IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 10, Issue 10, October 2023

DOI: 10.17148/IARJSET.2023.101006

DEVELOPMENT OF FOXTAIL MILLET-BASED COOKIES FORTIFIED WITH MORINGA OLEIFERA LEAF POWDER

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Abstract: Moringa oleifera, native to India, grows in the tropical and subtropical regions of the world. The leaves are rich in minerals, vitamins, and other essential phytochemicals. This study reports on the possibility of value addition of moringa leaves by processing of cookie incorporated with moringa leaf powder at 5 and 10% [V1 and V2] to the foxtail millet-based cookies and comparing with the control. The effect of Moringa oleifera leaf powder on physicochemical, and sensory properties were determined. The cookies' proximate analysis specifically moisture, ash, fat, calcium and iron were determined.15 untrained panelists participated in a 5-point hedonic test. The findings were analyzed to determine the best formulation. The results of the sensory evaluation showed that there were differences in the attributes that were determined such as in color, texture, aroma, taste and overall acceptability. The overall acceptability of the cookie sample incorporated with 10% moringa leaf powder was found to be better acceptable.

Key Words: Foxtail millet flour, Moringa leaves, sensory evaluation, proximate analysis

I.INTRODUCTION

Minor millets are a group of grassy plants with short slender culm and small grains possessing remarkable ability to survive under severe drought conditions. Millets have been food commodities since ancient times. Because of their important nutritional qualities, there is a need to revive their usage in daily diet. Millets can substitute major cereals for better health benefits. Millets are considered to be the oldest grains used for the household purposes of mankind. Millets are rich in all nutritious aspects like vitamins, fats, protein and especially dietary fibres that help in providing various medical and health benefits. A regular inclusion of millets into diet will reduce the risk of cardiovascular problems helps in treating constipation, diabetes etc.

Foxtail Millet (Setaria italica L.) an annual grass plant, produces seeds that possess health-promoting properties owing to its unique protein composition containing a high content of essential amino acids. Foxtail millets are packed with the goodness of proteins, carbohydrates, vitamins like Vitamin A and E and minerals like phosphorus, calcium, magnesium, sodium, etc. Scientifically proven properties of foxtail millets include, antioxidant properties, glucose-lowering properties, gastro-protective (managing or reducing injuries to the gastrointestinal tract) properties, anti-carcinogenic properties and also have the potential to manage fungal infections.
Supplementation of cereal-based products with millets has become increasingly popular due to nutritional and economic advantages. the characteristic nature of minor millet with high yielding capacity, disease resistant, tolerant to adverse conditions and with better nutritive value in terms of complex carbohydrate and high dietary fiber render their suitability for the development of convenience, therapeutic and Ready-To-Eat (RTE) products.

Thus, for the health-conscious genera of the present world, minor millet especially Foxtail millet is perhaps one more addition to the existing list of healthy foods, owing to its nutritional superiority. Apart from this, the grain has high utilization potential owing to its excellent capacity to blend with other food grains without imparting any off flavour or aftertaste. Thus, the millet can be incorporated in traditional foods and valuarized to novel food uses. Hence, the present investigation was undertaken to develop foxtail millet (Setaria italica L.) based value added cookies, by fortifying with moringa oleifera leaf powder and to analyse the consumer acceptability, nutritional profile.

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Moringa oleifera Lam. is a subtropical tree, native to the Indian subcontinent, where it was described as early as 2000 B.C. [1]. At times, it also goes by the name of "horseradish tree" or "ben oil tree" and in Senegal, the tree is called "Nebeday", probably derived from the English words "never die" [2]. Throughout the years, it has spread to the rest of Asia, Africa and Latin America. Moringa is well-known as the miracle tree, due to its high nutritional value, its many medicinal benefits and uses, and its disease- and drought-tolerance. The leaves, pods, seeds, flowers and roots can be consumed and the bark can be used for its fibre. According to ayurvedic medicine (traditional and alternative medicine of India) [3], it is attributed properties for the treatment of some diseases, such as asthma, epilepsy, eye and skin diseases, fever and haemorrhoids [4,5,6]. In fact, it is a medicinal plant traditionally known in the approach to malnutrition and other diseases. The leaves of M. oleifera are rich in minerals like calcium, potassium, zinc, magnesium, iron and copper [7].

