



Original Research Article

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Consumption Pattern and Nutritional Assessment of Minor Millets among Rural Women in Madurai District of Tamil Nadu, India

L. Senthamarai Selvi^{1*} and D. Malathi²

¹Department of Human Development and Family studies, Community Science College an Research Institute, Tamil Nadu Agricultural University, Madurai, Tamil Nadu, India

²Post Harvest Technology Centre, Agricultural Engineering College an Research Institute, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

*Corresponding author

ABSTRACT

Keywords

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The research study was conducted in Peraiyur taluk of Madurai district of Tamil Nadu to know the consumption pattern of minor millets among rural women. 120 rural women were selected from the village of Mangalrevu at Periyur taluk. Investigation on the millet consumption pattern including food habits and meal pattern, frequency of millet consumption, food expenditure pattern, frequency of millet purchase, the per capita food intake of the selected subjects in comparison with requirement, Anthropometric measurement, per capita nutrient intake of the selected subjects in comparison with RDA of the selected subjects were assessed.

Introduction

Minor millets are tiny seeds, grown throughout the world for food and fodder purpose in dry land regions of world. These were important staple foods prior to introduction of fine cereals in India. Millets are grown on about 17 million ha. with an annual production of 18 million tonnes and contribute 10 per cent to the country's food grain basket (Rao *et al.*, 2017). Millets are highly nutritious food grains. They are rich in fiber, vitamins and especially minerals like

calcium, iron, zinc and potassium. Due to their low glycemic index, millets are good for diabetic patients.

Millets play an important role in rainfed region of the country which contributes 60 percent of the total area. Especially minor millets are very rich nutrients and are minerals and resistant to drought and stress in rainfed farming. Consumption pattern of small millets was examined by using NSSO unit level data. Assam (18.82 kg/hsh/m) and Bihar (18.69 kg/hsh/m) states have highest consumption of

small millets found in all India and rural areas. Madhya Pradesh has highest area of small millets (32.4%) followed by Chhattisgarh (19.5%), Uttarakhand (8%), Maharashtra (7.8%), Gujarat (5.3%) and Tamil Nadu (3.9%). Uttarakhand has highest productivity of 1174 Kg/ha followed by Tamil Nadu (1067 Kg/ha) and Gujarat (1056 Kg/ha). Generally, these are rain fed crops grown in areas with low rainfall and thus resume greater importance for sustained agriculture and food security (Anbukkan *et al.*, 2017).

Millet is a primary crop in Tamil Nadu, Karnataka, Telungana, Himachala Pradesh and Gujarat, Hence, the distribution of millets either as a primary crop or as allied crops depends on the growing habitat and the rainfall in that region. Millets are used for human consumption in most of the developing countries but their use has been restricted to animal feed in developed countries. Indigenous products of minor millets viz., porridge, kali, pittu, malt, kolukattai and roti products possess unique inherent nutritional processing and the therapeutic qualities. Products of millets have an excellent taste and crispy texture, light and fluffy characters, superior textural quality of cooked starch and blends well with milk and milk products. Tradition and culture have preserved the significance of millet use in special occasions. Millets are nutritionally superior compared to cereals and serve as good source of protein, micronutrients and macronutrients. Minor millets contains 12-16% protein and 2-5% lipids, millets are very good sources of micronutrients such as vitamins and minerals and millets have a better amino acid profile.

Hence, millets are being utilized as a source of nutraceutical components for nutritional enrichment of processed food products to augment their proposed health benefits. Consumption of millet based diet is known to regulate plasma glucose levels on account of

its high fiber content. Further, the presence of antinutritional factors in millet based diets has been reported to reduce overall starch digestibility and thus result in lower absorbability (Kumari and Sumathi 2002).

Millets are said to possess cholesterol lowering property and thus have been linked to lowered risk of developing cardiovascular diseases (Coulibaly *et al.*, 2011).

Incorporation of millet in various low cost food formulations intended for adults and children could be used to alleviate malnutrition and other deficiency disorders and can serve as nutritionally dense value added products (Saleh *et al.*, 2013). The present investigation was carried out to know the consumption pattern of these nutritious millets in the area of Tamil Nadu.

Materials and Methods

Study area

Madurai district was selected for conducting the survey. Madurai district comprised of seven taluks namely Madurai North, Thirumangalam, Vadipatti, Usilampatti, Madurai South, Melur and Peraiyur. Of them Peraiyur taluk was selected as the study area. Peraiyur taluk holds about 75 revenue villages and among them Mangalrevu was selected for the study. One hundred and twenty rural women of Mangalrevu between the age group of 18 to 57 years were selected as the subjects. Information about type of diet and frequency of meals were collected in detailed questionnaire consists of dietary pattern.

