*Int.J.Curr.Microbiol.App.Sci* (2020) Special Issue-11: 4090-4099

*International Journal of Current Microbiology and Applied Sciences*
*ISSN: 2319-7706* **Special Issue-11 pp. 4090-4099**
Journal homepage: http://www.ijcmas.com

**Original Research Article**

# Studies on Nutritional Quality of Cookies Prepared by Maida and Little Millet Flour

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**A B S T R A C T**

The present research work was carried out to explore the possibility of utilization of underutilized but highly nutrient rich little millet in cookies. Little millet is a rich source of protein, crude fiber, micronutrient such as iron and can be utilized in bakery products such as cookies. Preliminary experiments were carried out to find out optimum level of little millet flour with maida for the preparation of quality cookies. The quality cookies were prepared from 30% maida and 70% little millet ($MLF_{70}$). The selected treatments were packed in LDPE and PP stored at ambient ($30 \pm 4^{0}$ C) for 90 days to study their storage feasibility. Chemical composition of the fresh cookies prepared from 30% maida and 70% little millet flour ($MLF_{70}$) showed that moisture content was 4.15%, protein 9.02%, crude fat 28.56%, crude fiber 5.41%, carbohydrates 69.07% and iron 7.3 mg/ 100 g. The sensory evaluation of cookies was carried out regularly at an interval of one month for 3 month during storage. The results on overall acceptability score of cookies are influenced by storage. The results indicated that score for overall acceptability decreased for $MLF_{70}$ from 7.9 to 6.9 in LDPE and from 7.7 to 6.6 in PP for 90 days of storage. Storage study of cookies showed that the cookies prepared by incorporation of maida, and little millet flour can be stored up to 3 month in LDPE with minimum losses in sensory, nutritional and textural characteristics as compare to PP. There was no significant difference in protein, crude fiber, calcium and iron content with advancement of storage period during 3 month. The cookies were found to be acceptable up to 3 month storage at ambient temperature. The total cost of production of cookies prepared from maida and little millet flour ($MLF_{70}$) for 1 kg was Rs. 191/-

**Keywords**

Little millet, cookies, nutritional value, organoleptic properties

## Introduction

Millets are small seeded annual coarse cereals grown throughout the world. It requires warm weather and matures quickly in the hot summer months. Practically devoid of grain storage pest, little millet has a long storage life. In developing countries, millets are consumed by people from the low economic strata and as forage crop (Baker, 2003). They are nutritionally comparable or even superior to staple cereals such as rice and wheat (Gopalan *et al.*, 2004). Millets are rich in vitamins, minerals, sulphur containing amino acids and phytochemicals, and hence are termed as "nutri-cereals". They have higher proportions of non starchy polysaccharides and dietary fibre. Millets

release sugars slowly and thus have a low Glycemic index. Millets have been in food use since time immemorial and an array of traditional foods are prepared across rural India. However, food use of millets is fast decreasing due to several reasons. There is therefore a need to revive these important groups of health promoting foods to enhance nutritional quality of diets of consumers.

Among the millets little millet (*Panicum miliare*) is an important underutilized grain, also called as *Save, Savi, Kutaki, Sama, Sam, Savai, Chama* etc. The average yield of little millet is around 0.5-1 tones/ ha. It is a rich source of protein with high digestible value and it is an excellent source of dietary fiber with good amount of soluble and insoluble fractions (Veena *et al.,* 2005). The carbohydrate content is low and slowly digestible. Besides, it is rich in minerals such as iron phosphorus and phytochemicals.

Additionally, it can blend with most of traditional and novel foods without imparting any flavour of its own. Nutritional composition of little millet is fat (4.7 g), crude fiber (7.7 g), iron (9.3 mg) and phosphorus (220 mg) per 100 g which is comparable to cereals and other millets (Gopalan *et al.,* 2010). Dietary fiber content of little millet is the contributing factor for its low glycaemic index and a recent study conducted on little millet indicated that it exhibits hypoglycaemic effect due to its higher proportion of dietary fiber (Itagi *et al.,* 2013).

