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Utilization of Cereals and Millets for Nutritious Rich Food Products

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Abstract

The present research entitled "Utilization of Cereals and Millets for Nutritious Rich Food Products" was undertaken to develop nutrition-rich food in which anti-oxidants and phenolic compounds, rich fiber content, vitamins, minerals, amino acids, and nutritional benefits of health. They fight against cardiovascular diseases, diabetes, obesity, and cancer, and reduce inflammation. Products like black rice, foxtail millets, and moringa leaves are utilized through baked products where the amount of nutritive value remains almost the same when compared with steamed or cooked and gives good color, and texture, and maintains its shelf life for many days. As in this experiment, the products like bread, muffins, and cookies are chosen for the preparation which helps every age group like to eat.

The research was conducted during the year 2020 in the Food lab of the Department of Food Nutrition and public health, Ethelind College of Home Science, Sam Higginbottom University of Agriculture. Technology and Sciences, Prayagraj, U.P., India. A close-ended Evaluation schedule was prepared to evaluate the developed product prepared in the university lab. Data were analyzed using suitable statistical tools i.e. Analysis of variance (Two-way ANOVA or Two-way classification) technique. A significant difference between the treatments was determined by using the CD (Critical Difference) test. The test was performed for comparing the difference in the nutritional content between control and best treatment of the developed food products. Based on the findings, it is concluded that the black rice flour, foxtail millet flour, and moringa leaves powder enhance the nutritive value of *"Bread, Cookies and Muffins"*. Sensory evaluation of prepared products T_2 (25:15:2:58) was highly acceptable.

Nutritionally, it was found that the nutrient content of best treatment T_2 of the three products, was significantly higher with regards to energy, protein, fat, carbohydrate, fiber, calcium, iron, and activity as compared to the control T_0. The cost was increased marginally in all treatment of prepared products comparatively control. The cost of the prepared product per 100 gm of raw ingredient for *"Bread"* ranged from Rs. 30 to Rs. 35, "*Cookies"* from Rs. 25 to Rs. 35, and *"Muffins"* from Rs. 30 to Rs. 40.

Keywords: Black Rice Flour, Foxtail Millet Flour, Moringa Leaves Powder, Anti-oxidants, Nutrition-rich Food

Introduction

Black rice was initially grown in China before the Chinese dynastic period and was called the 'luck rice' because it was believed that people consuming black rice would live longer and also it can cure most diseases. Earlier people refused to consume black rice due to its black color as they considered it to be 'dirty' because of the black color. Later it was found that the color of the grain is determined by the accumulation of colored pigments. Black rice is black due to the presence of the anthocyanin pigment on the outer layers (bran) of the rice kernel. The purple color pigment anthocyanin is rich in antioxidants and is naturally present in many berries like blueberry, black currant, and vegetables like eggplant (brinjal) (Nitin Kumar, Roshini Deepika Murali, et al., 2020).

The grain color of cereals is determined by the pigmentation of certain phytochemicals. the black grain color is caused by the deposition of anthocyanins (Rahman, et al., 2013) black color pigment called anthocyanin which is rich in antioxidants and poses a variety of health benefits such as anti-aging, anticancer, anti-diabetes, lowering the risk of obesity, etc. Black rice contains essential amino acids like lysine, tryptophan; vitamins such as vitamin B1, vitamin B2, folic acid; and it is a good source of minerals including iron, zinc, calcium, phosphorus, and selenium. It contains the highest amount of antioxidants, protein, and dietary fiber of all rice varieties, besides it has phenolics, flavonoids, and anthocyanins. Antioxidants are the first line of defense against free radical damage and are critical for maintaining optimum health and well-being. These antioxidant compounds have tremendous health benefits and can reduce the risk of developing various chronic diseases. On cooking, it turns into purple color with a shiny indigo finish and has a mild nutty flavor and its texture is smooth and firm Anthocyanins possess antioxidative and antimicrobial activities, improve visual and neurological health and also protects against non-communicable diseases. These all good health benefits are due to the antioxidant activity i.e., free radical scavenging activity which prevents the release of free radicals in the body. Anthocyanins are used to treat a wide variety of minor health issues like blood pressure, cold, and urinary tract infections. It can also cure major health problems like heart attack (CVD), cancer, obesity, and diabetes. Foxtail millet ranks second in the total world production of millets. Foxtail millet is fairly tolerant of drought; it can escape some droughts. It has been reported that foxtail millet has many nutritional and medicinal properties and is recommended in ayurvedic and Unani products by practitioners. Foxtail millet grains are about 2 mm in length and the glumes can be white, red, yellow, brown, or black. Neither white nor red varieties were found to contain tannins. The granule size varies from 0.8 to 9.6 μm. Foxtail millet can be waxy (high in amylopectin), normal (low amylose), or non-waxy (high amylose) (John R.N. Taylor, M. Naushad, et al., 2008).

