Studies on Development, Quality Evaluation and Storage Stability of Weaning Food Prepared from Multipurpose Flour, Papaya Powder and Milk Powder

S. Ahmad*, Dolly Gupta and A.K. Srivastava

Department of Post Harvest Engineering and Technology, Aligarh Muslim University, Aligarh 202002, India

Abstract

The present study was conducted on development, quality evaluation and storage stability of weaning food using different combination of rice gram flour, three levels of papaya powder (3, 5 and 7) and milk powder (7.5%). The quality of weaning food was based on nutritional characteristics namely: protein content, fat content, ash content, vitamin C and carbohydrate; physico-chemical characteristics namely: moisture content, browning index and viscosity; microbiological characteristics namely: total plate count and sensory characteristics including sensory attributes namely: colour, taste and aroma. Three weaning food samples so prepared using different combination of rice flour, gram flour and papaya powder along with equal amount of milk powder had protein content varying between 18.42-19.02, fat content 1.5-1.7, carbohydrate 17.24-17.58 % and ash content 3.5-3.8 respectively. The viscosity of three samples did not vary considerably (10% concentration viscosity found to be 35.3-36.7). Moisture content of weaning food was found in the range of 0.341-0.423 (OD), vitamin C in the range of 17.02-40.06 mg/100g. Total plate count log TPC/g was found in the range TFTC. Storage study of three weaning food sample packed by two different packaging systems viz: air packaging and nitrogen flush packaging with two packaging viz: pet jar and combination film. During four months it was observed all quality parameter were found under safe condition. The result of sensory evaluation revealed that the sensory attributes like colour, aroma, taste and overall acceptability of three samples was found in the range of score vale 6-7. The score values of sample nitrogen flush packaging were found to be almost 7 for all attributes after four months ambient storage.

Keywords: Storage stability; Multipurpose flour; Browning index; Viscosity; Vit C

Introduction

Mother's milk constitutes nature best food. It is considered as the most suitable food for newborn infants since time immemorial. It is the natural security provided for the survival of the infants. Although majorities of Indian babies are breast-feeding during the first 6-8 month of life [1], not everybody is fortunately in having a healthy mother who could provide adequate nutrition. Thus arises the need for baby and weaning foods. A baby has specific nutritional need for protein, fat, carbohydrate, minerals and vitamins. Feeding with mother’s milk shows certain unique metabolic features in babies, like

- Quick stomach-emptying time,
- Enhance lysozyme activity in the stool,
- Remarkable increases in the number of lactobacillus bifidus in the intestinal microflora,
- Less burdening of the kidney to low levels of minerals, and
- Easy digestion and absorption efficiency (Figures 1,2).

The general nutrition requirements and the specific problem of mother's milk such as high levels of mucopolysaccharides, lysozyme, unsaturated fatty acid, and low levels of protein, fat and minerals are relevant in humanizing cow and buffalo milk. Nutritionally inadequate empirical formulation cannot meet the needs of babies and can cause mortality [2].

A progressive decline in the incidence of breast-feeding has been observed during the last 25-30 years. According to the survey conducted by various agencies like WHO, OPCS, ICMR etc., there is a significant increase in the tendency of bottle feeding and early weaning all over

Figure 1: Process flow chart for preparation of papaya powder. Preparation of weaning food.

Ripe papaya

Washing

Peeling

Concentrating the pulp (10-14 °Brix)

Spray in cabinet tray keeping

HDPE at the bottom

Drying (60-65 °C; for 16-18hr)

Grinding and sieving

Packed inside the pet jars

*Corresponding author: Saghir Ahmad, Department of Post Harvest Engineering and Technology, Aligarh Muslim University, Aligarh 202002, India, E-mail: alsaghir@rediffmail.com

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the world. According to WHO study considering 24,000 mother-child pairs in Chile, Ethiopia, Guatemala, India, Nigeria, Philippines, Zaire, Sweden and Hungary, breast feeding was noted to be declining among urban elite but was constant and prolonged among the rural poor [3]. NIN, Hyderabad in Andhra Pradesh involving 36,000 children, conducted a multicentric survey. According to the survey, the breast-feeding is continued for more than one year in rural areas. However, the mother’s tend to discontinue breast-feeding after 5 months and 12 months and more than 90% of infants are fully weaned in urban areas [4]. Earlier, the right age for weaning was considered to be about one year or even more, while now-a days it is very common to wean the infants starting from the age of 3-4 months [3,4].

