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# Development of foxtail millet incorporated breakfast recipes and their comparison with traditional recipes made of cereals

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### Abstract

Foxtail millet (botanic name *Setaria italica*) is the second-most widely planted species of millet, and the most important in East Asia have not gain much importance in diet despite their nutritive value and therapeutic use. In this study efforts have been made to develop products like idly, dosa and upma by replacing the rice rawa and the wheat rawa in the recipe with foxtail millet rawa respectively. The study was aimed with objectives of developing products with foxtail millet rawa and their comparison with the traditional recipes of idly, dosa and upma, for their overall acceptability and evaluation of the organoleptic characteristics which was done by 10 semi-trained panelists and also the comparison of the three rawa in terms of their nutritional composition. Gluten content was determined by the method detailed in AACC (2000) method No.38-10. The study revealed that foxtail millet can be easily replaced and (or) incorporated in the local and common recipes for its greater utilization because of its health benefits and therapeutic use.

**Keywords:** Foxtail millet, Gluten free, product development

### 1. Introduction

Millets are the cereals besides the major crops like wheat, rice, and maize, and are often termed as dryland-cereals. They are major food sources for millions of people, especially those residing in hot and arid regions of the world. Because of their ability to grow under harsh weather conditions they provide food security in many under developed and developing countries. As they require low or no purchased inputs, they are backbone for dry land agriculture. As millets are gluten-free, are high in protein and antioxidants, and have a low glycemic index, which can help preventing or managing diabetes they are termed as nutri-cereals.

In 2007, global millet production reached about 32 million tonnes with India (10,610,000) being the largest producer (FAO, 2009) [8]. Millets may encompass a diverse group of cereals that include pearl, proso, foxtail, barnyard, little, kodo, browntop, finger and Guinea millets, sorghum (or great millet) and teff. The genetic diversity of millets offers opportunities for economic development through income generating activities in the food sector and in professional applications such as therapeutics and pharmaceuticals. The importance of millets as a staple food has declined with the rising incomes of people and urbanization in last few decades.

Foxtail millet (*Setaria italica*) is the second-most widely planted species of millet, and the most important in East Asia. Other names for foxtail millet include Italian millet, German millet, Chinese millet, and Hungarian millet, Korralu (Telugu), Navane (Kannada), and Thanai (Tamil). Among millets it has the longest history of cultivation and being grown in China ever since sixth millennium BC.

Millets are very nutritious and are reported to have various therapeutic functions (Obilana and Manyasa, 2002; Yang *et al.*, 2012) [12, 15]. Millets are superior over cereals because they are rich in calcium, dietary fiber, polyphenols and protein (Devi *et al.*, 2011) [7]. Millets generally contain significant amounts of essential amino acids particularly the sulphur containing amino acids (methionine and cysteine); they are also higher in fat content than maize, rice, and sorghum (Obilana and Manyasa, 2002) [12].

Magnesium and phosphorus are present in good amounts in millets therefore help in reduce the effects of migraine and heart attacks (due to Magnesium) while, phosphorus is an essential component of adenosine triphosphate (ATP) a precursor to energy in the body (Badau *et al.*, 2005; Liang *et al.*, 2010; Devi *et al.*, 2011) <sup>[4, 11, 7]</sup>.

The work of Liang *et al.* (2010) <sup>[11]</sup> presented the general properties of foxtail millet oil and its fatty acid profile. It is apparent that millet oil could be a good source of natural oil rich in linoleic acid and tocopherols (Liang *et al.*, 2010; Amadou *et al.*, 2011) <sup>[11, 2]</sup>. Foxtail millet as a low GI food product leads to modest improvement in long-term glycemic and lipidemic control in type 2 diabetics (Thathola *et al.*, 2005) <sup>[14]</sup>.