It has a significant role in providing significant amounts of antioxidants and phytochemicals in the diet (Ushakumari and Malleshi 2007; Pradeep and Guha 2011).

Hence, in the present study little millet was chosen to enhance the nutrient composition of cookies in terms of dietary fiber and other nutrients. Cookies are a form of confectionary products usually dried to low moisture content. Compared to extensively all over the world as a snack food and on a large scale in developing country. Most bakery products can easily be enriched and fortified to meet the specific needs of the target groups and vulnerable sections of the population who are undernourished. Bakery products can also be formulated in such a way to meet specific therapeutic needs of consumers. Among the bakery products, cookies are most significant.

The cookie formula consists of refined flour, hydrogenated fat, sugar and other additives. It is well documented that most of the ingredients used in commercial cookies lack important nutrients.

The refined flour lacks in dietary fiber and micronutrients which are important health promoting components. The hydrogenated fat comprises of trans-fats which have proven to be harmful to human health. Recognizing the negative health effects of trans-fats many countries have banned the trans-fats in foods and have recommended zero tolerance to trans-fats in foods for infants and other vulnerable groups. Nutrition labeling to indicate the trans-fats content is made mandatory in many countries.

However, still there is ample scope to enhance the nutritional value of cookies both quantitatively and qualitatively using nutritious food ingredients. In this regard, there are several food ingredients with exceptional nutritional qualities because of their nutraceutical and /or nutritional components, such as millets, oil seeds, condiments and other novel ingredients. Value addition to existing foods with such ingredients is a simple and feasible way of enhancing nutritional values of foods and in turn the health benefits.

## Materials and Methods

### Ingredients

The major ingredients for the preparation of products were little millet procured from Zonal Agriculture Research Station, Kolhapur. The wheat (*var*. Phule Samadhan) seeds were procured from ARS, Niphad. The maida was procured from local market.

### Packaging material

The packaging material *viz*., LDPE (above 51 micron) and PP bags were procured from local market and used for packaging of cookies and for storage study.

### Treatment details

The little millet cookies were prepared by using different levels of little millet flour with maida as shown below:

### Procedure for preparation of little millet flour

The little millet grains were cleaned to remove extraneous matter and taken in small bowel and then attached to the electric decorticator to remove brans. The dried debraned little millet grains were grinded in to flour and passed through sieve of 80 mesh to get uniform flour.

### Preparation of little millet flour cookies

The cookies were prepared using standard levels of ingredients as per the traditional creaming process (Fig1.)

### Physical characteristics of raw material

The raw materials little millet grains were analyzed for different physical characteristics like thousand kernel weight, bulk density and colour.

### Chemical properties of raw materials and cookies

Chemical constituents like moisture, fat, protein, carbohydrate, crude fiber and minerals like iron content of raw material and cookies were determined as per the standard procedure.

### Physico-chemical analysis of raw material and cookies

The method described in A.O.A.C. (2000) for determining moisture was used. The protein content of cookies was estimated by determining total nitrogen content using standard Micro-Kjeldhal method and fat content of the cookies estimated by the soxhlet method A.A.C.C (2000). The crude fiber content in the products was estimated by A.A.A.C. (2000). The carbohydrate content in the selected cookies were obtained by subtracting from 100, the sum of values of moisture, protein and fat content per 100 g of the sample (Raghuramulu, *et al.,* 1993). iron were analyzed using atomic absorption spectrometry (AAS). These methods give a good precision and accuracy (Ojeka and Ayodele 1995.)

### Packaging and storage of little millet cookies

The selected treatments of little millet cookies were packed in low density polyethylene and polypropylene and stored at ambient ($30\pm4^{0}$C) for 3 months. The cookies were drawn at an interval of 1 month and evaluated for chemical and sensory quality.

