

Formulation and Demonstration of High Nutrient Density Foods to Adhidraavidar Mothers

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ABSTRACT Low cost weaning foods namely *ladoo*, *kheer*, *halwa* and *puttu* were developed in the laboratory using germination and malting processes. The experimental formulations were based on germinated kodomillet, pulses (Green gram and Bengal gram) and roasted groundnut in the ratio of 75:25. All the formulations were evaluated thrice for their acceptability by a panel of judges using a hedonic scale. Nutrition education about weaning foods through demonstration method are given to the selected Adhidraavidar mothers and its impact was assessed. Results showed that all the experimental formulations were found to be acceptable obtaining moderately to extremely good scores ranging from 7.00 to 8.30. About 17.7 per cent increase in knowledge among the Adhidraavidar mothers was brought attained after the demonstration study about the weaning foods. Thus, the study helps to increase the nutritional knowledge about weaning foods among the selected Adhidraavidar mothers.

INTRODUCTION

Under nutrition is one of the major problems confronting infants and young children. Malnutrition is particularly prevalent in developing countries, where it affects one out of every three pre-school children (Sarni et al. 2009). The rate of malnutrition among children is very high. The majority are severely stunted and wasted, indicating a high prevalence of both chronic and acute malnutrition. Faulty feeding practices as well as lack of suitable weaning foods are responsible for under nutrition (Dutta et al. 2009). Weaning foods currently manufactured and used to meet the needs of growing children are made by roller drying or extrusion cooking of paste of cereal and legumes and are too costly to be afforded by the majority of the target population in the developing countries (Chakravarthi and Kapoor 2003). Simpler methods of making weaning foods using diverse and locally available raw materials which could be made available at low cost are necessary. Keeping in view, formulation and sensory evaluation of low cost high nutrient density food formulations was carried out in the laboratory along with the demonstration of the same to the selected Adhidraavidar mothers.

MATERIALS AND METHODS

Processing of Samples: The samples of Kodomillet, whole green gram and Bengal gram were purchased from the local market. These were washed and separately soaked in tap

water for 10 hours. Excess water was drained off and soaked grains were tied in wet muslin cloth separately for germination. The grains were allowed to germinate at room temperature in wet muslin cloth. The whole green gram and Bengal gram took 24 hours while Kodomillet took 48 hours to germinate. Germinated grains were dried at 60±% c for 7-8 hours. Germinated and ungerminated dried grains of Kodomillet, green gram and Bengal gram were milled into flour in a flour mill.

Preparation of High Nutrient Density Foods: Foods namely *Ladoo*, *Kheer*, *Halwa* and *Puttu* were formulated in the laboratories. The experimental formulations were based on germinated cereal (Kodomillet), pulses (green gram and Bengal gram) and roasted groundnut in the ratio of 75:25 while ungerminated Kodomillet formulations were treated as control. Developed recipes are given in Table1.

Sensory Evaluation: Developed products were evaluated thrice for their acceptability by a panel of 10 judges selected at random from Department of Food science, Periyar University, Salem. Judges were asked to score the products for appearance, flavour, texture, colour, taste and overall acceptability using a scorecard of 9-point Hedonic Rating Scale.

Demonstration Study: The demonstration of all developed high nutrient food formulations was carried out in Pallipatti village belonged to Salem District situated 10kms away from Salem Town. Fifty Adhidraavidar mothers with children less than 3 years were selected for the demonstration study. A questionnaire was de-

Table 1: Proportions of ingredients and methods of preparation of various products

