International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(2): 2193-2196

Received: 04-01-2019
Accepted: 08-02-2019

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Development of low-cost supplementary food and assessment of nutritive value and shelf life

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Abstract
Fortified food products are helpful to fight malnutrition. Local produce cost less and had a socio-cultural acceptance amongst population. On the basis of the collected data about the food habits, meal pattern and food type consumed, nutritional status of the target group was analyzed using standardized proximate principle table of the Indian Council of Medical Research and compared with the recommended dietary allowance for the target group. On the basis of the above comparison, nutritional deficiency of the respondents was assessed and need based supplementary food products were developed utilizing the locally available farm produce, which supplemented the required nutrients to the target group at affordable prices. Shelf life of fortified laddu was 21 days where as shelf life of fortified mathari was 31 days.

Keywords: soybean, shelf life, nutritive value, food acceptance, acceptability test, fortification

Introduction
Man needs adequate food for growth, development and wellness which one chooses from the wide range of food available in the vicinity. Nutritional quality of these foods differs from each other which affect human health. Cost of food plays an important role in food preference. Since source of protein food is more expensive in comparison to sources of carbohydrate large population with poor economic condition is compelled to depend upon carbohydrate base diet instead of balanced diet which includes protein sources also. Because of this reason children are also forced to eat low protein diet resulting into protein energy malnutrition.

One's ability to choose nutritionally appropriate alternative from the range of available food plays important role in meeting the nutritional need and satisfying hunger. Dietary habits of the population determine the selection of food from the nature's basket which develops over a time, resulting from interaction of man with the environment. Hence, preference for food and its preparation differs according to agro-climatic zones and the environment.

Dietary habit is evolved after good deal of trial and error for long duration of time based upon the satiety value, edibility and safety. Though satiety is the primary criteria for food intake but it is not a safe guide for the selection of healthy food. To build and sustain good health and lead active life, diet should be planned on sound nutritional principles. This study was conducted in order to find out the nutritional status of rural children followed by development of food supplement according to their nutritional needs. The study also included the study of shelf life of the developed food products, utilizing the local farm produce to ensure a quality check for food safety and affordability for the economically weaker section also.

The study was carried out with following objectives:

- To develop a need-based food supplement for the respondents, utilizing locally available farm produce.
- To study the acceptance of the developed food supplement amongst the respondents.
- To study the shelf life of the accepted food supplements.

Materials and Methods
The study was carried in Osmanabad district, Madhya Pradesh. It comprised of 2 sub-division, 7 Tehsils, 7 Block, 11 Towns and 983 villages. Schools going rural children of 7-12 years of age groups were selected. To collect the data about socio-economic and nutritional status of the respondents, the target group was interviewed through standard tools and the collected data was analyzed.

On the basis of the collected data (Regarding the food habits, meal pattern and food type consumed) nutritional status of the target group was analyzed using standardized proximate principle table of the Indian Council of Medical Research and compared with the recommended dietary allowance for the target group.

On the basis of the above comparison, nutritional deficiency of the respondents was assessed and need based supplementary food products were developed utilizing the locally available farm produce, which supplemented the required nutrients to the target group at affordable prices.

Food acceptance study and shelf – life study

For the supplementary food products, food acceptance study was conducted. The products were evaluated by sensory test involving the respondents and the most accepted food products were chosen for further study.

To find the storage condition in which a food product can be kept for longest interval of time, shelf life study was conducted at 0, 10days, 20 days, 30 Days and 40 days interval. Food products were kept in the simple metallic containers at two different temperatures and relative humidity conditions i.e. high humidity, low temperature and low humidity, high temperature condition. The shelved food products were sensory evaluated by the panel of trained experts.

