International Journal of Science and Research (IJSR)
ISSN: 2319-7064
ResearchGate Impact Factor (2018): 0.28 | SJIF (2018): 7.426

Formulation of Millet Based Breakfast Recipes, Their Acceptability, Nutrient Content and Popularisation among Children in Orphanages in Chennai City

Anna Rangini Chellappa

Associate Professor and Head , Department of Home Science –Nutrition, Food Service Management and Dietetics, Dr Ambedkar Government Arts College, Chennai 600039, India

Abstract: ***It is well established that malnutrition with specific reference to iron deficiency anaemia is widespread among children in India. Poverty, ignorance and food insecurity are some of the main causes identified for these problems. The formulation of traditional breakfast recipes with the incorporation of small millets is a logical pragmatic strategy to provide nutrient dense low cost foods to children who are vulnerable to nutrient deficiencies. Hence, in the present study, selected traditional breakfast recipes (idli ,dosa, idiyappam, kichadi and kozhukattai) were incorporated with a standardised proportion of millet mix powder prepared using Pearl millet, Barnyard millet Kodo Millet and Little Millet .The recipes were first standardised, tested for their acceptability using standard procedures and were popularised among orphanages. Mean sensory evaluation scores revealed that the acceptable proportion of millet mix incorporated to the standard recipe was 25% of millet mix powder for idli, idiappam , kozhukattai and kichadi and 75% for dosa. Statistical analysis (Students t-test) showed that all millet mix incorporated breakfast recipes had significantly higher content of iron, calcium, phosphorus and fibre than the standard recipes. The millet mix recipes were popularised in nine orphanages in Chennai city consisting of a total of 450 inmates and were found to be well accepted.***

Keywords: Small Millets, Nutrient Content, Malnutrition, Sensory Evaluation, Breakfast recipes

1. Introduction

The process of globalization has sharpened the threat to food security of many people living in developing countries, and India is no exception. An estimated 400 million Indians do not have access to regular and adequate quantities of food. As a result, hunger, malnutrition and iron deficiency anaemia are widespread (Swaminathan, 1999). According to Bhat et al. (2018) small millets are warm-seasonal cereals such as finger millet (*Eleucine coracana*), kodo millet (*Paspalum scrobiculatum*), proso millet (*Panicum miliaceum*), foxtail millet (*Setaria italica*), little millet (*Panicum sumatrance*) and barnyard millet (*Echinocloa frumentacea*). They are considered as nutri- cereals and are a source of food, feed and fodder Their richness in calcium, dietary fiber, polyphenol, iron and protein content in millets make them unique among the cereals. Generally, millets show significant amounts of amino acids like methionine and cystine and also have high fat content than rice and maize. Millets have nutraceutical properties in the form of antioxidants which prevent deterioration of human health such as lowering blood pressure, risk of heart disease, prevention of cancer and cardiovascular diseases, diabetes, decreasing tumor cases etc. Due to the contribution of millets to national food security and their potential health benefits, millet grain is now receiving increasing interest from food scientists, technologists and nutritionists (Bhat et al.2018).

Many studies have shown that the burden of micronutrient malnutrition is found to be very great among children with the adverse effect on their growth and development, mental and neuromotor performance, immune competence, physical working capacity, cognition, behavior and overall reproductive performance of affected individuals (McCann and Ames, 2007; Stoltzfus, 2003; Stoltzfus et al., 2001; Grantham-McGregor and Ani, 2001; Haas and Brownlie, 2001; Scrimshaw, 2000; Cook and Lynch, 1986). Hence there is an apparent need to provide millet based food products in the form of ready to use grains, convenience foods or mixes to meet the nutrient demands of children who are variety conscious and who are also susceptible to a wide array of deficiency diseases. Value addition of traditional food preparations using small millets is believed to not only improve health status but will offer variety, convenience and quality food to consumers and also help in revival of millet cultivation. In view of these facts the study was undertaken with the following objectives:

2. Objectives of the Study

1) To develop and standardize selected traditional breakfast recipes (idli, dosa, idiyappam, kichadi and kozhukattai) using millet mix powder comprising of pearl millet, barnyard millet, little millet and kodo millet.
2) To assess the sensory acceptability attributes like appearance, colour, flavour, taste, texture and overall acceptability of the millet mix incorporated breakfast recipes
3) To compare the nutrient content of millet mix incorporated recipes with that of the standard breakfast recipes
4) To prepare and serve the millet incorporated breakfast items to selected orphanages so as to popularise the usage of the selected millets among them and to assess the acceptability of these value added breakfast items among young children

