Research Article

An Evaluation of Ready-to-Cook *Dalia* Mixes Formulated for Preschool Children

Sujata Sethy[1]* and Renu Mogra[2]

[1]Krishi Vigyan Kendra, ICAR-National Rice Research Institute, Cuttack, Odisha
[2]Department of Food Science and Nutrition, College of Community and Applied Sciences, MPUAT, Udaipur, Rajasthan

Abstract

Multi-grain *dalia* premixes were formulated with an aim to provide protein-calorie rich food options for preschool children combating dual burden of malnutrition. Four types of *dalia* premixes were formulated from different proportion of grains. These premixes were evaluated for organoleptic parameters and the selected premix was evaluated for nutritional composition as well as shelf life. Results of organoleptic evaluation showed that all the *dalia* mixes were found to be well accepted and T2 was found to be the best and the values differ significantly ($p<0.05$) in all the parameters**.** Protein and energy content of *dalia* mix was estimated to be 17.24 percent and 381.37 kcal per 100g of premix and was rich in other parameters like fibre and minerals. Moisture content and peroxide value of developed premix though increased was within the permissible limit during 90 days of storage. Organoleptic evaluation of the formulated premix showed good acceptability scores across the storage period.

Keywords: Evaluation, Ready-to-Cook *Dalia*, Combating, Malnutrition

***Correspondence**
Author: Sujata Sethy
Email: sujata.sethy@gmail.com

Introduction

Protein-energy malnutrition among children is the major health challenges in developing countries [1]. This nutrition problem is ascribed to the inappropriate complementary feeding practices, low nutritional quality of traditional complementary foods and high cost of quality protein-based complementary foods [2]. It is evidence that high prevalence of deaths each year among children aged less than five years old in the developing world is associated with malnutrition [3]. The interaction of poverty, poor health and poor complementary feeding practices has a multiplier effect on the general welfare of the children population and also contributes significantly towards growth retardation, poor cognitive development, illness and death amongst children in developing countries [4, 5]. It is well known that high cost of fortified nutritious proprietary complementary foods in many parts of developing countries is always beyond the reach of most families [6]. Hence many families depend on inadequately processed and low-quality traditional complementary foods to wean their children.

Fortified nutritious commercial complementary foods are unavailable especially in the rural areas and where available, they are often too expensive and beyond the reach of most of families in developing countries. Therefore, most complementary foods used are locally produced and based on local staple foods, usually cereals that are processed into porridges. Among the other determinants of malnutrition, introduction of supplementary feeding with proper time, quality and quantity plays an important role. Children are facing an absence of healthy food options, or in 'food swamps', confronted with an abundance of low-quality food with high-calorie, low-nutrient, processed foods cause the greatest risk of all forms of malnutrition. The use of local foods formulated in the home and guided by the following principles i.e. high nutritional value to supplement breastfeeding, acceptability, low price and use of local food items [7, 8]. So that young children's mothers can formulate the food at their home level and can feed the child without disturbing the child's daily food consumption pattern. To combat the nutritional problem, viable and sustainable strategies like multi-grain premixes as home-scale fortification were formulated incorporating locally available pulses, millets and oil seeds with the staple food by applying simple home-scale processing technologies.

Dalia is made by milling or grinding the grains coarsely so that the refining process doesn't occur making the food more nutritious. It is a traditional breakfast cereal of north India, usually prepared from wheat and generally consumed by infants, young children, elderly people, and health-conscious consumers. Multi-grain approach is a most common and convenient way of formulating the desired quality of formulations because of the supplementary effect of different nutrients from the combination of different grains making the end product more nutritious at the same time rich in other healthy constituents. Multi-grain foods often have three to five different grains but can have up to twelve different grains [9]. The addition of cereal, millets, pulses, and oilseed makes the *dalia* wholesome and rich in

protein-calorie as well as other nutrients required for the child below five years of age. Hence, this present study was carried out with an objective to develop protein and energy dense multigrain *dalia* mix suitable for pre-school children.

Material and Methods

Procurement and processing of raw materials

Based on the local availability, nutrient content and cost, ingredients like wheat, pearl millet, sorghum, finger millet, green gram dal, masoor dal, grain amaranth and ground nut were procured in one lot, cleaned and dried properly. According to the grain type ingredients were pounded and ground into small grits. Grits of above ingredients were blended and four combinations of *dalia* premixes were formulated to achieve the nutritional requirement for children below five year.