Papaya is a very wholesome and inexpensive fruit which available during all seasons in almost all places to all people. As a source of β-carotene, it is unrivalled by any other fruit except perhaps mango. With its deep yellow colour, the ripe papaya fruit contains large quantities of a substance called carotene. Regular consumption of papaya ensures a steady supply of vitamin A and C, both of which are essential for good health. Eating papaya prevents blindness caused by vitamin A deficiency, which is quite common among large number of children in India. Papaya has more carotene as compared to other fruits such as apples, guavas, sitaphal etc. Hence it gives the maximum nutritional returns for the money spent. The ripe fruit has stomachic digestive, carminative and diuretic properties. Green papaya is said to be mildly laxative and diuretic and posses ecobolic properties.

In light of above discussion, a study on the development of weaning food was undertaken with the following objective investigation.

1. Development of weaning food from multi purpose flour (MPF), papaya powder (PP) and milk powder (MP).
2. To evaluate the nutritional, physico-chemical and microbiological characteristic of the prepared weaning food.
3. To evaluate sensory characteristic of weaning food.
4. To evaluate the storage stability of weaning food under different packaging materials and packaging systems.

Materials and Methods

The experiment work was carried out for development, quality evaluation and storage stability of weaning food packed in different packaging materials and systems. The weaning food was formulated by taking different combination of multi purpose flour (MPF), papaya powder (PP) and milk powder (MP). Quality of weaning food was evaluated on the basis of nutrient, physico-chemical, microbiological and sensory characteristics. The experimental plan set up and detailed methodology is being described below.

The papaya powder was prepared from evenly ripened fruit. Blend of MPF, papaya powder and milk powder in dry from in the given composition. The powder was suspended in water forming slurry. Ratio of powder to water in the slurry is 1:4. The slurry was further autoclaved at 121°C for 20 min and pressure 15 psi. The slurry was spread in thin layer over the trays of cabinet dryer and drying was continued at 100°C for 4-6 hours. A HDPE film was spread on tray and to avoid the sticking of material with that of trays so material were easily removed from the trays after dehydration and further pulverized to fine powder. The powder was sieved through 60-mesh sieve and packed in three different packaging materials namely PET jars, combination film with nitrogen gas flush. Storage study was conducted periodically after one-month interval.

Results and Discussion

The present study was carried out for development, quality evaluation and storage behavior of weaning food prepared from multipurpose flour (MPF), papaya powder (PP) and milk powder (MP). In MPF, gram flour and rice flour were selected. MP and PP was the essential part of the weaning food, while three different samples of weaning food were prepared by combination of rice flour, gram powder, and milk powder flour along with three different levels (3, 5 and 7%) of papaya. The quality of weaning foods so obtained was estimated on the basis of physical characteristics viz. viscosity, physico-chemical characteristics like moisture content, ash content, fat content, protein content, vitamin-C content and browning index, microbial characteristics namely total plate count (TPC) and finally sensory characteristics reported on the basis of four sensory attributes viz. colour, aroma, taste and overall acceptability in the powder form. For study on storage behavior of all three different samples of weaning food

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**Table 1: Proximate composition and viscosity of nine different weaning food samples in fresh condition prepared from multipurpose flour papaya powder, milk powder.**

| Sample code | Moisture content* % | Protein* % | Fat % | Ash content* % | Carbohydrate % | Viscosity* (cp) | 10% conc. | Vitamin C, mg/100g |
|-------------|---------------------|------------|------|----------------|----------------|----------------|-----------|-------------------|
| R<sub>PP</sub> | 3 ± 0.09            | 19.2 ± 0.14| 1.6  | 3.8 ± 0.01     | 72.4           | 35.88 ± 0.15  | 17.0 ± 0.12| 70.4 ± 0.25      |
| R<sub>M</sub> | 3 ± 0.11            | 18.82 ± 0.05| 1.7  | 3.7 ± 0.01     | 72.78          | 36.7 ± 0.14   | 30.4 ± 0.25| 70.3 ± 0.14      |
| R<sub>P</sub> | 3 ± 0.21            | 18.42 ± 0.21| 1.5  | 3.5 ± 0.02     | 73.58          | 35.3 ± 0.20   | 40.6 ± 12  | 70.2 ± 0.20      |

*Values are means of three replicates ± SD

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was packed by two different packaging systems viz. air packaging (APS) and nitrogen packaging (NP) with two packaging materials namely pet jar (PJ) and combination film (CF). The quality measuring parameters were determined in the fresh condition and also periodically evaluated every after one-month (for four months) during ambient temperature storage. The results of study have been represented in different Tables, graph and figures and are being discussed as given below.