Three days recall method

Food consumption pattern was assessed by three consecutive day recall method (Bamji *et al.*, 2009). Data was collected by interview method. A set of standardized vessels were

used to obtain estimates of the amount of raw food consumed by the selected subjects.

Food frequency pattern

Food frequency pattern are designed to obtain information about usual food consumption patterns. They provide estimates on intake over a specified time period, ranging from a week to one month. A food frequency pattern was designed for collecting the information on location and age specific foods based on the form described by ICMR (2010).

Nutrient intake and adequacy

The individual intake was calculated based on the three day recall dietary survey data. The cooked food was converted into raw ingredients.

The nutritive value was computed based on the food composition table (Gopalan *et al.*, 2004). The per cent adequacies of nutrients were computed in comparison to that of RDA suggested by ICMR (Raghuram *et al.*, 1997).

Anthropometric measurements

All the anthropometric measurements were taken following the standard techniques (WHO, 2004). Height and weight were measured to the nearest 0.1 cm and 0.5 kg, respectively, using an anthropometric rod, and standard weight scale, respectively.

Minimum waist (WC) and maximum hip (HC) circumferences and Mid Upper Arm Circumference (MUAC) were measured to the nearest 0.1 cm using a tape measure.

Three skin fold namely, triceps (TSF), sub scapular (SSF) and supra-iliac (SISF), were measured to the nearest 0.2 mm using a Harpenden skin fold calliper. The Body Mass Index (BMI) and Waist Hip Circumference

(WHR) were computed using the following standard equations.

Results and Discussion

The study was conducted to assess the millet consumption pattern and actual food and nutrient intake of the rural women by three day recall method and the results are given and discussed below

Food habits and meal pattern

All the respondents (100%) were non vegetarians. Seventy two per cent of them had no meal planning while the rest planned the meals in advance. Majority of the respondents (66%) had three meals per day with no regular time schedule (34%).

Millet consumption pattern

Table 1 provides the millet consumption details which included the most common millet consumed, preferred method of cooking, use of processed millet products, conventional millet based products preparation, preparation of millet savouries, preparation of millet sweet meat, consumption of millet based convenience foods, aptitude to purchase instant mixes, storage of millet grains and by products.

The most commonly consumed millet was found to be finger millet (30%) followed by sorghum (28%), kodo millet (17%), barnyard millet (16.7%) and pearl millet (8.3%). Boiling was the most preferred method of cooking (53%) while shallow fat frying/deep fat frying were least preferred methods (14%). Majority of the respondents used millet as a whole grains (61 %), while 39 per cent of the respondents used millet in the form of rice. The 80 per cent of the respondents used millet flour, while 5 per cent of them take in germinated form and 10 per cent used as

malted millet flour. None of them had used either popped or flaked millets. Porridge was the conventional millet based products prepared by majority of respondents (43.3%) followed by kali (16.7%), roti (11.6%), health mix (8.4%), dosa (6.6%) and dessert (3.4%). Millet was not used in the preparation of products like idli, idiyapam and paniyaram as the respondents did not have knowledge on preparation of these products. Savouries such as murukku, omapodi, karasev and pakoda were prepared with incorporation of any of the millets, the majority being sorghum consumers; however kodo millet was also used in the preparation of these products. Majority of the respondents (77.5%) prepared the Indian sweet like sweet appam exclusively from millet rice, while 10 per cent of them

used millet rice for kesari preparation and 12.5 per cent for payasam preparation. None of them had used millet for halwa preparation. As far as the consumption of millet based convenience food was concerned only 14 per cent of the respondents had consumed the sorghum biscuits as it was available in the village shops. Though instant mixes were available for purchase only 5 per cent of the respondents had the aptitude to purchase and use pittu and roti mix and 4 per cent for kali mix and adai mix. The whole grain millets were stored in gunny bags by majority of the respondents (73.4%) while the rest used earthen pots for the storage of these grains. Millet flour and malted millet flour were stored either in plastic container or polypropylene bag.