Foxtail millet is non-glutinous, like buckwheat and quinoa, and is a non-acid-generating food, hence considered an easily digestible food also possesses a higher amount of proteins and minerals that act as a potential functional food ingredient and a supplementary protein source to most cereals, due to its high lysine content (Mohamed, Zhu, Issoufou, Fatmata, Zhou, et al., 2009).

The availability of minerals increased during germination due to the catabolism of anti-nutrients like polyphenol and saponins which hinder the bioavailability of minerals described that germination of foxtail millet for 3 days resulted in the production of a high concentration of minerals. The consumption of sprouts as functional food can be considered very important in reducing human diseases related to

oxidative stress due to the presence of antioxidants (Silva, Pereira, & Azevedo, et al., 2013).

Additionally, owing to its low cost and excellent functional properties of flour and protein concentrate, foxtail millet can be considered a good candidate for replacing animal protein foods. Furthermore, there is huge potential for successfully developing low-cost, protein-rich functional food products helpful in the prevention and management of lifestyle-related chronic diseases.

The less explored, commercially available foxtail millet-milled fractions like whole flour & bran-rich fractions were studied for their antioxidant potency. Phytochemicals like alkaloids, phenolic, reducing sugars, and flavonoids were found only in methanolic & aqueous extracts, while tannins and terpenoids were present in all the solvent extracts of whole flour & bran-rich fraction. Antioxidants were extracted using methanol, ethanol, and water. Metabolic extracts of whole flour and bran-rich fraction exhibited a significantly higher. The grain of Foxtail millet is used in China as an astringent and emollient in choleric affections and diarrhea. The seeds are used in India as a diuretic, to strengthen virility, and treat indigestion, dyspepsia, and rheumatism. It helps to treat food stagnancy, white seeds are useful for fever and cholera, and in India to enhance vigor and treat bone fractures. The cooked grains are used in Chhattisgarh as a cure for diarrhea. The paste is externally used Foxtail millet can fight diabetes and reduces the chances of blockages in the heart resulting in cardiac arrest. 100 grams of Foxtail millet contains 12 g of moisture, 351 calories, 11.2 g of protein, 4 g of total fat, 63.2 g of carbohydrate, and 6.7 g of crude fiber. It grants 803 g of isoleucine, 1764 g of leucine, 103 g of tryptophan, 328 g of threonine, 233 g of lysine, 0.6 mg of thiamin, 63.2 g of carbohydrate, 2.8 mg of iron, 11.2 mg of protein, 3.2 mg of niacin, 4 g of lipid fat, 0.1 mg of riboflavin, and 31 mg of calcium. Vitamin B1 assists in the formation of the neurotransmitter acetylcholine (Sharma, et al., 2017).

