

# Formulation and Shelflife Evaluation of Kodo Millet Incorporated Ready to Cook Mixes

A. Mohana Vidhya\* and M. Roobhadevi

Department of Foods and Nutrition, Vellalar College for Women, Erode, Tamil Nadu, India;  
suprithahari2009@gmail.com

## Abstract

Minor millets are recognized as important substitute for major cereal crops to cope up with worldwide food shortage and to meet the demand of increasing population of both developing and developed countries [1]. Kodo millet is highly nutritious but has received little attention in terms of product utilization. Supplementation of millets in cereal based products have become increasingly popular due to nutritional and economic advantages. They are considered as a shield against nutritional deficiency disorder and provide nutritional security [2]. Hence the present study was done to formulate and standardize ready to cook mixes with incorporation of kodo millet at 10%, 20% and 30% respectively and to assess the shelf life of formulated ready to cook mixes. Results showed that recipes prepared out of ready to cook mixes with incorporation of kodo millet was highly acceptable. Shelf life evaluation showed that microbial load was within safe limit in the kodo millet incorporated ready to cook mixes upto 45 days.

**Keywords:** Convenience Food, Formulation, Kodo Millet Flour, Shelf Life Evaluation, Value Addition

## 1. Introduction

Minor millets are the staple food of the poor farmers and agricultural labourers. Millets are used to substitute to wheat and rice due to good functional properties in food application, high nutritional quality and abundant availability [3]. Apart from value addition by processing to traditional products from these grains, development of newer products offers variety, convenience, quality, cost efficiency and scope for increasing the nutritive value. Kodo millet is rich in phenolics, tannins and phytates which act as an antioxidant [4]. The beneficial role of millet based diet is to protect the body against oxidative stress and maintaining blood glucose level in Type II diabetes mellitus[5].

Nutritious, variety and taste are the key trends in the convenience food segment. The growth in the consumption

of convenience foods is due to several socioeconomic developments. One main factor is the change in lifestyle which has come in recent years due to higher disposable incomes, also the popularity of Indian cuisine is spreading globally and as such the international markets are also showing good demand for such foods [6]. The fibre content of kodo millet is very high. Kodo millet has around 11% protein and the nutritive value of protein has been found to be comparable of other small millets. As with other food grains, the nutritive value of kodo millet protein could be improved by supplementation with legume protein [7].

So, based on all these facts, the present study was undertaken to formulate and standardize ready to cook mixes with incorporation of kodo millet and organoleptically evaluate the recipes prepared out of ready to cook mixes and to assess the shelf life of formulated ready to cook mixes.

\*Author for correspondence

## 2. Materials and Methods

Good quality kodo millet was procured from Agricultural University, Coimbatore. Kodo millet was processed to flour by various steps viz, cleaning, winnowing, soaking in cold water for 24 hours, steaming for 20 minutes, drying and milling. The processed millet flour was analysed for crude fibre, iron, phosphorus, moisture, protein and calcium contents by standard methods [8]. The prepared kodo millet flour was used in the formulation of ready to cook mixes at 10%, 20% and 30% level.

### 2.1 Preparation of Standard Ready to Cook Mixes

Various ready to cook mixes such as Weaning mix, Murukku mix, Sevai mix, Adai mix and Dosa mix were prepared. The ingredients used for the formulation are as follows.

- Weaning mix  
Weaning mix was prepared using ragi, bajra, wheat, rice, maize, groundnut, almond, elachi, roasted bengalgram and jaggery.
- Murukku mix  
Ingredients such as parboiled rice, raw rice, Bengalgram dhal, black gram and dry chillies were used in the preparation of murukku mix
- Sevai mix  
In the preparation of sevai mix, rice and salt were used.
- Adai mix  
Adai mix were prepared using rice flour, greengram, redgram dhal, blackgram dhal, Bengalgram dhal, curry leaves, dry chillies and cumin seeds.
- Dosa mix  
Wheatflour and salt were used in the preparation of dosa mix.

### 2.2 Variations of Kodo Millet Incorporation

- Instead of rice, kodo millet was incorporated at 10%, 20% and 30% levels in the preparation of weaning mix, murukku mix, adai mix and sevai mix.
- Instead of wheat, kodo millet was incorporated at 10%, 20% and 30% levels in the preparation of dosa mix.