Standardization of dalia mixes

Standardization of foods is very important aspect of product development as it enables one to predict and control the quality as well as quantity of final product. The *dalia* premixes were prepared in the food laboratory of department of Food Science and Nutrition, College of Community and Applied Sciences, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan (Plate 1 to 10). Premixes were planned considering 100g of product would provide about 1/3rd of the Recommended Daily Allowance (RDA) of protein and calorie. To standardize the recipe ingredients were blended in four combinations i.e. T1: Wheat grits: sorghum grits: Masoor dal: Groundnut grits (40:20:30:10), T2: Wheat grits: Pearl millet grits: Green gram dal: Groundnut grits (40:20:30:10), T3: Wheat grits: Sorghum grits: Green gram dal: Grain amaranth (30:20:30:20), T4: Wheat grits: Finger millet grits: Masoor dal: Grain amaranth (40:20:30:10) (Plate 1 to 10). A series of preliminary trials were carried out and the standardized recipes were subjected to organoleptic evaluation. Organoleptic evaluation was carried out using a panel of 10 trained judges drawn from staff and students of the department and scored the samples for colour, flavour, taste, texture, appearance and overall acceptability using a score card on 9-point hedonic rating scale developed by Larmond [10].

Titration for protein estimation

Ashing for fibre estimation

Fat estimation

Digestion of samples for mineral estimation

Plate 1-10 Chemical analysis and standardization of recipes

Chemical analysis and shelf life study of developed premix

The highest acceptable premix selected based on organoleptic evaluation was weighed, homogenized and oven dried at 60° C. Dried samples were stored in air tight plastic bags for further study. Estimation of proximate composition i.e. moisture, protein, fat, fibre, ash, carbohydrate, energy and estimation of minerals i.e. iron, calcium and phosphorus were done by using standardized methods by AOAC [11]. To assess the shelf life of formulated premix, the products were packed in High density polyethylene pouches, heat sealed and stored at ambient temperature for a period of three months. The samples were drawn once in a month for evaluation of quality in terms of sensory and biochemical parameters viz., moisture and peroxide value. Estimation of moisture and peroxide value was carried out using standard methods of AOAC [11].

Statistical analysis

All the analysis was performed in replications and the results were presented as mean ± standard deviation (SD). Analysis of variance (ANOVA) and critical difference (CD) was applied to compare organoleptic parameters using SPSS 16 software.

Result and Discussion

Organoleptic evaluation

Four types of *dalia* premixes were formulated using different types of millets, pulses and oilseed with wheat *dalia* and their acceptability was studied through organoleptic evaluation. Results of organoleptic evaluation of *dalia* prepared from four types of *dalia* premixes were presented on **Table 1**. It was revealed that though all the treatments were scored in between "like moderately" to "like very much", T2 obtained the highest scores with respect to colour (8.5±0.52), flavour (8.6±0.51), taste (8.7±0.48), texture (8.4±0.51), appearance (8.3±0.48) and overall acceptability (8.4±0.51) when compared to other counter parts and the values differ significantly ($p<0.05$) in all the parameters**.** Therefore, the premix formulated with Wheat grits, Pearl millet grits, Green gram dal and Groundnut grits in the proportion of 40:20:30:10 (T2) was selected for further study. In a study quick cooking multigrain *dalia* was developed using wheat, barley, sorghum and pearl millet in different proportion and the mean sensory scores for all the sensory attributes of all MGD samples were more than 7 and all the samples were well accepted by the panellist for all the sensory characteristics [9]. Several researchers also formulated supplementary foods with multiple with

roasted flours of wheat, soybean and chickpea flour [12], with wheat, barley, green gram and jaggery [13] using household technologies like roasting, malting and blending.

Table 1 Mean organoleptic scores of *dalia* mixes

Treatments	Colour	Flavour	Taste	Texture	Appearance	Overall Acceptability
T1	8.0^{b}±0.66	8.3^{b}±0.48	8.0^{b}±0.66	7.7^{c}±0.48	8.1^{b}±0.56	8.1^{b}±0.56
T2	8.5^{a}±0.52	8.6^{a}±0.51	8.7^{a}±0.48	8.4^{a}±0.51	8.3^{a}±0.48	8.4^{a}±0.51
T3	7.7^{c}±0.48	8.4^{b}±0.51	8.1^{b}±0.56	8.0^{b}±0.66	7.9^{c} ±0.56	8.0^{b}±0.47
T4	7.3^{d}±0.48	7.6^{c}±0.51	7.7^{c}±0.67	7.5^{d}±0.52	7.5^{d}±0.52	7.6^{c}±0.51
SE	0.08	0.07	0.09	0.08	0.08	0.07
CD (0.05)	0.16	0.15	0.17	0.16	0.15	0.15

Mean±SD with different notation (a, b, c and d) indicates significant difference at 5% level.

