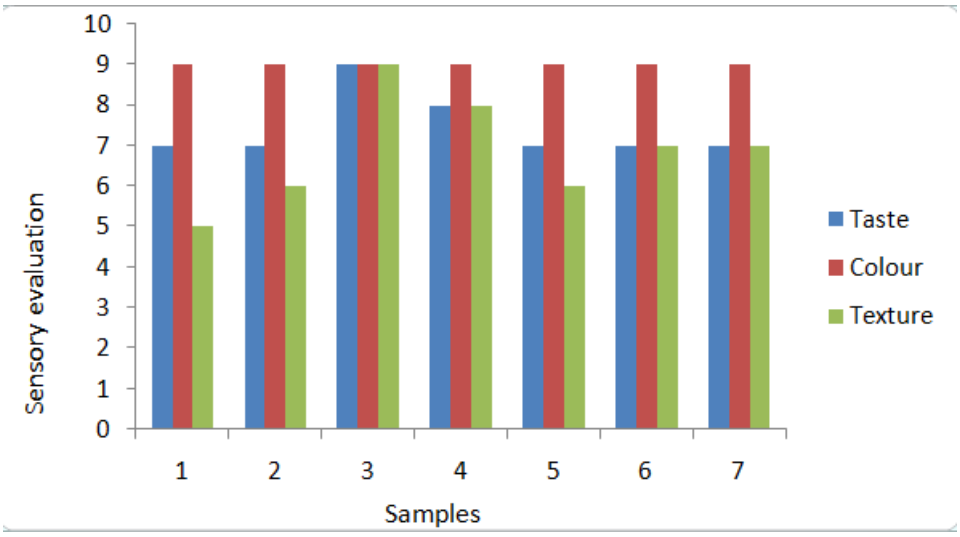
Sample No.	Major Ingredients (Flour)						
	Sorghum Flour	Pearl Millet Flour	Finger Millet Flour	Coconut Flour	Sesame Flour	Flax Seed Flour	Fox Nut Flour
Sample 1	20	10	10	10	10	10	5
Sample 2	10	20	10	10	10	10	5
Sample 3	10	10	20	10	10	10	5
Sample 4	10	10	10	20	10	10	5
Sample 5	10	10	10	10	20	10	5
Sample 6	10	10	10	10	10	20	5
Sample 7	10	10	10	10	10	10	10

Table 3: Results of chemical Analysis

Parameters	Control sample	Optimized sample
Moisture content (%)	25.56±0.22[b]	30.34 ±0.34[a]
Protein (g/100gm)	5.02 ±0.32[b]	7.05 ±0.56[a]
Dietary fiber (g/100gm)	3.34 ±0.34[b]	6.19 ±0.45[a]
Sugar (g/100gm)	6.56 ±0.67[b]	8.60 ±0.67[a]
Iron (mg/100gm)	1.23±0.45[b]	3.45 ±0.65[a]
pH	4.34 ±0.65[b]	7.75 ±0.87[a]
Acidity (%)	0.434 ±0.87[b]	0.803 ±0.67[a]
Calories(g/100gm)	234.12±0.23[b]	304.41 ±0.54[a]
Water activity	0.892 ±0.98[b]	0.678 ±0.78[a]

[a] n - 3, Mean ± standard deviation values in the same column which are not followed by the same letter are significantly different ($p < 0.05$).

Figure 1. Sensory evaluation of multigrain muffin prepared from seven flour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Sensory evaluation
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Samples
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Colour
Texture