

## NUTRITIONAL EVALUATION OF FINGERMILLET MALT

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**Abstract:** Fingermillet (*Eleusine coracana*), a coarse grain is an important food crop utilized in the preparation of various value added products like baked, roasted, steamed, fried, boiled, fermented product and also beverages. Fingermillet is known for malting which enhances the bio availability of nutrients and improves the overall nutritional quality. In the present study, fingermillet is utilized to prepare fingermillet malt with the main objective of processing, value addition and nutritional evaluation of fingermillet malt. Raw materials used for preparing malt- ragi, wheat and green gram were subjected to various processing methods for preparation of malt powder and malt beverage. Sensory evaluation of ragi malt beverage was conducted on a 5- point hedonic scale by a semi trained panel of ten judges for sensory attributes such as appearance, consistency, flavor and overall acceptability. Ragi malt was also studied for its shelf life for a period of three months at both room at refrigerated temperatures. Malt beverage prepared from fresh malt as well as stored at room and refrigerated samples did not show any significant difference between them for the sensory attributes. The nutritional profile of fingermillet malt showed that it had adequate protein content (8.9 gram/100gm), low fat (1.5 gm/100gm), high amount of calcium (193mg.) and phosphorus (268mg) with good amount of carbohydrate (79.0) and energy (365Kcal.). Significant differences were observed in the nutritive component of fingermillet malt stored at room and refrigerated temperature with respect to moisture and protein content between 0-3 months of storage. Non significant difference was found in fat and carbohydrate content between room and refrigerated temperature 5% level. However, significant difference was observed between 0-3 months storage at both room and refrigerated temperature with respect to calcium, phosphorus and iron at 5% level. The microbial count of fingermillet malt of fresh as well as samples stored at room and refrigerated temperature did not show any coliform count, yeast mould count. However the total bacterial count slightly increased on storage. Samples stored at room and refrigerated temperature and between 0-3 months at refrigerated temperature showed significant difference at 5% level.

**Keywords:** Fingermillet malt, fingermillet beverage, room temperature, refrigerated temperature

### I. INTRODUCTION

Fingermillet (*Eleusine coracana*) which belongs to the group of millets (coarse grains) is grown as an important food crop in many developing countries of the tropical region, mainly

in Africa and Asia. Fingermillet, also known as African millet, Koracana, ragi (India), Wimbi (Swahile), Bulo (Uganda) and Telebun (Sudan), is an important staple food in southern parts of India, especially Karnataka and Tamil Nadu. Important feature of fingermillet is that it can be stored for long period without insect damage. The main use of fingermillet is conversion to flour for preparation of various products ranging from unleavened pan cake (roti) or leavened pancakes (Injera) to the thick porridge (dumpling) or thin porridge (gruel, ambli). Fingermillet and its flour can be substituted (50%) for cereals (rice, wheat) and pulses (bengalgram dhal and black gram dhal), thereby utilizing it in the preparation of value added products like baked, roasted, steamed, fried, boiled, fermented products and also beverages [1], [2].

India is the leading producer of small millets *viz*, fingermillet, Kodomillet, foxtailmillet, prosomillet and littlemillet. Annual planting area around them is 2.5 million hectares and area under fingermillet comprising about 40-50% of crop's global area. The production of fingermillet in Karnataka is accounting to 58 percent of the total production. Ragi is an important staple food in some parts of India and is rich in protein, iron, calcium, phosphorus, fibre and vitamin content. It is a good source of diet for growing children, women and elderly. Traditionally fingermillet is used for preparation of flour, dumpling, pudding, porridge, roti, ambli and sari. However it can be utilised in many forms as this nutri-grain blends with all types of other grains like rice, wheat, bengalgram, greengram and it enhances the nutritional value of other cereal or pulse based products that are lacking in nutrients especially calcium.

Due to rich fibre content, fingermillet is believed to be a good laxative and prevents constipation. People who suffer from liver diseases, high-blood pressure, heart weaknesses and asthma should consume finger millet to ameliorate these conditions. The millet is also advised to a lactating mother if she is unable to produce sufficient milk to feed her infant. Finger millet is considered to be a boon for diabetics and obese people, as the digestion of fingermillet takes place at a slow pace and hence, glucose is released slowly into the blood. Also, this redmillet contains an amino acid known as tryptophan. This compound reduces the appetite, and thus, helps to control an individual's diet. It is specially recommended to young children, as the millet is rich in calcium, and therefore helps in proper growth and development. Being a rich source of iron, finger millet is good for all those suffering from anaemia as this millet helps to raise the haemoglobin level of blood. It helps to fight malnutrition and degenerative diseases. It also works well as an anti-ageing agent.

