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BLEND OF FLOUR WITH *VIGNA RADIATA* AND *VIGNA MUNGO* USED IN MUFFINS IN ORDER TO INCREASE NUTRITIONAL PROPERTIES

Sayeida Sadia Aimon[1], Anum Liaquat[1], Syeda Hafsa Aamir[1], Tehreem Qadeer[1], Seema Ashraf[1,2,4,*] and Rashida Ali[1,2,3]

[1]Department of Food Science and Technology, Jinnah University for Women, Nazimabad, Karachi, 74600, Pakistan; [2]Department of Food Science and Technology, University of Karachi, Pakistan; [3]English Biscuit Manufacturers (Pvt) Limited, Plot 1-4, Sector 23, Industrial Area, Karachi-749 00, Pakistan; [4]Division of Food Research, HEJ Research Institute of Chemistry, University of Karachi, Karachi, 75270, Pakistan

Corresponding author: s.seemajuw@gmail.com

ABSTRACT

Supplementation of foods is current intrigue due to increasing healthful mindfulness among consumers. Muffins can be effectively strengthened with protein-rich lentils to give advantageous nourishments, so as to enhance protein in the eating routine and sustenance. Fortification of lentil was attempted at 30, 40, and 50% to think about the nourishing, textural, practical, and physicochemical properties in muffins. Legumes in perception on their supplement profile appear to be perfect for incorporation in the structuring of bakery shop items, and its job in anticipating ailments, for example, malignant growth, diabetes, and coronary illness. It was the most extravagant wellsprings of plant proteins and gave around 10% of the all-out dietary prerequisites of the proteins. In light of high in dietary fiber prompting low GI (glycemic index) sustenance. The analysis shown that lentil muffins were the most delicious and most beneficial. Boost the protein, fiber, nutrient, and mineral substance that improves the surface of prepared products, expands the duration of the usability of prepared products.

Keywords: Muffin, Lentil, Supplementation, Dietary Fiber, Glycemic Index

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1. INTRODUCTION

Consumers have been changing their behavior with regards to the purchase and use of food as well as eating habits. As a consequence of consumer requiring fast, convenient and easy to transport food products, ready to eat convenient food have gained popularity especially considering that they ae frequently available as small products intended for mobile consumption. Typical bakery products in this category include bread, breadsticks, biscuit, donuts, cupcakes and muffins which are now available world-wide (Sha et al. 2013; Foschi et al. 2020).

Muffins are a type of semi-sweet cake or quick bread that is baked in appropriate portion. According to baking, wheat flour and legumes germinated, and exterminated flour starch shows changes in absorption of water. Legume flour absorbed more water than whole legume flour. While the loaf volume not shows much changing as germinated legume shows smaller volume than that of exterminated. The amylase, ash and starch are reduced while the reducing sugar increased in germination (Rebecca et al. 2016) crumb structure is lower in both cases. There is no off-flavor, bitter taste was observed. The whole grain wheat flour contains more fiber, nutrients, minerals and phytochemical when contrasted with wheat flour. It was a best well spring of dietary benefit and can be included any utilitarian food with medical advantage of forestalling cardiovascular infections, malignant growth and diabetes. The mung bean (Vigna transmit) was grown to the consumable pulses transversely over south (Hoover et al. 2010). These beans are diverse in concealing: typically found in green tone, yet discovered moreover different shades of green and yellow shade just as purplish dark. The tints of seed and closeness, nonappearance of disagreeable scaffolds have used to perceive different sorts of heartbeats. The presence of mung beans was sparkle not as much as pound beats. It was adaptable for utilization in southern regions. In spite of the fact that pulses have profoundly engrossing limit of protein instead of red meat (Zia-Ul-Haq et al. 2014; Graf et al. 2019).