Millets are more than just an alternative to common grains. They have beneficial health effects. Millets are rich in phytochemicals, including phytic acid, which is believed to lower cholesterol, and phytate, which is associated with reduced cancer risk (Coulibaly *et al.*, 2011) <sup>[6]</sup>. Millet is gluten-free, therefore an excellent option for people suffering from celiac diseases often irritated by the gluten content of wheat and other more common cereal grains. It is also useful for people who are suffering from atherosclerosis and diabetic heart disease (Gélinas *et al.*, 2008) <sup>[9]</sup>. Choi *et al.* (2005) <sup>[5]</sup> and Park *et al.* (2008) <sup>[13]</sup> reported that “protein concentrate of Korean foxtail millet and proso millet significantly elevated plasma adiponectin and HDL cholesterol levels and caused major decreases in insulin levels relative to a casein diet in type 2 diabetic mice.” Free radical quenching potential of

different millets kodo millet, finger millet, little millet, foxtail millet, barnyard millet (kudiraivali), great millet (jowar) and their white varieties were revealed to have significant antioxidant activity by 1, 1, Diphenyl -2- picrylhydrazyl (DPPH) method (Devi *et al.*, 2011; Qesada *et al.*, 2011; Kamara *et al.*, 2012) <sup>[10, 7]</sup>. Moreover, Kamara *et al.* (2012) <sup>[10]</sup> reported different radical scavenging activities of fractionated foxtail millet protein hydrolysate.

In Southern India (Rayalaseema and Telangana) this is cooked like rice and a generation ago this was among the common food items of the people. Foxtail Millet is again making place in our plates as this is more healthy than rice. Hence efforts have been made to develop products in which foxtail millet can be used as a replacement for rice and wheat rawa.

## 2. Materials and Methodology

**2.1 Materials:** The raw materials wheat rawa, rice rawa and foxtail millet are procured from the local market. Foxtail millet rawa is prepared in the laboratory by cleaning, sieving and then grinding it coarsely in the grinder.

**2.2 Product development:** Three products Idly, Upma and Dosa were prepared with the normal recipe using Rice rawa (idly and dosa) and Wheat rawa (upma) and also by replacing the former with Foxtail millet rawa and subjected to sensory evaluation using a suitable scale to know the product acceptability.

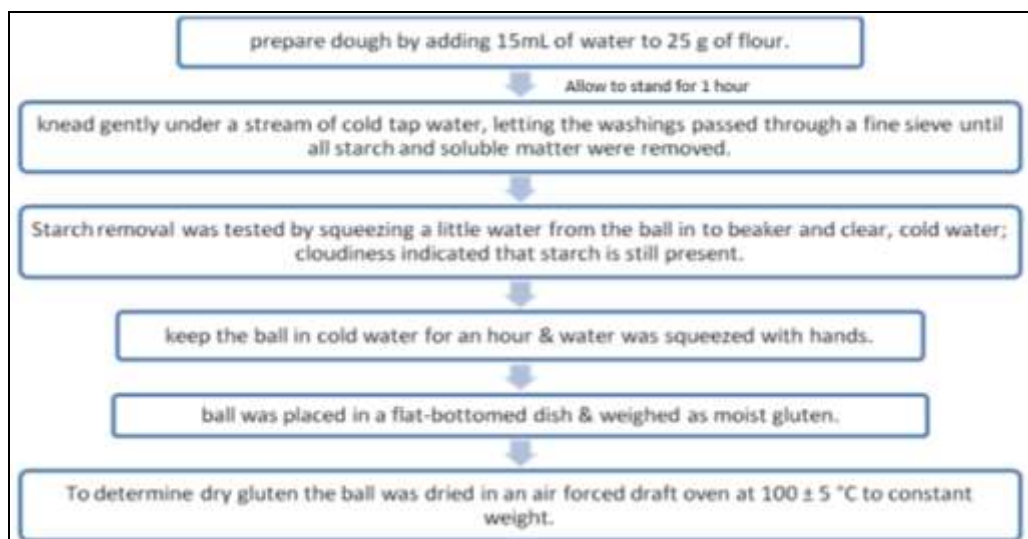
**Table 1:** Proportions of the ingredients used in different recipes