II. MATERIAL AND METHODS

The study involved the dehydration of moringa leaves and the formulation of various flour blends, combining refined wheat flour, foxtail millet flour, and moringa leaf powder in different proportions. Cookies were prepared based on specified ingredients, and proximate analysis was conducted to determine various nutritional components. Sensory evaluation was carried out to assess the attributes of colour, flavour, texture, appearance, and taste.

2.1. MATERIALS

2.1.1 RAW MATERIALS AND INGREDIENTS

Refined wheat flour, Foxtail millet, Moringa leaf powder, Butter, Sugar, Vanilla extract, Salt

2.1.2 PROCESSING EQUIPMENT

The analytical equipment's like hot air oven, muffle furnace, Soxhlet extractor was made available in the laboratories of Department of Food Science and Technology, MOP Vaishnav College for Women, Chennai.

2.2 METHODS

2.2.1. PROCESSING AND DEHYDRATION

The moringa leaves were separated from stalk, washed and taken. The separated leaves were kept for dehydration at 60°C in tray drier until it dried properly. The dried leaves were ground into powder by using an electric grinder and sieved. Then, the dehydrated powder was packed and used for further purpose of making cookies. The foxtail millet was also similarly roasted, dried into a flour and sieved to remove unwanted matter.

2.2.2 FORMULATION OF FLOUR BLENDS

Three different blend proportions including the control were formulated using mixtures of refined wheat flour (RWF), foxtail millet (FM) and moringa leaf powder (MLF).
The ratios of refined wheat flour and foxtail millet flour to that of moringa leaf powder is mentioned in table 1.

Table.1. Ratios of refined wheat flour and foxtail millet to that of the moringa leaf powder

VARIATIONS	REFINED WHEAT FLOUR	FOXTAIL MILLET FLOUR	MORINGA LEAF POWDER
CONTROL	50%	50%	-
VARIATION 1	50%	50%	5%
VARIATION 2	50%	50%	10%

2.2.3. INGREDIENTS FOR COOKIE PREPARATION:

Table.2 Ingredients required for the development of cookies

INGREDIENTS	QUANTITY
Refined wheat flour	50gm
Foxtail millet flour	50gm
Sugar (powdered)	60gm
Butter	100gm
Vanilla Extract	1/2tsp
Salt	1/4tsp

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2.2.4. PROCESS OF COOKIES PREPARATION:

The method of preparation of the millet cookie is given below in figure. 1. The formulation and baking of the cookie is given in figure.2.