### Sensory evaluation of cookies

Sensory evaluation of little millet cookies was carried on 9 point hedonic scale. The average scores of the ten judges for different quality characteristics *viz.* colour and

appearance, flavour, texture, taste and overall acceptability were recorded.

## Statistical analysis

All experiments were carried out by using Completely Randomized Design (CRD) Factorial Completely Randomized Design (FCRD) and T- test. The results obtained in the present investigation were analyzed for the statistical significance according to the procedure given by Rangaswamy (2010).

## Results and Discussion

## Physical characteristics of raw materials

The results obtained for physical characteristics of little millet grains are presented below:

The seed colour was dull whitish which indicated good quality. Bulk and true densities of little millet were low. Bulk density of seeds was found to be 1.51 g/ml, while the true density was 2.81 g/ml. The variations in density of little millet may be due to random harvesting of little millet at different maturity stages. This factor is important because it determines the capacity of storage, packaging and transport systems (James, 2005).The per cent porosity of sample was found to be moderate i.e. 46.26 %. Porosity depends on size, shape and boldness of seeds. It must be noted that porosity of the mass of seeds determines the resistance to air flow during aeration and drying procedures. With respect to various physical properties, the similar results have been reported by Vanesa, *et al.*, (2008).

## Chemical characters of raw materials

The results obtained for chemical characteristics of maida and little millet flour are presented here:

Chemical characters of various raw materials are comparable with findings reported by other scientist Tosco, (2004).

These values are also comparable with Gopalan, *et al.,* (2006).Chemical composition especially mineral contents of wheat revealed that wheat is rich source of minerals. Similar conclusions have been drawn by Bushway, *et al.,* (1981), Mayela, *et al.,* (2007) and Salazar, *et al.,* (2011).

## Sensory evaluations of fresh little millet cookies

The organoleptic evaluation of cookies prepared by different combination of little millet flour and maida were carried out. Little millet cookies were prepared and presented to panel of ten judge for assessing the quality and acceptability of product.

Organoleptic evaluation of cookies was carried out using a 9 point hedonic scale of sensory characteristics such as colour, flavour texture, taste and overall acceptability.

The score obtained for sensory evaluation for maida and little millet flour cookies are shown in Table 4. Maida and little millet cookies (30 maida: 70 little millet flour) cookies of good quality and stored at ambient temperature (30 ± 4°C) for 3 month.

Organoleptic quality parameters of a product assume pivotal role in anticipating the consumer response to the product (Rey 2006). Colour and appearance uniformity are vital components of visual quality of fresh as well as processed foods and play a major role in consumer choice (Alistair 2005).

Flavour being a combination of taste, smell and mouth feel, has multifaceted impact on sensory quality of a product (Amerine, *et al.,* 1980).

**Table.1** Treatment details for preparation of little millet cookies

| Treatments | Maida (%) | Little millet flour (%) |
|---|---|---|
| $T_0$ (Control) | 100 | 0 |
| $T_1$ | 90 | 10 |
| $T_2$ | 80 | 20 |
| $T_3$ | 70 | 30 |
| $T_4$ | 60 | 40 |
| $T_5$ | 50 | 50 |
| $T_6$ | 40 | 60 |
| $T_7$ | 30 | 70 |
| $T_8$ | 20 | 80 |
| $T_9$ | 10 | 90 |
| $T_{10}$ | 0 | 100 |

**Table.2** Physical characteristics of raw materials

| **Parameter** | **Little millet grains** |
|---|---|
| Colour | Dull whitish |
| 1000 grain weight (g) | 2.10 |
| Bulk density (g/ml) | 1.51 |
| True density (g/ml) | 2.81 |

**Table.3** Chemical characters of raw materials

| Chemical constituent | Maida | Little millet flour |
|---|---|---|
| Moisture (%) | 13.3 | 11.59 |
| Protein (%) | 11 | 7.7 |
| Crude fiber (%) | 0.9 | 4.7 |
| Fat (%) | 0.3 | 7.6 |
| Carbohydrates (%) | 73.9 | 67 |
| phosphorous (mg/100g) | 121 | 220.0 |
| Iron (mg/100g) | 2.7 | 9.3 |