By using ready to cook mixes, various recipes such as Nutrient ball, Murukku, Sevai, Adai and Dosa were developed by standard procedures and subjected to sensory evaluation. For organoleptic evaluation, five-point numerical scoring test were used to sense the parameters like colour, texture, taste, flavor and appearance of food products with the help of 20 semi trained panel members. Contribution of nutrients in the prepared ready to cook mixes (highly accepted) was calculated per 100g using Nutritive Value of Indian Foods, ICMR [9]. Ready to cook mixes were stored in plastic airtight containers and tested for their microbial load at initial, 15<sup>th</sup>, 30<sup>th</sup> and 45<sup>th</sup> day of storage. The data obtained was analysed statistically by t-test.

## 3. Results and Discussion

### 3.1 Nutrient Content of Kodo Millet Flour

The processed kodo millet flour contains 9.7g protein, 34.3mg calcium, 173 mg phosphorus, 0.6mg iron and 10g of fibre per 100g. The moisture content was found to be 12%.

### 3.2 Organoleptic Evaluation of Formulated Products

Quality has been defined as degree of excellence and includes such things as taste, appearance and nutritional content. We might also say that quality is the composite of characteristics that have significance and make acceptability. Acceptability however, can be highly subjective [10]. The mean scores for acceptability of various recipes prepared using ready to cook mixes are given in Tables 1 & 2.

From the Table 1 it was revealed that 30 per cent kodo millet incorporated nutrient ball received a maximum score of 5 for colour and the highest score 4.8 were recorded for texture. The mean overall acceptability scores for nutrient ball prepared with 10, 20 and 30 per cent level of incorporation of kodo millet flour were 4.7, 4.5 and 4.9 respectively. Among the varying level of incorporation of kodo millet flour, 30 per cent level of incorporation was highly acceptable. Statistical results inferred that there was a no significant difference between standard and 30 per cent kodo millet incorporated nutrient ball.

Regarding murukku, highest score was obtained for colour (4.6) and texture (4.9) prepared with 10 per cent level of kodo millet flour incorporation. The mean overall acceptability score of murukku prepared with 10 per cent kodo millet flour incorporation was similar to that of

**Table 1.** Mean scores for acceptability of nutrient ball and murukku

Organoleptic characteristics	Nutrient ball				Murukku			
	Level of Kodo millet Incorporation				Level of Kodo millet Incorporation			
	Std (a)	10% (b)	20% (c)	30% (d)	Std (a)	10% (b)	20% (c)	30% (d)
Appearance	4.7	4.9	4.4	4.9	4.7	4.9	4.3	4.5
Colour	4.9	4.4	4.4	5.0	4.7	4.6	3.9	4.6
Flavour	4.7	4.7	4.7	4.9	4.7	4.9	4.3	4.8
Texture	4.9	4.6	4.6	4.8	4.7	4.6	4.3	4.9
Taste	4.8	4.8	4.5	4.9	4.9	4.85	4.2	4.7
Mean Overall acceptability scores	4.81	4.7	4.54	4.96	4.7	4.77	4.2	4.74
Groups compared		a & b	a & c	a & d		a & b	a & c	a & d
t' value		1.04	2.896*	0.16		0.156	6.24*	0.47
Level of significance		NS	5%	NS		NS	5%	NS

**Table 2.** Mean scores for acceptability of sevai and dosai

Organoleptic characteristics	Sevai				Dosai			
	Level of Kodo millet Incorporation				Level of Kodo millet Incorporation			
	Std (a)	10% (b)	20% (c)	30% (d)	Std (a)	10% (b)	20% (c)	30% (d)
Appearance	4.8	4.7	4.6	4.6	5.0	5.0	5.0	4.9
Colour	4.8	4.6	4.6	4.6	5.0	5.0	5.0	4.9
Flavour	4.8	4.9	4.8	4.7	5.0	4.9	5.0	5.0
Texture	4.6	4.6	4.6	4.5	5.0	5.0	5.0	4.9
Taste	4.8	4.7	4.6	4.5	5.0	5.0	5.0	4.9
Mean Overall acceptability Scores	4.7	4.7	4.6	4.6	5.0	4.9	5.0	4.9
Groups compared		a & b	a & c	a & d		a & b	a & c	a & d
t' value		0.399	1.142	1.598		0	0	0
Level of significance		NS	NS	NS		NS	NS	NS

standard and it was found to be 4.7. Statistical results inferred that there was no significant difference between standard and 10 per cent kodo millet flour incorporated murukku.