Name of recipe	Description of recipe	Type and quantity of ingredients			
		Ungerminated ingredients with quantity (g)		Germinated ingredients with quantity (g)	
1. <i>Ladoo</i>	Roast, grind and sieve rice flakes and groundnut and made into flour. Flour was added and roasted. Jaggery syrup was prepared separately and ladoo's were prepared by using required amount of jaggery syrup.	KM	40	GKM	40
		KM+GG (3:1)	40	GKM+GGG (3:1)	40
		KM+BG (3:1)	40	GKM+GBG (3:1)	40
		Rice flakes	30	Rice flakes	30
		Jaggery	40	Jaggery	40
		Roasted groundnut	10	Roasted groundnut	10
2. <i>Kheer</i>	At the time of serving 150 ml milk was heated on the flame and 40 gram of ready to use mixture comprising of roasted flours, sugar and powdered groundnuts was added to milk and cooked till desired consistency.	KM	40	GKM	40
		KM+GG (3:1)	40	GKM+GGG (3:1)	40
		KM+BG (3:1)	40	GKM+GBG (3:1)	40
		Sugar	40	Sugar	40
		Groundnut (roasted powdered)	10	Groundnut (roasted powdered)	10
		Milk	150	Milk	150
3. <i>Halwa</i>	Sugar syrup was prepared. Oil was heated in a pan. Flour was added and roasted. Then powdered sugar and groundnuts were added and finally sugar syrup was added with continuous stirring and cooked till done.	KM	40	GKM	40
		KM+GG (3:1)	40	GKM+GGG (3:1)	40
		KM+BG (3:1)	40	GKM+GBG (3:1)	40
		Sugar	40	Sugar	40
		<i>Ghee</i>	10	<i>Ghee</i>	10
		Groundnut (roasted powdered)	10	Groundnut (roasted powdered)	10
4. <i>Puttu</i>	Roast the red gram dhal and power it. Mix it with the flour. Dissolve jaggery in water and strain through a muslin cloth. Made a batter of the flour and dhal power with the jaggery syrup. Steam cooks the batter on a piece of cloth. Mix it with the flour. Dissolve jaggery in water and strain through a muslin cloth. Made a batter of the flour and dhal power with the jaggery syrup. Steam cooks the batter on a piece of cloth.	Water	120	Water	120
		KM	40	GKM	40
		KM+GG (3:1)	40	GKM+GGG (3:1)	40
		KM+BG (3:1)	40	GKM+GBG (3:1)	40
		Redgram <i>dhal</i> (powder)	25	Redgram <i>dhal</i> (powder)	25
		Jaggery	25	Jaggery	25

Note:

KM	-Ungerminated kodo millet flour
GKM	-Germinated kodo millet flour
KM+GG	-Ungerminated kodomillet and Ungerminated Green Gram flour (3:1)
GKM+GGG	-Germinated kodo millet and Germinated Green gram flour (3:1)
KM+BG	-Ungerminated kodomillet and Ungerminated Bengal gram (3:1)
GKM+GBG	-Germinated kodomillet and Germinated Bengal gram (3:1)

veloped consisting of 7 demographic questions and 27 questions regarding high nutrient density foods. The final data was collected using the same questionnaire after 2 weeks of demonstration of the developed food formulations. The initial and final knowledge was tested using the formula

Gain in knowledge = Scores in post exposure test- scores in pre-exposure test

Statistical Analysis: The data was compiled and analyzed by using statistical method. ANOVA, mean SD was computed using statistical software SPSS version 14.0. Duncan's multiple range comparisons test was applied to determine the significant difference between the 24 variations of High Nutrient density foods

developed using germinated and ungerminated cereals and pulses and paired comparison test was used to find out the initial and final values of demonstration.

RESULTS AND DISCUSSION

The results of sensory evaluation of developed foods have been presented in Table 2. Regarding organoleptic evaluation of *ladoo*, it is clear from the Table 2 that for the attribute of appearance, KM *Ladoo* was found to get the maximum score of 6.90, followed by KM+GG getting a score of 6.50 and GKM, KM+BG, GKM+GBG got similar scores of 6.20 and minimum score was given for GKM+GGG. For