Moringa oleifera is the most nutrient-rich plant yet discovered. This humble plant has been making strides in less-developed societies for thousands of years, and significant nutritional research has been conducted since the 1970s. Moringa provides a rich and rare combination of nutrients, amino acids, antioxidants, and anti-aging and anti-inflammatory properties used for nutrition and healing. Moringa is sometimes called "Mother's Best Friend". A large number of reports on the nutritional qualities of Moringa now exist in both the scientific and popular literature. Moringa has been in use for centuries for nutritional as well medicinal purposes. These include vitamin C, which fights a host of illnesses including colds and flu; vitamin A, which acts as a shield against eye disease, skin disease, heart ailments, diarrhea, and many other diseases; Calcium, which builds strong bones and teeth and helps prevent osteoporosis; Potassium, which is essential for the functioning of the brain and nerves, and Proteins, the basic building blocks of all our body cells. Another important point is that Moringa leaves contain all of the essential amino acids, which are the building blocks of proteins. It is very rare for a vegetable to contain all of these amino acids. And Moringa contains these amino acids in a good proportion so that they are very useful to our bodies. These leaves could be a great boon to people who do not get protein from meat. Moringa even contains arginine and histidine two amino acids especially important for infants. Arginine and histidine, are especially important for infants who are unable to make enough protein for their growth requirements. Experts tell us that 30% of children in subSaharan Africa are protein deficient. Moringa could be an extremely valuable food source (Khawaja Tahir Mahmood, et al., 2013).

Materials And Methods

The study entitled "Utilization of Cereals, Millets for Nutritious Rich Food Products" was conducted in the Department of Food Nutrition and Public Health, Ethelind College of Home Science, Sam Higginbottom University of Agriculture, Technology and Science, Prayagraj, U.P. India.

The details of materials, experiments, procedures, and techniques adopted during the present investigation have been elaborated in this chapter under the following headings:

Table 1: Showing Experimental design of Bread, Cookies and Muffins for 100 gms

Value-added Food Product	**Treatments**				**Replications**
	T_0	T_1	T_2	T_3	
Black Rice Flour (g)	-	25 g	25 g	15 g	4
Foxtail Millet Flour (g)	-	23 g	15 g	25 g	
Moringa Powder (g)	-	2 g	2 g	2 g	
All-purpose Flour/Refined Flour (g)	100	48 g	68 g	68 g	

3.3 Detail of Treatments and Replications

Four treatments were prepared for *"Bread, Cookies and Muffins"* as follows:

(Control) T_0: The product was prepared using only 100 gms all-purpose flour.

Treatment (T_1): The product was prepared using 25% black rice powder, 25% of foxtail millet powder 2% of moringa powder, and 48% of all-purpose flour.

Treatment (T_2): The product was prepared using 25% black rice powder, 15% of foxtail millet powder 2% of moringa powder, and 58% of all-purpose flour.

Treatment (T_3): The product was prepared using 15% black rice powder, 25% of foxtail millet powder 2% of moringa powder, and 58% of all-purpose flour.

Replications: Control and treatments were replicated three times respectively to get the average value.

3.4 Sensory Evaluation of Developed Products

Sensory evaluation of the food products for their acceptability was done by a panel member of 5 judges. Panel members were selected based on their performance in initial evaluation trials. Sensory descriptors of the samples were appearance, color, aroma, taste, texture, and overall acceptability. The nine-point hedonic scale was used for sensory evaluation (Srilakshmi 2014).

3.5 Determination of Nutrient Content of Prepared Products

The nutritive value of the ingredients (black rice flour, foxtail millet flour, moringa leaves powder) used in the development of food products was calculated with the use of food composition tables by Gopalan et al. (2015). Nutrients such as energy, protein, carbohydrates, fat, iron, calcium and fiber were calculated.

Formula

$$\text{Nutrient / 100 g of product} = \frac{Ingredient\ used\,(g) \times Nutritive\ value\ of\ the\ Ingredient}{100}$$

3.6 Determination of Cost

The cost of the prepared products was determined based on the price of raw ingredients at the prevailing market price.