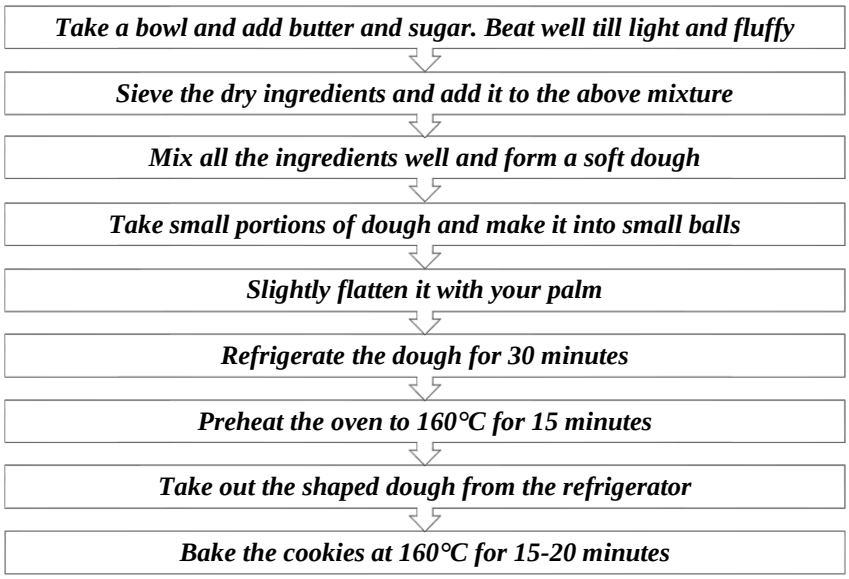

Fig.1 Method of preparation of the cookie

Fig.2. The formulation and baking of the cookie

2.2.5. PROXIMATE ANALYSIS OF COOKIES

Moisture, ash, fat, iron, calcium and fibre content was determined using different procedures. The methods used were:

1) Moisture (AOAC method, 2000)
2) Ash (AOAC method, 2000)
3) Fat (Solvent Extraction Method, AOAC, 2000)
4) Iron (Colorimetric assay)
5) Calcium (Titrimetric Method)

MOISTURE ANALYSIS:

Dry the empty dish and lid in the oven at 105*C for 3 hours and transfer to desiccator to cool. Weigh the empty dish and the lid. Weigh about 5g of sample to the dish. Spread the sample with spatula. Place the dish with sample in the oven. Dry for 3 hours at 105*C. After drying, transfer the dish with partially covered lid to the desiccator to cool. Reweigh the dish and its dried sample.

CALCULATION:

$$\textit{Moisture (\%)} = \frac{W1-w2}{w1} \; x \; 100$$

- W1 = weight (g) of sample before drying
- W2 = weight (g) of sample after drying

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ASH ANALYSIS:

Place the crucible and lid in the furnace at 550*C overnight to ensure that impurities on the surface of crucible are burned off. Cool the crucible in the desiccator for 30 minutes. Weigh the crucible and lid to 3 decimal places. Weigh about 3g sample into the crucible. Heat over low Bunsen flame with lid half covered. When fumes are no longer produced, place crucible and lid in furnace. Heat at 550*C overnight. During heating, do not cover the lid. Place the lid after complete heating to prevent loss of fluffy ash. Cool down in the desiccator. Weigh the ash with crucible and lid when the sample turns to grey. If not, return the crucible and lid to the furnace for the further ashing.

CALCULATION:

$$Ash\ (\%) = \frac{Weight\ of\ the\ ash}{Weight\ of\ the\ sample}\ x\ 100$$

FAT ANALYSIS:

Place the bottle and lid in the incubator at 105*C overnight to ensure that weight of bottle is stable. Weigh about 3-5 g of sample to paper filter and wrap. Take the sample into extraction thimble and transfer into soxhlet. Fill petroleum ether about 250 ml into the bottle and take it on the heating mantle. Connect the soxhlet apparatus and turn on the water to cool them and then switch on the heating mantle. Evaporate the solvent by using the vacuum condenser. Incubate the bottle at 80-90C until solvent is completely evaporate and bottle is completely dry. After drying, transfer the bottle with partially covered lid to the desiccator to cool. Reweight the bottle and its dried content.

CALCULATION:

$$Fat\ (\%) = \frac{Weight\ of\ the\ fat}{Weight\ of\ the\ sample}\ x\ 100$$

III. EXPERIMENTAL RESULTS AND DISCUSSIONS

3.1. SENSORY EVALUATION OF THE COOKIES CONTAINING DIFFERENT LEVEL OF FLOUR:

Cookie samples containing Control, V1 (containing 5% moringa leaf powder) and V2 (containing 10.0% moringa leaf powder) were subjected to sensory evaluation. The color, flavor, texture, appearance, taste and overall acceptability of cookie samples were evaluated by 15 panelists by using a five -point hedonic scale. The mean score for color, flavor, texture and overall acceptability preference are given below in figure.3.