3. Materials and Methods

3.1. Selection of millets and standardisation of millet mix powder

Pearl millet, little millet, kodo millet and barnyard millet were chosen for the study as they are reported to be rich in nutrients and their intake can promote health as well as prevent and treat various non - communicable diseases (Bhat et al. 2018) . The proportion of the millet used for preparing the millet mix was Barnyard millet- 40g/100g ; Pearl mill - 40g/100g ; Little millet-10g /100g and Kodo Millet - 10g/100g based on the recommendations of Anbu Malar (2015) who evaluated the bioavailability and acceptability of selected millet based breakfast and snacks. Gopalan et al.,(2013) stated that the protein , iron an energy content of barnyard and pearl millet is much higher than that of kodo and little millet and hence these two millets were used in higher proportions.

3.2. Breakfast items chosen for the study

Common breakfast food items preferred by children in South India include Idli, Dosa, Idiyappam Kichadi and Kolukattai and were thus chosen for the study.

3.3. Standardization of Millet mix incorporated recipes

The millet mix powder was added to the recipes in three varying proportions viz., 25%(Millet mix -MM1), 50% (Millet Mix ll –MM ll), and 75 % (Millet Mix lll – MM3).For sensory evaluation, a panel of (twenty) judges was used. Organoleptic evaluation was done for different sensory attributes such as colour and appearance, flavour, texture , taste and overall acceptability with a maximum score of five (5 point Likert scale) for each of the food items prepared. The data were tabulated and analyzed .The organoleptically evaluated products were arranged in descending order using the "overall acceptability score percentage"

3.4. Nutrient analysis of breakfast items prepared with and without the incorporation of millet mix powder

Standard procedures were used to assess the nutrient content of breakfast items prepared with and without the incorporation of millet mix powder.The moisture, protein,fat, energy, carbohydrate, crude fibre ,calcium , iron , phosphorus and calcium content of the millet mix recipes and the standard recipes were assessed and compared .The results were tested for statistical significance using Student t –test.

3.5. Popularisation of millet based recipes in selected orphanages

Nine orphanages in Chennai city consisting of a total of 450 inmates were randomly selected and were served the five breakfast recipes to test their acceptability and also to popularise the usage of millets in traditional recipes

3.6. Test for acceptability

The housekeepers and caretakers of the orphanages were provided with an evaluation form to rate the acceptability of the breakfast items in terms of taste, texture, appearance, flavour and overall acceptability.

4. Results and Discussion

4.1 Nutritional value of the millet mix used in the study

An overview of the nutrients present in the selected millets such as pearl millet, barnyard millet, kodo millet and little millet used in the preparation of millet mix for the study as well as the nutrient composition of commonly used cereals such as rice and wheat used for preparing breakfast are presented in Table 1.

Table 1: Overview of nutrient composition of selected millets and commonly used cereals such as rice and wheat

S. No	Nutrients /100g	Selected Millets for the study				Commonly used cereals	
		Pearl	Barnyard	Kodo	Little	Rice arboiled	Wheat
1	Moisture (g)	12.4	11.9	12.8	11.5	12.6	12.8
2	Protein (g)	10.6	11.2	8.3	8.7	8.5	11.8
3	Fat(g)	4.8	3.9	1.4	5.3	0.6	1.5
4	Crude Fibre (g)	1.3	10.1	9.0	7.6	0.26	1.2
5	Carbohydarte (g)	67.5	65	65.9	67.0	71.4	71.2
6	Energy (Kcal)	361	300	309	341	349	346
7	Calcium (mg)	42	11	27	17	10	41
8	Phosphorus(mg)	296	280	188	220	280	306
9	Iron (mg)	16.9	15.2	2.34	9.3	2.8	5.3
10	Ash (mg)	2.2	4.5	1.2	1.72	0.33	2.0

Source: Indian Food Composition Tables, NIN – 2017, Rao, et.al., 2017, Zubair et.al., 2015, Anbu Malar, et.al., (2015).

The nutrients present in the millet mix developed using pearl millet, barnyard millet, kodo millet and pearl millet were analyzed as per the standard procedures and the same is presented in Table- 2 and Fig -1.

