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Screening of Small Millet Varieties for Standardization of Porridge

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A B S T R A C T

Kodo millet varieties (T_1V_1 - CO3 and T_1V_2 - Market variety) Little millet varieties (T_2V_1 - CO2, T_2V_2 - CO4, T_2V_3 - CO3, T_2V_4-Chittansamai, T_2V_5-Kozhuthanasamai and T_2V_6 - Market variety), Foxtail millet varieties (T_3V_1 - CO5, T_3V_2 - CO6, T_3V_3 - CO (Te)7 and T_3V_4- Market variety) were procured from different places and study their physical and sensory characteristics to found that best millet variety for the standardization of porridge. The physical characteristics of little millet varieties viz., thousand grain weight, thousand grain volume and bulk density were studied. The thousand grain weight for the whole and dehulled grains of T_1V_1 was 5.93g and 3.87g and T_1V_2 was 5.87 and 3.82 respectively. Among the T_2 and T_3 samples the higher thousand grain weight was found in T_2V_2 and T_3V_3 when compared to other samples. The samples T_1V_1, T_2V_2 and T_3V_3 were found to have a higher grain volume with values 8.23 ml, 4.00 ml and 3.80 ml for whole grains and 4.98 ml, 3.20 ml and 2.95 ml for dehulled grains respectively. The bulk density of T_3V_3 sample was 0.75 and 0.87g per ml for whole and dehulled grains respectively which was higher than the other T_3 samples. The sensory attributes viz., colour and appearance, flavour, texture and taste were evaluated for T_1, T_2 and T_3 samples. The score values were observed to be maximum at 100 per cent incorporation level. The overall acceptability of kodo millet porridge scored 8.90 and 8.70 for T_1V_1 and T_1V_2 respectively at 100 per cent incorporation levels. The taste of the little millet porridge was highly acceptable for the sample T_2V_2 at 100 per cent incorporation level with the values being 8.90. The porridge developed from the foxtail millet sample T_3V_3 was found to be highly acceptable at 100 per cent incorporation level with the score value of 8.80. Based on the results of physical and sensory characteristics of the small millet composite flour used for the optimization of porridge, the varieties T_1V_1, T_2V_2 and T_3V_3 were identified to be best suited for the porridge development.

Introduction

Millet is a collective term referring to a number of small seeded annual grasses that are hardy and grow well in dry zones as rain fed crops, under marginal conditions of soil fertility and moisture. Millets are underutilized in many developed countries.

There is an immense potential to process millet grains into value added foods (Chandrasekara *et al.,* 2010). Millet grains account for about one sixth of the total food

grain production hold an important place in the food grain economy of India (Pradhan *et al.,* 2010). Kodo millet and little millet are the minor millets having certain specialities, which if exploited, may yield products of superior nutritional and technological characteristics than the major cereals, but their utilization is limited.

Millets are highly nutritious, non glutinous and non-acid forming foods. Hence they are soothing and easy to digest (Kumar, 2010). Cereal based food products supplemented with millets have become increasingly popular due to nutritional and economic advantages.

Value added products from millets have the potential to add value to business and has a large potential for growth as consumers believe that millets and millet based foods contribute good, directly to their health (Seetharam *et al.,* 2001).

Materials and Methods

The small millets namely kodo millet, little millet and foxtail millet were selected for the study based on their popularity, nutritional characteristics and other specific characteristics in Tamil Nadu.