Table.1 Millet consumption pattern

S.No	Particulars	Numbers	Per cent (%)
1	Most consumed millets		
	Sorghum	34	28
	Kodo millet	20	17
	Finger millet	36	30
	Little millet	-	-
	Foxtail millet	-	-
	Pearl millet	10	8.3
	Barnyard millet	20	16.7
	Proso millet	-	-
2	Preferred method of cooking		
	Boiling	64	53
	Steaming	40	33
	Roasting	-	-
	Shallow fat frying/ deep fat frying	16	14
3	Form of use of millet		
	Whole grain	74	53
	Millet rice	56	47
4.	Millet by products		
	Millet flour	96	80
	Popped millet	-	-
	Flaked millet	-	-
	Germinated millet	6	5
	Malted millet flour	12	10
4	Conventional millet based products preparation		

	Idli	-	-
	Dosai	12	10
	Pittu	8	6.6
	Idiyapam	-	-
	Kali	20	16.7
	Porridge	52	43.3
	Paniyaram	-	-
	Roti	14	11.6
	Dessert	4	3.4
	Adai	-	-
	Health mix	10	8.4
5	Preparation of millet savouries		
	Murukku	36	30
	Omapodi	24	20
	Karasev	24	20
	Pakoda	36	30
6	Preparation of millet sweet		
	Halwa	-	-
	Kesari	12	10
	Payasam	15	12.5
	Sweet appam	93	77.5
7	Consumption of millet based convenience foods.		
	Bun	-	-
	Bread	-	-
	Biscuits	16	14
	Noodles	-	-
8	Aptitude to purchase instant mixes		
	Idli/dosa mix	-	-
	Adai mix	5	4
	Pittu mix	6	5
	Idiyapam mix	-	-
	Kali mix	5	4
	Roti mix	6	5
	Paniyaram mix	-	-
	Halwa mix	-	-
	Kesari mix	-	-
9	Storage of millet grains		
	Earthen pot	32	26.6
	Gunny bag	88	73.4
10	Storage of millet by products		
	Plastic containers	60	50
	Glass containers	-	-
	Stainless steel containers	-	-
	Polypropylene bags	60	50

Table.2 Frequency of millet consumption

Food items	Daily	W3	W2	W1	M2	M1	Occasionally	Total
Sorghum	0	0	0	34 (28)	0	86 (72)	0	120 (100)
Kodo millet	0	0	0	0	20 (17)	100 (83)	0	120 (100)
Finger millet	0	0	0	0	36 (30)	84 (70)	0	120 (100)
Little millet	0	0	0	0	0	0	120 (100)	120 (100)
Foxtail millet	0	0	0	0	0	0	120 (100)	120 (100)
Pearl millet	0	0	0	0	0	120 (100)	0	120 (100)
Barnyard millet	0	0	0	0	20 (17)	100 (83)	0	120 (100)
Proso millet	0	0	0	0	0	0	120 (100)	120 (100)

Note: Figures in parentheses indicate percentage

Table.3 Frequency of millet purchase

Food items	Daily	Weekly	Once in fortnight	Monthly	Once in six months	Annually	Occasionally	Total
Sorghum	0	34 (28)	0	86 (72)	0	0	0	120 (100)
Kodo millet	0	0	20 (17)	100 (83)	0	0	0	120 (100)
Finger millet	0	0	36 (30)	84 (70)	0	0	0	120 (100)
Little millet	0	0	0	0	0	120 (100)	0	120 (100)
Foxtail millet	0	0	0	0	0	120 (100)	0	120 (100)
Pearl millet	0	0	0	0	0	120 (100)	0	120 (100)
Barnyard millet	0	0	0	20 (17)	100 (83)	0	0	120 (100)
Proso millet	0	0	0	0	0	0	120 (100)	120 (100)

Note: Figures in parentheses indicate percentage

Table.4 Per capita nutrients intake of the selected subjects in comparison with RDA

