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Development And Evaluation of Value-Added Cookies Using Dehydrated Moringa Powder

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ABSTRACT

Biscuits and cookies are usually prepared from refined wheat flour are deficient in proteins, vitamins, minerals and fiber. The present study was conducted with an objective of developing value-added cookies using Moringa powder and to analyse sensory and nutritional qualities. The Moringa leaves were sun dried and powdered and added at 5%, 10% and 15% for the development of cookies. The cookies were subjected to sensory evaluation using 9 point hedonic by the semi trained panellists. The results of the sensory evaluation scores revealed that cookies with 5% incorporation of the Moringa powder were best accepted in terms of taste, flavour and appearance. The nutrient analysis of the best accepted cookies showed 7.88 g of Protein, 24.20 g of Fat, 4.93 g of Moisture, 3.10g of Total Ash, 59.89 g of Carbohydrates, 312 mg of Calcium content, 6.0mg of Iron and 488 Kcal of Energy content per 100 grams. The study concluded that the baking industry can use Moringa powder as cost-effective and natural source of nutrients to produce nutritionally better cookies.

INTRODUCTION

Green leafy vegetables have been called as treasure of nutrients. Green leafy vegetables are very important part of traditional diets because they are easily grown in local region, accessible, and they are great sources of nutrients and phytochemicals. (Tontisirin et al., 2002).

Among commonly consumed convenience foods, biscuits are one of the most popular ready-to-eat baked products. Typically prepared with wheat flour, biscuits are valued for their extended shelf life, portability, and consumer acceptability, making them an ideal vehicle for nutritional fortification (Patil et al., 2022).

One green leafy vegetable of remarkable nutritional and medicinal importance is Moringa oleifera, often called the "miracle tree," has garnered significant attention due to its impressive nutrient profile and therapeutic properties. *M. oleifera* leaves are particularly noted for their high content of vitamins, minerals, and bioactive compounds, contributing to their wide array of health benefits. (Shifat et al., 2024). The leaves of Moringa was considered as a very nutritional material as it contains vitamin A, vitamin C, iron, calcium and potassium in concentrations as much as in carrot, orange, spinach and banana. *Moringa* leaves have anti-inflammatory properties (Sulaiman et al., 2009). It reduces blood sugar and cholesterol level in the body (Mbikay 2012). *Moringa oleífera* leaves powder is also standardised and developed into a natural dietary supplement (Ali et al., 2019)

Dehydrated moringa leaves powder was added to the products like Steamed products like Khaman, Fried products Tikia, Mathari, Sweet Product like Ladoo at different levels, it increased the protein, iron, calcium and beta-carotene levels of the value-added products (Joshi, et al. 2017). Preparation of muffin with *Moringa*

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leaf powder increased moisture, ash, protein, fat, iron, calcium, potassium, beta carotene and Vitamin C than the control muffin. (Srinivasamurthy et al. 2017).

With this background a study was undertaken to develop and evaluate the quality of cookies incorporated with dehydrated *Moringa* leaves powder.

MATERIALS AND METHODS

The ingredients required for the developing cookies, Moringa leaves, wheat flour, rolled oats, organic jaggery, flax seeds, butter, salt, baking soda, baking powder, lemon juice, cardamom, pepper, jeera were procured from a local market in Bengaluru.

Fresh leaves of Moringa were sorted for its edible part, washed and tray dried and solar dried by spreading the leaves on a tray covered with glass to avoid direct sun light and to increase drying process. The drying of greens was done for 12 hours (temperature 32- 40 ^{o}C). The dried greens were powdered, and packed in food grade polythene covers. The packed powder was refrigerated till the usage.