Pulses can be cultivated in wide range of soils and climates and because of their short growing season. It is rich in protein fiber, mineral, vitamins, iron and phosphorus content, which include 40% protein. Pulses have extraordinary significance in the India because of protein substance of 17 to 25% when contrasted with cereals. They have capacity to fix air nitrogen and improved richness of soil. Its development is wide because of monetary and wholesome advantages. Vigna radiata or mung bean developed in India from antiquated times in the wake of ricing it is developed for the most part Since its development in north, south US. Lentils are rich in starch content and mostly used in protein foods. The extraction of starch taken place, but the yield depends on the method used for extraction. The effect of

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germination also checked on nutritive value of mung bean, lentils, and beans (Gómez et al. 2008; Thavarajah et al. 2009a; Thavarajah et al. 2009b).

Using mainly ingredients are flour, fats and oil, sugar, egg, liquid, salt, leavening agents, cocoa powder, vanilla essence and paste of mung & mash pulse. Flour makes the fundamental structure for the whole cake. Wheat flour is the most prevalent structure; however, it isn't utilized in gluten free cakes. Fat prevents gluten from combining as easily. It also contributes to the fluffiness. This is due to the fact that when fat is combined with sugar, the sugar cuts the fat, which causes air pockets to form. This aeration results in a texture that is less grainy and tender. Sugar helps to maintain the cake moist and tender, however it is able to additionally create a crisp, browned crust due to caramelizing (Kavitha et al. 2013; Gupta et al. 2013). Eggs are a leavening agent and the yolks upload fat for a tender and light texture. The yolks additionally act as an emulsifier for a clean or even texture inside the completed product. And the proteins make contributions to the shape of the baked right. Egg act as a binder, which is what maintains the finished product collectively. Used as a whole, they could bind, thicken, or be used as brought flavor. When brushed onto a baked exact, they can be used as a glaze to brown the pinnacle. Liquid allows bring flavorings all through the product, bureaucracy gluten bonds, and reacts with the starch in the protein for a sturdy however light structure. Salt is used as a taste enhancer, as it brings out the taste of what it is added to. Baking powder is the usual desire cakes, though its over-use can bring about a rough cake that can be deemed inedible. Cocoa powder can also be utilized in recipes with other chocolates. When used on my own in cakes, cocoa powder imparts a complete rich chocolate taste and dark color. Vanilla essence enhances the other entire flavor in the recipe. Pulses are our main ingredient to add in muffins (Ali et al. 2017; Wang and Daun 2005).

The aim of this research was to determine the physicochemical and sensory effects of using a pulse's paste in a muffin. Different levels (30, 40, and 50%) of pulse's paste were used in this kind of muffin recipes. Analytical testing on volume, pore size, moisture, color, specific volume, screening etc. With these tests, we set out to determine what acceptability level if any may be acceptable both from physicochemical and sensory perspective. This study contributed to the innovation of bakery products which are not acceptable to the consumer but are also nutrient rich and will consequently increase market requirement for bakery products.

2. MATERIALS AND METHODS

2.1. Materials

All-purpose flour, granulated sugar, unsweetened cocoa powder, baking powder, salt, eggs, milk, vegetable oil, vanilla extract, mung pulse, mash pulse bought from M/S Imtiaz Super Mart, sodium chloride – salt (National Industry), and vegetable oil (EVA).

2.2. Lentil paste formulation and Muffins formulation

Pulses (100g each of *Vigna radiata* and *Vigna mungo*) were soaked for 15 min, boiling was carried out at 100°C for 30 min by the ratio of 1:5. All the boiled pulses were placed for cooling. Pulses were then shifter to the grinder for grinding, water (500ml) was added, and blending was carried out for 3 min. As a result, a smooth texture was obtained. Particle size becomes equal, the pasty appearance was observed. All the other dry ingredients (All-purpose flour 100g, granulated sugar 70g, unsweetened cocoa powder 18g, baking powder 12g, and salt 4g) were mixed. Wet ingredients like eggs, milk, oil, and vanilla (eggs 90g, milk 15ml, oil 50ml, and vanilla 4.2ml) were also mixed evenly. The beating of ingredients on a medium speed took place for a couple of minutes. Baking was carried out for 20-22 min using an oven (DW 259C, Dawlance, Karachi, Pakistan) until the cupcakes met the toothpick trick. The final formula was then placed to cool.