Fingermillet has good potential of providing nutritional security to the consumers. It's consumption can be increased in urban areas too through proper processing and value addition [3]. Fingermillet is superior to rice and wheat with respect to mineral and micronutrients. It is a major source of dietary carbohydrate for a large section of the society [4].

With the changes in scenario of utilization of processed products and awareness of the consumers about the health benefits, the focus has to be given on processing, value addition and effective utilization of this nutri-rich grain. If the utilization of fingermillet is more by consumers, even farmers will be benefitted indirectly. Fingermillet processing and value addition can provide income and employment opportunities for people in both rural and urban areas.

Millets are known for malting which enhances the bio-availability of nutrients and improves the overall nutritional quality. The iron content of fingermillet is high but low in bio-availability due to presence of polyphenols in bran fraction. Traditional household processing such as germination reduces the amount of inhibitors and improves iron utilization. Processing techniques like malting and popping aid in increasing the bioavailability of nutrients.

Malt contains amylase enzyme. When heated during preparation of malt beverage it gets hydrolyzed to dextrin and lower molecular weight carbohydrates which reduces the water holding capacity and increases the nutrient density. Malted fingermillet powder was also utilized in the preparation of products like noodles and cake [5] and [6]. In the present investigation fingermillet is utilized to prepare fingermillet malt with the main objective of processing, value addition and nutritional evaluation of fingermillet malt.

## II. MATERIALS AND METHODS

**Procurement of raw materials:** Good quality raw materials like ragi, wheat and greengram were procured from local market. The grains were cleaned and subjected to sensory evaluation.

**Processing of raw materials** Ragi, wheat and greengram were subjected to various processing methods like soaking, germination, drying, roasting and boiling. The process of preparation of fingermillet malt and fingermillet malt beverage are indicated in Figure 1 and Figure 2.

### **Sensory evaluation of ragi malt beverage**

Sensory evaluation is conducted on a five point hedonic scale by a semi trained panel of ten judges [7].

### **Shelf-life study of ragi malt**

The microbial study was conducted for a period of 90 days as per the guidelines for both the finger millet samples kept at room and refrigerated temperatures [8], [9] & [10].

### **Statistical analysis of the data**

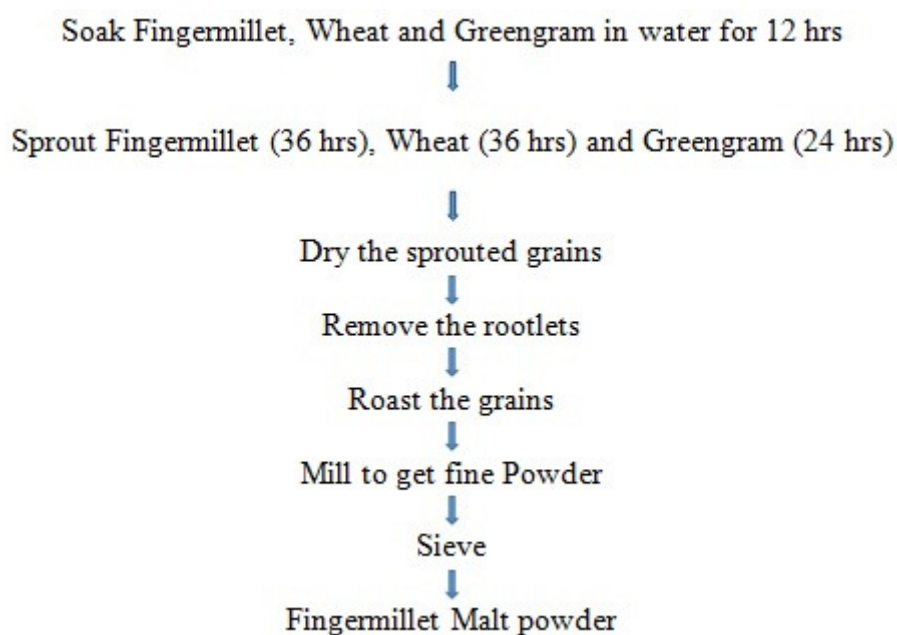
The statistical analysis of the data is done as per SPSS software [11].

