DEVELOPMENT OF NUTRIENT DENSE SUPPLEMENTARY PRODUCTS FOR CHILDREN BY USING LOCALLY AVAILABLE WHOLE WHEAT FLOUR, RAGI FLOUR, GREEN GRAM FLOUR, SOY FLOUR, ROASTED GROUNDNUT FLOUR AND JAGGER

Kumari Rosy*, Gupta Alka# and Sheikh Sarita$

ABSTRACT
Malnourished children are often victim of various infections like weight loss, iron deficiency, iodine deficiency, vitamin A deficiency etc. As with underweight, the prevalence of different micronutrient deficiencies varies widely across states. Prevention of malnutrition can be started by providing nutrient dense supplementary foods to the children. So present study was designed to develop low cost nutrient dense supplementary products for children by using locally available whole wheat flour, ragi flour, green gram flour, soy flour and roasted groundnut flour and jaggery. The specific objective of the study was, to develop low cost functional food products with the incorporation of locally available indigenous food especially designed for children and to assess organoleptic quality of the prepared product. Laddo were developed and their sensory evaluation cost analysis was done. It was found that the product was organoleptically acceptable and overall acceptability scores revealed that product was acceptable. Product was containing higher percentage of nutrients in comparison to standard with a cost of Rs. 2.83 to 3.4.

Keywords: Supplementary food, Coarse grains, Laddo, sensory analysis, cost

INTRODUCTION
India is home to 40 percent of the world's malnourished children and 35 percent of the developing world's low-birth-weight infants; every year 2.5 million children die in India, accounting for one in five deaths in the world. More than half of these deaths could be prevented if children were well nourished. India's progress in reducing child malnutrition has been slow. The prevalence of child malnutrition in India deviates further from the expected level at the country's per capita income than in any other large developing country (Braun et al. 2008). Malnutrition in children occurs in weaning stage when babies need more than just breast milk and weaning towards the normal family diet must begin. At these time to fulfill the nutrient requirement of baby, it is necessary that weaning and supplementary food should be nutrient dense so it can fulfill the increased requirements of babies. Supplementary Food is any food other than breast milk which can fulfill and correct the nutritional deficiencies in growing children and is nutrient dense. Supplementary food should be introduced at the age of six months. But in India where a large population is below poverty line, illiterate and ignorant don't have a proper knowledge and attitude towards the child malnutrition and supplementary feeding. Cereal based food items are generally given to the child which has low energy density, high fiber content and high anti nutrients. Commercially available supplementary foods are expensive and out of reach of poor and rural population (Igah, 2008). Effective supplementary feeding can improve the nutritional status of moderately malnourished children. According to a review of supplementary feeding trials, supplementary feeding, when given in adequate amounts to malnourished children, has a positive effect on growth (Rivera et al. 1991). So, it is necessary that supplementary food should contain a staple as the main ingredient (i.e, preferable a cereal), a protein supplement from a plant or animal food source (e.g. beans, groundnut, milk, meat, chicken, fish, eggs, etc), a vitamin and mineral supplement (e.g. a vegetable or a fruit), an energy supplement to increase the energy density of the mix (e.g. fat, oil or sugar etc). When these four ingredients are used together in suitable proportions, they form a complete meal [2].

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Another most common cereal available all over the world and today is even more in demand for its abundant health benefits is wheat. Through decades, wheat has been one of the major cereals crops in the world. The protein content of wheat is 11.8 g per 100 g and the energy content is 346 kcal per 100 g (Gopalan, 2004).

Ragi or Finger millet is a short, profusely tillering plant with characteristic finger like terminal inflorescences, bearing small reddish seeds. Maturity of crop is between 3 to 6 months depending on the variety and growing conditions. The crop is adapted to fairly reliable rainfall conditions and has an extensive but shallow root system. It is an annual plant extensively grown as a cereal in the dry areas of India, especially southern part of India. Ragi contains high amount of calcium, protein with well balanced essential amino acids composition along with Vitamin A, Vitamin B and phosphorous. It also contains high amount of calcium. Ragi flour in Karnataka is mostly prepared into ragi balls, popularly known as ragi mudde, made into flatbreads, leavened dosa and thinner, unleavened rotis. Its high fiber content also
checks constipation, high blood cholesterol and intestinal cancer.

Wheat is rich in catalytic elements, mineral salts, calcium, magnesium, potassium, sulfur, chloride, arsenic, silicon, manganese, zinc, iodide, copper, vitamin B, vitamin E and ferments. Thereby, you can call wheat as the base foundation of nourishment. Issues like anemia, demineralization, gallstones, breast cancer, chronic inflammation, obesity, asthenia, tuberculosis, pregnancy problems and breastfeeding problems are smartly dealt by whole wheat.