Table 2: Organoleptic evaluation of developed laddoo

Products	Appearance	Colour	Flavour	Texture	Taste	Overall acceptability
KM	6.90±0.73 ^a	7.50±0.90 ^a	7.60±1.64 ^b	7.40±0.84 ^{ab}	6.20±1.16 ^a	7.00±1.05 ^a
GKM	6.20±1.13 ^a	7.10±1.30 ^a	7.40±0.84 ^b	7.90±0.56 ^b	7.70±0.82 ^{bc}	8.00±1.81 ^{ab}
KM+GG	6.50±1.26 ^a	7.30±0.67 ^a	6.90±0.99 ^{ab}	7.40±0.96 ^{ab}	7.90±0.87 ^{bc}	7.10±1.28 ^{ab}
GKM+GGG	5.90±1.76 ^a	7.20±1.39 ^a	7.90±1.44 ^b	7.10±1.19 ^{ab}	7.40±1.50 ^b	8.30±0.67 ^b
KM+BG	6.20±1.31 ^a	7.80±0.42 ^a	6.10±1.50 ^a	7.10±1.19 ^{ab}	8.50±0.70 ^c	7.30±0.14 ^{ab}
GKM+GBG	6.20±1.03 ^a	7.80±0.78 ^a	8.00±0.18 ^b	6.70±1.63 ^a	8.30±0.67 ^{bc}	7.30±1.76 ^{ab}
F ratio	0.742	0.905	3.145	1.299	5.554	1.791
P value	0.125	0.179	0.090*	0.016*	0.000*	0.130

* The mean difference is significant at the .05 levels.

Values with same superscripts do not differ significantly on the application of Duncan's Multiple Range Test

the attribute of colour, KM+BG and GKM+GBG obtained high scores of 7.8 whereas GKM got least score of 7.1. For flavour attribute, GKM+GBG was found to be dominating with a score of 7.9 and KM+BG obtained low score of 6.1 texture attribute was found to be maximum for GKM of 7.9 followed by KM and KM+GG with scores of 7.4, GKM+GGG and KM+BG with scores of 7.1 and GKM+GBG of minimum score of 6.7. Taste attribute was found to be high for KM+BG with 8.5 and next comes GKM+GBG with 8.3 and low for KM with 6.2. The overall acceptability was greater for GKM+GGG with score of 8.3.

Duncan's test revealed that there was no significant difference between the attributes of appearance and colour. Regarding flavour, a significant difference was found between KM and BG, with KM, GKM, GKM+GGG and GKM+GBG. Texture attribute revealed that there was a significant difference between GKM+GBG with GKM, and it is clear from the taste attribute that there was a significant difference between KM, GKM+GGG and GKM+GBG and for overall acceptability, a significant difference was found between KM and GKM+GGG.

Priyanka and Usha (2004) observed that *laddoo* formulated using nutritious millets were found to be more acceptable compared to the cereal based *laddos*.

From the Table 3, organoleptic evaluation of *kheer* revealed that, GKM+GBG got maximum score of 7.80 and KM got minimum score of 6.6 and 6.9 for appearance, and colour attribute. For flavour and texture attribute, GKM+GBG got high score of 7.6 and KM+GG got least scores of 6.5 and 6.8. Taste attribute concluded that GKM+GBG got maximum score of 5.4, GKM and KM+GG got similar scores of 4.7 and KM+BG got minimum score of 3.6. Overall acceptability revealed that GKM+GBG got high score of 7.6, followed by KM+BG, GKM+GGG, KM+GG; GKM and low score was given for KM of about 3.6.

Duncan's test revealed that there was no significant difference between the attributes of appearance, colour, flavour and texture. A significant difference was found between KM+BG with GKM+GBG for taste attribute and regarding overall acceptability, a significant difference was found between KM, KM+GG with GKM+GGG, KM+BG and GKM+GBG.

Table 3: Organoleptic evaluation of developed kheer

Products	Appearance	Colour	Flavour	Texture	Taste	Overall acceptability
KM	6.50±0.52 ^a	6.50±0.52 ^{abc}	6.00±0.94 ^a	4.60±1.07 ^a	5.80±0.63 ^a	7.10±1.19 ^a
GKM	5.90±0.73 ^a	6.30±0.94 ^{ab}	6.40±0.84 ^a	5.60±1.07 ^b	6.10±0.73 ^a	7.00±1.49 ^a
KM+GG	6.20±0.91 ^a	6.10±0.73 ^a	7.00±1.24 ^a	5.90±0.73 ^b	6.00±0.66 ^a	7.30±0.82 ^a
GKM+GGG	6.30±0.94 ^a	5.80±0.78 ^a	6.20±1.31 ^a	6.00±1.15 ^b	5.80±0.63 ^a	6.60±0.69 ^a
KM+BG	7.70±0.94 ^b	7.00±0.81 ^{bc}	6.70±1.49 ^a	6.00±1.15 ^b	6.80±0.78 ^b	6.70±0.48 ^a
GKM+GBG	8.20±0.63 ^b	7.20±0.91 ^c	6.40±0.84 ^a	5.90±0.73 ^b	7.80±1.03 ^c	7.40±0.51 ^a
F-ratio	13.283	4.446	0.973	3.415	10.656	1.146
P-value	0.000*	0.002*	0.443 ^{ns}	0.009*	0.000*	0.348

* The mean difference is significant at the .05 levels.