2.3. PROXIMATE ANALYSIS

2.3.1. Moisture Contents

Moisture contents were determined by oven-dry (AOAC 950.46, 2019) or by LOD (loss on drying) method wherein the samples were initially weighed 3g and placed in an oven for one hour to obtain the final weight. The amount of the moisture was calculated using the formula:

Moisture contents = initial weight - weight after drying (bitstream).

2.4. Total Ash Contents

Ash contents were determined by taking a 5g sample and charred on a hot plate, incinerated in a furnace at 550°C for 3 hours, cooled it in desiccator weighed and ash was finally calculated.

2.5. Total Fat Contents

The fat contents of the sample were determined as free fat and the total fat (EEC 90/496, 1990). Free fat was extracted from lyophilized sample by Soxhlet (ISO 1444,) using ether as a solvent.

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The total fat content was determined by the acid-hydrolysis method (AOAC 948.15, 2019). Fat contents were determined by obtaining10g a sample and 10g from each ratio of 30, 40, and 50% in a thimble, the thimble was then placed in the Soxhlet extractor (1000ml Flask 29/32 joint, Graham Condenser 60/45 joint, Extraction Tube 60/45 29/32 joint), a round bottom flask of 150ml was selected and filled with 150ml petroleum ether, the extraction process was continued for almost 6 hours. After extraction, the extracted oil was shifted to a rotary evaporator to separate oil from the solvent.

2.6. Total Protein Contents

Protein test was performed through Kjeldahl method. Protein contents were estimated from nitrogen (N · 6.25) using Gerhardt semi-micro Kjeldahl method (AOAC 979.09, 2019) and the Leco CHNS 932 apparatus based on combustion method (AOAC 990.03, 1990).

2.7. Total Carbohydrate

The contents of the available carbohydrate were determined by the following equation:
Carbohydrate (g100g sample) = 100 – (moisture + fat + protein + ash + crude fiber)

2.8. Metabolized Energy Contents

Fat, protein or carbohydrates supply energy. Metabolizable energy (ME) was calculated using the following formula:
ME (kcal /100g) = [(3.5 x cp) + (8.5 x cf) + (3.5 x nfe)].
Where, me = metabolic energy;
cp = % crude protein;
cf = % crude fat;
nfe = % nitrogen free extract (carbohydrate).

2.9. Physical Analysis

2.9.1. Bulk Density and Physical Volume

Bulk density was determined through measuring cylinder as the relation between volume and mass of muffins of all ratios. Specific volume determined by seed displacement method, and by analyzing length, width and height by Vernier caliper.

2.9.2. Shelf Life Stability Analysis

Shelf life of Moong and Mash dal muffins were analyzed in 4 categories:
1) 1 muffin each from both mash and moong dal packed in aluminum foil and placed in the refrigerator.
2) 1 muffin each from both mash and mung dal packed in aluminum foil and placed at room temperature.
3) 1 muffin from both mash and moong dal packed in aluminum foil and placed in refrigerator along with the addition of sodium benzoate.
4) 1 muffin from both mash and moong dal packed in aluminum foil and placed at room temperature along with the addition of sodium benzoate.

2.10. Physiochemical Analysis

The pH was determined through pH meter and Brix was determined by both optical and digital refractometer.

2.10.1. Peroxide Value

Peroxide value was determined by the AOAC method. Took 5.04g sample, added 30ml of acetic acid: chloroform ratio, added saturated potassium iodide and placed in the dark for 1 min, then added 30ml distilled water and few drops of 1% starch, titrated it with 0.01N sodium thiosulphate.

2.10.2. Free Fatty Acid (FFA) Value

FFA ingas determined by the AOAC method by taking 20g of oil sample, heating the solution for 1min, titrated with 0.01m NaOH. Noted the reading, and calculated the FFA.
FFA = Burette reading × N × 28.2 / volume × 100

2.13. Statistical Analysis

The organoleptic properties of the cake were analyzed by 10 panelists. The panelists were asked to evaluate the product's aroma, color, taste, texture, appearance, overall acceptability. The ratings were on 9 points hedonic scale

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ranging from 10 (like extremely) to 1 (dislike extremely) for each organoleptic property. Data analyzed on different concentrations and by following on way ANOVA and P<0.05 was considered as significant.