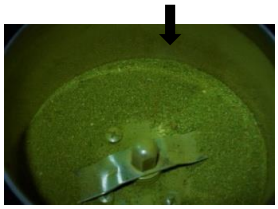
Sorting of fresh *Moringa* leaves

Washing

Draining and tray dry

Solar drying

Dried leaves



Grinding into powder and sieving

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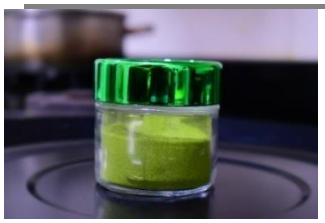

Storage in air tight container

Figure 1: Preparation of Moringa Powder

The ingredients required for the preparation of cookies were weighed precisely. Beating of butter and organic jaggery powder (salt and sweet cookies) and Cumin seeds and pepper powder (spicy cookies) water mixture to form cream mixture the mixing the cream mixture with the dry mixture of flour slowly with constant mixing was done then addition of baking powder, baking soda, lemon juice and spices should be done and it should be kneaded to prepare a dough. Dough was scraped from the bowl and placed on lightly greased cookie sheet. The dough was rolled, spread evenly and cut them into required shape. Cookies were placed ton the tray lined with baking paper and bake for 25 min at 180◦ C. After baking, the cookies were cooled at room temperature and packed in air tight polythene bags for further studies.