3.3 Statistical Analysis

The data were statistically analyzed by using the Analysis of variance (Two-way ANOVA or Two-way Classification) technique. A significant difference between the treatments was determined by using the CD (Critical Difference) test (Appendix). "t-test" was performed for comparing the difference in the nutritional content between the control and best treatment of the developed food products (Chandel, 2006).

Results and Discussion

Table 2: Average Sensory Scores of Different Parameters in Control and Treated Samples of *"Bread"*

Parameters	**Mean ± SE**				**Statistical Analysis**
	T_0	**T_1**	**T_2**	**T_3**	
Colour and Appearance	7.7 ± 0.42	7.03 ± 0.35	7.5 ± 0.48	7.26 ± 0.39	**F = 4.59 (4.76) S* C.D. = 0.47**
Body and Texture	7.1 ± 0.35	7.6 ± 0.39	7.5 ± 0.38	7.06 ± 0.11	**F = 4.88 (4.76) S* C.D. = 0.24**
Taste and Flavor	7.4 ± 0.39	7.7 ± 0.28	7.6 ± 0.30	7.7 ± 0.49	**F = 27.30 (4.76) S* C.D. = 0.56**
Overall Acceptability	7.2 ± 0.31	7.4 ± 0.30	7.4 ± 0.14	7.7 ± 0.25	**F = 0.76 (4.76) S* C.D. = 0.42**

Table 3: Average Sensory Scores of Different Parameters in Control and Treated Samples of *"Cookies"*

Control and Treatments	**T_0**	**T_1**	**T_2**	**T_3**
Colour and Appearance	7.5	7.1	7.6	7.3
Body and Texture	7.1	7.2	7.6	6.9
Taste and Flavour	7.4	7.5	7.8	7.3
Overall Acceptability	7.4	7.1	7.8	7.1

Table 4: Average Sensory Scores of Different Parameters in Control and Treated Samples of *"Muffins"*

Parameters	**Mean ± SE**				**Statistical Analysis**
	T_0	**T_1**	**T_2**	**T_3**	

Colour and Appearance	7.5 ± 0.40	7.0 ± 0.30	7.6 ± 0.40	7.4 ± 0.41	**F = 4.59 (4.76) S* C.D. = 0.25**
Body and Texture	7.2 ± 0.30	7.0 ± 0.17	7.7 ± 0.28	7.3 ± 0.02	**F = 1.26 (4.76) S* C.D. = 0.13**
Taste and Flavor	7.4 ± 0.39	7.3 ± 0.34	7.2 ± 0.40	7.2 ± 0.46	**F = 27.30 (4.76) S* C.D. = 0.47**
Overall Acceptability	7.4 ± 0.63	7.1 ± 0.12	7.4 ± 0.51	7.0 ± 0.43	**F = 0.59 (4.76) S* C.D. = 0.21**

Table 5: The Average Nutrient Content of *"Bread"* per 100 g

Treatments	Energy (kcal)	Protein (g)	Fat (g)	Carbohydrate (g)	Fiber (g)	Iron (mg)	Calcium (mg)
T_0	452.52	15.72	7.20	22.26	2.46	3.92	63.27
T_1	453.86	17.33	7.88	78.66	4.21	3.66	69.07
T_2	452.66	17.58	7.66	38.76	3.75	3.71	67.146
T_3	454.26	17.75	7.75	38.70	2.59	3.11	66.51

Table 6: The Average Nutrient Content of *"Cookies"* per 100 g

Treatments	Energy (kcal)	Protein (g)	Fat (g)	Carbohydrate (g)	Fiber (g)	Iron (mg)	Calcium (mg)
T_0	454.88	15.72	7.203	22.592	2.462	3.92	63.28
T_1	456.74	17.331	7.881	79.36	4.21	3.66	69.08
T_2	455.54	17.59	7.66	38.89	3.72	3.718	67.15
T_3	457.14	17.76	8.701	38.55	2.59	3.11	66.52