*****Each value is the average of three determinations

**Table.4** Sensory evaluation of fresh maida and little millet cookies*

| Sample code | Sensory attributes* | | | | | |
|---|---|---|---|---|---|---|
| | Colour and appearance | Flavour | Texture | Taste | Overall acceptability | Rank |
| $MLF_0$(Control) | 8.0 | 8.0 | 8.0 | 8.1 | 8.02 | 8 |
| $MLF_{10}$ | 8.2 | 8.3 | 8.1 | 8.5 | 8.27 | 7 |
| $MLF_{20}$ | 8.2 | 8.3 | 8.3 | 8.5 | 8.32 | 6 |
| $MLF_{30}$ | 8.2 | 8.3 | 8.5 | 8.6 | 8.4 | 5 |
| $MLF_{40}$ | 8.3 | 8.5 | 8.6 | 8.6 | 8.47 | 4 |
| $MLF_{50}$ | 8.3 | 8.5 | 8.6 | 8.6 | 8.5 | 3 |
| $MLF_{60}$ | 8.7 | 8.7 | 8.7 | 8.8 | 8.75 | 2 |
| $MLF_{70}$ | 8.9 | 9.0 | 9.0 | 9.0 | 8.97 | 1 |
| $MLF_{80}$ | 7.8 | 7.9 | 7.6 | 7.8 | 7.80 | 9 |
| $MLF_{90}$ | 7.6 | 7.8 | 7.3 | 7.6 | 7.57 | 10 |
| $MLF_{100}$ | 7.1 | 7.4 | 7.0 | 7.2 | 7.17 | 11 |
| Mean | 8.11 | 8.25 | 8.24 | 8.30 | 8.20 | - |
| S.E.± | 0.06 | 0.07 | 0.07 | 0.06 | 0.011 | - |
| C.D at 5% | 0.20 | 0.21 | 0.22 | 0.18 | 0.032 | - |