The mean scores obtained through organoleptic evaluation of sevai and dosai prepared using ready to cook mix were depicted in Table 2. In case of colour, flavor and texture, highest score of about 4.6, 4.9, 4.6 was recorded for 10 per cent kodo millet incorporated sevai. The scores for colour and texture is slightly low, it may be due to darker colour and grainy feel of the kodo millet. Among the varying level of incorporation of kodo millet flour in sevai mix, 10 per cent level of incorporation was highly rated. Statistical results inferred that there was no significant difference between standard and 10 per cent kodo millet incorporated sevai.

Regarding dosai, 20% kodo millet incorporated dosai received a highest score similar to that of standard for all the criteria evaluated organoleptically. Hence it was highly acceptable. There is a slight difference in the acceptability of 10 and 20 per cent kodo millet incorporated dosa. Statistical analysis revealed that there was a no significant difference between standard and all the variations of kodo millet incorporated dosai.

### 3.3 Adai

Both standard and all the variations of kodo millet incorporated adai received a maximum score (5) for all the criteria such as appearance, colour, flavor, texture and taste used for organoleptic evaluation. Hence all the formulated products were found to be highly acceptable.

### 3.4 Comparison of Nutrients in Ready to Cook Mixes

Nutrient content of the standard and highly acceptable kodo millet incorporated ready to cook mixes such as Weaning mix, Murukku mix, Adai mix, Sevai mix and Dosa mix were calculated with the help of ingredients used in the preparation of ready to cook mixes per 100g and it was compared and its percentage loss or gain were found out. It is given in Tables 3 and 4.

### 3.5 KMF- Kodo Millet Flour

It was revealed that there was a decrease in energy and carbohydrate contents in the kodo millet flour incorporated weaning mix and murukku mix. A slight decrease in phosphorus and iron content was noted in murukku mix and weaning mix. All the other nutrients such as protein, fibre and calcium content were increased in both weaning and murukku mix.

On comparing the nutrients in standard and kodo millet incorporated sevai mix, the nutrients such as protein, phosphorus, fibre and calcium contents were increased and a loss in energy and carbohydrate contents were observed.

Regarding dosa mix, fibre content was increased to as much as 75 per cent in 20% kodo millet incorporated dosa mix, as the fibre content of kodo millet was very high.

In adai mix, only a slight increase in fibre, calcium, phosphorus contents were found and the protein and iron contents remains the same for both standard and kodo millet incorporated adai mix.

### 3.6 Microbial Load

Microbial load of standard and highly acceptable ready to cook mixes evaluated at regular intervals for a period of 45 days is depicted in Table 5.

**Table 3.** Comparison of nutrients between standard and kodo millet incorporated weaning mix and murukku mix

Nutrients	Std Weaning Mix	30% KMF Weaning Mix	Percent increase/decrease	Std Murukku Mix	10% KMF Murukku Mix	Percent increase/decrease
Energy (k.cal)	362.9	333.9	-7.99	385	381	-1.0
Protein (g)	9.98	10.18	+ 2.0	10.85	10.85	-
Carbohydrate(g)	70.5	69.4	-1.56	70.3	70.1	-0.28
Iron (mg)	2.6	1.92	-23.0	1.83	1.76	- 3.82
Phosphorus(mg)	235.8	239.6	+1.61	215.5	217.3	- 0.83
Fibre (g)	1.15	1.84	+60	1.24	1.44	+16.12
Calcium(mg)	53.8	55.3	+2.7	65.7	66.5	+1.21

**Table 4.** Comparison of nutrients between standard and kodo millet incorporated sevai mix, dosa mix and adai mix

Nutrients	Std Sevai Mix	10% KMF Sevai Mix	Percent Increase/decrease	Std Dosa Mix	20% KMF Dosa Mix	Percent increase/decrease	Std Adai Mix	30% KMF Adai Mix	Percent Increase/decrease
Energy (k.cal)	346	342.3	-1.06	366	362.2	-1.28	754.6	751.6	-0.39
Protein (g)	6.4	6.5	+1.56	11.5	10.77	-6.95	59.9	59.9	-
Carbohydrate (g)	79	77.6	-1.77	666	65.62	-0.66	2890	2889	-0.3
Iron (mg)	1.0	0.95	-5	4.6	3.8	-4.34	40.1	40.1	-
Phosphorus (mg)	143	147.5	+3.14	337	307.6	-8.9	2763	2766	+0.12
Fibre (g)	0.2	1.08	+440	1.80	3.16	+75	84.45	85.1	+0.76
Calcium (mg)	9	10.8	+20	45.6	41.83	-8.3	2613	2614	+0.05