Soy is truly seems to be a wonder food. Soy is an excellent source of dietary fiber and protein (43%). It is rich in vitamin B6 - important in building amino acids and in the formation of neurotransmitters. As a high quality, complete protein, soy protein is comparable in protein quality to the protein found in animal sources, such as meat, milk and eggs. Soy protein products can be good substitutes for animal products because, unlike some other beans, soy offers a 'complete' protein profile (Henkel, 2000). Soybean also contain Omega-3 fatty acids, for example, alphalginolic acid) which are special fat components that benefit many body functions. Some beneficial effects are associated mainly with the longer-chain fatty acids eicosapentaenoic acid (20:5n-3, EPA) and docosahexaenoic acid (22:6n-3, DHA) found in some algae and oily fish.

Green gram (Vigna radiate) belongs to the family Leguminosae. Green gram is one of the important pulse crops in India. It has been reported that Green gram has been cultivated in India since ancient times. Green gram, also known as mung bean, has been cultivated exclusively for the seeds that are contained in the plant's pod. Green gram is a protein rich staple food. It contains about 25 percent protein, which is almost three times that of cereals. Because of the high amount of fiber, green gram dal is considered low-glycemic. green gram is free of flatulence-causing agents. This makes it an acceptable food for convalescents and pleasant weaning food for babies. The protein is especially rich in the amino acid, lysine, but it is somewhat deficient in sulphur-containing amino acids. The seeds are rich in calcium, phosphorous, magnesium, potassium, folate and other B Vitamins. They also contain appreciable amounts of Vitamin C. Its regular use during childhood, pregnancy and lactation helps one to get the required nutrition and promote health. Water in which green grains are soaked is an excellent medicine during cholera, measles, chicken-pox, small-pox, typhoid and all types of fevers. It can be given in a small quantity even during acute phase of appendicitis.

Jaggery of any type is better for health than refined white sugar. Jaggery, apart from being used in households as a sweetener and a flavoring agent, is also used extensively in the food and beverage industry. It is also called country sugar, whereas sugar, being called molasses due to its semi-solid state. It is rich in minerals, salts, vitamins and even contains some fiber, whereas sugar, being highly refined, lacks these things. The darker the jaggery is in color, the richer it is in mineral content (particularly iron content) and the better it is for health.

The peanut, or groundnut (Arachis hypogaea), is a species in the legume or "bean" family (Fabaceae). Peanuts are rich in nutrients, providing over 30 essential nutrients and phytonutrients. Peanuts are a good source of niacin, folate, fiber, vitamin E, magnesium and phosphorus. They also are naturally free of trans-fats and sodium, and contain about 25% protein (a higher proportion than in any true nut). Peanuts has found antioxidants and other chemicals that may provide health benefits.

MATERIALS AND METHODS

The present investigation was carried out in the Nutritional Research Laboratory Department of Foods and Nutrition, Ethelind School of Home Science, Sam Higginbottom Unnstitute of Agriculture, Technology And Sciences, (Deemed to be University), (Formerly Allahabad Agricultural Institute), Allahabad U.P. The raw materials such as Ragi, Soybean, Green gram dhal, Wheat and Groundnut were procured form local market of Allahabad.

Preparation of Wheat flour and Ragi flour

Wheat grains and Ragi were thoroughly cleaned to remove dirt, dust, insect excreta/ feathers and admixture of other food grains. The clean graded materials were ground in the electric grinder to make fine flour and sieved by 80-100 mesh sieves. The flour samples obtained were kept in airtight container before use.

Preparation of Soy flour

Soybeans were thoroughly cleaned to remove the dust and other foreign materials. The clean grains were soaked in water for 4-6 hours and then autoclaved for 5 minutes in a pressure cooker. They were removed and dried directly in the sun for 3-4 days till the material was completely dried having 6-8% moisture content. Soybean was then ground to make fine flour and sieved through 80 - 100 mesh sieves. The flour samples obtained were kept in airtight container before use.

Preparation of moong dal flour

Moong dhal was thoroughly cleaned to remove the dust and other foreign materials. The clean dhal was soaked in water for 4-6 hours. They were removed and dried directly in the sun for 3-4 days till the material was completely dried having 6-8% moisture content. Soybean was then ground to make fine flour and sieved through 80 - 100 mesh sieves. The flour samples obtained were kept in airtight container before use.

Preparation of Groundnut flour

Groundnuts were thoroughly cleaned to remove, dust, insect excreta/ feathers and admixture of other food grains. They were removed and roasted for till the groundnut become brown. The clean graded materials were ground in the electric grinder to make fine flour and sieved by 80-100 mesh sieves. The flour samples obtained were kept in airtight container before use.

Food Product Development Home based recipes were selected which could be enriched suitably to meet the objective of this experimentation. The criteria of selection were easily availability of ingredients, commonly consumed by local people, low in cost. Keeping all the consideration in mind product laddo premix were standardized and developed in food laboratory of Foods and Nutrition of SHUATS and their compositions are shown in table no 1. Four variant of recipe were prepared i.e standard, variant A, variant B, variant C.