Table-1 clearly indicates that the moisture content of the millet mix (0.9± 0.02g) is much lower than the commonly used cereals (rice 12.6%; wheat 12.8%) .This could be due to the loss of moisture that occurs due to the dry process millets are subjected to prior to milling them (Anbu Malar ,2015)The protein content of the millet mix(13.5g±0.15) was found to be higher than all the individual millets. This could be attributed to the fact that 40 % of pearl and barnyard millet were used respectively, both being the highest source of protein among the millets chosen. This finding is in accordance with those of Anbu Malar (2015) who also reported that the average protein content of millets range from 9·8 to 15·9% as quoted by Ravindran , **(**1992) . In the present investigation the millet mix contained 1.4±0.06g/100g of crude fibre which was only slightly higher than the selected individual millets. This could be due to the milling and sieving process adopted in this study (Geervani and Eggum, 1989).The table also clearly shows that the nutritional attributes of the millet mix over powers the nutrient content of commonly used cereals such as rice and wheat with specific reference to iron, calcium and

energy content thereby justifying the objective of incorporating the millet mix in the traditional recipes that use rice or wheat as the main ingredient. This table is in accordance with the FAO reports that suggest that dietary diversification is instrumental in combating micronutrient malnutrition (Bhat et al.2018)

Table 2: Nutrient content of millet mix per 100gm

S. No	Nutrients /100g	Millet mix (MM)
1	*Moisture(g)*	0.9± 0.02
2	*Protein (g)*	13.5±0.15
3	*Fat(g)*	4.29±0.05
4	*Crude Fibre(g)*	1.4±0.06
5	*Carbohydrate (g)*	77.68±1.2
6	*Energy (Kcal)*	382± 0.04
7	*Calcium (mg)*	42.6±0,05
8	*Phosphorus (mg)*	281.82±1.3
9	*Iron(mg)*	13.9±0.02
10	*Ash (mg)*	3.28±0.02

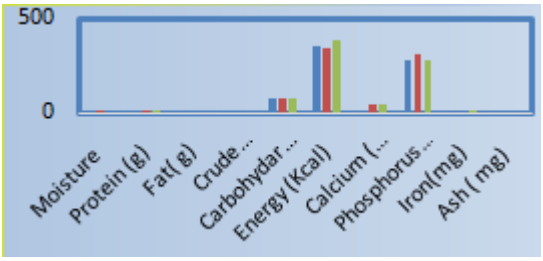

Figure 1: Comparison of nutrient content of rice, wheat and millet mix

Table -3 denotes that idli that was prepared with 25% of millet mix (viz., 75 % of standard idli batter along with 25% of millet mix had the highest score for appearance, colour (5±0.62) and texture(4.65±0.48.) when compared to idli prepared with higher proportions of millet mix. The scores for overall acceptability was also highest for idli prepared with 25% millet mix (4.7±0.47). The idli that contained 75% of the millet mix received the lowest scores for all sensory characteristics. This could be perhaps due to the fact that that the millet mix is brown in colour which resulted in a product that was brown and unappealing. Such a high proportion of millet mix also resulted in idli's that were leathery and not fluffy and soft like the traditional standard idli.

With regard to dosa, it was interesting to note that the brown colour of the millet mix made the dosa appear more appealing. The mean scores clearly indicate that the appearance as well as colour of dosa incorporated with 75% of millet mix received highest scores (4.7±0.50) than that of the standard dosa (4.5±0.50). Although a standard

4.2. Sensory evaluation of value added breakfast items

Table 3: Comparison of mean sensory evaluation scores of selected traditional breakfast items incorporated with varying proportions of millet mix

Variations	*Appearance & colour*	*Flavour*	*Taste*	*Texture*	*Overall acceptability*
IDLI					
Standard	4.55±0.60	4.8±0.41	4.8±0.3	5.0±0.0	4.8±0.51
MM1(25%)*	5.0±0.62	4.6±0.50	5.0+0.1	4.65±0.48	4.7±0.47
MM2(50%)*	4.5±0.51	4.55±0.51	4.75±0.44	3.6±0.59	4.2±0.44
MM3(75%)*	3.1±1.02	3.4±0.50	3.75±0.71	2.8±0.41	3.0±0.44
DOSA					
Standard	4.5±0.50	4.8±0.41	4.8 ± 0.36	5.00 ±0. 0	4.5±0 0.51
MM1(25%)	4.4±0.50	4.55±0.51	4.5±0.01	4.65±0.48	4.5±0.51
MM2(50%)	4.1±0.78	4.6±0.50	4.75±0.44	4.4±0.50	4.5±0.51
MM3(75%)	4.7±0.50	4.7±0.36	4.95±0.75	4.8±0.41	4.8±0.50
KOZHUKATTAI					
Standard	4.5±0.51	4.8±0.41	4.85±0.36	5.0±00	4.51±0.51
MM1(25%)	4.4±0.50	4.5±0.51	5.0±.00	4.65±0.48	4.5±0.51
MM2(50%)	4.1±0.78	4.1±0.50	4.75±0.44	4.44±0.50	4.0±0.64
MM3(75%)	3.7±0.73	4.35±0.48	4.25±0.63	3.45±0.75	3.5±0.60
IDIYAPPAM					
Standard	4.5±0.51	4.7±0.47	4.86±3.6	5.0±0.01	4.55±0.51
MM1(25%)	4.4±0.3	4.4±0.50	5.0±00	4.65±0.48	4.5±0.51
MM2(50%)	4.1±0.78	4.1±0.81	4.5±0.51	3.7±0.57	3.85±0.58
MM3(75%)	3.05±0.77	3.5±0.60	3.65±0.58	4.3±0.27	2.85±0.36
KICAHDI					
Standard	4.5±0.51	4.8±0.41	4.85±0.36	5.0±00	4.5±0.51
MM1(25%)	4.4±0.50	4.5±0.51	5.0±00	4.65±0.48	4.5±0.51
MM2(50%)	4.1±0.18	4.1±0.50	4.75±0.44	4.3±0.47	3.8±0.52
MM3(75%)	3.5±0.68	4.2±0.44	3.9±0.7	3.2±0.49	2.9±0.49