Procurement and weighing of ingredients

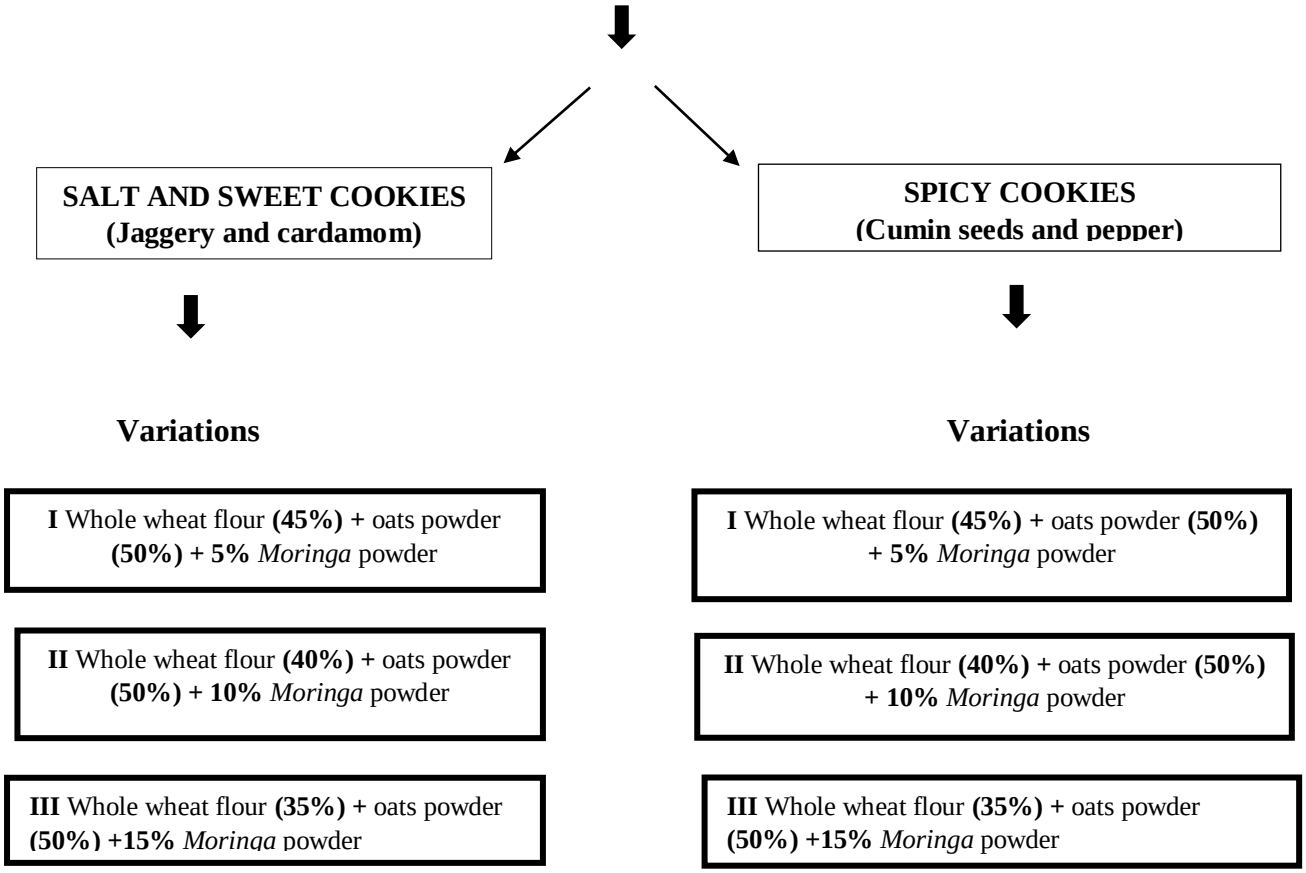

Figure 2: Development of value-added cookies using *Moringa* powder

Control sample biscuits were prepared using standardised procedure without the addition of Moringa leaves powder. Variation I cookies were developed by substituting 5 g of wheat flour with Moringa leaves powder. Similarly, variation II and variation III cookies were prepared with 10g and 15 g of Moringa leaves powder.

The developed cookies were evaluated for its sensory qualities using 9-point hedonic scale by 30 semi trained panel judges. The cookies were evaluated by each panelist for appearance, texture, color, flavor, taste, and overall acceptability on a 9-point hedonic scale. The scores between 1 and 9, which ranged from dislike extremely to like extremely were given by the judges. The best accepted cookies among the variations were

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further used to analyse the nutritional composition using suitable AOAC procedures. Suitable statistical methods were used to analyse the data of sensory scores and nutritional qualities.

RESULTS AND DISCUSSION:

The variations of Salt and Sweet value-added cookies were evaluated for sensory qualities and the mean and SD scores were shown in Table 1. The sensory scores of cookies of variation I (5 %) were on par with the scores of basic cookies. The mean sensory scores of cookies of Variation I was higher in all sensory attribute compared to cookies of variation II and III. As the level of incorporation of Moringa powder increased in variation II and III, the sensory scores of decreased. This may be because of low scores in taste and texture which may be attributed due to bitterness and hard texture.

Table 1: Sensory evaluation of Salt and Sweet value-added cookies

Attributes		Cookies			
		Basic	**Variation I**	**Variation II**	**Variation III**
Appearance	Mean	8.7	8.36	8.2	7.8
	Sd	0.65	0.96	1.03	1.34
	F - test	0.10	0.48	0.49	0.82
Colour	Mean	8.66	8.2	8.06	7.6
	Sd	0.47	0.84	0.90	1.29
	F - test	0.39	0.11	0.33	0.90
Texture	Mean	8.6	8.46	8.33	7.8
	Sd	0.56	0.62	0.75	1.32
	F - test	0.02	0.003	0.19	0.24
Taste	Mean	8.4	8.03	7.63	6.9
	Sd	0.85	1.09	1.67	1.64
	F - test	0.59	0.88	0.15	0.49
Odour	Mean	8.43	8.03	7.86	7.13
	Sd	0.77	1.12	1.27	1.87
	F - test	0.10	0.06	0.19	0.13
Overall acceptability	Mean	8.56	8.22	8.02	7.46
	Sd	0.57	0.79	1.002	1.41
	F - test	0.48	0.30	0.88	0.80

The variations of Salt and Sweet value-added cookies were evaluated for sensory qualities and the mean and SD scores were shown in Table 1. The sensory scores of cookies of variation I (5 %) were on par with the scores of basic cookies. The mean sensory scores of cookies of Variation I was higher in all sensory attribute compared to cookies of variation II and III. As the level of incorporation of Moringa powder increased in variation II and III, the sensory scores of decreased. This may be because of low scores in taste and texture which may be attributed due to bitterness and hard texture.

Patil et al., (2023) concluded that gluten free biscuits fortified with 2.0% moringa leaf powder was rated as good and acceptable. In another study Rathore et al., (2022) revealed that all value-added products developed

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from Moringa leaves powder with 5%, 10% and 15% incorporation assessed for their sensory characteristics viz. colour, flavor, taste, texture, appearance and overall acceptability had improvement. The mean score for overall acceptability of mathri was ranged from 6.60-8.50 for all the trials.