The two varieties of kodo millet from peraiyur, Madurai District, three varieties of little millet from the Centre for Plant Breeding and Genetics, Tamil Nadu Agricultural University, Coimbatore, two varieties of land traces of little millet from Javwadhu hills, Thiruvannamalai District and three varieties of foxtail millet from the Centre for Plant Breeding and Genetics, Tamil Nadu Agricultural University, Coimbatore and one variety of foxtail millet from the local market were procured and utilized for the study. Small millet particulars are given below

Common Name	Tamil Name	Botanical Name	Varieties
Kodo millet	Varagu	*Paspalum scrobiculatum*	**CO 3, Market variety**
Little millet	Samai	*Panicum miliare*	**CO2, CO3, CO4, Chittansamai, Kozhuthanasamai and market variety**
Foxtail millet	**Thenai**	***Setaria italica***	**CO (Te) 7, CO 5, CO-6 and market variety**

Methods

Physical characteristics of small millet varieties

Physical appearance of grain is an important characteristic which determines consumer acceptability and hence the study of physical characteristics of the grains becomes a basic step in any research. The characteristics like thousand grain weight, thousand grain volume and bulk density of kodo millet, little millet and foxtail millet were studied by following the procedures.

The size of the seed was measured using calipers to the nearest of 0.01 mm. Weight of randomly selected thousand grains was recorded in grams using electronic balance with a sensitivity of 0.01 mg.

Thousand randomly selected grains were dropped in a measuring cylinder containing known volume of distilled water. The difference in volume was recorded in ml.

A 30g (14 per cent moisture content) of the sample was put into a 100ml measuring cylinder. The cylinder was tapped continuously until a constant volume was obtained. The bulk density was calculated as weight of grain (g) divided by grain volume (ml) and the bulk density was expressed as g per ml.

Processing of small millet flour

The procured small millet grains were cleaned to remove dust and other foreign materials and ground in a commercial roller mill. The flour was sieved using a BS 40-mesh sieve to obtain fine flour and was stored in stainless steel container.

Formulation and Preparation of porridge

The functional ingredient, small millet flour was used in the preparation of porridge replacing rice flour at 50, 75 and 100 per cent levels. The composite flour was weighed 25g and mixed with 150ml of water without lumps to make slurry.

The mix was cooked with continuous stirring for 5 minutes till the mixture started to boil. Then the porridge was allowed to cool.

Sensory evaluation of small millet based porridge

Porridge was developed and evaluated for its sensory attributes by a panel of 25 members using nine point hedonic scale rating (Watts *et al.,* 1989). The mean scores was obtained for all the characteristics and the data were statistically analyzed.

Results and Discussion

Physical characteristics of the small millet varieties

The whole millet grains and the dehulled grains were assessed for their physical properties. The physical characteristics of millet varieties viz., thousand grain weight, thousand grain volume and bulk density were studied and presented in Table 1.

The mean thousand grain weight for the whole and dehulled grains of $T_1V_1$was 5.93g and 3.87g and T_1V_2 was 5.87 and 3.82 respectively. Among the T_2 samples, the higher thousand grain weight was found in T_2V_2 with the values being 2.87g and 2.47g for whole and dehulled grains respectively, when compared to other samples.

The thousand grain weight of T_3 samples ranged from 2.69 to 2.75g for whole grain and 2.24 to 2.29g for dehulled grains, among which T_3V_3 was found to have higher values of 2.75g and 2.29g for whole and dehulled grains respectively than the other samples.

Similarly the thousand grain volume of the whole and dehulled grain was assessed. The samples T_1V_1, T_2V_2 and T_3V_3were found to have a higher grain volume with values 8.23ml, 4.00ml and 3.80ml for whole grains and 4.98ml, 3.20ml and 2.95ml for dehulled grains respectively.

The bulk density of T_1V_1 and T_1V_2 was 0.60 and 0.59g per ml for whole grains and 0.86 and 0.84g per ml for dehulled grains respectively. The values for bulk density of T_2 samples ranged from 0.70 to 0.75g per ml for whole grains and from 0.88 to 0.92g per ml for dehulled grains respectively.

The bulk density of T_2V_2 was found to be maximum with the values being 0.75 and 0.92g per ml for whole and dehulled grains respectively. The bulk density of T_3V_3 sample was 0.75 and 0.87g per ml which was higher than the other T_3 samples.

Formulation of small millet incorporated porridge

The formulation of small millet porridge by the standard procedure incorporating kodo millet, little millet and foxtail millet varieties at 50, 75 and 100 per cent levels as given in Table 2.