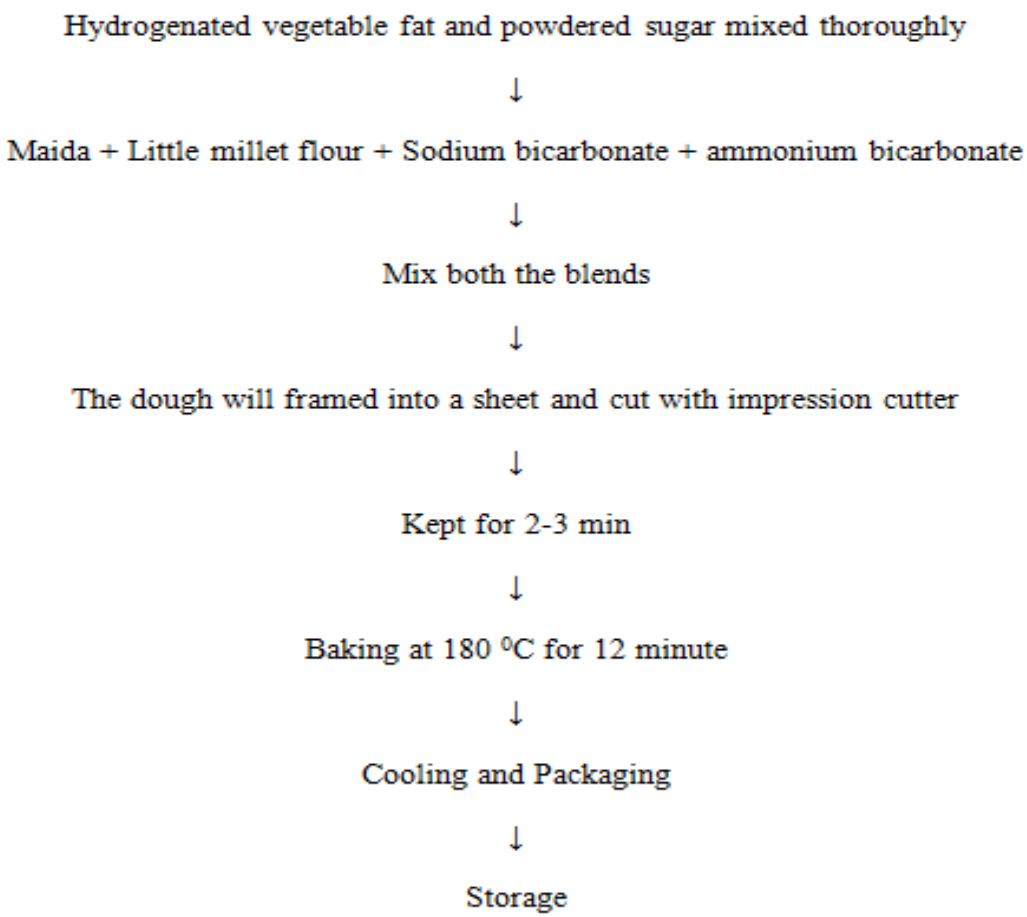
*Maximum score out of 9.
All results are mean value of ten determinations.
whereas,
$MLF_0$ = (100 maida: 0 little millet flour), $MLF_{10}$ = (90 maida: 10 little millet flour),
$MLF_{20}$ = (80 maida: 20 little millet flour), $MLF_{30}$ = (70 maida: 30 little millet flour),
$MLF_{40}$ = (60 maida: 40 little millet flour), $MLF_{50}$ = (50 maida: 50 little millet flour),
$MLF_{60}$ = (40 maida: 60 little millet flour), $MLF_{70}$ = (30 maida: 70 little millet flour),
$MLF_{80}$ = (20 maida: 80 little millet flour), $MLF_{90}$ = (10 maida: 90 little millet flour),
$MLF_{100}$ = (0 maida: 100 little millet flour).

**Table.5** Nutritional changes in little millet cookies during storage at ambient temperature

| Parameters | Initial | | | | Final | | | |
|---|---|---|---|---|---|---|---|---|
| Chemical constituent | T1P1 | T1P2 | T2P1 | T2P2 | T1P1 | T1P2 | T2P1 | T2P2 |
| Moisture (%) | 4.11 | 4.11 | 4.15 | 4.15 | 4.21 | 4.24 | 4.22 | 4.25 |
| Protein (%) | 12.10 | 12.10 | 9.02 | 9.02 | 11.93 | 11.91 | 8.87 | 8.85 |
| Fat (%) | 25.89 | 25.89 | 28.56 | 28.56 | 25.78 | 25.76 | 28.45 | 28.44 |
| Crude fiber (%) | 0.30 | 0.30 | 5.41 | 5.41 | 0.21 | 0.20 | 5.30 | 5.28 |
| Carbohydrate (%) | 73.90 | 73.90 | 69.07 | 69.07 | 73.80 | 73.78 | 68.94 | 68.92 |
| Iron (mg/100g) | 2.70 | 2.70 | 7.32 | 7.32 | 2.60 | 2.57 | 7.22 | 7.18 |

Whereas: $T_1$ - (100% Maida)
$T_2$ - (30% Maida and 70% Little millet flour)
$P_1$ – Low density polyethylene (LDPE), $P_2$ - Polypropylene bag (PP)

**Fig.1** Flow chart for preparation of little millet cookies




Overall acceptability of product is a function of various factors including colour and appearance, flavour, texture and taste.

Amongst all samples containing maida 30 per cent and little millet 70 per cent combination was found to be more acceptable. Statistical analysis showed that sample $MLF_{70}$ is best sample in all sensory attributes. Gupta and Singh (2005) reported overall acceptability of biscuits containing colour and appearance, flavour, texture and taste which gives overall acceptance by considering above all attributes. Singh *et al.*, (2000) reported overall acceptability of product like cookies is a function of various factors including colour and appearance, flavour, texture and taste in the soy fortified biscuits storage.