**Physical properties and composition of weaning food**

The composition of weaning food prepared from different combination of multi purpose flour (MPF), papaya powder (PP) and milk powder (MP) has been presented in table 1. It is obvious that protein content of weaning food based on gram flour, rice flour and other ingredients is high as compared to remaining. The protein contents of weaning food samples R$_{g1}$, R$_{g2}$ and R$_{g3}$ were found to be 19.2, 18.82 and 18.42% respectively. The initial moisture content of three types of weaning food was found in between 2.4 to 3.5%. Ash content of all weaning food samples was found to be very high and it ranged between 3.5 to 3.8%. Carbohydrate contents, the main energy-supplying component was highest in R$_{g3}$ sample (76.45%) while it was lowest in R$_{g1}$ sample (66.73%).

The results of the viscosity measurements of nine different samples of weaning food have been presented in table 1. The viscosities of the sample were measured in centipoise (cp) at 10% concentration. Values of viscosity for the samples of weaning food prepared at three different levels of papaya powder, rice flour, gram flour and MP namely R$_{g1}$, R$_{g2}$ and R$_{g3}$ were found to be 35.88, 36.7 and 35.3 cp.

The moisture contents of weaning food sample (R$_{g1}$) after four months storage was found to be 6, 6.4 and 4.3% in CF (APS), PJ (APS) and CF (NP) respectively. The initial moisture contents of the weaning food sample R$_{g1}$ were reported to be 3%. The increase in moisture contents was found to be 3, 3.6 and 2.3% in CF (APS), PJ (APS) and CF (NP) respectively. Increase in moisture contents was found to be lowest in the weaning food sample R$_{g1}$ packed in CF (NP) and increase in moisture contents was highest in sample packed in PJ (APS).

The moisture contents of weaning food sample (R$_{g2}$) after four months storage was found to be 6.2, 6.5 and 4.7% in CF (APS), PJ (APS) and CF (NP) respectively. The initial moisture contents of the weaning food sample R$_{g2}$ were reported to be 3%. The increase in moisture contents was found to be 3.2, 3.5 and 2.7% in CF (APS), PJ (APS) and CF (NP) respectively. Increase in moisture contents was found to be lowest in the weaning food sample R$_{g2}$ packed in CF (NP) and increase in moisture contents was highest in sample packed in PJ (APS).

![Figure 3: Sensory score evaluation of weaning food packed under three different packing material / system during ambient storage.](image)

| Sample code | Storage period (days) | Moisture content (%) |
|-------------|-----------------------|----------------------|
| CF (APS)    | PJ (APS) | CF (NP) |
| R$_{g1}$    | 0        | 3.0 ± 0.098 | 3.0 ± 0.098 | 3.0 ± 0.098 |
| R$_{g1}$    | 30       | 4.2 ± 0.158 | 4.0 ± 0.168 | 3.5 ± 0.023 |
| R$_{g1}$    | 60       | 4.9 ± 0.855 | 4.9 ± 0.155 | 3.8 ± 0.068 |
| R$_{g1}$    | 90       | 5.2 ± 0.128 | 5.5 ± 0.208 | 4.0 ± 0.58  |
| R$_{g1}$    | 120      | 6.0 ± 0.111 | 6.4 ± 0.251 | 4.3 ± 0.125 |
| R$_{g2}$    | 0        | 3.0 ± 0.115 | 3.0 ± 0.115 | 3.0 ± 0.115 |
| R$_{g2}$    | 30       | 4.2 ± 0.128 | 4.3 ± 0.187 | 3.4 ± 0.148 |
| R$_{g2}$    | 60       | 5.1 ± 0.125 | 5.7 ± 0.231 | 3.9 ± 0.168 |
| R$_{g2}$    | 90       | 6.0 ± 0.126 | 6.6 ± 0.214 | 4.2 ± 0.195 |
| R$_{g2}$    | 120      | 6.5 ± 0.155 | 7.2 ± 0.321 | 4.5 ± 0.098 |
| R$_{g3}$    | 0        | 3.0 ± 0.214 | 3.0 ± 0.214 | 3.0 ± 0.214 |
| R$_{g3}$    | 30       | 4.1 ± 0.154 | 3.9 ± 0.234 | 3.4 ± 0.321 |
| R$_{g3}$    | 60       | 4.6 ± 0.217 | 4.5 ± 0.124 | 4.0 ± 0.236 |
| R$_{g3}$    | 90       | 5.3 ± 0.111 | 5.5 ± 0.214 | 4.3 ± 0.285 |
| R$_{g3}$    | 120      | 6.2 ± 0.125 | 6.5 ± 0.158 | 4.7 ± 0.023 |

The moisture contents of weaning food sample (R$_{g3}$) after four months storage was found to be 6.2, 6.5 and 4.7% in CF (APS), PJ (APS) and CF (NP) respectively. The initial moisture contents of the weaning food sample R$_{g3}$ were reported to be 3%. The increase in moisture contents was found to be 3.2, 3.5 and 2.7% in CF (APS), PJ (APS) and CF (NP) respectively. Increase in moisture contents was found to be lowest in the weaning food sample R$_{g3}$ packed in CF (NP) and increase in moisture contents was highest in sample packed in PJ (APS).