**Table 5.** Microbial count of ready to cook mixes

Ready to cook mixes	Bacterial count (cfu/g)			
	Initial	15 <sup>th</sup> day	30 <sup>th</sup> day	45 <sup>th</sup> day
Weaning mix	3X10 <sup>6</sup>	4X10 <sup>6</sup>	4X10 <sup>6</sup>	5X10 <sup>6</sup>
Standard 30% KMF	3X10 <sup>6</sup>	4X10 <sup>6</sup>	5X10 <sup>6</sup>	5X10 <sup>6</sup>
Adai mix	3X10 <sup>6</sup>	3X10 <sup>6</sup>	4X10 <sup>6</sup>	5x10 <sup>6</sup>
Standard 30% KMF	4X10 <sup>6</sup>	5X10 <sup>6</sup>	6X10 <sup>6</sup>	6X10 <sup>6</sup>
Murukku mix	1X10 <sup>6</sup>	2X10 <sup>6</sup>	2X10 <sup>6</sup>	2X10 <sup>6</sup>
Standard 10% KMF	1X10 <sup>6</sup>	2X10 <sup>6</sup>	2X10 <sup>6</sup>	2X10 <sup>6</sup>
Sevai mix	1X10 <sup>6</sup>	1X10 <sup>6</sup>	2X10 <sup>6</sup>	2X10 <sup>6</sup>
Standard 10% KMF	1X10 <sup>6</sup>	3X10 <sup>6</sup>	4X10 <sup>6</sup>	6X10 <sup>6</sup>
DosaMix	5X10 <sup>6</sup>	7X10 <sup>6</sup>	8X10 <sup>6</sup>	9X10 <sup>6</sup>
Standard 20% KMF	5X10 <sup>6</sup>	6X10 <sup>6</sup>	7X10 <sup>6</sup>	8X10 <sup>6</sup>

It was noted that at the initial stage, the colony formation (streptococci.sp) was very low in all the ready to cook mixes and there was a slight increase in the bacterial count at the 45<sup>th</sup> day of storage, however the levels of the bacterial count was within the recommended standards.

## 4. Conclusion

It may be concluded from the above findings, that recipes such as nutrient ball and adai were highly acceptable upto 30% of kodo millet incorporation. Dosa prepared out of wheat and kodo millet was best acceptable up to 20% of kodo millet incorporation. Murukku and sevai were found to be acceptable only up to 10% of kodo millet incorporation. Ready to cook mixes prepared out of underutilized kodo millet could enhance the nutrients fibre and calcium and reduces energy and carbohydrate

contents. As a convenience food, it saves cooking time and aids in ease of preparation. On microbial analysis it was revealed that kodo millet incorporated ready to cook mixes could be effectively stored for a period of 45 days.

## 5. References

1. Sujatha R., and Josephine Immaculate J., "Evaluation of nutritive value and organoleptical changes on malted *Paspalum Scrobiculatum* L. (kodo milleti)", *Journal of Food, Nutrition and Dietetics*, vol. 2(3), p. 3, 2005.
2. Negalakshmi K., and Annete B.D., "Health benefits of millets" Souvenir, *3<sup>rd</sup> International Conference on Food Technology*, 7, 2013.
3. Parker R., *Introduction to food science*, Delmer Publication, p. 92–94, 2003.
4. Srivastara A. "Comparative study on nutritional quality of barnyard/foxtail millet kachari and traditional rice kachari", *Food Technology Abstracts*, vol. 41(5), p. 324, 2006.
5. Choi, and Osada, "Effects of dietary proteins of Korean foxtail millet on plasma adinopectin HDL- cholesterol, and insulin levels in genetically type-2 diabetic mice", *Food Technology Abstracts*, vol. 41(5), p. 106, 2006.
6. Nanditavijay, *Convenience Foods*, Food Digest, vol. 30, p.182–190, 2007.
7. Available: [www.icisrat.com](http://www.icisrat.com)
8. Raghuramulu N., Nair K.M., and Kalyanasundaram S.A. "Manual of laboratory techniques", National Institute of Nutrition, Hyderabad. 1983.
9. Gopalan C., Sastri B.V.R., and Balasubramanian S.C., *Nutritive value of Indian Foods*, NIN, 2004.
10. Potter N.N., and Hotchkiss J. H., *Food Science*, 5<sup>th</sup> Ed., CBS Publishers, New Delhi, 2005.