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Quality characteristics and antioxidant properties of *Muffins* enriched with the multigrain flour and fruit juice /pulp

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Abstract

The study was carried out to develop rich Multigrain *Muffins*. The combination of Oats, Ragi, Bajra and Maize flour with incorporation of fruits pulp/juice such as orange, pineapple the objective was to develop *Muffins* using multigrain flour and fruit pulp/juice mixture and to assess its organoleptic, nutritional properties, antioxidant and cost. Standard recipe *Muffins* served as a Control (T₀) with five treatments of *Muffins* were prepared by replacing refined flour with different ratio of multigrain flour mixture which was referred to as T₁, T₂, T₃ and T₄, T₅ respectively. They were analyzed on 9 point hedonic score card for different sensory attributes. The result revealed that the T₅ (8.5±0.16) was found to be the most acceptable with regards to its overall acceptability followed by T₁ (6.4±0.16), T₀ (7.9±0.08), T₂ (6.5±0.08) T₃ (7.0±0.05) and T₄ (8.1±0.09), respectively. Proximate analysis was used to determine the nutritional composition *Muffins*. The result revealed that Nutrients content was significantly increased in treatment T₅ as compared to control and cost content was significantly increased in treatment T₅ as compared to control. So it was concluded from the result that the value addition of incorporation of Multigrain flour and fruit pulp/juice at different level can improve the sensory attributes of *Muffins* thereby enhancing the nutritive value and cost though acceptable and reasonable in market price.

Keywords: Multigrain flour, functional food, organoleptic characteristics, proximate analysis, antioxidant

Introduction

Traditionally only wheat has been used as a whole wheat meal (atta) in production of chapattis, paratha and poori whereas refined flour (maida) finds great application in manufacture of bakery foods like bread, *Muffins* and cookies Nigham *et al.*, (2013) ^[10]. 75 per cent wheat is produced as whole wheat flour and only 25 per cent is used in preparation of bakery goods. It has been proved that regular consumption of single items affect health directly. The multigrain products feature a combination of grains such as wheat, oat, bajra, maize, Ragi etc. and provide opportunity for snack manufacturers to develop products within an imaginative appearance, featuring new texture and colour with a beneficial nutritional profile Indran *et al.*, (2010) ^[11] Multigrain products must be of course whole grain to offer maximum nutritional benefits and They make a positive contribution to the taste and texture of products and consumer readily accept the health benefits Mandge *et al.*, (2014) ^[12]. The Institute of Medicine's Food and Nutrition Board (IOM/FNB, 1994) defined functional foods as "any food or food ingredient that may provide a health benefit beyond the traditional nutrients it contains." Functional foods are an important part of an overall healthful lifestyle that includes a balanced diet. Functional foods provide benefits beyond basic nutrition and play a role in reducing or minimizing the risk of certain diseases and other health conditions. Functional characteristics of many traditional foods are being discovered and studied, while new food products are being developed to include beneficial components. By knowing which foods can provide specific health benefits, we can make food and beverage choices that allows greater control of our health. (Hasler *et al.*, 1998) ^[8]. Therefore, they supply a substantial amount of energy to the diet. Enrichment of foodstuffs with functional elements like cereals and seeds has been commonly utilized so that they can improve their pro-health qualities. In this regards, bakery products are consumed in colossal quantities daily and thus, providing a convenient medium for distributing dietary fibre and other salubrious compounds to consumers. Also, in developed countries, more than 50% of the total energy intake is from cereal food products (e.g. bread, cookies etc.) emerging them the best vehicle for the functional supplements (Akhtar *et al.*, 2011) ^[14]. Multigrain products also provide required quantity of Thiamine, Phosphorous, Potassium, Riboflavin, Pantothenic Acid, Calcium, Iron, Zinc and Copper and Functional foods contain considerable amount of Calcium, Potassium, Vitamin C,

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Carbohydrates, Crude Fiber, and Anti-Oxidant. Both have some remarkable bioactivities such as anti-oxidant, anti-carcinogenic, anti-ulcer, anti-typhoid, anti-bacterial, anti-fungal, anti-inflammatory. Thus keeping in view the effective properties of multigrains following objectives are framed.

- To standardize recipe for *Muffins* and assess its sensory acceptability, nutrient content and antioxidant properties and cost.