❖ percentage of millet mix that replaced the main standard cereal ingredient

proportion of rice and black gram dhal was used in the preparation of the standard batter for idli and dosa it was interesting to note that the texture of the dosa was crispy and not leathery as that of idli prepared with 75%of millet mix. This could be due to cooking method used viz., steaming method used for idli and shallow fat frying and roasting for dosa. The overall acceptability mean scores of millet mix

dosa prepared with 75% of millet mix flour was the highest (4.8±0.50)

Idiyappam is another famous steamed breakfast dish in South India .The above table shows that idiyappam prepared with 25 % of millet mix received the highest mean score for overall acceptability (4.5 ±0.51) when compared to the idiappam prepared with 50% of millet mix (3.85±0 0.58) and 75% of millet mix (2.85 ±00.36) Traditionally, idiappam is a soft fluffy stringy white breakfast item. The millet mix used in higher ratios resulted in brown, sticky and leathery idaiappam which was not acceptable and palatable.

Kozhukattai is also prepared using the steaming method.The table clearly indicates that that the steaming method of breakfast products prepared with higher proportions of millet mix resulted in unappealing dark brown ,tough products with a low overall acceptability mean scores of (4.00±.64 MM2 kozhukattai; 3.5±0.60 for MM3 kozhukattai when compared to (4.5±0.51of MM1). It was interesting to note that kozhukattai prepared with 25% of millet mix and the standard kozhukattai received the same mean score for overall acceptability (4.5±0.51). This indicates that by consuming millet mix incorporated kozhukattai, consumers will be able to obtain a food product which is of higher nutrient content as well as with high overall sensory acceptability scores.

Kichadi is breakfast item that involves a combination method of cooking viz,., dry roasting of semolina and millet mix followed by boiling .Kichadi with 25% of millet mix received the highest means scores for texture (5.0±00) and overall acceptability(4.5±0.51).Millet mix has a tendency to absorb water. This could have resulted in the soggy sticky product that was obtained when millet mix was used in higher proportions. This could be the probable reason for the kichadi prepared with 50% and 75% of millet mix flour to have received lower overall acceptability scores (3.8±0.52-MM2; 2.9±0.49-MM3) respectively.

4.3. Comparison of nutrient content of selected breakfast items with and without Incorporation of millet mix

Table -4 and figures 2,3,4,5,6 indicate the nutrient content of breakfast items prepared using standard ingredients and value added breakfast items prepared incorporating millet mix into the standard recipe

Idli
Idli prepared with 25 % of millet mix had higher content of calcium (43.3± 0.13mg / 100g,p<0.05); fibre (1.49g ± 0.87 /100g p<0.05) , carbohydrate(75.52g±0.03, p<0.05) and iron (2.14 ± 0.02mg /100g p<0.01) than that of idli prepared without millet mix . The increase could be due to the fact that the nutrient content of millet mix as seen in Table 2 is a rich source of these nutrients . The substitution of 25% of millet mix flour in the place of idli batter prepared with rice as the main ingredient could be the reason for the increase observed in the nutrient content of the millet mix idli.

Dosa
Dosa prepared with 75% of millet mix had a higher nutrient content with special reference to iron (3.75± 0.mg /, p<0.001), fibre (2.0 ±0.07 g/, p<0.001) phosphorus (215.3±0.03, p<0.05) and calcium (40.4±0.05 /100g p<0.01) compared to dosa prepared using the standard formula (iron 40.4±0.05 mg/100g; fibre 0.36±0.02g/100g; calcium 36.75±0.12 mg/100). This increase may be attributed to the fact that the standard dosa batter was replaced with 75% of millet mix which is rich source iron, calcium and phosphorus as seen in table -2.