S. No.	Recipe Name	Code	Proportion of Ingredients
1	Rice Idly	RI	• Rice rava and Blackgram dal (3:1 parts)
2	Foxtail millet Idly	FI	• Foxtail rava and Blackgram dal (3:1 parts)
3	Rice Dosa	RD	• Rice rava and Blackgram dal (3:1 parts)
4	Foxtail millet Dosa:	FD	• Foxtail rava and Blackgram dal (3:1 parts)
5	Wheat (Semolina) Upma	WU	• Semolina:
6	Foxtail Millet Upma:	FU	• Foxtail millet: 120 gm

**2.3 Sensory evaluation:** A semi-trained panel of 10 judges has evaluated the six products, two idly products of which one product was prepared using rice rawa and another with foxtail millet rawa; two dosa products of which one product was prepared using rice rawa and another with foxtail millet rawa and two upma products of which one product was prepared using wheat rawa and another with foxtail millet rawa. The products were evaluated for colour (20), texture (30), taste (30), aroma (10), absence of defects (10) using composite scoring method with a total score of 100. Based on the total score obtained products were evaluated for their overall acceptability using a five point scale i.e., Excellent= 80-100, very good = 60-80, good = 40-60, fair = 20-40 and poor = 0-

20. Samples were coded using random three-digit numbers. Panelists were provided with a glass of water and instructed to rinse and swallow water between samples.

**2.4 Gluten estimation:** Gluten is a protein composite of gliadin and glutenin, found in wheat and related grains conjoined with starch in the endosperm. Gluten gives elasticity to dough, helping it rise and keeps its shape and often gives the final product a chewy texture. Being insoluble in water, they can be purified by washing away the associated starch. Gluten content of wheat, rice and foxtail millet rawa samples was determined by the AACC (2000) method No.38-10.



**Fig 1:** Gluten estimation AACC (2000) method No.38-10.

### 3. Results and Discussion

The nutrient profile comparison of wheat, rice and foxtail millet is given in Table 1. The table shows that Foxtail millet has the highest amount of energy (361g), protein (12.3g) and fat (4.3g) as compared to rice and wheat. Rice has the highest amount of carbohydrate (78.2g). While the fiber (12.2 g), iron

(5.3 g), calcium (41g) and phosphorous (306 mg) content is highest in Wheat. However, less than wheat, foxtail millet has a good amount of fiber, ash, iron, calcium and phosphorous as compared to rice. Thus, it makes foxtail millet a healthy option compared to rice.

**Table 1:** Nutrient Profile Comparison

Component (per 100g portion, raw grain)	Wheat	Rice	Foxtail millet
Energy(Kcal)	346	345	361
protein (g)	11.8	6.8	12.3
fat (g)	1.5	0.5	4.3
carbohydrates (g)	71.2	78.2	60.9
fiber (g)	12.2	0.2	8
Ash	1.5	0.6	3.3
iron (mg)	5.3	0.7	2.8
calcium (mg)	41	10	31
Phosphorous (mg)	306	160	290

**Source:** Nutritive value of Indian foods

**3.1 Sensory evaluation:** A panel of 10 semi-trained panelists was given the six food samples for evaluation of organoleptic characteristics *viz.* colour, texture, aroma, taste, absence of defects and overall acceptability. Table 2 shows the average score given by the judges.