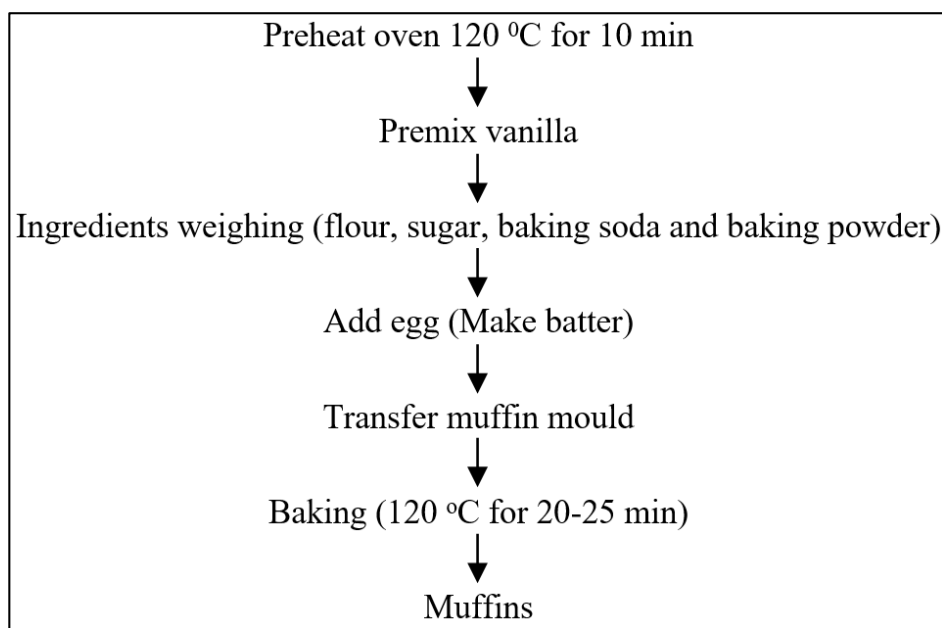
Materials and Methods

The present study was conducted in the Department of Food Nutrition and Public Health, Ethelind College of Home Science, Sam Higginbottom University of Agriculture, Technology and Sciences Allahabad. All the required raw materials were purchased from the local market of Allahabad. The multigrain flour was prepared by mixing flours of Ragi, Maize, Oats and Bajra. All the flours were mixed in the ratio of 25% respectively. The functional food such as orange, pineapple and fruit Pulp/juice. Collect with the Orange and Pineapple fruits pulp/juice in equal proportion i.e.50 ml respectively for the preparation of value added *Muffins*. Proximate Analysis was done for Moisture, Fat, Iron, And Calcium of *Muffins* were estimated by standard method (AOAC 2007) [1]. The Carbohydrate was estimated as the difference obtained after subtracting the values of organic

Protein, Ash content, Fat or oil, crude Fibre, and moisture content from 100. Protein estimation was done by the method developed by Lowry *et al.*, (1951) [3] and Antioxidant Analysis Vitamin C and Total β -carotene was extracted in acetone was estimated by method given by colorimetrically. (Ranganna 2001). The Sensory evaluation of *Muffins* was carried out and it was evaluated on five parameters viz. color, appearance, flavour, taste, and overall acceptability was done by panel of judges. The score card based on 9 point Hedonic Scale (Srilakshmi, 2015) [2]. Cost of the prepared products was calculated taking into account the cost of individual raw ingredients used in the preparation of food products as the prevailing market price. The data was statistically analyzed by using analysis of variance (two way ANOVA) and critical difference technique (Banerjee, 2004) [5].

Formulation and Preparation of *Muffins*

Figure 1 shows the nixtamalization multigrain flour with fruit pulp/juice in prepared *Muffins*. Different treatments were prepared in which control (T_0) was prepared by using 100% refined flour while five other treatment were prepared by utilization of refined flour, multigrain flour and fruit pulp/juice like T_1 (40:45:15), T_2 (40:40:20), T_3 (40:35:25) and T_4 (40:30:30) T_5 (40:25:35). The experiment was replicated 3 times to get an average value.



(Source: <http://www.taste.com.au/recipes/basic-muffin-mix/>)

Fig 1: A flowchart for standard preparation method for development of *Muffins*.

Results and Discussion

Organoleptic Evaluation of the *Muffins* prepared by the Multigrain Flour by the incorporation of fruit pulp/juice.