The carbohydrate content of millet mix dosa was lower (66.12 ±0.1 p<0.01) than standard dosa. In the present study 40 % of the millet mix is prepared using barnyard millet. According to Veena et.al., 2005 the carbohydrate content of barnyard millet is low and slowly digestible. The findings are also in accordance with that of Bhat et al. (2018) who reported that Kodo millet is an excellent source of fibre (15%) as opposed to rice (12.9%) and wheat (5.2%).In the present study the millet mix constituted 40% of kodu millet.

Idiyappam
Millet mix idiyappam showed that carbohydrate content was lower (75.17±0.03g/100g, p<0.05 and fibre content (1.7 ±0.02, p<0.05) was higher than the standard formula. This is in accordance with Veena et al. (2015) who stated that the carbohydrate content of barnyard millet is low which could be the possible reason for the finding. The millet mix also contains little millet whose low complex carbohydrate digests slowly which is very helpful for diabetic patients. Millet mix idiyappam was also higher in phosphorus(187.8±0.04mg/100g, p<0.05) and iron content (2.99±0./100g, p<0.01

Kichadi
In millet mix kichadi the carbohydrate content was lower (75.14 ±0.1/100g, P<0.01) whereas the fibre (1.82±0.01/100g, p<0.05, iron (2.8±0.04/100g, p<0.01) and phosphorus content(154.2 ±0.03, p<0.05 was higher than the standard kichadi that was prepared using semolina as the base ingredient . These findings reiterate the fact that millets are a good source of nutrients especially fibre, iron, calcium and phosphorus (Rao et al. 2017)

Kozhukattai
Millet mix incorporated kozhukattai was lower in carbohydrate (96.76 ±0.06, p<0.05) content but higher in fibre (2.4±0.06, p<0.05) phosphorus (243.8 ±0.06, p<0.05) and, calcium (32.1±0.45, p<0.05) content (when compared to that of kozhukattai prepared using standard rice flour formula. NIN (2017) reports that the fibre, iron phosphorus and calcium content of rice is lower than that of barnyard millet, kodo millet, little millet and pearl

Table 4: Mean nutrient content of the selected breakfast items with and without incorporation of millet mix (per 100 g)
Values are Mean±SD of three determinations. Data are significant differences at *p<0.05; **p<0.01 and ***p<0.001

Nutrients	*Selected foods*									
	Idli		*Dosa*		*Idiyappam*		*Kichadi*		*Kozhukattai*	
	STD	STD-MM	STD	STD-MM	STD	STD-MM	STD	STD-MM	STD	STD-MM
Moisture(g)	12.71 ±0.01	10.76 ±0.52	12.16 ±0.12	11.58 ±0.21	13.7 ±0.01	13.37 ±0.02	18.32 ±0.02	20.44 ±0.21	21.78 ±0.05	21.54 ±0.16
Protein (g)	10.8 ±0.03	10.58 ±0.03	9.6 ±0.25	10.42 ±0.09	6.8 ±0.38	7.52 ±0.15	10.64 ±0.05	10.44 ±0.01	14.14 ±0.02	14.86 ±0.06
Fat (g)	0.65 ±0.01	1.37 ±0.05	0.54 ±0.01	1.51 ±0.21	0.5 ±0.12	1.44 ±0.39	10.82 ±0.02	11.87 ±0.01	8.61 ±0.15	9.76 ±0.02
Energy (kCal_	346.5 ±1.29	342.8 ±0.62	448.9 ±0.05	423.8 ±0.11	345.0 ±0.01	341 ±0.05	448 ±0.04	443 ±0.11	510.4 ±0.04	505.5 ±0.01
Carbohydrate(g)	74.15 ±0.45	75.52 ±0.03*	69.8 ±0.54	66.12 ±0.1**	78.2 ±0.41	75.17 ±0.03*	77.02 ±0.03	75.14 ±0.12**	99.8 ±0.05	96.76 ±0.06*
Crude fibre (g)	0.38 ±0.01	1.49 ±0.87**	0.36 ±0.02	2.28 ±0.07*	0.2 ±0.01	1.7 ±0.02**	0.32 ±0.05	1.82 ±0.01*	0.92 ±0.01	2.4 ±0.06*
Ash (g)	1.42 ±0.04	1.66 ±0.03	1.16 ±0.02	1.76 ±0.02	1.2 ±0.05	1.7 ±0.02	2.24 ±0.01	2.28 ±0.15	1.44 ±0.12	1.53 ±0.12
Calcium (mg)	42.3 ±0.83	43.3 ±0.13*	36.75 ±0.12	40.4 ±0.05**	10 ±0.02	13.9 ±0.03*	25.38 ±0.03	27.78 ±0.018*	28.1 ±0.01	32.1 ±0.45*
Phosphorous (mg)	203.6 ±0.06	207 ±0.038*	183.7 ±0.25	215.3 ±0.03*	160 ±0.01	187.8 ±0.04*	112 ±0.05	154.2 ±0.03*	216.2 ±0.03	243.8 ±0.06*
Iron (mg)	1.7 ± 0.01	2.14 ±0.02**	0.4 ±0.05	3.75 ±0.03***	0.7 ±0.01	2.99 ±0.06**	1.7 ±0.02	2.8 ±0.04**	1.56 ±0.05	2.86 ±0.04**