Sensory characteristics of small millet incorporated porridge

The porridge prepared with small millet flour was evaluated for their organoleptic characteristics and the results are presented in Table 3. The sensory attributes viz., colour and appearance, flavour, texture and taste were evaluated for T_1, T_2 and T_3 samples. The score values were observed to be maximum at 100 per cent incorporation level. The colour and appearance scored 8.80 and 8.50 for T_1V_1 and T_1V_2 respectively. The score values for flavour ranged from 8.40 to 8.90 for T_1V_1 and 8.20 to 8.70 for T_1V_2. The texture and taste of the kodo millet porridge scored maximum value of 8.80 and 9.00 for T_1V_1, 8.60 and 8.70 for T_1V_2 respectively. The overall acceptability of kodo millet porridge scored 8.90 and 8.70 for T_1V_1 and T_1V_2 respectively at 100 per cent incorporation levels.

The T_2 samples were found to be more acceptable at 100 per cent incorporation level for colour and appearance, flavour, texture and taste. The scores for colour and appearance were between 8.20 to 8.60, 8.40 to 8.70, 8.10 to 8.50, 8.10 to 8.60, 8.30 to 8.50 and 8.20 to 8.50 for T_2V_1, T_2V_2, T_2V_3, T_2V_4, T_2V_5 and T_2V_6. The flavour and texture of the developed little millet porridge scores varied between the samples with values between 8.50 to 8.80and 8.50 to 8.70 for T_2V_1, 8.60 to 8.90 and 8.50 to 8.80, for T_2V_2, 8.40 to 8.70 and 8.30 to 8.60 for T_2V_3, 8.50 to 8.70 and 8.40 to 8.70 for T_2V_4, 8.30 to 8.60 and 8.10 to 8.50 for T_2V_5 and 8.20 to 8.70 and 8.10 to 8.50 for T_2V_6 respectively. The taste of the little millet porridge was highly acceptable for the sample T_2V_2 at 100 per cent incorporation level with the values being 8.90. The overall acceptability of the T_2 samples ranged between 8.50 to 8.70, 8.50 to 8.80, 8.20 to 8.60, 8.30 to 8.60, 8.20 to 8.50 and 8.10 to 8.60 for T_2V_1, T_2V_2, T_2V_3, T_2V_4, T_2V_5 and T_2V_6 respectively.

Porridge developed from T_3 samples were also found to be highly acceptable at 100 per cent incorporation level based on the scores obtained for the sensory attributes. The colour and appearance of the T_3 samples increased in the score value with the increase in the incorporation of foxtail millet flour.

Table.1 Mean value of physical characteristics of the varieties of grains

Treatment and Varieties	Thousand Grain weight (g)		Thousand Grain volume (ml)		Bulk Density (g/ml)	
	Whole grain	Dehulled grain	Whole Grain	Dehulled grain	Whole Grain	Dehulled grain
T_1V_1	5.93	3.87	8.23	4.98	0.60	0.86
T_1V_2	5.87	3.82	8.20	4.95	0.59	0.84
T_2V_1	2.60	1.79	3.60	2.20	0.71	0.89
T_2V_2	2.87	2.47	4.00	3.20	0.75	0.92
T_2V_3	2.70	1.90	3.55	2.40	0.72	0.90
T_2V_4	2.74	1.98	3.60	2.50	0.72	0.89
T_2V_5	2.59	1.89	3.50	2.17	0.70	0.88
T_2V_6	2.71	2.06	3.60	2.60	0.73	0.90
T_3V_1	2.72	2.26	3.74	2.92	0.73	0.86
T_3V_2	2.69	2.24	3.72	2.88	0.72	0.84
T_3V_3	2.75	2.29	3.80	2.95	0.75	0.87
T_3V_4	2.71	2.25	3.75	2.90	0.73	0.85

