DEVELOPMENT AND QUALITY ANALYSIS OF BANANA AND MORINGA LEAVES BASED WEANING FOOD FOR HEALTH IMPROVEMENT OF MALNOURISHED CHILDREN

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Abstract: Food is the basic and main source for sustainable development of infants. In the project, such weaning food was developed, by optimal incorporation of drumstick leaves in banana flour and jaggery powder with respect to its quality and nutritional density . Flours were prepared using conventional dehydration process, subsequent to which a mixture design involving incorporation of drumstick leaves flour in banana flour and jaggery powder was used. Drumstick leaves in banana flour and jaggery powder incorporation was optimized with respect to nutritional quality, flavor, taste, and overall acceptability. Products were evaluated for composition and functional properties, as fat content, moisture content and ash content. The result indicated that a ratio of 65:15:20 percent banana flour, drumstick leaves and jaggery powder respectively was optimal incorporation. Sensory analysis and proximate analysis revealed that incorporating drumstick leaves in banana flour and jaggery powder significantly improved all sensory characteristics and hence the nutritional quality. The optimal value of fat content was 5.09%, moisture content 5.23 % and ash content was 4.05%. All levels had fallen below allowable recommended range. The microbial load count level fell below allowable recommended range 16,000 – 32,000 plate count / 100gm as per ISO recommended value is 50,000 plate count / 100 gm. Study on the shelf life of the product was revealed that it has a versatile effect on the health improvement of malnourished children.

Keywords*:* Weaning Food, Malnutrition, Nutritional Quality, Sustainable Development.

Introduction: India leads in the greatest population of severely malnourished children in the world. Except this, childhood malnutrition is a massive crisis caused by a combination of factors including inadequate or inappropriate food intake, childhood diseases, harmful childcare practices, and improper care during illness: all contributing to poor health and millions of deaths annually. A deficiency in the amount of food leaves millions starving, many of whom are children, unable to change their situation. According to the National Family Health Survey of India, 48% of children in India are malnourished. 55% of children living in rural areas suffer from malnutrition compared to 45% of children in urban areas. The situation is particularly grave in states like Bihar, Uttar Pradesh, Madhya Pradesh and Rajasthan. According to the Indian Council of Media Research, there is a great lack of nutrition with many leaving out the most crucial nutrients from their diet. (Blakeman, 2005).

Banana is a very popular fruit/vegetable across world as its nutrition facts are quite impressive. Vitamins and minerals are abundant in the banana, offering 123 I.U. of vitamin A for the large size. Banana also has a full range of B vitamins with 0.07 mg of Thiamine, 0.15 mg of Riboflavin, 0.82 mg Niacin, 0.88 mg vitamin B6, and 29 µg of Folic Acid. There is even 13.8 mg of vitamin C. On the mineral scale Calcium counts in at 9.2 mg, Magnesium 44.1 mg, with trace amounts of iron and zinc. Putting all of the nutritional figures together clearly shows the banana is among the healthiest of fruits. The plantain, when cooked, rates slightly higher on the nutritional scale in vitamins and minerals but similar to the banana in protein and fiber content. (Sharrock, 2000).

Moringa oleifera commonly referred to simply as "Moringa", the most widely cultivated species of the genus Moringa, which is the only genus in the family Moringaceae. It is locally known by various names in India (Quattrocchi and Umberto, 2000) and it is considered one of the world's most useful trees, as almost every part of the Moringa tree can be used for food or other beneficial applications. Moringa leaves are considered significant source of β-carotene, Vitamin C, protein, iron, potassium, calcium and phosphorus and are commonly dried and crushed into a powder and stored without refrigeration for months without loss of nutritional values (Fahey, 2005) and used in soups and sauces (Fuglie, 2001). Moringa leaves contains phytochemical, having potent anticancer and hypotensive activity and are considered full of medicinal properties and used in Siddha medicine (Rajangam et al., 2001). Various nutritional and medicinal properties of M. oleifera leaves have been reported by various researchers (Fahey, 2005). Leaves can be eaten fresh, cooked, or stored as dried powder for many months without refrigeration, and reportedly without loss of nutritional value. Moringa is especially promising as a food source in the tropics because the tree is in full leaf at the end of the dry season when other foods are typically scarce (Jed W. Fahey, 2005).

Objectives:

- To develop weaning food by banana flour & Drumstick leaves

- To evaluate the physico-chemical and sensory
- To study the shelf life of product in different packaging material.