Results and Discussion

Table 1: Difference between the recommended dietary intake and the mean value of essential nutrients consumed by the children of Hoshangabad

Nutrients	RDI	Mean Intake	Difference	Percentage (%)
Energy (KCal/d)	1950	1243.09	-706.91	-36.25
Protein (g/d)	41	36.93	-4.07	-9.92
Calcium (mg/d)	400	215.69	-184.31	-46.07
Iron (mg/d)	26	15.48	-10.52	-40.46

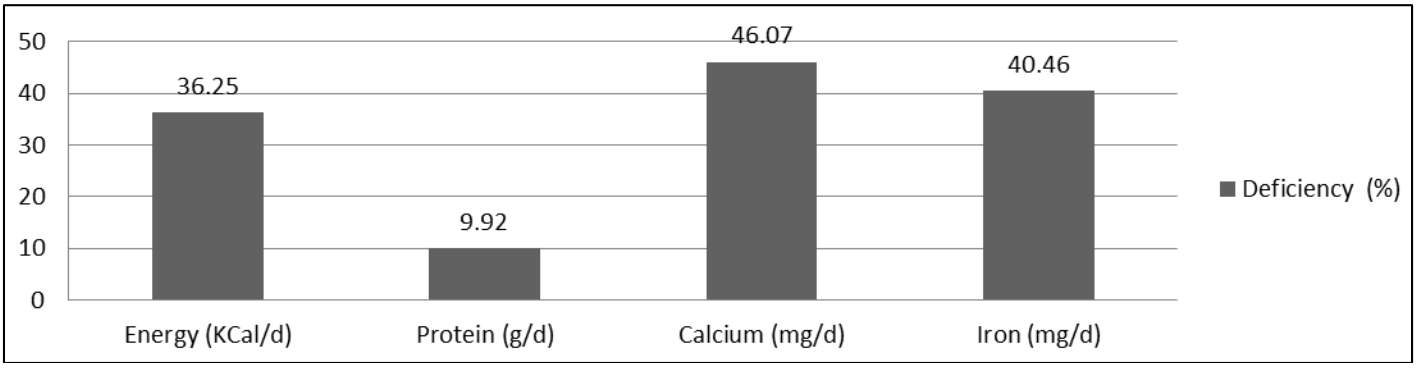

Table 1: Difference between the recommended dietary intake and the mean value of essential nutrients

Data in Table 1 shows the difference between the recommended dietary intake and the mean value of nutrients consumed by the children. It is evident from the table that children consumed much less than the recommended dietary allowances of ICMR. The difference for energy was found to be -706.91 KCal/d, for protein - 4.07 g/d, for calcium - 184.31mg/d and for iron-10.52 mg/d. The difference in energy intake, calcium and iron were significantly lower. In the table (-) sign shows deficient amount of nutrients.

A child between 7 to 9 years of age is a developing child with the development of bone and teeth. Gopalan (1996) stated that calcium is required for the formation of skeleton and teeth. Deficiency of calcium by 46.07 per cent could lead to weak skeleton and teeth of the child. He further added that deficiency of iron by 40.46 per cent could lead the children to anemia, as iron is an essential element for the formation of hemoglobin of red cells of blood and plays an important role in the transport of oxygen.

Table 2: Amount of ingredients in developed fortified local foods

Developed Local food	Amount (g)					
	Wheat	Soybean	Oil	Jaggery	Sugar	Total Weight (g)
Fortified Sattu	60	28	05	-	-	93
Fortified Matharee	06	25	04	-	-	35
Fortified Laddu	-	50	10	-	15	75
Fortified Laddu- sev	-	43	06	35	-	84
Fortified Panjiri	57	25	04	-	05	91

The data in table 2 shows amount of ingredient utilized for development of supplementary local food. Five food products were identified ie Sattu, Matharee, Laddu, Laddu made of Sev, and Panjiri which are widely eaten by the rural children were chosen for fortification to supplement the deficient nutrient in the daily diet of the children. Sattu, Panjiri, Laddu, Laddu (Sev) and Mathari are very popular snacks eaten by children in rural area which are sweet in taste except Mathari which is salty. These widely eaten food products were fortified by processed soybean which is inexpensive and more nutritious food source than the other sources of protein, energy, calcium and iron. Developed food products were fortified sattu, fortified mathari, fortified laddu, fortified laddu (Sev) and fortified panjiri to cater the requirement of recommended dietary allowances for the target group. Entire recipes were locally prepared by fortification with soybean to supplement the deficiencies as Soybean contains 43.2 g high quality protein apart from 20.9 g Carbohydrate, 19.5 g Fat,

