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Development of iron rich muffin and its acceptability evaluation

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Abstract

Muffins are convenient snack food containing a blend of simple and complex carbohydrates, protein, fat, fiber, vitamins and minerals. Seeds are generally discarded by most of the population. The consumption of these seeds improves health and nutritional status of people. Sunflower seeds are rich sources of iron, essential fatty acids, vitamins and minerals whereas sesame seeds and watermelon seeds are rich in iron and protein. Thus, agro waste seeds have potential to act as a nutritious food and health enhancing agent. The objective of this study was to develop iron rich muffin and its acceptability evaluation. Muffins contain three different seeds in proportion of 10% in each variant A, B, C of muffin whereas variant D consist 3.3% of all three seeds. The nutrient content and sensory characteristics were determined for developed muffins. The work was performed into five phases. First phase of study includes the collection of all raw materials (watermelon, sunflower and sesame seeds) and preparation of iron rich muffin. Second phase of study includes acceptability evaluation of muffins using a 9 point hedonic scale. In third phase proximate analysis of product (moisture, ash, fiber, fat, protein, carbohydrates, iron and calcium) were analyzed. In fourth phase phytochemicals (saponins, tannins, flavonoid and total phenols), vitamin-C and shelf life testing were done. Fifth phase of study includes the statistical analysis of the best acceptable product. The result of nutrient and sensory and phytochemical analysis indicated that variant D obtained higher score as compared to standard muffin. It is highly acceptable and nutritious muffin for adolescents and children.

Keywords: Phytochemicals, proximate, acceptability evaluation, nutritious

Introduction

Today's consumers are more conscious of their diet and many prefer eating healthy food. The development of new products and the use of wastes have been more intensively explored in different areas of the world. The use of not so commonly used by-products minimizes the loss of nutritive value^[1].

Iron deficiency anemia is a serious and widespread public health concern in developed as well as developing countries. Iron Deficiency Anemia is a major public health problem which affects all age groups. Women in reproductive years are more susceptible to iron deficiency and consequent anemia. A lot of reasons are a part of the etiological factors of anemia and diet being one of the major causes. Generally iron deficiency results when there is a prolonged inadequate intake of iron and its reserves in body gets depleted^[2]. A poor, nutrient deficient diet makes anemia part of a vicious cycle which fails to end^[3].

According to a report of India, there are 79% of children of age group 6-35 months and women between 15 and 49 years of age are anemic^[4]. Nutritionists or dieticians are now trying to encourage people for supplementation of fruits in nutritional recipes to combat with these micronutrient deficiencies.

Demands of those food which are handy, convenient with good taste, reasonable price with good quality maintained are growing in the market. The bakery industries are a developing market sector in India. Among bakery products, muffins are less sweet than other bakery products such as cakes and generally have a somewhat more open crumb structure. In the final product of muffin, principle ingredients which play an important role in its appearance, structural and eating quality are flour, sugar, fat and an egg^[5]. Muffins are a type of sweet or savory bread, baked in small portions that usually look like small cakes or cupcakes in shape; but muffins are less sweet in comparison to cupcakes, and they do not have any frosting. Muffins are popular breakfast foods, and their quality can be assessed by studying structural characteristics through rheometry, microscopy, image analysis, and texture analysis^[6].

Manipulating the ingredients used in bakery products with potentially nutritive ingredients would be beneficial to improve the nutritional quality of the baked products^[7].

Watermelon (*Citrullus lanatus*) a fruit crop, is an herbaceous plant belonging to the family *Cucurbitaceae*. The fruit is a good source of lycopene and carotenoid. It helps in quench the

free radicals that contribute to conditions like asthma, atherosclerosis, diabetes, colon cancer and arthritis. The therapeutic effect of watermelon has been reported and has been ascribed to antioxidants compounds^[8].

Sunflower seeds are a good source of plant protein, providing 6 grams or 12 percent of daily value per ounce. These are an excellent source of vitamin E and selenium. One ounce of sunflower seeds is a good source of iron, providing 10 percent of the daily value^[9].

Sesame which is known for properties of good health consists of a plethora of nutrients such as proteins, carbohydrates, lignans, tocopherols and other micronutrients. Potential health benefits of sesame include antioxidative, anti-cancer, anti-hypertensive and anti-immunoregulatory actions. Sesame has ray health benefits of health in lowering cholesterol,

controlling blood pressure, dermatological disease management and many more areas^[10].

The objectives of this study were as follows to develop iron rich muffins and its acceptability evaluation, to estimate the proximate composition of prepared muffin, to conduct phytochemicals screening and antioxidant activity of muffin and to check the shelf life of muffin.