Sensory evaluation The sensory evaluation of recipe were carried out by using nine-point Hedonic rating scale through 15 semi- trained panel members selected by triangle difference test. Colour, taste and flavour, body and texture and overall
acceptability were different attributes considered for evaluation. The scale for different attributes were: Liked Extremely (9), Liked very much (8), Liked moderately (7), Liked slightly (6), Neither liked nor disliked (5), Disliked slightly (4), Disliked moderately (3), Disliked very much (2), Disliked extremely.

Cost analysis Coasting is an important component to achieve financial success. It makes it easier for people with incomes and expenses of all sizes with conscious decisions about the allocation of money. The prevailing prices of the ingredients used in the preparation of the products were used to calculate their actual cost.

Statistical Analysis The data collected were tabulated and analyzed statistically with the help of a approved statistical techniques analysis using analysis of variance (ANOVA), Chi-square, Frequency, Percentage, Mean scores, z-test, analysis of variance, Critical Difference and Correlation Coefficient were applied and other appropriate statistical technique

### Table -1 : Percentage of ingredients use to developed the low cost energy and protein product

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Ragi flour (%)</th>
<th>Moong dal flour (%)</th>
<th>Soy flour (%)</th>
<th>Whole wheat flour (%)</th>
<th>Groundnut flour (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>5</td>
<td>15</td>
<td>25</td>
<td>45</td>
<td>10</td>
</tr>
<tr>
<td>T2</td>
<td>5</td>
<td>15</td>
<td>30</td>
<td>40</td>
<td>10</td>
</tr>
<tr>
<td>T3</td>
<td>5</td>
<td>15</td>
<td>35</td>
<td>35</td>
<td>10</td>
</tr>
</tbody>
</table>

**Replications** - Control and each of the treatments for each product were replicated three times. Ragi flour, Moong dal flour, Soy flour is in constant and the variations between Whole wheat flour and Ground flour.

**RESULTS AND DISCUSSION**

**Sensory quality characteristics of Prepared Product**

From figure 1, it was observed that different kinds of flour were developed to make Laddo and subjected to sensory evaluation. The results revealed that the sensory scores of various attributes viz; colour & appearance, texture, taste and flavor and overall acceptability (Figure 1) in relation to colour which indicates that T1 (8.36) had the highest score followed by T2 (8.06), T3 (7.83) and T4 (7.63) respectively. The texture of laddo clearly indicates that the treatment T1 (8.86) had the highest score for the texture of followed by T4 (8.6), T2 (8.3) and T3 (8.5) respectively. The effect of composite flour on the taste & flavor of laddo indicates that treatment T1 (8.6) held the maximum scores as compared to control T0 (8.1), T2 (7.4), and T3 (8.25). The mean scores of laddo in relation to overall acceptability indicates that the treatment T1 (8.56) scored maximum followed by treatment T4 (8.41), T3 (7.40), T2 (7.6) making it quite obvious that an increase in the amount of composite flour also inversely influences overall acceptability acceptability of laddo. Scoring shows that the treatment T1 was liked very much while T0, T2 and T3 were moderately liked by the panel of judges. However, on increasing the level of composite flour, there were a decrease in the textural quality and overall acceptability of the product. This indicates that higher amount of composite flour affected the textural quality characteristics. On the basis of their observations T1 composite flour consisting of 45:35:10:5 (Wheat flour: Ragi flour: Soyabean flour: Moong dal flour: Groundnut flour: Jaggery) could be considered the best for preparation of good quality of Laddo.

Similar results were also reported by Kiran et al (2013) the data shows that the biscuits prepared from commercial wheat flour incorporated with oat flour, finger millet, pigeon pea and green gram flour in different proportion (i.e. 0%, 10%, 25% and 50%) along with fenugreek leaf/ fenugreek powder. The sensory evaluation was done for colour, taste, flavour, texture and overall acceptability. Treatments have significant effect on taste and overall acceptability of biscuits.

Sensory evaluation The mean scores of different sensory parameters of various recipes developed by incorporating (Wheat flour: Ragi flour: Soy flour: Moong dal flour: Groundnut flour: Jaggery) are shown in table no 1. On the basis of overall acceptability scores of recipe it was found that T1 scored highest and among the three variants.

Cost analysis The Cost of the product was within the range of Rs. 2.83 to 3.4 for Laddo. So it can be concluded that the entire developed product was low in cost with a punch of energy and nutrient.

**CONCLUSION**

It can be concluded that developed products would be helpful for local population because Composite flours are available easily and also very cheap. Product development by Composite Flour through mixing them with, Ragi flour, Green gram flour, Soy flour, Roasted groundnut flour and jiggery may be beneficial to prevent PEM due to its higher nutritive value and it can be beneficial for children to prevent them from malnutrition. As the product was organoleptically acceptable, nutrient dense and low in cost. Thus it can act as a panacea in combating the various problems prevalent during early period of life.

**REFERENCES**