3. RESULTS AND DISCUSSION

Over the sample lentil muffins, different tests were applied, in which proximate analysis, physical, sensorial, stability test, and some physiochemical analysis had been done. The results had shown the different properties of the sample muffins, therefore, the interpretation shown drastic change within the nutritional properties. The moisture contents were not highly influenced by lentil paste addition as that control sample had (16.61%) moisture and the mung muffins (16.22-17.9%) moisture is observed. The moisture absorption of muffins was the same because the temperature had a high influence, because of the higher temperature the moisture removes as shown in the sensorial score of Figure 1. On the other hand, during boiling the beans when the outer part was softened, and due to osmosis they start to absorb water and their moisture content had increased. But when they were incorporate into the cake mix and start to bake, due to higher temperature the moisture starts to evaporate and shows a decline in moisture content (Ashraf et al. 2012). The mash daal sample cupcake moisture content is 16.5-18.2%. Moisture had more retain in mash because of their intact cell wall and it will not allow the removal of water content. Control sample 16% more water was removed due to less water bounded with the other molecules. Low moisture content reduces microbial spoilage and increased shelf life.

Table 1: Proximate analysis of Mash and Mung samples

Samples	Moisture %	Protein %	Fat %	Mineral %	Cho %	Energy kcal/100g
Control	16.61	7.36	3.07	0.66	72.3	320.46
Mash 30%	18.27	16.07	4.9	4.46	56.3	294.94
Mash 40%	17.49	16.69	5.2	5	55.62	297.28
Mash 50%	16.50	17.32	5.8	5.7	54.68	301.3
Mung 30%	17.94	15.56	5.5	3.16	57.84	303.65
Mung 40%	16.22	16.43	5.9	3.38	58.07	310.9
Mung 50%	17.04	16.81	6.2	3.45	56.5	309.28

Table 2: Physical analysis of Mash and Mung samples

Samples	Bulk density (g/ml)	Volume (cm^3)
Control	0.679	2.81
Mung 30%	0.55	2.07
Mung 40%	0.612	1.96
Mung 50%	0.612	1.84
Mash 30%	0.62	2.01
Mash 40%	0.69	1.88
Mash 50%	0.7	1.72

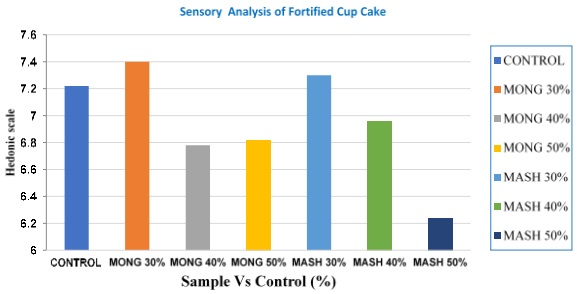

Fig. 1: Sensorial Analysis (Hedonic overall acceptability test of mong and mash daal) showing acceptance of panelists.

Table 3: Shelf life stability analysis of Mung and Mash cupcakes

Sample #	Sample detail	Spoilage occurs after (duration)
Mung cupcake		
1.	Mung cupcake at room temperature	After 2 days spoilage starts
2.	Mung cupcake In refrigerator	After 1-week spoilage starts
3.	Mung cupcake + aluminum foil (room temperature)	After 5 days spoilage starts
4.	Mung cupcake + aluminum foil (room temperature)	After 1-month spoilage starts
5.	Mung cupcake + aluminum foil (refrigerator)	After 1-week spoilage spoiled
6.	Mung cupcake + sodium benzoate (r)	After 42 days fungal growth starts
7.	Mung cupcake + sodium benzoate (r.t)	After 36 days spoilage occurs
8.	Mung cupcake + sodium benzoate+ aluminum foil (room temperature)	After 60 days the smell is abet change but still fresh.
Mash cupcakes		
1.	Mash cupcake (room temperature)	After 2 days spoilage occurs
2.	Mash cupcake (refrigerator)	After 1-week spoilage starts
3.	Mash cupcake + aluminum foil (room temperature)	After 5 days spoilage starts
4.	Mash cupcake + aluminum foil (refrigerator)	After 1-month spoilage starts
5.	Mash cupcake + sodium benzoate+	After 1-week spoilage spoiled
6.	Mash cupcake + sodium benzoate+	After 42 days fungal growth starts
7.	Mash cupcake + sodium benzoate+ aluminum foil (room temperature)	After 36 days spoilage occurs
8.	Mash cupcake + sodium benzoate+ aluminum foil (refrigerator)	After 60 days the smell is a bit change but still fresh.