Age group (years)	Food group	RDA	Summer		Rainy		Winter			
			N	Mean (g)	N	Mean (g)	N	Mean (g)	SE	t value
Women (SW)	Energy (K.cal)	1900	16	1525.23	16	1510.27	16	1475.06	13.78	49.77**
Women (MW)		2230	104	1692.50	104	1625	104	1618	17.42	50.99**
Women (SW)	Protein (g)	55	16	30.5	16	29.80	16	27.98	0.67	35.20**
Women (MW)		55	104	26.35	104	25.98	104	24.06	0.84	24.16**
Women (SW)	Fat (g)	40	16	20.26	16	19.73	16	19.41	0.70	20.94**
Women (MW)		50	104	25.25	104	24.70	104	24.50	0.81	29.86**
Women (SW)	Fibre (g)	25	16	13.25	16	12.88	16	12.02	0.30	29.65**
Women (MW)		25	104	12.52	104	12.12	104	11.08	0.52	66.81**
Women (SW)	Calcium (mg)	600	16	452.02	16	449.22	16	438.00	14.30	29.65**
Women (MW)		600	104	368.22	104	346.13	104	345.00	16.52	66.81**
Women (SW)	Iron (mg)	28	16	12.86	16	11.75	16	11.48	0.12	134.21**
Women (MW)		28	104	11.59	104	11.27	104	10.25	0.21	70.10**
Women (SW)	Carotene (mcg)	4800	16	2430.52	16	2418.23	16	2410.03	82.13	50.91**
Women (MW)		4800	104	2556.49	104	2548.28	104	2542.33	58.77	74.69**
Women (SW)	Thiamine (mg)	1.0	16	0.52	16	0.50	16	0.48	0.01	30.26**
Women (MW)		1.1	104	0.48	104	0.46	104	0.42	0.01	25.95**
Women (SW)	Niacin (mg)	12	16	6.26	16	6.10	16	6.98	0.16	6.95**
Women (MW)		14	104	7.28	104	7.10	104	7.00	0.21	8.29**
Women (SW)	Riboflavin (mg)	1.1	16	0.63	16	0.60	16	0.59	0.01	88.10**
Women (MW)		1.3	104	0.60	104	0.59	104	0.56	0.01	101.67**
Women (SW)	Vitamin C (mg)	40	16	21.01	16	19.22	16	19.10	1.58	17.01**
Women (MW)		40	104	20.90	104	20.50	104	19.98	1.19	25.74**

SW- Sedentary worker, MW- Moderate worker, ** significance at the p<0.01%, *significance at the p<0.05 %

Table.5 Correlation between nutrient intake and anthropometric indicators/ indices variables of the selected subjects

(N-120)

Nutrients	'r' values					
	Weight	Height	BMI	MUAC	WHR	Per cent body fat
Energy	0.36**	0.001 NS	0.359**	0.287 **	-0.277 **	0.397**
Protein	0.189*	0.167 NS	0.158 NS	0.296 **	0.294 **	0.026 NS
Fat	0.267*	-0.040 NS	0.277 **	0.206 *	0.176 **	0.253 *
Crude fibre	0.302*	-0.030 NS	0.0298*	0.240 *	-0.226 **	0.350 **
Calcium	0.058 NS	0.079 NS	0.071 NS	0.111 NS	-0.112 NS	0.365 **
Iron	0.230*	0.002 NS	0.231**	0.160NS	-0.94*	0.320**
Carotene	0.211*	-0.069 NS	0.200 *	0.206 *	-0.230**	0.275 **
Vitamin C	0.168 NS	0.043 NS	0.176 *	0.254**	-0.134 NS	0.332 **
Thiamine	0.129 NS	0.005 NS	0.129 NS	0.110 NS	--0.213*	0.121 *
Riboflavin	0.189 NS	0.005 NS	0.015 NS	0.014 NS	-0.361NS	0.122 *
Niacin	0.001 NS	-0.13 NS	0.084 NS	0.01 NS	-0.075NS	0.016 *

** Correlation is significance at the 0.01 % (2 tailed)

* Correlation is significance at the 0.05 % (2 tailed)

Table.6 Percentage of RDA met for nutrients among the selected subjects

Nutrients	25 % RDA	25-50 % RDA	50-75 % RDA	75 % RDA	Total
Energy (K.cal)	0	0	0	120 (100)	120 (100)
Protein (g)	0	64 (53)	56 (47)	0	120 (100)
Fat (g)	0	120 (100)	0	0	120 (100)
Fibre (g)	0	120 (100)	0	0	120 (100)
Calcium (mg)	0	64 (53)	40 (33)	16 (14)	120 (100)
Iron (mg)	0	120 (100)	0	0	120 (100)
Carotene (mcg)	0	120 (100)	0	0	120 (100)
Thiamine (mg)	0	120 (100)	0	0	120 (100)
Niacin (mg)	0	120 (100)	0	0	120 (100)
Riboflavin (mg)	0	120 (100)	0	0	120 (100)
Vitamin C (mg)	0	120 (100)	0	0	120 (100)

Frequency of millet consumption

Table 2 gives the frequency of millet consumption as daily, weekly thrice, twice, once and monthly twice or once and occasionally. From the table, it could be seen that majority of the millets were consumed monthly once while kodo millet, finger millet and barnyard millet were consumed monthly twice by 17, 30 and 17 per cent respondents respectively. Sorghum was consumed weekly once by 28 per cent respondents. Little millet, foxtail millet, barnyard millet and proso millet were consumed occasionally by cent per cent of respondents.