Values with same superscripts do not differ significantly on the application of Duncan's Multiple Range Test

Table 4: Organoleptic evaluation of developed halwa

Products	Appearance	Colour	Flavour	Texture	Taste	Overall acceptability
KM	6.60±1.90 ^a	6.90±1.37 ^a	7.20±1.14 ^a	7.20±0.79 ^a	4.90±2.02 ^{ab}	3.60±1.65 ^a
GKM	7.40±1.26 ^a	7.30±0.95 ^a	7.40±1.26 ^a	7.30±0.95 ^a	4.70±1.49 ^{ab}	4.60±1.78 ^{ab}
KM+GG	7.10±1.20 ^a	7.20±1.14 ^a	6.50±1.72 ^a	6.80±1.32 ^a	4.70±1.06 ^{ab}	5.20±2.44 ^b
GKM+GGG	7.20±1.14 ^a	7.70±1.06 ^a	7.40±1.51 ^a	7.40±0.70 ^a	3.90±1.52 ^{ab}	7.10±1.60 ^c
KM+BG	6.90±1.45 ^a	7.40±1.43 ^a	7.50±1.51 ^a	7.10±1.20 ^a	3.60±1.51 ^a	7.40±0.52 ^c
GKM+GBG	7.80±0.92 ^a	7.80±0.92 ^a	7.60±0.70 ^a	7.60±1.26 ^a	5.40±1.43 ^b	7.60±0.52 ^c
F ratio	0.942	0.815	0.876	0.661	1.885	11.314
P value	0.085	0.135	0.115	1.147	0.050*	0.050*

* The mean difference is significant at the .05 levels.

Values with same superscripts do not differ significantly on the application of Duncan's Multiple Range Test

Kheer as a weaning food was also prepared by Kaur (1977) who reported that acceptability trials with infants (6 to 18) showed all the children who were served with *kheer* liked it.

Regarding organoleptic evaluation of *halwa*, it is clear from the above table that for the attribute of appearance, GKM+GBG has got the highest score followed by KM+BG with a score 7.70 (see Table 4). The least score 5.90 was obtained by GKM variations. For colour attribute, the maximum score was obtained by GKM+GBG followed by KM+BG with as score of 7.00 and is followed by KM, GKM, KM+GG with a score of 6.50, 6.30 and 6.10 respectively. The texture attribute was found to be high for GKM+GGG and KM+BG with a score of 6.00 and they were followed by KM+GG and GKM+GBG with a score of 5.90 and least score 4.60 is obtained by KM variety. The taste attribute was maximum for GKM+GBG with a score of 7.80 which is followed by KM+BG with a score of 6.80, and it is followed by GKM and KM+GG with scores of 6.10 and 6.00 respectively. The overall acceptability scores seems to be highest for GKM+GBG variety with a score of 7.40 and is followed by KM+

GG with a mean score of 7.30 and the least score 6.60 was obtained by GKM+GGG.

Duncan's test reveals that there was a significant difference between GKM+GBG and KM, GKM, KM+GG, GKM+GGG and also between KM+BG with KM, GKM, KM+GG and GKM+GGG. Regarding colour attribute there was a significant difference between KM+GG, GKM+GGG and KM+BG, GKM+GBG and also between GKM and GKM+GBG. Regarding flavor attribute there was no significant difference between the variations for texture attribute there exist a significant difference between KM and other varieties. The taste attribute was found to be significant between KM+BG with rest of the varieties and also between GKM+GBG with other varieties. Regarding the overall acceptability there was no significant difference between variations.