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Table 4: Physiochemical analysis Mung and Mash daal at various concentrations

Samples	pH	Brix°	FFA%	Peroxide value (meq/kg)
Control	5.60	42.35	0.016	12.0
Mung 30%	6.48	55.04	0.022	5.95
Mung 40%	7.14	61.52	0.033	4.56
Mung 50%	7.20	63.98	0.045	7.73
Mash 30%	5.70	51.76	0.067	5.55
Mash 40%	6.14	54.71	0.084	5.35
Mash 50%	7.40	62.93	0.101	3.17

Table 5: Statistical analysis of sensory analysis (hedonic overall acceptability)

Samples	N	Subsets			
		1	2	3	4
C	7	6.2000			
F	7		6.7143		
B	7		6.8571	6.8571	
E	7		6.9429	6.9429	
Control	7		7.1143	7.1143	7.1143
A	7				7.2857
D	7				7.4571
Significance level		1.000	0.075	0.55	0.113

A= mash 30%, B= mash 40%, C= mash 50%, D= mung 30%, E= mung 40%, mung=50%.

Protein the most target nutrient in the current research was higher increased in lentil muffins and control samples. The amount of protein in mung daal muffins (15.5-16.8%) the control sample protein (7.36%) and mash daal sample protein were 16-17.32%. The protein contents increased drastically similarly they also increased the overall nutrition of the cupcake. The all-purpose flour had low protein so that product made from this had low protein. Lentils were higher in protein content so the product also had high protein content. The raw material protein was higher than the final product. But when we compared the control sample and test sample shown the double increment of protein content. Therefore, initially reduction has occurred, when the provide temperature to protein folded structure was disintegrated and coagulated resulting in the total protein reduced in the final product. The protein was considered the main nutrient in overall composition. The proteins reduced the malnutrition. The total lipid contents of sample muffins exceeded than control cupcakes as shown in Table 1; a slight increment in fat content, as compared to the control sample (3%) but mash sample muffins fat content in between 4.9-5.9% and, mung sample muffins fat content 5.5-6%. The fat content was increased due to the raw material lentil paste of radiate and mungo was higher than wheat flour extracted and analyzed by Soxhlet method. Moreover, fat content was increased also because of the addition of other ingredients so the total fat content was influenced as the increased in concentration. There was a drastic increment in ash contents, the sample contains 5% ash content and the Mash sample contains 5.7% ash content and according to standard the ash content found in Mash dal was 5.8% as shown in Table 1, was near to the standard results. The 50% of mash contains more ash content. Whereas, mung sample muffins ash content 3%, therefore, the result was significant. The control sample contains 0.66% ash content, the ash content of the sample cupcake was higher due to raw lentils had higher minerals so the overall product ash increased.