Nutritional evaluation

Composition of proximate and minerals of the formulated premixes is presented in **Table 2**. The data indicated that moisture, total ash, fat, fibre and carbohydrate content of *dalia* premix was found to be 8.17, 2.37, 5.73, 1.28, 65.21 per cent respectively. Protein and energy content of *dalia* mix was17.24 g and 381.37 kcal per 100g of premix. Mineral content of the formulated premix was found to be 58.30, 3.42 and 319.21 mg/100g for calcium, iron and phosphorus respectively. Protein-calorie rich *dalia* premix meet the BIS specification for all the components like moisture (max. 10%), crude protein (min. 14%), total ash (max. 5%), crude fat (max. 7.5%), crude fibre (max. 5%), and carbohydrate (min. 45%) for cereal based complementary food [14]. When grains mixed together, because of the supplementary effect of different nutrients from the combination of grains make the end product more nutritious at the same time rich in other healthy constituents. It was reported that incorporation of whole grain non-wheat flours from different grains improved the nutritional quality of flour [15].

Table 2 Proximate and mineral composition

Nutrient compositions	*Dalia* mix	**BIS specification
Moisture (%)	8.17±0.03	max. 10%
Total ash (%)	2.37±0.03	max. 5%
Crude protein (%)	17.24±0.11	min. 14%
Crude Fat (%)	5.73±0.06	max. 7.5%
Crude Fibre (%)	1.28±0.05	max. 5%
Carbohydrate (%)	65.21±0.25	min. 45%
Energy (Kcal)	381.37±1.10	-
Calcium (mg/100g)	58.30±0.20	-
Iron (mg/100g)	3.42±0.08	-
Phosphorus (mg/100g)	319.21±0.05	-

*BIS (Bureau of Indian Standard), 2006 - Guideline for cereal based complementary foods

Shelf life study of developed premix

Effect of storage on organoleptic parameters of formulated premix

Effect of storage for 90 days on organoleptic parameters of developed protein-calorie rich premixes at ambient temperature was analysed and results **Table 3** showed that in *dalia* mix initial mean scores for colour, flavour, taste, texture, appearance and overall acceptability were 8.5, 8.6, 8.7, 8.4, 8.3 and 8.4 respectively. The mean scores were found to be decreased significantly (P 0.5) for all sensory parameters as the storage period advanced. The mean sensory scores for overall acceptability scores for *dalia* mix sample was decreased ≥ 8 i.e. in the hedonic category of liked very much to ≥ 7 liked moderately after the 90 days of storage. The data indicated that though scores were found to be decreased after storage of three months, the premix was found to be organoleptically acceptable at the end of storage period. Results are in conformity with the observations made by Itagi *et al* [16] in *halwa* mixes developed from multigrain mixes of cereals, millets, legumes, nuts and condiments and reported significant change in the specific sensory attributes for all the four samples during storage study under ambient condition about 6 months (180 days) of shelf life.

Table 3 Effect of storage on organoleptic parameters of formulated *dalia* mixes

Attributes	Colour	Flavour	Taste	Texture	Appearance	Overall Acceptability
0 day	8.5 [a]±0.52	8.6 [a] ±0.51	8.7 [a] ±0.48	8.4 [a] ±0.51	8.3 [a] ±0.48	8.4 [a] ±0.51
30 days	8.3 [b]±0.48	8.2 [b] ±0.78	8.7 [a] ±0.48	8.1 [b] ±0.56	8.1 [b] ±0.56	8.2 [b] ±0.63
60 days	8.3 [b] ±0.48	8.0 [b] ±0.66	8.5 [b] ±0.52	7.9 [c] ±0.56	8.0 [b] ±0.47	8.0 [c] ±0.66
90 days	8.1 [c]±0.56	7.9 [b] ±0.73	8.4 [b] ±0.51	7.6[d]±0.51	7.9 [b] ±0.56	7.9 [c] ±0.56
SE	0.07	0.10	0.07	0.08	0.07	0.08
CD (0.05)	0.15	0.20	0.14	0.15	0.15	0.17

Mean±SD with different notation (a, b, c and d) indicates significant difference at 5% level.