Table 7: The Average Nutrient Content of *"Muffins"* per 100 g

Treatments	Energy (kcal)	Protein (g)	Fat (g)	Carbohydrate (g)	Fiber (g)	Iron (mg)	Calcium (mg)
T_0	514.94	19.878	10.98	22.44	2.597	3.411	63.27
T_1	516.8	25.213	11.66	79.41	3.462	6.145	69.31
T_2	515.6	24.095	11.44	38.94	3.75	4.53	67.39
T_3	517.2	24.479	12.48	38.68	2.59	3.84	66.74

Table 8: The Average Cost of *"Bread"* per 100 g of Raw Ingredients

Ingredients	T_0		T_1		T_2		T_3	
	Amt (g)	Cost (Rs)	Amt (g)	Cost (Rs)	Amt (g)	Cost (Rs)	Amt (g)	Cost (Rs)
Black Rice Flour @ Rs. 56	-	-	25	14	25	14	15	8.4
Foxtail Millet Flour @ Rs. 23.50	-	-	25	5.87	15	3.52	25	5.87
Moringa Leaves powder @ Rs. 49.90	-	-	2	0.9	2	0.9	2	0.9
Maida @ Rs. 3.90	100	3.9	48	1.87	58	2.26	58	2.26
Yeast @ Rs. 129	1.5	1.9	1.5	1.9	1.5	1.9	1.5	1.9

Sugar @ Rs. 3.80	3	0.1	3	0.1	3	0.1	3	0.1
Salt @ Rs. 1.70	1	0.01	1	0.01	1	0.01	1	0.01
Butter @ Rs. 32	1	0.4	1	0.04	1	0.04	1	0.04
Milk @ Rs. 5.60	60 ml	3.36	60 ml	3.36	60 ml	3.36	60 ml	3.36
Baking Powder @ Rs. 30	2	0.6	2	0.6	2	0.6	2	0.6
Total Cost Rs./100gm		**10.27**		**27.75**		**26.69**		**23.44**

Table 8 shows that the cost of *"Bread"* per 100 g of raw ingredients at the prevailing cost of the raw materials was T_0 is Rs. 10.26 for treatment, T_1 is Rs. 27.75, T_2 is Rs. 26.69, T_3 is Rs. 23.44. This shows that as the incorporation level of black rice flour increased the cost also increased marginally.

Table 9: The Average Cost of *"Cookies"* per 100 g of Raw Ingredients

Ingredients	**T_0**		**T_1**		**T_2**		**T_3**	
	Amt (g)	**Cost (Rs)**	**Amt (g)**	**Cost (Rs)**	**Amt (g)**	**Cost (Rs)**	**Amt (g)**	**Cost (Rs)**
Black Rice Flour @ Rs. 56	-	-	25	14	25	14	15	8.4
Foxtail Millet Flour @ Rs. 23.5	-	-	25	5.87	15	3.52	25	5.87
Moringa Leaves Powder @ Rs. 49.90	-	-	2	0.9	2	0.9	2	0.9
Maida @ Rs. 32	100	1.95	48	1.87	58	2.26	58	2.26
Vanilla Essence @ Rs. 44.90	1	0.224	1	0.449	1	0.449	1	0.449
Sugar @ Rs. 3.80	50	1.25	50	2.5	50	2.5	50	2.5
Salt @ Rs. 1.70	1	0.01	1	0.017	1	0.017	1	0.017
Butter @ Rs. 32	80	19.8	80	39.6	80	39.6	80	39.6
Milk @ Rs. 5.60	3 ml	0.16	3 ml	0.16	3 ml	0.16	3 ml	0.16
Baking Powder @ Rs. 30	2	0.6	2	0.6	2	0.6	2	0.6
Total Cost Rs./100 g		**23.60**		**32.98**		**32**		**30**

Table 9 shows that the cost of *"Cookies"* per 100 g of raw ingredients at the prevailing cost of the raw materials was T_0 is Rs. 23.60 for treatment, T_1 is Rs. 32.98, T_2 is Rs. 32, T_3 is Rs. 30. This shows that as the incorporation level of black rice flour increased the cost also increased marginally.