Table 2: Change in moisture content of weaning food samples prepared from different combination of rice flour, gram flour, milk powder and papaya powder during ambient storage in different packaging materials.

| Sample code | Storage period (days) | Moisture content (%) |
|-------------|-----------------------|----------------------|
| CF (APS)    | PJ (APS) | CF (NP) |
| R$_{g1}$    | 0        | 3.0 ± 0.098 | 3.0 ± 0.098 | 3.0 ± 0.098 |
| R$_{g1}$    | 30       | 4.2 ± 0.158 | 4.0 ± 0.168 | 3.5 ± 0.023 |
| R$_{g1}$    | 60       | 4.9 ± 0.855 | 4.9 ± 0.155 | 3.8 ± 0.068 |
| R$_{g1}$    | 90       | 5.2 ± 0.128 | 5.5 ± 0.208 | 4.0 ± 0.58  |
| R$_{g1}$    | 120      | 6.0 ± 0.111 | 6.4 ± 0.251 | 4.3 ± 0.125 |
| R$_{g2}$    | 0        | 3.0 ± 0.115 | 3.0 ± 0.115 | 3.0 ± 0.115 |
| R$_{g2}$    | 30       | 4.2 ± 0.128 | 4.3 ± 0.187 | 3.4 ± 0.148 |
| R$_{g2}$    | 60       | 5.1 ± 0.125 | 5.7 ± 0.231 | 3.9 ± 0.168 |
| R$_{g2}$    | 90       | 6.0 ± 0.126 | 6.6 ± 0.214 | 4.2 ± 0.195 |
| R$_{g2}$    | 120      | 6.5 ± 0.155 | 7.2 ± 0.321 | 4.5 ± 0.098 |
| R$_{g3}$    | 0        | 3.0 ± 0.214 | 3.0 ± 0.214 | 3.0 ± 0.214 |
| R$_{g3}$    | 30       | 4.1 ± 0.154 | 3.9 ± 0.234 | 3.4 ± 0.321 |
| R$_{g3}$    | 60       | 4.6 ± 0.217 | 4.5 ± 0.124 | 4.0 ± 0.236 |
| R$_{g3}$    | 90       | 5.3 ± 0.111 | 5.5 ± 0.214 | 4.3 ± 0.285 |
| R$_{g3}$    | 120      | 6.2 ± 0.125 | 6.5 ± 0.158 | 4.7 ± 0.023 |
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Evaluation of sensory characteristics of weaning food samples

Sensory attributes three samples of weaning food samples were evaluated during four-month storage at room temperature, packed in different packaging materials/systems [CF (APS), CF (NP), PJ (APS)]. Hedonic Rating Test Method made the evaluation of different samples of weaning food. Scores awarded to the individual sensory attribute by semi-trained panelist are reported in figures 3-5. Figures show the effect of packaging materials/systems on overall sensory scores of different kind of weaning food samples.

The result of sensory characteristics of weaning food samples prepared from rice flour, gram flour and other ingredients evaluated in terms of different sensory attribute namely; colour, aroma, taste and overall acceptability have been presented in figures 3-5. The sensory score of weaning food of this group contained three different levels of papaya powder (3.5 and 7%) along with the MPF (89.5, 87.5 and 85.5%) and milk powder (7.5 %) respectively. In the fresh condition the colour scores of weaning food sample R\textsubscript{G1}, R\textsubscript{G2} and R\textsubscript{G3} were 8.0, 8.1 and 8.0 respectively and the aroma scores were found to be 8.3, 8.4 and 8.3 respectively. The samples of weaning food were perceived to