Frequency of millet purchase

The frequency of millet purchase is shown in Table 3 and it was found from the table that sorghum was purchased monthly by 72 per cent of respondents and the rest buy weekly. The kodo millet was purchased monthly by 83 per cent and once in fortnight by 17 per cent and finger millet was purchased by 70 per cent of the respondents monthly and by 30 per cent of the respondents once in fortnight, barnyard millet was purchased once in six months by 83 per cent respondents and once in a month by 17 per cent. The millets that were annually purchased by cent per cent of the respondents included little millet, foxtail millet and pearl millet while proso millet was purchased only occasionally.

Per capita food intake of selected subjects in comparison with requirement

The per capita food intake of the selected women who were classified as sedentary worker and moderate worker based on their occupation was assessed and the intake was compared with the quantity suggested by ICMR (2010 a) for a balanced diet and the results are tabulated in Table 4 and 5. The cereal intake by the sedentary workers was more or less equal with the requirement with

values being 270 and 330 g, while a slight deficit in the intake of millets was noted and it was statistically significant. The pulses intake by sedentary worker and moderate workers were deficit with values being 30 and 45 g and the deficiency was more prone in the rainy and winter season, however data was statistically non significant.

The consumption of root and tubers was also less than the requirement and the value of the moderate worker group was much more than sedentary worker group, being statistically significant. Similarly the intake of green leafy vegetables and other vegetables were lower with the sedentary workers (100 g) and comparatively more by the moderate workers (100 g). But both the groups showed deficiency in the intake of green leafy vegetables and other vegetables when compared with the requirement. The intake of fruits by the moderate workers ranged from 17.26 to 20.74 g while that of the sedentary workers ranged from 66.22 to 70.75 g. The requirement for milk and milk products per day as given by ICMR is 300 g but the intake was poor among the sedentary workers and ranged from 120 to 150 g per day. The intake of fats and oils, sugar and jaggery were near to the daily requirement in both the groups. A statistically significant difference in the per capita intake of other vegetables, fruits, milk and milk products, flesh foods, fat and oils, sugar and jaggery between seasons was observed except green leafy vegetable that was non significant. Seralathan *et al.*, (1993) has indicated deficit of all food groups in the diet of the women as observed in the present investigation.

Per capita nutrient intake of the selected subjects in comparison with RDA

The per capita nutrient intake of the selected subjects during the three day recall method were computed from the quantity of food consumed and was compared with RDA

suggested by ICMR (2010 a) and the results obtained are given in Table 4 and 5.

It is evident from the tables that 100 per cent of the respondents met out 75 per cent of RDA for calories and 47 per cent of respondents met 50-75 per cent of RDA for protein, while 40 per cent of the respondents met 50-75 per cent of RDA for calcium from their food intake. Only 14 per cent of respondents met 75 per cent of RDA for calcium. Studies of Lawrence (2003) and Yenagi *et al.*, (2007) indicated that the deficit in the intake of micronutrient like calcium, iron, carotene, thiamine, niacin, riboflavin and Vitamin C among the rural women met only 50 per cent of the RDA for these nutrients. Similar results were also noted in the present study with 100 per cent subjects meeting 25 to 50 per cent RDA values for iron, carotene, thiamine, niacin, riboflavin and Vitamin C.

Correlation between nutrient intake and anthropometric indicators/ indices variables of the selected subjects

Correlation was found for variables pertaining to nutrient intake and anthropometric indicators and the results are given in Table 5. Present study revealed that there were significant associations in case of some nutrients with anthropometric indicators. Weight was positively correlated for all the nutrients except calcium, vitamin C, thiamine, riboflavin and niacin. Whereas height was not positively correlated, Significant positive correlation was observed in energy, fat, crude fibre, iron, carotene and Vitamin C for Body Mass Index (BMI). All the nutrients were positively correlated with Mid Upper Arm Circumference (MUAC) and energy, protein, fat, crude fibre and vitamin C being statistically significant. Waist Hip Ratio (WHR) was positively correlated with protein and fat whereas all the nutrients exhibited a positive correlation with per cent body fat in

which the energy, fat, crude fibre, minerals and B vitamins being statistically significant (Table 6).

Several factors affect the consumption of millets which resulted in shifting of consumers from millets to fine cereals. Socioeconomic factor is one of the major variable which changes the food purchasing behavior which is unique for each consumer. The education, income and health level of the family are the major factors that were found to influence the consumption of millets. Small millet consumption was found to be positively associated with health status. The study showed that the respondents were aware of benefits of millet consumption and yet the respondents were not actually consuming millets because of reasons like lack of purchasing capacity, drudgery involved in preparation of millet products and non availability of millet products in the market. The data on frequency of consumption of millets showed that millets were being consumed monthly once or monthly twice in a days and the respondents were benefited by consumption of millets.

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