240 mg Calcium and 10.4 mg Iron per 100g weight. Soybean contains all the eight essential amino acids. Apart from being nutritious, it is the cheapest source of protein available (Mandi Board: 1.04.2015). The amounts of ingredients were adjusted according to the need of the target group. Highest amount of soybean was used in Fortified Laddu (50 gms) followed by Fortified Laddu –sev (43 gms) and Fortified sattu (28 gms)

Table 3: Nutritive value of developed supplementary food products

Developed Food Products	Amount (g)	Energy KCal/d)	Protein (g/d)	Calcium (mg/d)	Iron (mg/d)	Servings Required
Sattu	93	370.56	20.22	96	5.85	2
Matharee	35	164.46	11.526	62.88	2.894	4
Laddu (plain)	75	365.7	21.61	121.8	5.22	2
Laddu (sev)	84	373.81	18.71	131.2	5.39	2
Panjiri	91	370.21	17.69	88.32	5.4	2

Data in table 3 presents the nutritive value of the various supplementary food products developed. It shows that Laddu (sev) serves the highest energy and calcium, whereas laddu (plain) serves highest amount of protein and sattu serves highest amount of iron amongst all. All the products require 2 servings per day to fulfill the nutritional need of the target group except Matharee which required 4 servings per day. According to WHO the dietary management of children with moderate acute malnutrition is based on the optimal use locally available foods to improve nutritional status and prevent the condition from deteriorating to severe acute malnutrition. In situation of food storage, or where some nutrients are not sufficiently available through local food, supplementary foods have been used to treat children with moderate acute malnutrition.

Table 4: Food Products Consumed by the Children for Acceptability Test

Food product	Mean Value		
	Amount Served (g)	Amount Left (g)	Amount Consumed (g)
Fortified Sattu	100	30g	70g
Fortified Panjiri	100	36g	64g
Fortified Laddu	100	45g	55g
Fortified Laddu (sev)	100	3g	97g
Fortified Mathari	100	10g	90g

Data in table 4 shows the mean value of the amount of food products served, amount left and amount consumed by the children for acceptability test. Hundred grams each of the five developed food products was served to the children for acceptability test. As per amount of food product consumed, fortified laddu (sev) was the most preferred food product (97g) followed by fortified Mathari (90g).

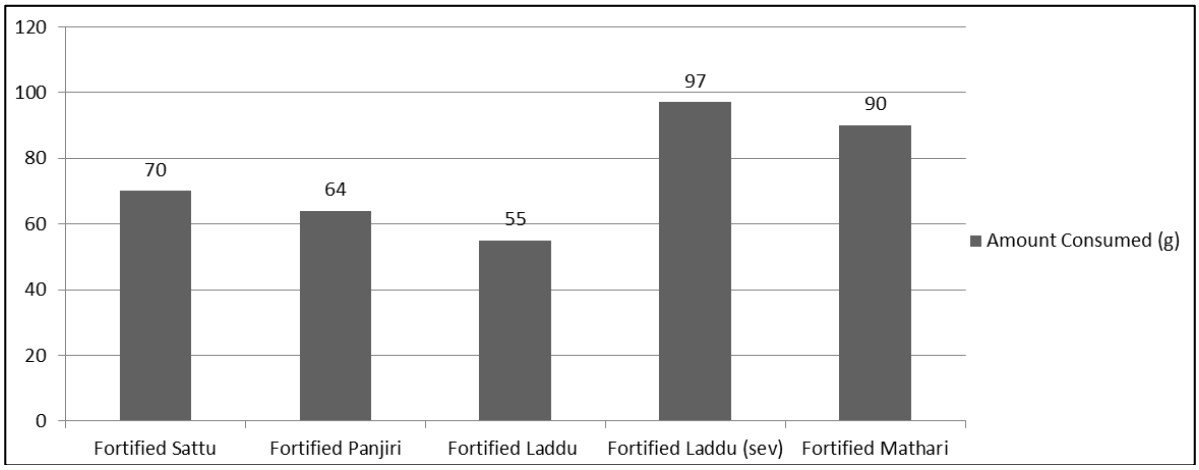

Table 2: Acceptiblility of the Food Products

Table 5: Shelf Life of Food Products

Days after Preparation	Fortified Laddu (sev)		Fortified Mathari	
	Standard Plate Count in PDA	Free Fatty Acid Content (%)	Standard Plate Count in PDA	Free Fatty Acid Content (%)
01	Nil	0.49	Nil	0.51
10	Nil	0.60	Nil	0.74
20	Nil	0.96	Nil	0.99
30	Nil	1.29	Nil	1.19
40	Nil	-	Nil	1.27

*Percentage of Free Fatty Acid should not be more than 1.25%.