The mean scores of sensory evaluation showed that the overall acceptability of the idly prepared with rice had the highest score ( $89.3 \pm 8.87$ ) followed by rice dosa ( $87.1 \pm 9.09$ ). The upma prepared with wheat rawa had the highest score in colour ( $17.8 \pm 1.87$ ), rice idly had the highest score for texture ( $7.26 \pm 0.79$ ), aroma ( $9.2 \pm 1.31$ ) and taste ( $27.6 \pm 3.31$ ). Rice dosa had the highest score ( $8.9 \pm 1.37$ ) for absence of

defects. All the products prepared were within the acceptable range. No significant difference was observed in any of the characteristics and overall acceptability of wheat and foxtail millet upma, which means it is totally acceptable. However, no significant difference was observed between any of the organoleptic characteristics of rice and foxtail millet rawa idly, but a significant difference was observed between the overall acceptability of the two products. No significant difference was observed between overall acceptability and other organoleptic characteristics except the taste of dosa made by rice rawa and foxtail millet.

**Table 2:** Mean Sensory Scores (Mean  $\pm$  SD)

Product	Colour	Texture	Aroma	Taste	Absence of defects	Overall Acceptability
F. Upma	17.6 $\pm$ 1.96	25.4 $\pm$ 4.99	8.4 $\pm$ 1.96	24.7 $\pm$ 4.69	7.9 $\pm$ 2.37	82.6 $\pm$ 14.62
W. Upma	17.8 $\pm$ 1.87	25.6 $\pm$ 2.83	8.6 $\pm$ 1.43	24.8 $\pm$ 4.16	8.0 $\pm$ 1.83	84.1 $\pm$ 10.92
t-value	-0.23 <sup>NS</sup>	-0.11 <sup>NS</sup>	-0.26 <sup>NS</sup>	-0.05 <sup>NS</sup>	-0.11 <sup>NS</sup>	-0.25 <sup>NS</sup>
F. Idly	14.2 $\pm$ 3.85	22.8 $\pm$ 6.87	8.3 $\pm$ 2.13	24.1 $\pm$ 4.42	7.8 $\pm$ 1.40	76.6 $\pm$ 15.29
R. Idly	17.7 $\pm$ 2.26	26.5 $\pm$ 3.17	9.2 $\pm$ 1.31	27.6 $\pm$ 3.31	8.3 $\pm$ 1.25	89.3 $\pm$ 8.87
t-value	-2.47 <sup>NS</sup>	-1.54 <sup>NS</sup>	-1.13 <sup>NS</sup>	-2.00 <sup>NS</sup>	-0.84 <sup>NS</sup>	-2.27*
R. Dosa	15.8 $\pm$ 4.10	26.4 $\pm$ 2.99	8.5 $\pm$ 1.18	27.2 $\pm$ 2.04	8.9 $\pm$ 1.37	87.1 $\pm$ 9.09
F. Dosa	14.3 $\pm$ 4.16	23.2 $\pm$ 6.27	7.1 $\pm$ 1.79	22.3 $\pm$ 5.48	7.2 $\pm$ 2.34	74.6 $\pm$ 17.95
t-value	0.81 <sup>NS</sup>	1.41 <sup>NS</sup>	2.06 <sup>NS</sup>	2.64*	1.98 <sup>NS</sup>	1.96 <sup>NS</sup>