Table 10: The Average Cost of *"Muffins"* per 100 g of Raw Ingredients

Ingredients	**T_0**		**T_1**		**T_2**		**T_3**	
	Amt (g)	**Cost (Rs)**	**Amt (g)**	**Cost (Rs)**	**Amt (g)**	**Cost (Rs)**	**Amt (g)**	**Cost (Rs)**
Black Rice Flour @ Rs. 28	-	-	25	7	25	7	15	4.2
Foxtail Millet Flour @ Rs. 11.75	-	-	25	2.93	15	1.76	25	2.93
Moringa Leaves Powder @ Rs. 24.95	-	-	2	0.45	2	0.45	2	0.45
Maida @ Rs. 1.95	100	1.95	48	0.94	58	0.94	58	0.94

Sugar @ Rs. 1.90	70	1.3	70	1.3	70	1.3	70	1.3
Egg @ Rs. 20	50	3	50	3	50	3	50	3
Salt @ Rs. 8.50	1	0.01	1	0.01	1	0.01	1	0.01
Vanilla Essence @ Rs. 22.45	1	0.224	1	0.224	1	0.224	1	0.224
Butter @ Rs. 16	70	17.3	70	17.3	70	17.3	70	17.3
Milk @ Rs. 2.80	10	2.31	10	2.31	10	2.31	10	2.31
Baking Powder @ Rs. 15	50	3	50	3	50	3	50	3
Total Cost Rs./100 g		**28.77**		**38.45**		**37.47**		**35.85**

Table 10 shows that the cost of *"Muffins"* per 100 g of raw ingredients at the prevailing cost of the raw materials was T_0 is Rs. 28.77 for treatment, T_1 is Rs. 38.45, T_2 is Rs. 37.47, T_3 is Rs. 35.85.

The study entitled "Utilization of Cereals and Millets for Nutritious Rich Food Products" was carried out to formulate and standardized the product as well as to assess their sensory attributes and nutrient content as well as determine the cost of the prepared products based on raw ingredients.

The three food products *"Bread"*, *"Cookies"* and *"Muffins"* were prepared by incorporation of cereals like black rice flour and millets like foxtail millets flour. The basic recipe of each product with and without incorporation of T_2 (25:15:2:68, black rice flour + foxtail millet flour + moringa leave powder + Maida) followed by T_0 (100% of all-purpose flour; Maida), T_1 (25:25:2:48, black rice flour + foxtail millet flour + moringa leaves powder + Maida), T_3 (15:25:2:68, black rice flour + foxtail millet flour + moringa leaves powder + Maida) respectively, and the basic recipe of product T_2 (25:15:2:68, black rice flour + foxtail millet flour + moringa leave powder + Maida) followed by T_0 (100% of all-purpose flour; Maida), T_1 (25:25:2:48, black rice flour + foxtail millet flour + moringa leaves powder + Maida), T_3 (15:25:2:68, black rice flour + foxtail millet flour + moringa leaves powder + Maida) respectively. T_2 (25:15:2:68, black rice flour + foxtail millet flour + moringa leave powder + Maida) followed by T_0 (100% of all-purpose flour; Maida), T_1 (25:25:2:48, black rice flour + foxtail millet flour + moringa leaves powder + Maida), T_3 (15:25:2:68, black rice flour + foxtail millet flour + moringa leaves powder + Maida) respectively.

And the method of cooking was baking at 180° C for 10-20 minutes. The experimental trial was replicated three times and in each replication of products were *Bread, Cookies and Muffins*. The organoleptic evaluation of the products about attributes of color, texture, taste, flavor, and overall acceptability was done using the panel of five judges. "Nine-point hedonic scale" and nutritive value was calculated using the food composition tables given by Gopalan, et al., (2015). The findings of the entire study are reported as follows. The observations were recorded and tabulated and results were statistically analyzed by analysis of variance and critical difference technique and t-test. The costs of the products were calculated from the cost of raw materials used.