Effect of storage on moisture and peroxide value of formulated mixes

During storage, moisture and peroxide value of developed premixes were studied and presented in **Figure 1** and **2**. It was observed that moisture content of formulated *dalia* premix was found to be 8.17 to 8.36 percent from 0 days to 90 days. The increase in moisture content was slow and within the permissible limit and values differ significantly. Nagi *et al* [17] observed that the gain in moisture content during storage might be due to hydroscopic nature of food products, storage environment (relative humidity and temperature) as well as nature of packaging material used.

Lipid peroxidation in foods which results in the development of off flavour in low moisture condition is the major cause of rejection of processed foods by the consumer. Effect of storage studies for 90 days on peroxide values of developed premixes at ambient temperature was analysed and perusal of results showed that initially peroxide value was not detected in *dalia* mix. With advancement of storage period, peroxide value in *dalia* mix was found to be 1.12 to 4.10 meq/kg during 30 days to 90 days of storage and within the permissible limit i.e. peroxide value should not exceed 10meq/kg of extracted fat [18] even after storage period of three months. The progressive increase in peroxide value during storage could be attributed to degradation of fat and oxidation of fat leads into formation of peroxides.

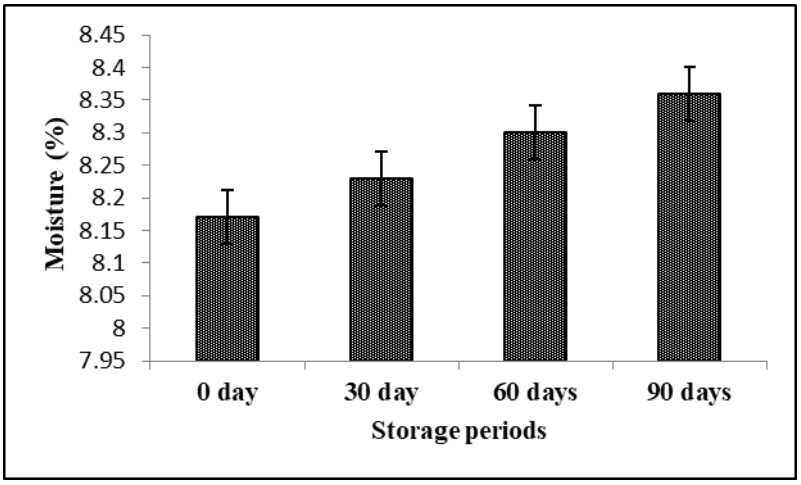

Figure 1 Effect of storage on moisture

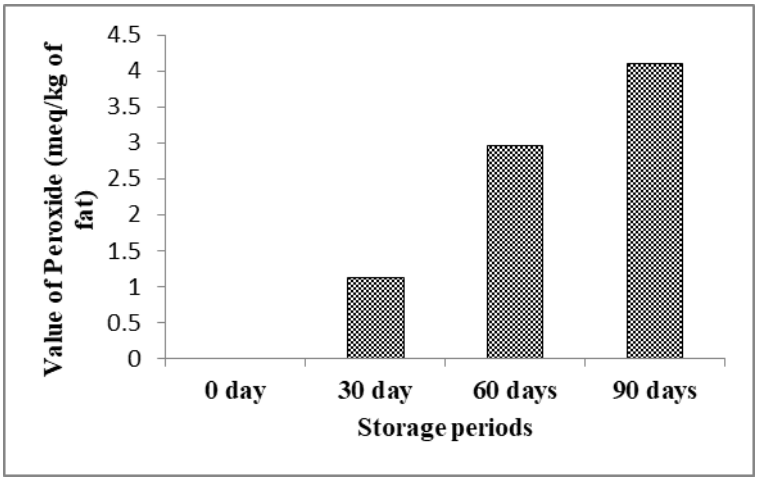

Figure 2 Effect of storage on Peroxide value

Conclusion

The multigrain *dalia* premix formulated in the present study was based on locally available inexpensive food materials that can be affordable even by the people of low economic status. The developed premix has promising nutritional attributes with significantly increased levels of protein, energy, fat, fibre and minerals and in accordance with BIS standards. Multigrain *dalia* premix can be stored for more than a period of three months with better organoleptic scores. Peroxide value, though increased during storage, was within permissible limit. The processing techniques were simple and affordable at the household level. Hence, *dalia* premix can be promoted for improving the health and nutritional status of children, thereby preventing the dual burden of malnutrition among children below five years of age i.e. occurrence of undernutrition as well as obesity.

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