R=Rice rawa; F= Foxtail millet rawa; W= wheat rawa

\*95% CI ( $p < 0.05$ ), NS-Not Significant

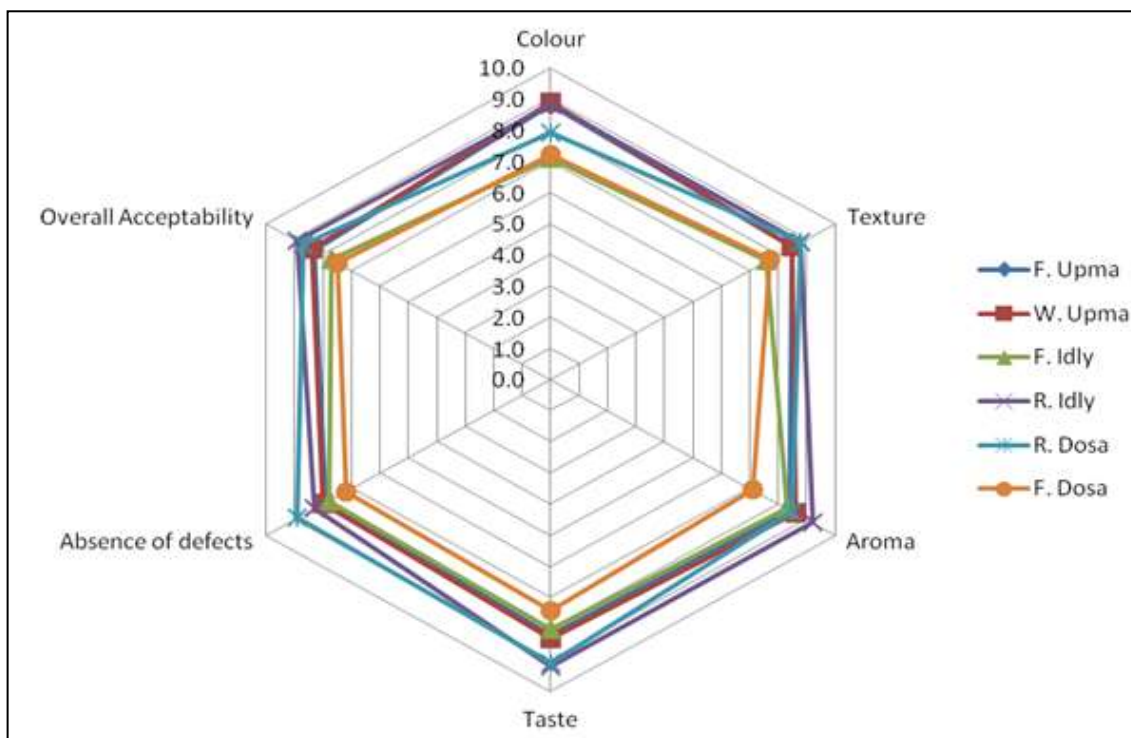


Fig 2: Sensory Scores

A certain peculiar taste and light yellow color of foxtail rawa products as compared to white colour of rice products were the reason for lower acceptability of idly and taste of dosa prepared with foxtail millet. A slight change in proportion of foxtail millet might help. However no significant difference was observed in the overall acceptability of two types of upma.

**3.2 Determination of Gluten:** Wet and dry gluten contents in different flour samples were determined by hand wash method as detailed in AACC (2000) method No.38-10.

$$\text{gluten \% (on dry basis)} = \frac{10,000 \times (W2 - W1)}{W(100 - M)}$$

Where, W2 = weight (g) of dish with dry gluten

W2= weight (g) of empty dish

W= weight (g) of material taken

M = moisture % in sample

The gluten% (on dry basis) was calculated as 8.15% in wheat rawa. Whereas gluten was absent in rice rawa and wheat rawa. Being gluten free foxtail millet is a good option for people with glucose intolerance as compared to rice.

#### 4. Conclusion

All the three products (upma, idly and dosa) prepared using foxtail millet were within the acceptable range. Upma prepared using Foxtail was liked equally as by the wheat rawa. A slight difference in the proportion of foxtail millet, also not completely avoiding the rice rawa in in recipe of idli and dosa could increase the overall acceptability of products. The use of foxtail millet in local and common recipes would greatly enhance the utilization of this crop in developing countries for therapeutic purpose. The nutritional quality of rice and wheat rawa products like idly, dosa, upma etc could be improved with incorporation of foxtail millet. Being a low GI, high fiber and gluten free food it is beneficial for the

diabetic, obese and cardiovascular, and gluten intolerant people respectively. As it is a calorie dense and protein rich food it is also useful for undernourished. Despite of the local and easy availability and numerous health benefits it still has not gain that much popularity to make its place in the plate of a common man.

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