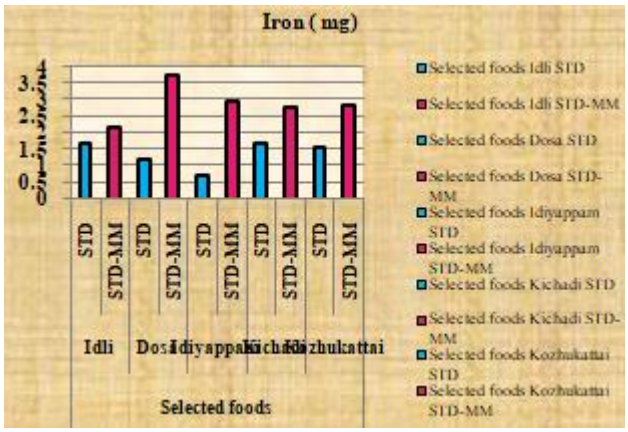

Figure 2: Comparison of iron content of breakfast items prepared with and without incorporating millet mix

Figure-2 clearly shows a distinct increase in iron content of all selected breakfast items ($p<0.05$) prepared with the incorporation of millet mix powder. This is obviously due to the high iron content of millets selected for the study as seen in Table -2 and Figure-1. This finding is in accordance with that of Balasubramaniam (2013) who reported that millets are a good source of iron .

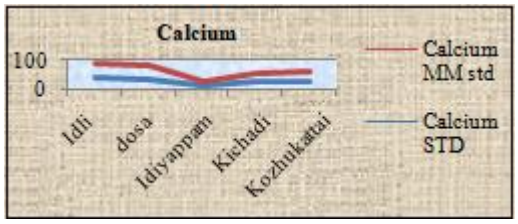

Figure 3: Comparison of the calcium content of breakfast items prepared with and without incorporating millet mix

Rao et al., (2017) reported that minor millets are a very good source of calcium and health promoting micronutrient. The findings of the study also revealed that the calcium content of the breakfast recipes prepared with millet mix was much higher in dosa ($p<0.01$), idli ($p<0.05$), idiappam ($p<0.05$), kichadi ($p<0.05$) and kozhukattai ($p<0.05$) than the breakfast items prepared using standard ingredient

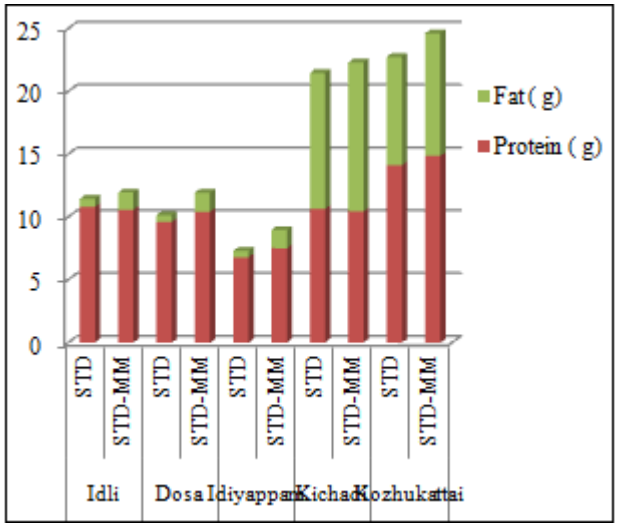

Figure 4: Comparison of the fat and protein content of breakfast items prepared with and without incorporating millet mix

Figure – 4 denotes that there is no significant difference in the fat and protein content of breakfast items prepared with and without the incorporation of millet mix. However the marginal increase in protein content of millet mix incorporated breakfast times could be due to the fact that pearl millet especially contains considerably high proportion of proteins (Rao et al. 2017)