Materials and Methods

Materials

The ingredients used for making the iron rich muffins included wheat flour, refined flour, baking powder, baking soda, cocoa powder, oil, milk and vanilla essence which were procured from the local market of Dilshad Garden, Delhi. For the iron enrichment, watermelon seeds, sesame seeds, sunflower seeds and jaggery were chosen.

Table 1: Composition of the iron rich muffin formulation

Muffin Variations	Variant A	Variant B	Variant C	Variant D	Other ingredients
Watermelon seed (g)	10	-	-	3.3	
Sunflower seed (g)	-	10	-	3.3	
Sesame seed (g)	-	-	10	3.3	

Wheat flour- 20 g
Refined flour- 20 g
Jaggery- 20 g
Cocoa powder- 2 g
Baking powder-1 g
Baking soda- 1 g
Milk- 15 mL
Oil- 10 mL
Vanilla essence- 1mL

Methods

Preparation of muffin

Muffins were prepared by taking appropriate proportions of ingredients with following sequence. The good quality raw material was selected i.e. it was free from foreign particles and microbial load after that refined wheat flour and sugar was sieved for proper dough mixing and achieving proper smooth consistency. Then, one large mixing bowl was taken and in that equal proportion (1:1) of sugar and butter was added & mix it well. After that dry mix (refined flour, spices, leavening agents & cocoa powder) and wet ingredients (milk) and added seeds such as watermelon seeds, sunflower seeds and sesame seeds with its appropriate proportions was taken and added these ingredients simultaneously into mixing bowl with proper mixing in fixed direction (clockwise or anticlockwise). After that, kneading was done to attain the desired dropping consistency. The vanilla essence was added, and then the batter was poured into muffin moulds (cupcakes). Finally the muffins were baked in baking oven (which was preheated) at 110 °C for 30 to 40 minutes or until gets golden brown color. After cooling the muffins were weighed and packed in plastic bags and stored in airtight plastic container at ambient room temperature.

Sensory evaluation of muffins

Sensory evaluation was carried out on the muffin formulations by a panel of 30 semi-trained members with the help of a sensory score card. Each of the muffin formulations was assigned a random 3-digit number. The scorecard was developed to test the organoleptic attributes of the muffins with a grading scale representing degree of liking from fair to excellent, with a range of 1 being the minimum score and 10 being the highest one^[11]. In addition, a descriptive quality scoring for sensory attributes using free choice profiling was used^[12]. Data was analyzed for mean sensory scores of

acceptability and using number of responses for descriptive quality.

Nutritional analysis

All variations of muffins (with different seeds) and the control sample were analyzed for nutritional composition. Moisture was determined using standard oven drying method^[13]. Determination of protein was carried out by Kjeldahl method^[14], digestion and distillation for N content and conversion to protein. Fat content was determined by Soxhlet method (extraction in petroleum ether and weight measurements)^[14]. Total ash was determined by incineration of sample and measuring the weight of ash^[15]. Ash solution was prepared and used to estimate the calcium, iron and phosphorus contents. Iron was estimated by Wong's method, using spectrophotometry^[15]. Phosphorus estimation was also carried out spectrophotometrically by reading intensity of the blue color developed^[16]. Calcium was estimated by precipitation, followed by titration with standard potassium permanganate^[17]. Soluble and insoluble dietary fiber was determined by an enzymatic-gravimetric method^[18].

Storage study

For storage studies, muffins were stored at room temperature in a PET (polyethylene terephthalate) container for seven days. By the variation in pH and temperature the storage stability was evaluated^[14].

Statistical analysis

Sensory analysis data was subjected to statistical analysis using analysis of mean, standard deviation and student test to determine whether the mean scores obtained for the attributes of different muffin formulations were significantly different from each other^[19].

Results and Discussion

Sensory evaluation

In this section of study sensory evaluation of recipe were

carried out using triangle test for selection of the panel members and for judging the recipe were tested on 9-point hedonic rating scale with respect to various attributes.

Table 2: Mean hedonic test scores of iron rich muffin

Attributes	Standard (Mean±SD)	Sample A (Mean±SD)	Sample B (Mean±SD)	Sample C (Mean±SD)	Sample D (Mean±SD)
Colour	8.6±0.68	8.2±0.71	7.8±1.18	7.8±1.18	8.1±1.13
Appearance	8.6±0.63	8.1±0.74	7.8±1.19	7.01.20	8.0±1.09
Flavour	8.4±0.94	6.0±1.16 ^{NS}	6.7±1.01 ^{NS}	6.9±1.11 ^{NS}	7.5±1.14
Texture	8.5±0.68	7.3±0.98 ^{NS}	7.2±0.83	7.3±1.34	7.3±1.18
Taste	8.3±1.03	6.4±1.27 ^{NS}	6.3±1.26 ^{NS}	6.4±1.05 ^{NS}	7.2±1.32
Overall Acceptability	8.4±0.75	7.1±0.96 ^{NS}	6.9±0.99 ^{NS}	7.2±0.95 ^{NS}	7.6±1.13

^{NS}= Non significant (p>0.05)

Proximate analysis of iron rich muffin

The proximate composition of control muffin (100% refined flour and wheat flour muffin) and most acceptable iron rich

muffin i.e. variant A (10% watermelon seeds), variant B (10% sunflower seeds), variant C (10% sesame seeds) and variant D (3.3% of all mixture of seeds) were analyzed.