Table 2: Sensory evaluation of spicy value-added cookies

Attributes		Cookies			
		Basic	**Variation I**	**Variation II**	**Variation III**
Appearance	Mean	8.46	8.3	7.8	7.5
	Sd	1.46	0.79	0.92	1.13
	F - test	0.96	0.95	0.95	0.76
Colour	Mean	8.4	8.33	7.7	7.46
	Sd	1.44	0.80	0.91	1.07
	F - test	0.58	0.61	0.58	0.87
Texture	Mean	8.33	8.13	7.73	7.5
	Sd	0.80	0.73	1.01	1.04
	F - test	0.51	0.005	0.01	0.01
Taste	Mean	8.26	7.7	6.96	6.8
	Sd	0.90	1.23	1.65	1.68
	F - test	0.85	0.97	0.69	0.79
Odour	Mean	8.3	7.8	7.3	6.86
	Sd	0.87	1.24	1.53	1.77
	F - test	0.27	0.03	0.03	0.02
Overall acceptability	Mean	8.35	8.05	7.5	7.22
	Sd	0.71	0.82	1.02	1.1
	F - test	0.90	0.82	0.58	0.95

The variations of Salt and Sweet value-added cookies were evaluated for sensory qualities and the mean and SD scores were shown in Table 2. The products were evaluated for sensory qualities and the mean, SD scores and F test of Basic, Variation I, Variation II, variation III were calculated. The results showed that the mean scores of Basic and Variation I was higher compared to other variations. Variation I was more accepted in Spicy cookies which contained 5% *Moringa oleifera* leaves powder.

The study conducted by Bourekoua et al., 2018 showed that the Gluten free bread with 2.5% Moringa Leaf Powder (MLP) was most acceptable it resulted in lightness of crumb and crust decreased with increase in addition of MLP. The study by Khan et al., 2023 revealed that the bread supplemented with moringa Leaf Powder (MLP) exhibited significantly improved proximate and mineral profile, however, the overall acceptability scores of breads showed gradually decrease with corresponding rise in the addition levels of MLP. The incorporation of dried Moringa oleifera leaf powder (MOLP) into a popularly consumed food product like Muffin was studied Srinivasamurthy et al., 2017 with respect to product optimization, analysis of physicochemical and functional content and storage study (sensory and microbiology) in comparison with the control muffin.

Table 3: Nutritional composition Analysis *Moringa oleifera* leaves powder Cookies

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Nutrients	Per 100g
PROTEIN	**7.88 (**g/100g)
FAT	**24.20 (**g/100g)
MOISTURE	**4.93 (**g/100g)
TOTAL ASH	**3.10 (**g/100g)
CRUDE FIBER	**<0.1 (**g/100g)
CARBOHYDRATES	**59.89 (**g/100g)
ENERGY	**488 (**Kcal / 100g)
CALCIUM	**312 (**mg / 100g)
IRON	**6.0 (**mg / 100g)

The table 3 showed the nutritional composition of the value-added cookies from MLP was determined by conducting proximate analysis of best accepted cookies. The results showed 7.88 g of Protein, 24.20 g of Fat, 4.93 g of Moisture, 3.10g of Total Ash, <0.1 g of Crude Fiber, 59,89 g of Carbohydrates, 312 mg of Calcium, 6.0mg of Iron and 488.88Kcal of Energy content per 100 grams of cookies.

The results from the study conducted by Patil et al., 2023 showed gluten free biscuits fortified with 2.0% moringa leaf powder revealed that the fortified biscuit contains 5.70%, 2.43%, 12.4%, 14.5%, 60.72% and 2.45 % percentages of moisture, ash, protein, fat, carbohydrates and fibre respectively with good amount of calcium and iron.

CONCLUSION

Moringa leaves are rich in calcium, iron, etc and it can be incorporated in various food preparations for increased nutrition as it is also easily grown and easily available and also it is inexpensive. The cookies with 5% incorporation of the Moringa leaves powder were best accepted in terms of taste, flavour and appearance. The nutrient analysis of the best accepted cookies showed 7.88 g of Protein, 24.20 g of Fat, 4.93 g of Moisture, 3.10g of Total Ash, 59.89 g of Carbohydrates, 312 mg of Calcium content, 6.0mg of Iron and 488 Kcal of Energy content per 100 grams. Further research is needed of the incorporation of *Moringa oleifera* leaves powder in various food products for a better nutrition.

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