Materials And Methods: The experiment was carried out in the research laboratory, Department of Food processing, Vaugh School of Agriculture Engineering and Technology, Sam Higginbottom Institute of Agriculture, Technology and Sciences. The details of materials and methods used during the course of the present project are as follows:

1. Procurement of raw materials.
2. Preparation of flours.
3. Determination of optimum level of banana and drumstick leaves incorporation by organoleptic evaluation.
4. Experimental design.
5. Organoleptic evaluation of product.
6. Proximate analysis of the product.
7. Statistical analysis.
8. Period of study.

Procurement of raw material:

Fresh unripe banana was purchased from the local market of Allahabad.

Drumstick leaves was collected from the local region of Allahabad.

Preparation of flours

Preparation of Banana flour:

Pre-gelatinized banana flourproduced

Banana
↓
Washing with tap water
↓
Cooked in pressure cooker at temperature of 98-100°C for 5 min until tender
↓
Cooling banana fingers under tap water (23°C)
↓
Peeling of banana
↓
Slicing in to half inch slices
↓
Place in trays and drying it in oven at 60°C for 12 hours.
↓
Grinding
↓
Banana flour

characteristics of final product.

- **Preparation of Drumstick leaves flour:**

Drumstick leaves
↓
Washing with tap water
↓
Blanching
↓
Cooling drumstick leaves under tap water (23°C)
↓
Place in trays and Shed drying
↓
Grinding
↓
Drumstick leaves flour

Determination of optimum level of Banana and Drumstick leaves incorporation:

The product was organoleptically judged by a panel of judges from Vaugh School of Agricultural Engineering and Technology. The product with different percentage of Banana and Drumstick leaves was organoleptically evaluated on basis of Hedonic scale from 1 to 9. (Ranganna.S 2007).

Experimental Setup:

- Tray dryer
- Solar Dryer
- Hot air oven
- Electronic Balance
- Heat sealing machine
- Soxhelt apparatus
- Muffle furnace
- Milling machine
- Kjeldehl apparatus
- Incubator

Procedure for preparation of weaning foods:

1. Firstly all the ingredients e.g. banana, Drumstick leaves was weighed with the help of an electronic balance.
2. All the ingredients viz. banana flour, Drumstick leaves flour was mixed in different proportion to enhance nutritional quality.
3. The developed weaning food was packed in two different packaging materials (LDPE and HDPE) to prolong the shelf life.

Table 3.1 Work plan for Product formulation

Sample	% Banana flour	% Drumstick leaves	% jaggery powder
(A)	65	15	10
(B)	65	15	15
(C)	65	15	20
(D)	65	15	25

Quality analysis of weaning food:

The quality analysis of weaning food was continued for 45 days at 15 days interval.

Chemical Analysis

Estimation of Moisture:- About 5 grams of flour / other materials such as blends weaning food powder was weighed into a crucible and dried into a hot air oven at 105°C for 3-4 hours and was cooled down in a dessicator. The process of heating and cooling was repeated till the constant weight is achieved. The percent moisture content was calculated by the following formula.

$$\text{Moisture content (\%)} = \frac{\text{Initial weight of sample-final weight}}{\text{Weight of the sample}} \times 100$$

Determination of Protein Content:- The flour/blend/weaning food sample (0.5 to 2.0 g) was weighed into a dry Kjeldhal flask. It was followed by the addition of 5g of digestion mixture (viz. 98 part K_2SO_4 + 2 parts of $CuSO_4$) and pure concentrated sulfuric acid (20ml) to the sample, and the mixture was digested for 4 to 5 hr. The glass beads was added to prevent bumping. The digestion was continued till the contents became quite clear. It was then cooled and diluted with distilled water. It was then subjected to distillation by adding excess of 75ml of 40 percent sodium hydroxide solution. A small quantity of pumice stone powder was added to avoid bumping of the solution during distillation. The liberated ammonia was distilled into receiving flask containing 0.1 N Sulfuric acids (25ml). The excess of acid was now back titrated again 0.1N sodium hydroxide solution using methyl red as indicator. Unless otherwise stated, reagent blank was digested and distilled, and the resultant titre value of the blank was subtracted from the titre value obtained for the flour/blend/weaning food sample to obtain the true titre value. The protein content was determined by using the following formula:

$$\text{Total protein} = \frac{(\text{Titre value} - \text{blank titr e value}) \times 14 \times \text{normality} \times 6.25/5.28}{\text{Weight of the sample} \times 1000 \text{ mg}}$$

Determination of Total Carbohydrates:

Total carbohydrates are calculated as follows, after determining the percentage of moisture, total protein, fat and total ash:

Total carbohydrate = 100 – (A + B + C + D)

Where, A = percent by mass of moisture;
B = percent by mass of total protein;
C = percent by mass of fat; and
D = total ash, percent by mass

Determination of Total Crude Fat:- Total crude fats/lipids and free and bound lipids in weaning food was estimated as follows:

4gm. flour/weaning food was extracted in soxhlet apparatus using petroleum ether (40-60°) at 80° C. The petroleum ether extract was concentrated under reduced pressure below 50° C (under N_2 atmosphere). Thus, the lipids obtained are designated as "Free lipids". The residues obtained after extracting the free lipids were hydrolyzed with 2N HCL at 100°C for 2 hr., and lipid was extracted with distilled petroleum ether (40-60° C) was concentrated as above and designated as "Bound lipids". Unless otherwise stated, the analysis was carried out in triplicates.