| Sample code | Storage period (days) | Log (TPC)/g* (CF (APS)) | PJ (APS) | CF (NP) |
|-------------|-----------------------|-------------------------|----------|---------|
| R\textsubscript{G1} | 0 | 0.341 ± 0.023 | 0.341 ± 0.023 | 0.341 ± 0.023 |
|  | 30 | 0.397 ± 0.056 | 0.39 ± 0.054 | 0.353 ± 0.054 |
|  | 60 | 0.461 ± 0.011 | 0.473 ± 0.032 | 0.371 ± 0.051 |
|  | 90 | 0.503 ± 0.012 | 0.498 ± 0.038 | 0.393 ± 0.051 |
|  | 120 | 0.581 ± 0.025 | 0.593 ± 0.022 | 0.411 ± 0.084 |
| R\textsubscript{G2} | 0 | 0.423 ± 0.065 | 0.423 ± 0.065 | 0.423 ± 0.065 |
|  | 30 | 0.467 ± 0.045 | 0.477 ± 0.061 | 0.435 ± 0.054 |
|  | 60 | 0.474 ± 0.021 | 0.493 ± 0.021 | 0.453 ± 0.012 |
|  | 90 | 0.498 ± 0.045 | 0.508 ± 0.085 | 0.472 ± 0.045 |
|  | 120 | 0.548 ± 0.021 | 0.569 ± 0.015 | 0.492 ± 0.065 |
| R\textsubscript{G3} | 0 | 0.398 ± 0.054 | 0.398 ± 0.054 | 0.398 ± 0.054 |
|  | 30 | 0.42 ± 0.012 | 0.412 ± 0.054 | 0.404 ± 0.054 |
|  | 60 | 0.479 ± 0.045 | 0.497 ± 0.081 | 0.421 ± 0.064 |
|  | 90 | 0.499 ± 0.054 | 0.52 ± 0.052 | 0.438 ± 0.041 |
|  | 120 | 0.573 ± 0.022 | 0.58 ± 0.054 | 0.476 ± 0.065 |

Browning index of nitrogen-flushed sample packed in combination film (CF) was found to be 0.476 after four months storage. The initial browning index of weaning food sample R\textsubscript{G1} was 0.398. There was lowest change in browning index of weaning food sample R\textsubscript{G1} packed in CF (NP), while change in browning index was highest in PJ (APS) (Table 3).

The weaning food samples prepared from rice flour, gram flour, MP and PP were evaluated for total plate count. It was found that TPC values in the fresh condition were too few colonies to be counted. Even after 30 and 60 days there was no available countable colonies in any of the three weaning food samples (R\textsubscript{G1}, R\textsubscript{G2} and RG3). Countable colonies were observed after 90 days storage. Log TPC/g value for R\textsubscript{G1} sample were found to be 3.602, 3.544 and 3.568 for three packaging materials/systems CF (APS), PJ (APS) and CF (NP) respectively after 120 days storage. Similar observations were also made for R\textsubscript{G2} and RG3 samples. Log TPC/g values of these samples were found to be less than 4.0 after four months storage. It is observed that total plate count is under safe limit after four months storage (Table 4).
be desirable by the panel and therefore the score awarded was beyond “very good” range. Colour of the sample was also acceptable to the panel. As a matter of the fact the taste scores awarded for the weaning food samples R\textsubscript{10}, R\textsubscript{12} and R\textsubscript{3} were 8.1, 8.2 and 8.1 respectively or a little lower than that score values of colour and aroma. The taste of weaning food samples did not resemble to the any of the four basic tastes namely, sweet, bitter, sour and salty. The taste contributed to weaning food was resulted from addition of 7.5% sugar to make it more palatable for the babies before consumption. During ambient temperature storage the sensory scores of colour, aroma and taste were consistently decreased. However, these samples (R\textsubscript{10}, R\textsubscript{12} and R\textsubscript{3}) of weaning food packed under different packaging material/system were found to be acceptable as per the sensory evaluation of the panelists.

The weaning food samples stored in CF (NP) were found to be superior in sensory properties and therefore their scores are little higher than the samples stored in CF (APS) and PJ (APS) after four-months storage. The sensory attribute of three different samples of weaning food are in order CF (NP) > CF (APS) > PJ (APS).

**Conclusion**

Three kinds of weaning food of high nutrient density were formulated and prepared from combination of multi purpose flour, three levels of papaya powder and equal quantity of milk powder. Blend formulation shows the strongest impact on formulation. The composition and nutritive value of weaning food so made based on rice flour, gram flour, papaya powder and milk powder represented the balanced quantity of protein, carbohydrate and ash content and these samples were acceptable in sensory evaluation. The protein content of these weaning food samples were found to be in between 18.42–19.20%. The rice and gram flour based weaning foods was found to be best in nutritional and sensory quality. Thus based on the ranking data, gram flour based weaning foods exhibited a suitable nutritional profile. They can be stored safely in two packaging materials/system namely; combination film with air packaging system [CF (APS)], pet jar with air packaging system [PJ (APS)] and combination film with nitrogen flush packaging [CF (NP)] for more than four month. Till four-month study there was no sign of any deterioration.

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