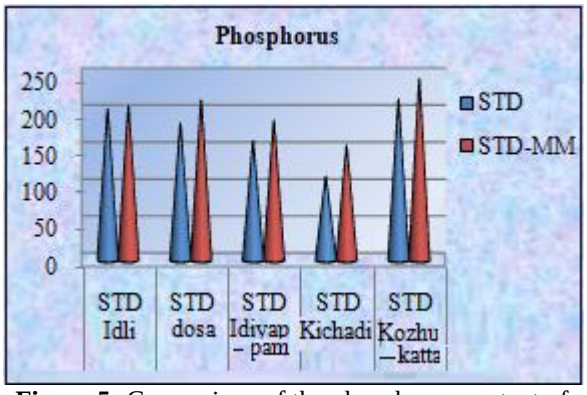

Figure 5: Comparison of the phosphorus content of breakfast items prepared with and without incorporating millet mix

Millets are a rich source of phosphorus (Devi et al. 2011). It contains many essential minerals like magnesium, phosphorus, zinc etc. It contains essential amino acids and vitamins also which contribute to its therapeutic properties. (Rao et al i2017). In accordance with these reports the present study also showed that all the breakfast items prepared with millet mix had a higher phosphorus ($p<0.05$)content than breakfast items prepared without millet mix.

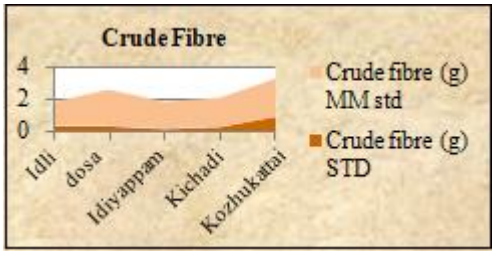

Figure 6: Comparison of the crude fibre content of breakfast items prepared with and without incorporating millet mix

It is well documented that the edible component of millet kernel is the rich source of phytochemicals, such as dietary fiber and polyphenols (0.2-0.3. (Rao et al. 2017). Bran of the millets is rich source of dietary fibre, which is termed as complex unavailable polysaccharides. Due to higher viscosity, glycemic index and water holding capacity dietary fibres plays a key role in reduction of blood glucose level as well as insulin response The above figure-5 clearly shows that the breakfast items prepared with millet mix had high fibre content (the maximum seen in dosa ($p<0.05$, idli (($p<0.05$), idaippam ($p<0.05$ kichadi ($p<0.05$) and kozhukattai ($p<0.05$than those prepared without the incorporation of millet mix . This finding is valuable since fibre helps to control blood sugar, cholesterol levels and helps in preventing obesity (Rao et.al., 2017)

Popularization of Millets in Selected Orphanages

Based on the overall sensory acceptability of millet incorporated breakfast items and the nutritional significance of the same, selected millet based recipes were popularized among nine orphanages in Chennai city with a total number of 450 inmates. Feedback form was obtained from the care taker of the orphanages. Based on the response of the inmates (orphans) It was interesting to note that all (100%) of the care takers highly commended the taste, appearance, flavor, texture and overall acceptability of the breakfast items incorporated with millet mix and stated that they would follow the same procedure in future . A sample (500g) of millet mix powder was distributed to all the nine orphanages.

Millet mix incorporated food served to the children at Sarvodhaya Home

Millet mix incorporated food served to the children at Shelter Home

Millet mix incorporated food served to the children at Karunalaya

Millet mix incorporated food served to the children at Karunalaya Home -2

Street child cricket team to play at Lords –London

Millet mix incorporated food served to the children at Karunalaya Home -3

Millet mix incorporated food served to the children at Corporation Home

Millet mix incorporated food served to children at Dazzling Home

Serving millet food at Aravanaikum karanangal

Serving millet incorporated food at DonBosco Anbu Illam

Millet mix incorporated food served to children at Sharma Nagar home for girls

5. Conclusion and Recommendations

Millet mix incorporated breakfast items had a significantly higher content of iron, crude fibre, calcium and phoshours and lower carbohydarate content than standard breakfast items. Awareness programmes among school children about the nutritional benefits of millet based foods is the need of the hour. Home makers should also be sensitised about the importance of enhancing nutrient intake of their children by a simple method of incorporating millet mix powder/ flour in breakfast items. Orphanages that house school children can be encouraged to incorporate millet mix powder in all foods.