Estimation of Ash: 5 gram of sample (weaning blend / flour) was weighted accurately into a crucible. It was subjected to heating on low flame until the material was completely charred. It was followed by heating in a muffle furnace for about 3-5 hours at about 600° C. It was then cooled in a dessicator and weighed. To ensure completion of ashing, crucible is reheated for ½ an hour, cooled and weighed. Percent ash was calculated using the formula under.(Ranganna.S 2007)

$$\textbf{Ash (\%)} = \frac{\text{Weight of ash}}{\text{Weight of the sample taken}} \times 100$$

Shelf life study:

Total plate count:

Procedure: Cleaning, sterilization, preparation of dilution blank, pouring of plates.

The sample (1 ml) from dilution blank was poured in sterile Petri plate in sterile conditions in triplicate. One plate was kept as blank. Liquefied Trypton Yeast extract, Glucose Agar (TyGA) at 42 to 44°C introduced 12 to 15 ml in each plate by rotating and tilting the dish mixture was spread evenly over the bottom of plate.

Incubation: After solidification of media the plates were inverted and promptly placed in the incubator at 37°C for 24 to 48 hours.

Counting the Plates: After 48 hours incubation, all colonies on selected plates were counted.

Recording the Counts: After counting the colonies, the numerical estimate of colonies per plate was multiplied by proper dilution factor and the results recorded as plate count per milliliter or plate count per gram (pc/ml or pc/g).

Coliform Count in Weaning Food: One ml of sample dilution of decimal dilution was introduced into sterile Petri plates, to each plate; 10 to 15 ml of violet red bile agar was added as per the procedure referred previously. The content was thoroughly mixed by tilting and rotating the dish. After the mixture was solidified, 3-4 ml of the media was distributed completely over the surface of solidified medium. In order to inhibit the surface forming colonies, the plates were inverted and incubated at

37°C for 18 to 24 hours.

Counting: The colonies of coliform which were dark red having diameter of 0.5 mm were counted.

Computation: The coliform counts were multiplied by the dilution factor to have coliform count per gm.

Sensory analysis of finished Products: Sensory attributes including color, aroma, taste and overall acceptability is determined by hedonic rating tastes as recommended by Ranganna (2007). Hedonic rating taste is used for evaluation of sensory characteristics. This test is used for acceptability by consumer for the product. The detail methodology is presented below. A panel of 5 expert judges of different age group having different habit was selected and sample was serving to them. The expert panelist was asked to rate the acceptability of the product through sense organs on scale of nine (9) points ranging from like extremely to dislike extremely.

ORGANOLEPTIC SCORE					
PRODUCT	COLOR	TASTE	AROMA	OVERALL	REMARKS
A					
B					
C					
D					

Sensory Evaluation card (1-9 Hedonic scale)
1-Dislike very much
2- Dislike much
3- Dislike moderately
4- Slightly dislike
5- Neither like nor dislike
6- Slightly like
7- Like moderately
8- Like much
9- Like very much

Statistical analysis

The experiments was conducted by adopting completely randomized design. The data was recorded during the course of investigation and statistically analyzed by the 'analysis of Variance' suggested by Gupta (1999). The significant effect of treatment was judged with the help of 'F' (variance ratio). Calculated F value was compared with the table value at 5% level of significance. If calculated value exceeded the table value, the effect was considered to be significant. The significance of the study was tested at 5% level.

Results: The result indicated that a ratio of 65:15:20 percent banana flour, drumstick leaves and jaggery powder respectively was optimal incorporation. Sensory analysis and proximate analysis revealed that incorporating drumstick leaves in banana flour and jaggery powder significantly improved all sensory characteristics and hence the nutritional quality. The optimal value of fat content was 5.09%, moisture content 5.23 % and ash content was 4.05%. All levels had fallen below allowable recommended range. The microbial load count level fell below allowable recommended range 16,000 – 32,000 plate count / 100gm as per ISO recommended value is 50,000 plate count / 100 gm. Study on the shelf life of the product was revealed that HDPE is a best barrier of moisture, air & microbes than LDPE because the significant decreasing in fat content and ash content and significant increase in moisture content was lesser in HDPE than LDPE.

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