Table 3: Proximate analysis of iron rich muffin

Nutrients	Standard (Mean±SD)	Variant A (Mean±SD)	Variant B (Mean±SD)	Variant C (Mean±SD)	Variant D (Mean±SD)
Moisture (g/100g)	29.5±0.25	35.8±0.95	36.1±1.10	40.0±1.0	26.0±1.5
Ash (g/100g)	0.4±0.1	1.79±0.16	1.7±0.43	1.55±0.13	1.55±0.13
Fat (g/100g)	5.2±1.51	7.5±1.95	6.5±2.36	5.8±0.95	6.10.25
Protein (g/100g)	6.05±0.15	9.8±1.25	7.5±1.50	10.41±0.90	11.94±0.06
Crude Fiber (g/100g)	1.4±0.45	1.5±0.32	1.86±0.35	1.23±0.25	2.43±0.35
Iron (mg/100g)	4.03±0.60	7.5±0.39	8.8±0.33	10.5±0.05	11.41±0.85
Calcium (mg/100g)	30.5±5.66	45.6±0.33	50.0±1.05	53.0±2.66	11.41±0.85
Carbohydrate (g/100g)	55.4±0.15	50.5±0.06	51.1±1.02	52.74±0.09	55.0±0.76

Phytochemical analysis of iron rich muffin

Phytochemicals (*Phyto* means plant in Greek) are naturally occurring plant chemicals, bioactive, non-nutrient, compounds found in vegetables, fruits and spices. They provide plants with color, odor and flavor. Phytochemical have defense mechanism and protect from various diseases. Terpenes exhibit various important pharmacological activities i.e., anti-inflammatory, anticancer, inhibition of cholesterol synthesis, anti-viral activities^[20].

As presented in table 4 the iron rich muffin showed the absence or presence of tannins, saponins, flavonoids and phenolic compounds. In variants A, B and C showed the presence of tannins and phenolic compounds. The whole grain consumption has health promoting effects like prevention of insulin resistance, heart disease, diabetes, obesity, breast cancer, childhood asthma and premature death^[21].

Table 4: Phytochemical analysis of iron rich muffin

Phytochemicals	Variations of iron rich muffin				
	Standard	Variant A	Variant B	Variant C	Variant D
Saponin	+ve	-ve	-ve	+ve	+ve
Phenolic compound	+ve	+ve	+ve	+ve	-ve
Tannins	+ve	+ve	+ve	+ve	-ve
Flavonoid	-ve	-ve	-ve	+ve	-ve

+: Denote as for presence. -: Denote as for absence

Vitamin-C content of iron rich muffin

Table 5: Mean score of vitamin C in iron rich muffins

Antioxidant properties	Standard	Variant A	Variant B	Variant C	Variant D
Vitamin C (mg)	3.7±0.30	3.4±0.15	3.5±0.16	3.2±0.25	4.2±0.20

Shelf life

Storage stability of muffins depends on a variety of factors, such as the best by date, method of preparation and how it is stored. Iron rich muffin stay last for 5-6 days. The shelf life analysis was done on prepared muffin in the first week. Mainly two days alternatively pH and temperature were done. The results concluded that muffin can't store for long time. Its

shelf life is maximum up to 5-6 days. It's very important to store muffins in refrigerator because refrigerator cool air increase its shelf life and the result showed that the pH for iron rich muffin were 6.0 to 6.56. It was reported that the ability of antioxidants to donate an electron or H-atom was strongly influenced by types of solvent and pH conditions.

Table 6: Shelf life in iron rich muffin

Condition	Standard	Variant A	Variant B	Variant C	Variant D
pH	6.56±0.60	6.0±0.5	6.03±0.85	6.05±0.75	6.5±0.56
Temperature (°C)	32.6±62.56	32.6±2.6	33.5±3.5	34.5±3.69	32.4±1.5

Conclusion

The present study concluded on the basis of sensory evaluation, the most acceptable variant was sample D on the basis of results of proximate, phytochemical analysis and antioxidant content. The highly nutritious variant was found. Developed iron rich muffins are more nutritious than standard. The iron rich muffin would be beneficial for iron deficiency anemia because it contains all types of macronutrients and micronutrients especially in variant D such as protein, fiber, fat, calcium and iron. These are healthier as compared to standard muffin.

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Conflict of interest

There is no conflict of interest between authors.

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