Bawa (2002) found that *halwa* formulated from carrot were organoleptically acceptable obtaining very good scores.

Regarding organoleptic evaluation of *puttu*, it is clear that for the attribute of appearance GKM+GBG has scored the highest value of

Table 5: Organoleptic evaluation of developed puttu

Products	Appearance	Colour	Flavour	Texture	Taste	Overall acceptability
KM	6.10±0.56 ^a	6.90±0.56 ^{ab}	6.40±0.51 ^a	6.20±0.42 ^a	7.80±0.42 ^c	6.80±0.42 ^a
GKM	7.20±0.42 ^b	7.40±0.69 ^{bc}	6.70±0.67 ^{ab}	7.20±0.42 ^b	8.80±0.42 ^c	6.90±0.31 ^a
KM+GG	7.80±0.42 ^c	8.00±0.47 ^{cd}	7.50±1.08 ^{bc}	7.20±0.42 ^b	9.00±0.00 ^c	7.80±0.78 ^b
GKM+GGG	8.00±0.00 ^c	6.60±0.69 ^a	7.50±1.43 ^{bc}	8.1±0.73 ^c	6.20±0.42 ^a	7.90±0.73 ^b
KM+BG	8.50±0.52 ^d	6.50±0.52 ^a	7.50±1.08 ^{bc}	8.30±0.67 ^c	6.70±0.67 ^b	8.30±0.67 ^b
GKM+GBG	8.60±0.51 ^d	8.50±0.97 ^d	7.80±1.03 ^c	8.00±1.33 ^c	8.30±0.67 ^d	7.70±0.82 ^b
F-ratio	42.807	14.116	2.940	11.307	53.668	8.162
P-value	0.000**	0.000**	0.020*	0.000**	0.000**	0.000**

** The mean difference is significant at the .01 levels.

*The mean difference is significant at the .05 levels.

Values with same superscripts do not differ significantly on the application of Duncan's Multiple Range Test

8.60, and is followed by KM+BG with a score of 8.50 and is followed by GKM+GGG with a score of 8.00 and the least score 6.10 is obtained by KM. Regarding the colour attribute the maximum score 8.50 was obtained by GKM+GBG, and is followed by KM+GG with a score of 8.00 and the least score 6.50 was obtained by KM+BG. The flavor attribute score 7.80 was maximum for GKM+GBG variety, and least score 6.40 is obtained by KM variety. Regarding the texture attribute, the maximum score was obtained by KM+BG variation followed by GKM+GGG variation with a score of 8.1. The least score 6.20 is obtained by KM variety. Regarding the taste attribute the maximum score 9.00 was obtained by KM+GG variety followed by GKM and GBG variety with a score of 8.80 and 8.30 respectively and the least score 6.20 was obtained by GKM+GGG variety. The overall acceptability score was maximum for KM+BG variety followed by GKM+GGG variety with a score of 7.90 and is followed by KM+GG variety with a score of 7.80. The least score 6.80 is obtained by KM variety.

Duncan's test revealed that there exists a significant difference between KM and the rest of the varieties and also GKM and the rest of the varieties, GKM+GGG with other varieties except KM+GG, KM+BG with other varieties except GKM+GBG regarding appearance attribute. The colour attribute shown that there exists a significant difference between KM and KM+GG, GKM+GBG and also the significant difference exists between GKM+GGG and GKM, GKM+GBG, KM+GG, and the significant difference exists between GKM and KM+BG, GKM+GBG and also between KM+GG AND KM+BG. Regarding the flavor attribute, the significant difference exists between KM and KM+GG, GKM+GGG, KM+BG, GKM+GBG and also between GKM and GKM+GBG. The texture attribute has shown that there exists a significant difference between KM and rest of the variation and between (GKM and KMGG) with KM, GKM+GGG, KM+BG, GKM+GBG, the significant difference for taste attribute exists between KM and rest of the variations, GKM and KM+GG has significant difference with other variations GKM+GGG has significant difference between KM+BG and GKM+GBG and also between KM+BG and GKM+GBG. The overall acceptability attribute has shown that significant difference exists between KM, GKM and KM+GG, GKM+

GGG, KM+BG, GKM+GBG. Arora (1999) formulated same preparation and reported that ungerminated dalia received less scores in comparison to germinated preparations.