Kodo millet varieties: T_1V_1 - CO3 (TNAU) and T_1V_2 - Market variety. Little millet varieties: T_2V_1 - CO2 (TNAU), T_2V_2 - CO4 (TNAU), T_2V_3 - CO3 (TNAU), T_2V_4 - Chittansamai (landrace), T_2V_5 - Kozhuthanasamai (landrace) and T_2V_6 - Market variety. Foxtail millet varieties: T_3V_1 - CO5 (TNAU), T_3V_2 - CO6 (TNAU), T_3V_3 - CO (Te)7(TNAU) and T_3V_4- Market variety

Table.2 Formulation of composite flour for porridge

Varieties	Level (%)	Rice flour (g)	Kodo millet flour (g)	Little millet flour (g)	Foxtail millet flour (g)	Water (ml)
T_0	100	100	-	-	-	600
T_1V_1	50	50	50	-	-	600
	75	25	75	-	-	600
	100	-	100	-	-	600
T_1V_2	50	50	50	-	-	600
	75	25	75	-	-	600
	100	-	100	-	-	600
T_2V_1	50	50	-	50	-	600
	75	25	-	75	-	600
	100	-	-	100	-	600
T_2V_2	50	50	-	50	-	600
	75	25	-	75	-	600
	100	-	-	100	-	600
T_2V_3	50	50	-	50	-	600
	75	25	-	75	-	600
	100	-	-	100	-	600
T_2V_4	50	50	-	50	-	600
	75	25	-	75	-	600
	100	-	-	100	-	600
T_2V_5	50	50	-	50	-	600
	75	25	-	75	-	600
	100	-	-	100	-	600
T_2V_6	50	50	-	50	-	600
	75	25	-	75	-	600
	100	-	-	100	-	600
T_3V_1	50	50	-	-	50	600
	75	25	-	-	75	600
	100	-	-	-	100	600
T_3V_2	50	50	-	-	50	600
	75	25	-	-	75	600
	100	-	-	-	100	600
T_3V_3	50	50	-	-	50	600
	75	25	-	-	75	600
	100	-	-	-	100	600
T_3V_4	50	50	-	-	50	600
	75	25	-	-	75	600
	100	-	-	-	100	600

Kodo millet varieties: T_1V_1 - CO3 (TNAU) and T_1V_2 - Market variety. Little millet varieties: T_2V_1 - CO2 (TNAU), T_2V_2 - CO4 (TNAU), T_2V_3 - CO3 (TNAU), T_2V_4 - Chittansamai (landrace), T_2V_5 - Kozhuthanasamai (landrace) and T_2V_6 - Market variety. Foxtail millet varieties: T_3V_1 - CO5 (TNAU), T_3V_2 - CO6 (TNAU), T_3V_3 - CO (Te)7(TNAU) and T_3V_4- Market variety

Table.3 Mean value of sensory characteristics of small millet incorporated porridge

Varieties	Incorporation levels (%)	Sensory Attributes				
		Color and Appearance	Flavor	Texture (consistency)	Taste	Overall Acceptability
T_1V_1	50	8.5	8.4	8.5	8.6	8.5
	75	8.6	8.6	8.6	8.8	8.7
	100	8.8	8.9	8.8	9.0	8.9
T_1V_2	50	8.2	8.2	8.3	8.2	8.3
	75	8.3	8.4	8.5	8.4	8.5
	100	8.5	8.7	8.6	8.7	8.7
T_2V_1	50	8.2	8.5	8.5	8.4	8.5
	75	8.4	8.6	8.6	8.5	8.6
	100	8.6	8.8	8.7	8.7	8.7
T_2V_2	50	8.4	8.6	8.5	8.6	8.5
	75	8.6	8.7	8.6	8.8	8.6
	100	8.7	8.9	8.8	8.9	8.8
T_2V_3	50	8.1	8.4	8.3	8.1	8.2
	75	8.3	8.5	8.5	8.3	8.4
	100	8.5	8.7	8.6	8.5	8.6
T_2V_4	50	8.1	8.5	8.4	8.2	8.3
	75	8.3	8.6	8.5	8.4	8.5
	100	8.6	8.7	8.7	8.7	8.6
T_2V_5	50	8.3	8.3	8.1	8.4	8.2
	75	8.4	8.5	8.3	8.5	8.3
	100	8.5	8.6	8.5	8.6	8.5
T_2V_6	50	8.2	8.2	8.1	8.2	8.1
	75	8.4	8.5	8.2	8.4	8.3
	100	8.5	8.7	8.5	8.6	8.6
T_3V_1	50	8.3	8.1	8.2	8.1	8.0
	75	8.4	8.3	8.4	8.4	8.2
	100	8.6	8.5	8.7	8.6	8.5
T_3V_2	50	8.1	8.0	8.1	8.1	8.4
	75	8.3	8.3	8.3	8.3	8.5
	100	8.5	8.6	8.6	8.5	8.7
T_3V_3	50	8.4	8.4	8.4	8.3	8.3
	75	8.6	8.5	8.6	8.5	8.5
	100	8.8	8.7	8.8	8.9	8.8
T_3V_4	50	8.4	8.0	8.2	8.1	8.2
	75	8.5	8.2	8.4	8.2	8.3
	100	8.6	8.5	8.7	8.5	8.5