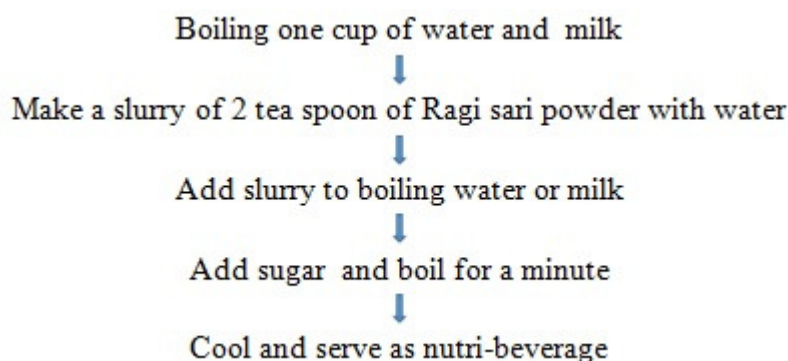
## **III. RESULTS AND DISCUSSION**

### **Preparation of finger millet malt and beverage**

The process of preparation of finger millet malt powder and malt beverage is as shown in Figure 1 and 2.

**Fig. 1: Preparation of finger millet malt powder**



**Fig. 2: Preparation of fingermillet malt beverage****Mean sensory scores of fingermillet malt stored at room and refrigerated temperature**

Fingermillet malt beverage was prepared initially and evaluated for sensory attributes such as Appearance, Consistency, Flavour and Overall acceptability. Subsequently malt was stored at room and refrigerated temperature and beverage prepared at monthly intervals upto three months and evaluated for sensory parameters. Beverage prepared initially and prepared using malt stored did not show any significant difference between room temperature and refrigerated samples for either appearance, consistency, flavor and overall acceptability.

**Table 1:** Sensory profile of fingermillet malt stored at room and refrigerated temperature

Parameters	Storage period(months)	At Room Temperature	At Refrigerated Temperature	'F' Value
Appearance	0	4.80	4.80	0.00 <sup>NS</sup>
	1	4.30	4.30	0.00 <sup>NS</sup>
	2	3.60	4.00	1.16 <sup>NS</sup>
	3	3.60	3.60	0.00 <sup>NS</sup>
Consistency	0	4.30	4.30	0.00 <sup>NS</sup>
	1	3.90	3.80	0.14 <sup>NS</sup>
	2	3.50	3.50	0.00 <sup>NS</sup>
	3	3.50	3.30	0.34 <sup>NS</sup>
Flavour	0	4.50	4.50	0.00 <sup>NS</sup>
	1	4.20	4.10	0.06 <sup>NS</sup>
	2	3.90	4.00	0.08 <sup>NS</sup>
	3	3.60	3.70	0.09 <sup>NS</sup>
Overall	0	4.80	4.80	0.00 <sup>NS</sup>
Acceptability	1	4.10	4.20	0.06 <sup>NS</sup>
	2	4.00	4.10	0.08 <sup>NS</sup>
	3	3.90	3.90	0.00 <sup>NS</sup>

Maximum Score – 5, NS-Non Significant

### Nutritional components of fingermillet malt (per 100g)

The nutritional profile of fingermillet malt is indicated in Table 2. It was observed that the protein content was adequate with low fat. The micronutrients like calcium (193mg) and phosphorous (268mg) were found to be high with good amount of carbohydrate (79g) and energy (365Kcal). The processing techniques like malting, aid in increasing the bioavailability of nutrients. It was observed that malted samples of Foxtailmillet (*Setaria italica*) had higher carbohydrate and energy values. Starch digestibility (42.4%) and protein digestibility (13.2%) [12].

It was also indicated that the nutritional quality of both roller dried proprietary weaning food and malted weaning food were comparable [13].

**Table 2: Nutritional profile of fingermillet malt (per 100g)**

Nutrients	Per 100g
Moisture(%)	6.2
Protein(g)	8.9
Fat(g)	1.5
Ash(g)	1.9
Crude Fibre(g)	2.6
Carbohydrate(g)	79.0
Energy (Kcal)	365.0
Calcium(mg)	193.0
Phosporous (mg)	268.0
Iron (mg)	5.2

### Nutritive component of fingermillet malt stored at room and refrigerated temperature (per 100g)

The results as depicted in Table 3 revealed that moisture and protein content showed significant difference between room and refrigerated samples. Non-significant difference was found in fat and carbohydrate content between room and refrigerated temperatures. However, significant difference between 0-3months at room temperature with respect to crude fibre, energy, calcium, phosphorous and iron was found at 5 per cent level.

Malt stored at refrigerated temperature showed significant difference at 5 per cent level between 0-3 months for moisture, protein, ash, calcium, phosphorous and iron. However, non-significant difference was found with respect to carbohydrate and energy.