According to the results illustrating in Table No. 1 and Fig no.2 pertaining average sensory attributes in the multigrain and fruit pulp/juice *Muffins* illustrated that the overall acceptability of product treatment T_5 is more acceptable by the panel followed by Colour and Appearance, Body and Texture and Taste and Flavour using nine point hedonic scales. The sensory evaluation of *Muffins* prepared by multigrain flour and fruit pulp/juice illustrated that according to overall acceptability mean score of *Muffins* indicates that the treatment T_5 (8.5) scored maximum followed by treatment T_0 (8.2), T_1 (6.6), T_2 (6.6) and T_3 (7.1), T_4 (8.1) respectively so T_5 is more acceptable by the panel of judges followed by

different parameters of sensory, Color and Appearance, Body and Texture and Taste and Flavour. Hence From the ANOVA table of all three products that, it is evident that the calculated value of F is greater than the table value on 2,10 (d.f.) at 5% probability level so there was significant difference between treatments regarding all sensory attributes of the product. Overall acceptability of *Cookies* was recorded more than 8.0. Malshe *et al.*, (2014) [12] concluded that the acceptance of blended healthy gluten free high protein) flour; our aim was to standardize an innovative, preservative free, simple, nutritional blend that is coast effective. This makes the product gluten free, protein rich having high fiber content with good amounts of antioxidants. The Evaluation was performed on sensory attributes like Appearance, color, taste, texture, aroma, and overall acceptability of the product.

Table 2, shows the comparison between the control and the best treatment of *Muffins* per 100g. On applying the t-test, significant difference was found between Iron (11.25) Moisture (29.98), Energy (147.9), Protein (69.63), Carbohydrate (51.75), Calcium (82.19) and Fibre (4.68), content of control and best treatment. Non-significance difference was found for Fat (0.68) and Ash (2.45) content of control and best treatment. Incorporation of multigrain flour and fruit pulp/juice utilized in different ratio for product development and their standardization results to improve nutritional content of *Muffins*. It was concluded that its nutritional composition as per 100g was found to be rich in Calcium, Iron, Fiber, Carbohydrate and Protein was found to be rich in treatment T₅ (40:25:35) as compared to control T₀ due to multigrain flour (Ragi flour, Bajra flour, oats, maize flour) and fruit pulp/juice (pineapple and orange). According to Agrawal *et al.*, (2015)^[7] multigrain flour can provide more Nutrients, Phytochemicals and Antioxidants fortifying a food increases the level of Macro and Micro Nutrients, Dietary fibres, and Phenolic compounds which shows to impart an

antimutagenic, anti-glycaemic and anti-protective activities which should be in demand for maintaining a good health status.

Table 3 shows the comparison between the control and the best treatment of *Muffins* per 100g. On applying the t-test, significant difference was found between Vitamin C (84.85), β - carotene (68.99) content of control and best treatment. Incorporation of multigrain flour and fruit pulp/juice utilized in different ratio for product value and their standardization results improve nutritional content of *Muffins*. It was concluded that its nutritional composition as per 100g was found to be rich in Vitamin C, β -carotene (μg) was found to be rich in treatment T₅ (40:25:35) as compared to control T₀ due to multigrain flour (Ragi flour, Bajra flour, oats, maize flour) and fruit pulp/juice (pineapple and orange). Hemalatha *et al.*, (2013)^[6] concluded that Pineapple is a rich source of ascorbic acid supplement to our diet. The pineapple fruits are normally eaten fresh or as fresh pineapple juice. Pineapple fruits are an excellent source of vitamins and minerals. The average ascorbic acid content of pulp (21.5 mg/100g).

Table 1: Average sensory scores of *Muffins* control and different treatments of Multigrain Flour and Fruit pulp/juice.

Control and Treatments	Colour and Appearance	Body and Texture	Taste and Flavour	Overall Acceptability
T ₀	8.1 ± 0.23	8.2 ± 0.05	8.0 ± 1.44	7.9 ± 0.08
T ₁	6.2 ± 0.11	6.5 ± 0.16	6.4 ± 0.19	6.4 ± 0.16
T ₂	6.5 ± 0.19	6.6 ± 0.17	7.0 ± 1.44	6.5 ± 0.08
T ₃	6.9 ± 0.34	7.4 ± 0.19	7.2 ± 0.08	7.0 ± 0.05
T ₄	7.8 ± 0.11	7.6 ± 0.31	7.8 ± 0.08	8.1 ± 0.09
T ₅	8.3 ± 1.44	8.3 ± 0.11	8.4 ± 0.19	8.5 ± 0.16
F-test	S	S	S	S
C.D	0.28	0.22	0.31	0.22