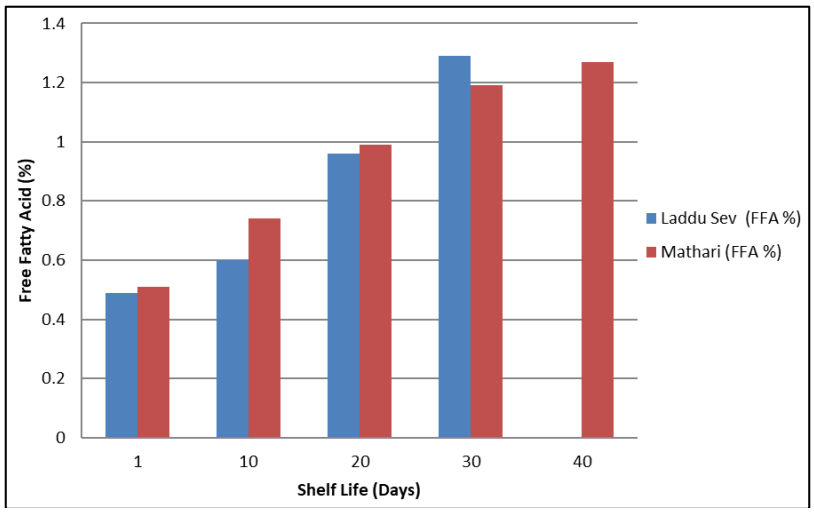

Table 3: Shelf Life of Food Products

Shelf life study of developed and two most accepted supplementary food products was conducted by microbial analysis and biochemical analysis. Data in Table 5 shows that no microbial growth was seen in fortified laddu (sev) and fortified mathari till 40th day of storage.

For microbiological analysis, standard plate count of fortified laddu (sev) and fortified mathari was done on 1st, 10th, 20th, 30th and 40th day. No microbiological colonies were recorded till 40th day. Non-development of microbiological colonies may be due to presence of oil in the food products, which hinders the microbiological growth. Another reason for non-development of microbiological colonies may be due to presence of low moisture in the food products.

Data on shelf life study by analyzing FFA shows the increase in free fatty acid content in percentage against number of days, for fortified laddu (sev) and fortified mathari. It also shows that shelf life of fortified laddu (sev) is 20 days (0.96% FFA) and shelf life of fortified mathari is 30 days (1.19% FFA) as percentage of Free Fatty Acid should not be more than 1.25 in any edible product (Potter). Since biochemical deterioration of fortified mathari was recorded on 40th day only, and the food product became unsafe for human consumption, therefore, the standard plate count of fortified laddu (sev) was not done after 40th day. For fortified laddu (sev), free fatty acid test was done on 1st, 10th, 20th and 30th day. Free fatty acid content on 20th day was 0.96% and on 30th day value of free fatly acid content increased to 1.29% i.e. more than reference point (1.25%); hence the shelf life of fortified laddu was recorded as 20 days.

Conclusion

Developed and accepted fortified food products can be distributed in the mid day meal programme run by the government in the schools which will help in providing tasty and nutritious food to the students and hence in increasing their attendance in the class. Self-help groups can be trained to prepare the developed and accepted fortified food products which can be distributed among the children attending the anganwadi Kendras run by the department of women and child welfare. This will not only provide self-employment to the rural women but will also serve the children with variety of tasty and nutritious food. Serving of these food products can be adjusted as per nutritional requirement of the children of different age group. Extension functionaries of the development agency such as Krishi Vigyan Kendra and other non-government organizations working in the field of nutrition can be trained as master trainer to prepare the fortified food which will intern train the population in need of the nutritious food.

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