Based on these findings, there is an apparent need to develop, standardise and popularise more millet based food products for children in the form of ready to use grains, convenience foods or mixes. Consumption of millet based foods will be a cost effective intervention strategy to combat micronutrient deficiencies among children, especially in orphanages. This is a pressing need since nutrient deficiencies in childhood will have adverse effect on their growth and development, mental and neuromotor performance, immune competence, physical working capacity, cognition, behaviour and overall reproductive performance of affected individuals . Hence, the findings of the study clearly indicate the importance of including millets such a pearl millet, little millet, kodo millet and barnyard millet in the daily diet for children

6. Acknowledgment

This study is a part of the minor project funded by University Grants Commission, Hyderabad. Sincere thanks and heartfelt gratitude are recorded for the same. I would to express my thanks to all the participants in the study and the orphanages that granted permission for the successful completion of this project

References

[1] Anbu Malar, M., (2015). Development of Millet Mixes, Acceptability of Millet Mix Based Recipes, their Iron Bioavaiability and Popularisation. Nutrition Reviews. 1-17.

[2] Balasubramanian S., (2013). Possessing of millets. Paper presented at National Seminar on Recent Advances in processing, utilization and nutritional impact of small millets. Madurai Symposium, Thamukkam Grounds, Madurai, 13 September, 2013.

[3] Bhat.S, C.,Nandini,V., Tippeswamy, A and Prabhakar. K, (2018). Significance of small millets in nutrition and health -A review. Asian J. Dairy and Food Res. 37(1) : 35-4

[4] Cook, J.D and Lynch, S.R.(1986). The liabilities of iron deficiency. Blood. *1986, 68:* 803-809.

[5] Devi, P. B., Vijayabharathi, R., Sathyabama, S., Malleshi, N. G. and Priyadarisini, V.B., (2011). Health benefits of finger millet (Eleusinecoracana L.) polyphenols and dietary fiber: a review. Journal of Food Science and Technology. 51(6): 1021-1040.

[6] Gopalan, C., Ramshashtri, V,, Balasubramanian, S,C., (2013) Revised and updated by Narasinga Rao BS, Deosthale Y.G, Pant K.C, (2013.) Nutritive value of Indian Foods, National Institute of Nutrition, ICMR.

[7] Geervani P, Eggum O (1989). Nutrient composition and protein composition of minor millets. Plant Foods for Human Nutrition, **39**, 201–208.

[8] Grantham-McGregor, S. & Ani, C. (2001) .A review of studies on the effect of iron deficiency on cognitive development in children. Journal of Nutrition, 2001,131, 649-66S.

[9] Haas, J.D.& Brownlie, T. (2001).Iron deficiency and reduced work capacity: A critical review of the research to determine a causal relationship. Journal of Nutrition, 131,676S-690S.

[10] McCann, J.C.& Ames, B.N. (2007).An overview of evidence for a causal relation between iron deficiency during development and deficits in cognitive or behavioral function. American Journal of Clinical Nutrion,85,931-945.

[11] National Institute Of Nutrition., (2017*)*Indian Food Composition Tables, NIN – *2017* and Nutritive value of Indian foods, *NIN – 2007*

[12] Rao,B,D., Bhaskarachary, G.D., Arlene Christina G. Sudha Devi Vilas, A. Tonapi (2017). Nutritional and Health Benefits of Millets. Indian council of Millets Resaearch,IIMR, Hyderabad

[13] Ravindran, G., (1992). Seed protein of millets: amino acid composition, proteinase inhibitors and in vitro protein digestibility. Food Chemistry. 44: 13-17

[14] Scrimshaw N.S., (2000). Prevalence, consequences and prevention of iron deficiency and iron deficiency anemia. International Micronutrient Conference; 2000 Jun 5-7; Quebec, Canada. Retrieved August 23,2000 from http://www.micronutrient.org/framesets/resources /res_usi.htm

[15] Stoltzfus, R,J. (2003). Iron deficiency: global prevalence and consequences. Food and Nutrition Bulletin, 24(4 suppl.),S99-S103.

[16] Stoltzfus, R.J., Kvalsvig, J.D., Chwaya, H.M., Montresor, A., Albonicao, M &, Tielsch, J.M. (2001). Effect of iron supplementation and anti helmenthic treatment on motor and language development of preschool children in Zanzibar: A double blind placebo controlled study. British Medical Journal, 323,1389.

[17] Swaminathan,M.S, (1999). Food Security in India in the 21st century, Proceedings of the Nutrition Society of India, vol 46, 1-10.

[18] Veena, B., Chimmad, B.V., Naik, R.K., Shantakumar, G., (2005). Physic – chemical and nutritional studies in barnyard millet. Karnataka J. Agril. Sci., 18(1): 101 – 105.

[19] Zubair, M.A., Rahman, M.S.,Islam, M.S., Abedin,M.Z and Sikder, M.A, (2015) .A Comparative study of the proximate composition of selected rice varieties in Tangail, Bangdalesh J. Environ. Sci. Natural Resources, 8 2:97-102.