## Selection of Best Combination for Preparation of little Millet Fortified Cookies

On the basis of organoleptic properties (colour and appearance, flavour, texture, taste and overall acceptability) the best combination from maida and little millet flour was 30:70. For the storage study this combinations with control (100% maida) were selected and the cookies prepared from them used for further storage study. During storage study their nutritional composition, organoleptic properties and microbial quality were analysed using standard procedures.

The average values of fresh cookies for control (100% maida) was moisture 4.11 per

cent, protein 12.1 per cent, fat 25.89 per cent, crude fiber 0.30 per cent, carbohydrate content 73.90 per cent and iron content was 2.70 mg/100g. For $MLF_{70}$ (30% maida and 70% little millet flour) was moisture 4.15 per cent, protein 9.02 per cent, fat 28.56 per cent, crude fiber 5.41 per cent, carbohydrate content 69.07 per cent and iron content was 7.32 mg/100g.

The average values of 90 days cookies for control (100% maida) in LDPE packaging material was moisture 4.21 per cent, protein 11.93 per cent, fat 25.78 per cent, crude fiber 0.21 per cent, carbohydrate content 73.80 per cent and iron content was 2.60 mg/100g whereas in PP packaging material 4.24 per cent, protein 11.91 per cent, fat 25.76 per cent, crude fiber 0.20 per cent, carbohydrate content 73.78 per cent and iron content was 2.57 mg/100g

The average values of 90 days cookies for $MLF_{70}$ (30% maida and 70% little millet flour)) in LDPE packaging material was moisture 4.22 per cent, protein 8.87 per cent, fat 28.45 per cent, crude fiber 5.30 per cent, carbohydrate content 68.94 per cent and iron content was 7.22 mg/100g whereas in polypropylene packaging material was moisture 4.25per cent, protein 8.85 per cent, fat 28.44 per cent, crude fiber 5.28per cent, carbohydrate content 68.92 per cent and iron content was 7.18 mg/100g

Protein, fat, crude fiber, carbohydrate and iron decreased in ambient temperature during storage period of 3 month. Except moisture all other parameters found decreased in final analysis as compared to initial analysis. Cookies stored in low density polyethylene (LDPE) shows better quality than polypropylene (PP).

In cookies production, addition of fat imparts tenderness making it more palatable; assist in texture improvements. External added fat during preparation of cookies have plasticizing effects reported by Mulvancey and Cohen (1997).

The interaction including physical and chemical forces among protein molecules play key role on the rheological properties (Shiau and Yeh, 2001). The increase in protein content is acceptable for better rheological characteristics.

Sujitha and Thirumani (2014) also reported increase in moisture content from 3.6-5.6% of flaxseed cookies during the storage period of 60 days.

This increase was primarily due to packaging material (polythene bags).The packaging was not airtight and lack of temperature control resulted in an increase in moisture contents of cookies..

Moreover, cookies absorbed moisture from surrounding atmosphere due to hygroscopic behavior of wheat flour. An increase in moisture contents of cookie samples during storage has also been reported by Leelavathi and Rao (1993), Rao, *et al.*,(1995) Pasha, *et al.*,(2002), Butt, *et al.,* (2004) and Shariff, *et al.*,(2005) either due to atmosphere or packaging materials.

These results indicates that $MLF_{70}$ cookies (30 per cent maida and 70 per cent little millet flour) with constant levels of other ingredients stored at ambient temperature had better acceptability till $90^{th}$ day.

It is evident from all the physicochemical properties that $MLF_{70}$ cookies (30 per cent maida and 70 per cent little millet flour) are the best for preparation of little millet cookies of good quality. The cookies stored in LDPE bags showed good quality than polypropylene (PP) during 3 month storage.

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