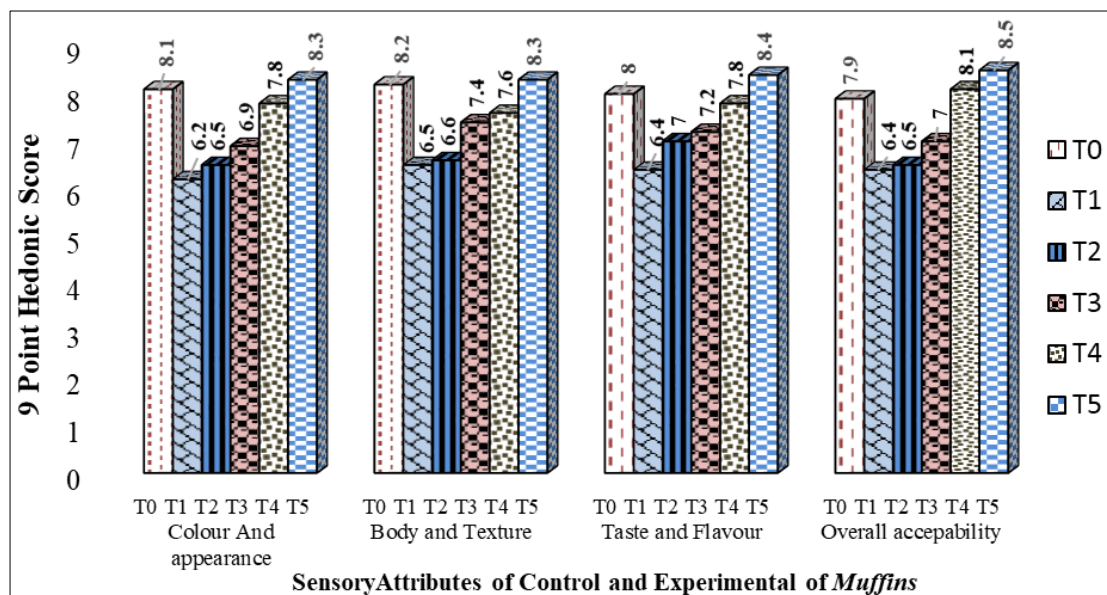


Fig 2: Sensory attributes of *Muffins* made with incorporation of multigrain flour and fruit pulp/juice.

Table 2: Comparison between nutrient content of control and best treatment of *Muffins* by using t-test

Nutrients	T ₀	T ₅	(Difference) T ₅ - T ₀	t.cal.	t.tab. (5%)	Results
Moisture %	42.88	69.86	26.98	29.98	2.96	S
Ash (g)	1.6	2.5	0.9	2.45	2.96	NS
Energy (kcal)	651.7	539.89	111.81	147.9	2.96	S
Protein (g)	16.34	12.69	3.65	69.63	2.96	S
Fat (g)	21.22	21.7	0.48	0.68	2.96	NS
Carbohydrate(g)	98.75	73.65	23.1	51.75	2.96	S
Calcium (mg)	50	65.63	15.63	82.19	2.96	S
Iron (mg)	3.57	4.81	1.24	11.25	2.96	S
Fibre(g)	0.3	1.27	0.97	4.68	2.96	S

At 5% level of significance

Table 3: Comparison between Antioxidant content of control and best treatment of *Muffins* by using t-test

Nutrients	T ₀	T ₅	(Difference) T ₅ - T ₀	t.cal.	t.tab. (5%)	Results
Vitamin C(µg)	0	18.02	18.02	84.85	2.96	S
β-carotene (µg)	193	230.9	37.9	68.99	2.96	S

Cost

The total cost of *Muffins* per 100g of dry ingredients at the prevailing cost of the raw materials was T₀ is Rs. 7.36 for treatment, T₁ is Rs. 12.7, T₂ is Rs. 12.3, T₃ is Rs. 11.9, T₄ is 11.51 and T₅ is 11.01. It is therefore concluded that T₁ has the highest cost and T₂, T₃, T₄ T₅ and T₀ has the lowest cost because the incorporation level of Multigrain flour and fruits pulp/juice did increase the cost of the prepared products marginally.

Conclusion

On the basis of sensory evaluation, it was found that the treatment T₅ of *Muffins* prepared by the incorporation of multigrain flour and fruits pulp/juice (refined flour, multigrain flour and fruits pulp/juice 40:25:35) was found to be most acceptable as compared to other treatments. Nutritionally, it was found that the nutrients content of best treatment T₅ of both the products, were significantly higher with regards to moisture, ash, protein, Fibre, energy, calcium, iron, β-carotene, vitamin C activity as compared to the control T₀. Cost was increased marginally in all treatment of prepared products comparatively control.

Recommendation

The anti-oxidant properties also add to their beneficial contributions. In addition to their nutritional benefit, they can provide a variety in the daily dietaries and also can be used out of season Multigrain flour with Incorporation of fruits pulp /juice can be gainfully utilized in enhancing the nutritive value of traditional recipes improving their proximate, macronutrient and micronutrient contents of the food products This is good for therapeutic purposes and can be included in the diets of people of all age group for its health related benefits.

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