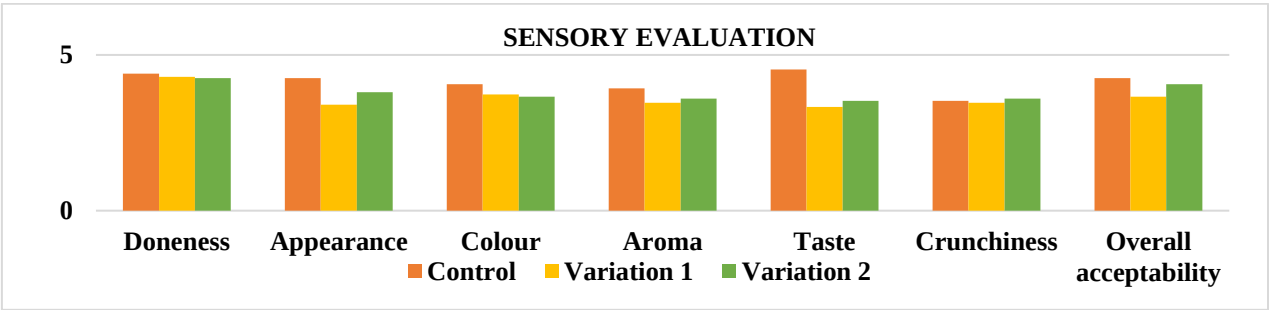

Fig.3: Sensory Evaluation of the cookie formulations

3.2. PROXIMATE ANALYSIS OF THE COOKIES

Chemical analysis for the prepared cookies were performed.

Table.3. Proximate analysis of the cookies

VARIATIONS	MOISTURE%	ASH%	FAT%	IRON (mg)	CALCIUM (mg)
Control	4.25	3.04	22.88	0.3	550
Variation 1	3.97	3.58	25.04	0.65	900
Variation 2	4.21	3.16	25.85	1.2	1100

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The sensory evaluation conducted on the cookies fortified with varying levels of moringa leaf powder indicated that the formulation containing 10% moringa leaf powder exhibited the most favourable sensory attributes, including an appealing colour, desirable texture, enticing aroma, and a distinctly pleasant taste. Notably, the overall acceptability score was significantly higher for the cookies with 10% moringa leaf powder, indicating a strong preference among the panelists. Moreover, the proximate analysis of the cookies unveiled noteworthy findings. The moisture content of the cookies across all formulations fell within the acceptable range for achieving a desirable crispy and crumbly texture. Notably, the 10% moringa leaf powder formulation demonstrated an acceptable moisture content, suggesting its potential for maintaining optimal texture. Furthermore, the ash content, an essential indicator of mineral content, remained within the acceptable range for all formulations. Interestingly, the formulations with increased levels of moringa leaf powder exhibited higher levels of iron and calcium, suggesting a significant enhancement in the nutritional profile of the cookies which is mentioned in table 3.

The findings from the proximate analysis align with the sensory evaluation, further affirming the positive impact of moringa leaf powder fortification on both the sensory attributes and the nutritional value of the cookie.

IV. CONCLUSION AND FUTURE WORK

The results of the comprehensive analysis provide compelling evidence supporting the effective incorporation of moringa leaf powder into foxtail millet-based cookies. Notably, the cookies fortified with 10% moringa leaf powder emerged as the preferred choice, reflecting their superior sensory attributes and elevated nutritional content. This underscores the viability of moringa leaf powder as a valuable fortification ingredient, capable of enhancing the overall quality and nutritional value of food products. The study's outcomes indicate that the inclusion of moringa leaf powder not only enriches the cookies' mineral content, particularly iron and calcium, but also contributes to their overall sensory appeal. Given the rising demand for nutritious and appealing food options, the successful integration of moringa leaf powder represents a promising avenue for the development of functional and health-conscious food products. These findings not only contribute to the growing body of knowledge regarding the application of moringa leaf powder in food product development but also underscore its potential to address prevalent nutritional deficiencies. Moving forward, further research and development initiatives can explore the incorporation of moringa leaf powder in a diverse range of food products, aiming to offer consumers innovative, nutrient-dense, and appealing dietary options

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