In "Bread" the difference in the t-calculated value of 5.48 for protein content, 14.97 for carbohydrate content, 5.14 for calcium content, 10.04 for iron calcium, and 26.77 for fiber content was higher than the tabulated value of "t" which is 2.96 at 5% probability level indicate that there is a significant difference

between the nutrient content of control (T_0) and the best treatment (T_2) about antioxidants, energy, carbohydrate, calcium, fat, protein. However, a non-significant difference in the 1.88 and 2.78 for energy and fat content respectively were found. Comparison between the nutrient content of control and best treatment of *"Cookies"* by using "t-test" the difference in the t- calculated value of 7.94 for energy content, 3.66 for fat content, 63.11 for carbohydrate content, 5.23 for calcium content, and 4.31 for iron content was higher than the tabulated value of "t" which is 2.96 at 5% probability level indicate that there is a significant difference between the nutrient content of control (T_0) and the best treatment (T_1) about energy, carbohydrate, calcium, fat, protein. However, a non-significant difference in the 0.60 and 0.42 for iron fiber content respectively were found. In "Muffins" the difference in the t-calculated value was 5.48 for protein content, 14.97 for carbohydrate content, 5.14 for calcium content, 10.04 for iron calcium and 26.77 for fiber content was higher than the tabulated value of "t" which is 2.96 at a 5% probability level indicating that there is a significant difference between the nutrient content of control (T_0) and the best treatment (T_2) about antioxidants, energy, carbohydrate, calcium, fat, protein. However, a non-significant difference in the 1.88 and 2.78 for energy and fat content respectively were found.

Since to calculate the cost of prepared products it was found the highest price was of T_2 and T_0 of the products namely: *"Bread, Cookies and Muffins"* per 100 g for control and treatment.
The average cost of the "*Bread, Cookies and Muffins"* per 100 g of raw ingredients was

- The cost of the product *"Bread"* per 100 g of the raw ingredient, ranged from Rs. 25 to Rs. 30
- The cost of the product *"Cookies"* per 100 g of raw ingredient ranged from Rs. 45 to Rs. 50
- The cost of the product *"Muffins"* per 100 g of raw ingredient ranged from Rs.65 to Rs. 70

Conclusion

Based on the findings, it is concluded that the Black rice flour + Foxtail millet + Moringa leaves powder + Maida were successfully incorporated and enhanced the nutritive value *of "Bread, Cookies and Muffins"*. Based on sensory evaluation T_2 (25+15+2+68) was highly acceptable based on overall acceptability for *"Bread, Cookies and Muffins"* about color and appearance, body and texture, taste, and flavor, and overall acceptability. Nutritive value of prepared product indicates carbohydrate, protein, fiber, energy, calcium, iron content and also anti-oxidants, flavonoids, anthocyanins, and phenolic compounds increased in enriched *"Bread, Cookies and Muffins"* as compared to control bread T_2 is Rs. 26.69, cookies T_2 is Rs. 32, muffins T_2 is Rs. 37.47 and their cost are as recorded.

Recommendation

1. Incorporation of different proportions of more flours from cereals or any other agricultural-related product for value addition in traditional recipes can be encouraged and popularized to improve the intake of protein, fat, calcium, carbohydrate and iron, and most importantly also anti-oxidants, flavonoids, anthocyanins, and phenolic compounds are very high in these cereals and millets.
2. Black rice and foxtail millets are very high in anti-inflammatory agents which is one of the main responses in the immune system
3. The three food products Black rice, foxtail millet, and moringa leaves are very high in iron, calcium antioxidants vitamins like B, E, C and A folic acids, pyridoxine, and nicotinic acids by which the nervous system, digestive system, and skin health are controlled and maintained
4. These products can also help provide variety in the daily dietaries in addition to their nutritional

benefits other than the lifting of food.

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