Kodo millet varieties: T_1V_1 - CO3 (TNAU) and T_1V_2 - Market variety. Little millet varieties: T_2V_1 - CO2 (TNAU), T_2V_2 - CO4 (TNAU), T_2V_3 - CO3 (TNAU), T_2V_4 - Chittansamai (landrace), T_2V_5 - Kozhuthanasamai (landrace) and T_2V_6 - Market variety. Foxtail millet varieties: T_3V_1 - CO5 (TNAU), T_3V_2 - CO6 (TNAU), T_3V_3 - CO (Te)7(TNAU) and T_3V_4- Market variety

The scores for T_3V_1, T_3V_2, T_3V_3 and T_3V_4 was between 8.30 to 8.60, 8.10 to 8.50, 8.40 to 8.80 and 8.40 to 8.60 respectively. The score values for flavour and texture were observed to be between 8.10 to 8.50 and 8.20 to 8.70 for T_3V_1, 8.00 to 8.60 and 8.10 to 8.60 for T_3V_2, 8.40 to 8.70 and 8.40 to 8.80 for $T_3V_3$and 8.00 to 8.50 and 8.20 to 8.70 for T_3V_4 respectively. The taste of the foxtail millet scored maximum with the values being 8.60, 8.50, 8.90 and 8.50 for T_3V_1, T_3V_2, T_3V_3 and T_3V_4 respectively at 100 per cent incorporation level. The porridge developed from the sample T_3V_3 was found to be highly acceptable at 100 per cent incorporation level with the score value of 8.80.

Summary and conclusion are as follows:

The mean thousand grain weight for the whole and dehulled grains of T_1V_1 was 5.93g and 3.87g, T_2V_2 was 2.87g and 2.47g and that of T_3V_3 was 2.75g and 2.29g respectively which was higher than the other samples. The thousand grain volume of the whole and dehulled grain for T_1V_1, T_2V_2 and T_3V_3 was 8.23 ml, 4.00 ml and 3.80 ml and 4.98 ml, 3.20 ml and 2.95 ml respectively. The bulk density of T_1V_1, T_1V_2 and T_3V_3 was 0.60, 0.59 and 0.75g per ml for whole grains and 0.86, 0.84 and 0.87g per ml for dehulled grains respectively. The functional ingredient, small millet flour was used in the preparation of porridge replacing rice flour at 50, 75 and 100 per cent levels. The overall acceptability of kodo, little and foxtail millet porridge was highly acceptable at 100 per cent incorporation level for the samples T_1V_1, T_2V_2 and T_3V_3.

From the results of physical and nutritional characteristics of the small millet varieties and sensory characteristics of the small millet composite flour used for the optimization of porridge, it was concluded that the varieties T_1V_1, T_2V_2 and T_3V_3 were best suited for the product development.

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