Thus, concluded that carbohydrate was responsible for providing energy to the body hence, according to results the control sample has a greater percentage of carbohydrate as compared to samples with lentils, due to lentils had complex carbohydrate but not providing calories in consumption and considered as a good source and healthy carbohydrate. As raw lentils were 63% carbohydrate with 11% dietary fiber and 25% protein, 1% fat (Ashraf et al. 2012; Min et al. 2015). Therefore, results had shown the carbohydrate value according to standard. The incorporation of lentils maintained the carb's value and enhanced it in more directions, while the calories increased with proportions due to carbohydrate, lipids, and protein composition. The final product carbohydrate was less may be due to processing reduced the amount but increased the number of calories as metabolized energy content increased in the final product. Thus, carbohydrates considered as major constitute in lentils seeds as it comprises starches of lentil seeds as shown in Table 1. Carbohydrate ratio was higher as according to results lentils in raw material as compared to final product while the final product of muffins had higher metabolized energy as compared to raw material had low energy may be due to low fat. Lentils paste got swell up with the other constituents present in the muffins having greater water holding capacities result in increasing moisture. Similarly, the lipid content was less in raw material as compared to final product because ingredients as egg, oil had greater lipid content which increases the amount of lipids in cupcakes, while the mineral content shown almost equivalent ratio but lower in control sample which was lack of lentil paste but in muffins, 30% mash sample had overall greater ash content. These were all the composition affecting on carbohydrate and energy-releasing per calories of 100g as shown in Table 1 (Kumar et al. 2016; Graham et al. 2018; Jahan et al. 2019).

On the basis of bulk density and physical volume Mash dal samples, the lowest bulk density shown by 30% mash dal with even pore size, which is 0.5g/ml, and the highest bulk density shown by 50% mash muffin sample, which is 0.612 g/ml due to uneven porosity, mung daal muffin, the highest density shown by 50% mung cake that is 0.7g/ml, and the lowest bulk density shown by 30% mung muffin that is 0.62g/ml in Table 2 (Ashraf et al. 2012). The result indicated that the control sample was more volume as compared to other samples because the materials used in formulation reduced the gluten formation so, as the lentil paste concentration increased the volume was reduced in muffins and become denser. Moreover, the moisture in the muffin was increased than control due to paste use in

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replacement of flour, the air incorporation was also reduced, simultaneously reduced the volume. The shelf life was observed at different temperatures and techniques used on both mung and mash muffins as shown in Table 3. Use hurdle technique to the increased shelf life of muffin by reducing temperature place on refrigerator temperature. Sodium benzoate addition the microbial, mold growth retarded, overall shelf life of muffins was increased, and aluminum foil used as a barrier to moisture and light so oxidation and deterioration were reduced. When all techniques used in combination, the overall quality, and shelf life were increased.

The 30 % mung and mash lying in slightly acidic pH greater than the control sample, 40% mung was very slightly acidic and mash towards the alkaline, while the mung and mash of 50% had neutral pH. The difference in pH was due to batter ingredients and concentrated formulation of mung and mash paste. Then, compare the Brix value of 50% mung and mash the sample has greater Brix value due to more concentration of lentils paste to use as they had more soluble solids present in the solution of lentils (Podder et al. 2017; Podder et al. 2018). The analysis of FFA (control, 30% mash, 40% mash, 50% mash, and as the same sample prepared for mung cupcake samples). The control sample had a lower value of free fatty acid and less oxidation occurs as the concentration of paste increased in fatty acid value and oxidation due to high temp and light as shown in Table 4. The peroxide value was evidence of rancidity as unsaturated fatty acids had a double bond in which free radicals act as scavengers and result in oxidation of the oil. Thus, the presence of rancid oil in the sample caused increases in peroxide value (Gupta et al. 2013; Zhang et al. 2014; Paucean et al. 2018; Podder et al. 2020). The PV should be less than 10meq/kg which represents the presence of fresh oil used during processing as shown in Table 4. Therefore, the result shown in Table 5, sample "C" was significantly different from all other samples. The mung 30% and mash 30% sample were more acceptable as compared to the control sample during the sensory analysis by the panelists as shown in the sensorial score of Fig. 1 (Ashraf et al. 2012).

Conclusion: Our study concludes that muffins were made by the incorporation of *Vigna radiata* and *Vigna mungo* showed most satisfactory results as increased the protein contents and total lipid contents were noted. The proportion of 30% mung and mash found to be best among all of them in flavor and overall acceptability but according to nutritional value, 50% proportion of mung and mash increased the most protein contents.

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Author's Contribution: SSA and SHA conceived the idea, conducted the research and collected the data of the bench work. AL Co-supervised and designed the study. SA, TQ and RA supervised and analyzed the entire data and also reviewed the article. All authors approved the final version of the manuscript.

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