Demographic Profile of the Selected Mothers

Nearly 22 per cent of the mothers were in the age group of 15-20 years. About 34 per cent of the mothers were in the age group of 21-25 years about 44 per cent of the mothers were in the age group of 26-30 years.

About literacy rate, 42 per cent of the mothers were educated up to primary school level, 22 per cent and 4 per cent of the mothers were educated up to high school and graduate level respectively.

Results on type of the family showed that 70 per cent of mothers belonged to nuclear families and about 30 per cent of the mothers were in joint families. According to Mosha (1990), most of the mother respondents belonged to nuclear families (90 per cent) and two-thirds of the mothers were illiterate.

The working status of the selected mothers revealed that 24 per cent of the mothers were in sedentary work, 56 per cent of the mothers were in moderate work and 20 per cent of the mothers were in heavy work category.

About dietary pattern, 24 per cent of mothers were vegetarians and about 76 per cent of the total selected were in non-vegetarian dietary pattern.

In case of income group, 76 per cent of the mothers belonged to economically weak section, 38 per cent of the mothers were in low income group, 6 per cent of the mothers were in middle income group.

Nearly 12 per cent of the mothers spent 20-40 per cent of their monthly income for food, 28 per cent of the mothers spent about 41-60 per cent of the income for their food, 40 per cent of the mothers spent 61-80 per cent of their income on food and about 20 per cent of mothers spent above 81 per cent of their monthly income as their food expenditure.

Impact of Demonstration Study on Nutritional Knowledge of the Selected Adhidravidar Mothers

Gain in knowledge = Score in Post exposure test - Scores in pre-exposure test

Scores in post-Post- exposure test = 82.1
 Scores in Pre- exposure test = 64.4
 percent
 Gain in knowledge by the mothers = 17.7
 percent

The gain in the mean percent knowledge level of the selected Adhidraavidar mothers after demonstration of the developed food was about 17.7 percent. Thus, significant increase in knowledge among the Adhidraavidar mothers was brought about through the demonstration study.

The limitation in the present study is no nutrient analysis and toxicity tests were carried out for the formulated high nutrient density foods.

CONCLUSION

Thus, the study concluded that germinated grain flour high nutrient density food formulations were more acceptable compared to control products made from ungerminated grain flour. About the nutritional knowledge test the scores of pretest and post exposure stages were compared which was found to be increased than the initial value. Thus, this study helps in increasing the nutritional knowledge about the high nutrient density foods to the selected Adhidraavidar mothers to combat malnutrition among their children.

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REFERENCES

- Arora M 1999. *Protein and Starch Digestibility of Products Prepared from Germinated Cereal and Legume Flour*. M.Sc. Thesis. Ludhiana: Punjab agricultural University.
- Bawa AS 2002. Studies on dehydration of grated carrots. *Journal of Food Science and Technology*, 39: 268-271.
- Chakravarthi S, Kapoor R 2003. Development of a nutritious low viscosity weaning mix using natural ingredients and microbial amylases. *Int J Food Sci Nutr*, 54: 341-347.
- Dutta A, Pant K, Puthia R, Sah A 2009. Prevalence of undernutrition among children in the Garhwal Himalayas. *Food Nutr Bull*, 30(1):77-81.
- Kaur P 1977. *Study on the Nutritive Value of Triticale and the Effects of Its Supplementation to Wheat and Bengal Gram Flour*. M.Sc. Thesis. Ludhiana: Punjab Agricultural University.
- Mosha, AC 1990. The acceptance and intake of bulk reduced weaning foods. *Food Nutr Bull*, 12: 69-74.
- Priyanka K, Usha S 2004. Impact of supplementation of quality protein maize based ladoos on the nutritional status of pregnant women. *The Ind J Nutr Dietet*, 41: 528-535.
- Sami RO, Carvalho MF, Monte CM, Albuquerque ZP, Souza FI 2009. Anthropometric evaluation, risk factors for malnutrition, and nutritional therapy for children in teaching hospitals in Brazil. *J Pediatr (Rio J)*, 85(3): 223-228.