**Table 3: Nutritive components of fingermillet malt stored at room and refrigerated temperature (per 100g)\*\***

Storage Period (months)	Moisture(%)		Protein(g)		Fat(g)		Ash(g)		Crude Fibre(g)		Carbo-hydrate(g)		Energy (Kcal)		Calcium (mg)		Phos-Phorous (mg)		Iron (mg)	
	Rm	Rf	Rm	Rf	Rm	Rf	Rm	Rf	Rm	Rf	Rm	Rf	Rm	Rf	Rm	Rf	Rm	Rf	Rm	Rf
<b>0 (Initial Reading)</b>	6.2	6.2	8.9	9.0	1.5	1.4	1.9	2.1	2.6	3.0	79.0	78.0	365	361	193	170	268	274	5.2	5.6
<b>1</b>	6.4	6.5	8.7	9.0	1.4	1.5	2.2	2.2	2.6	3.1	79.0	78.7	363	362	170	169	267	271	5.0	5.4
<b>2</b>	6.7	6.7	8.5	9.0	1.5	1.5	2.3	1.9	2.5	2.9	79.0	78.0	364	362	169	146	261	268	4.4	4.4
<b>3</b>	6.8	6.9	7.8	8.7	1.4	1.4	1.9	1.9	2.4	2.9	80.0	78.0	364	359	159	126	253	266	4.2	4.3
SEM $\pm$	0.015		1.500		0.012		0.012		0.015		1.250		1.750		2.000		1.75		0.017	
CD	0.042		0.041		0.034		0.034		0.041		3.43		4.80		5.480		4.80		0.048	
<b>F-Value</b>																				
Between Room and Refrigerated temperature	13.0*		32.8*		0.4 <sup>NS</sup>		4.2*		15.16*		1.4 <sup>NS</sup>		6.0*		177.4*		77.0*		59.0*	
Between 0 to 3 months (Room temperature)	0.04 <sup>NS</sup>		54.0*		0.0 <sup>NS</sup>		0.8 <sup>NS</sup>		54.0*		5.0 <sup>NS</sup>		20.6*		200.0*		128.6*		11.6*	
Between 0 to 3 months (Refrigerated temperature)	17.4*		25.8*		0.5 <sup>NS</sup>		5.3*		2.2 <sup>NS</sup>		0.2 <sup>NS</sup>		1.1 <sup>NS</sup>		170.0*		59.8*		74.8*	

Rm - Room temperature Rf : Refrigerated temperature \* - Significant at 5 % level, NS –Non-significant

\*\* - Values are average of three determinations



### Microbial counts of fingermillet malt stored at room and refrigerated temperature

The microbial counts of fingermillet malt stored at room and refrigerated temperature are depicted in Table 4. When fingermillet malt was studied as fresh samples for microbial count, sample did not contain coliform count, yeast and mould count. However, subsequently on storage both at room and refrigerated temperature samples did not show any microbial counts with respect to coliform, yeast and mould.

Initially, total bacterial count was  $1.27 \times 10^3$  and slightly increased on storage. Comparatively, lesser counts for bacteria were observed in samples stored at refrigerated temperature. Samples stored at room and refrigerated temperature and between 0-3 months at refrigerated temperature showed significant difference at 5 per cent level. However, between 0-3 months at room temperature was non-significant.

**Table 4: Microbial counts of fingermillet malt stored at room and refrigerated temperature**

Product	Storage period (months)	Coliform Count	Total Bacterial Count	Yeast and Mould Count
Fingermillet malt(Room temperature)	0	ND	$1.27 \times 10^3$	ND
	1	ND	$1.35 \times 10^3$	ND
	2	ND	$1.49 \times 10^3$	ND
	3	ND	$1.60 \times 10^3$	ND
	0	ND	$1.27 \times 10^3$	ND
Fingermillet malt(Refrigerated temperature)	1	ND	$1.30 \times 10^3$	ND
	2	ND	$1.45 \times 10^3$	ND
	3	ND	$1.54 \times 10^3$	ND
SEm±		-	2650	-
CD		-	7271	-
<b>'F' value</b> <b>Between Room and Refrigerated Temperature</b> <b>Between 0-3 months(Room Temperature )</b> <b>Between 0-3 months (Refrigerated Temperature)</b>	-	-	21.7*	-
	-	-	2.1 <sup>NS</sup>	-
	-	-	28.2*	-

ND – Not detectable (Total number of colonies per count was less than 30)

\*Significant at 5%level

NS-Non-significant

#### IV. CONCLUSION

Fingermillet malt is one of the nutriproduct that can substitute regular beverages in our daily dietary habits. It is a powerhouse of good quality macronutrients like protein, carbohydrate and micronutrients such as calcium and phosphorous with adequate fibre. Hence it can be a good nutrifood for all age groups like infants, pre-school, school children, adolescents, adults and geriatrics too.

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