The Pharma Innovation Journal 2021; SP-10(2): 237-240

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.03
TPI 2021; SP-10(2): 237-240

www.thepharmajournal.com
Received: 28-12-2020
Accepted: 24-01-2021

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Formulation and determining shelf-life of complementary weaning meal

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Abstract
The main aim of conducting the study was to formulate the health boosting food for malnourished children from locally available food stuffs. Six treatments each of 100gm were prepared with the incorporation of apple flour, sweet potato flour, carrot flour, soya bean seeds flour and wheat grain flour in different ratio. Sensory evaluation of all the six treatments of weaning food reconstituted with milk was done by using 9 point hedonic scale. The experiment was replicated three times and the data obtained during the investigation were statistically analyzed by using analysis of variance (ANOVA). The treatment T_3(soya bean flour 20gm, wheat flour 20gm, apple flour 25gm, sweet potato flour 15gm and carrot flour 20gm) was found to be the best. The best treatments sensory evaluation was done at 0, 15 and 30 days interval and the non-significant results were found as no changes were observed in colour, flavor, consistency and the overall acceptability. No microbial growth was seen till 30 days. So, it was concluded that weaning food can be prepared using the combination of apple, sweet potato, carrot, soya bean and wheat and is useful in improving infants health.

Keywords: Weaning meal, aim of conducting, boosting food

Introduction
Malnutrition has become one of the major health problems facing by the developing countries which contributes to infant mortality, poor physical and intellectual development of children which lowers the resistance to diseases. Throughout the developing world, malnutrition affects about 800 million people which approximately accounts for 20 percent of the world population. For instance, Sri Lanka Demographic and Health Survey (2006/07) highlighted that 18% of Sri Lankan children are stunt, 15% are wasted, 22% are underweighted and 4% are severely underweighted. High price of commercially available weaning foods, vegetables, animal proteins and the non-availability of low priced nutritious foods, combined with bad feeding practices and late introduction of supplementary foods, are mostly responsible for the observed malnourishment among children in Asia. Weaning is the process of complete transition from breast feeding to a semi solid diet. Weaning foods are generally introduced between the ages of six months to three years where the breast feeding itself no longer meets the increasing nutritional requirements of the child. Therefore, there is a high possibility of occurring Protein Energy Malnutrition (PEM) during this transitional phase when children are weaned from liquid to semi-solid or fully adult foods where the growing body of children needs a nutritionally balanced and calorie dense supplementary foods such as weaning foods in addition to mother`s milk. This can be more severe if abrupt weaning is practiced where the family menu is directly introduced to the infant that leads to malnutrition, growth retardation and higher rates of mortality.

In developing countries Weaning is the gradual replacement of breast milk by a good mixed diet (Issac and Koleosho, 2012). Weaning foods are needed to fill the gap between the total nutritional needs of the child and the amount provided by the breast milk and also bridge the change in milk diet to adult food (WHO, 2000). A variety of complementary foods are commercially available with high nutritive value, which are directly used for instant preparation of gruels. However these products are beyond the economic means of most families. So mothers use traditional gruels – water suspensions of maize or sorghum, as complementary foods for infants. These gruels usually have low energy density and poor protein, vitamin and mineral contents **(**Nagarajaha *et al*. 2003). Thus, protein-energy malnutrition is a common problem among infant and children in the poor socio-economic groups of developing countries.

Traditional complementary food could be improved by combining locally available food that complement each other in such a way that the new pattern of amino acids created by this combination is similar to that recommended for infants (Mensa-Wilmot *et al*. 2001). Processing technique used for weaning food has been largely fermentation, sprouting/germination, extrusion and less often toasting (Obizoba and Ati, 1981). Germination can reduce the high bulk of traditional complementary food by reducing the viscosity of the cereal gruel or porridge (Potter and Hotchloss, 1995).

Soybean is a rich source of protein hence it is beneficial for malnourished children mainly suffering from Protein Energy Malnutrition. Beans have been called the "poor man's meat," as they are cheap and are easily afforded by the poor people. Carrot are mainly rich in vitamins and fibres. Carrots are a good source of potassium, which can help maintaining healthy sodium levels in the body. The nutrient in carrot helps preventing digestive disorders, and mainly the vision problems. The main nutritional material in sweet potato's tubers are carbohydrates (starches and simple sugars), protein, fat and fat-soluble vitamins. Moreover, cultivars with a yellow flesh also contain significant amounts of carotenes (Allen *et al*. (2012) [1]. Apples are loaded with vitamin C. Almost half of an apple's vitamin C content is just under the skin, so it is beneficial to eat apples with their skins. It is also rich in fiber. Apples contain insoluble fiber, which provides bulk in the intestinal tract. The bulk holds water that cleanses and moves food quickly through the digestive system (Sharp, 2014) [3]. Wheat is of great benefit, it is nutritionally-balanced and helps in removing millions of cases of nutritionally-related deficiency disease. It is a good source of protein, minerals, B-group vitamins and dietary fiber hence all are good for making weaning food.

Methodology

Raw material

Soya bean, carrot, sweet potato, wheat and apple were collected from local market of Allahabad, and then they all were cleaned by removing dirt and damaged parts.

Processing of soya beans, carrot, sweet potato, apple and wheat.

The cereal grains soya beans and wheat were freed from dirt and extraneous materials by manual sorting and washed thoroughly with sterile distilled water. They were then germinated for 24 hours at 13°C to 21 °C. soyabean and wheat grains were then dehydrated in dehydrator at 60 to 65 °C for 3-4 h, dry milled and sieved to obtain a fine powder. They were packed in clean air tight containers and were stored until further use. Similarly carrots, sweet potato and apples were freed from dirt and were washed properly, they were then cut into slices and were blanched in 2% sal solution further they were dehydrated at 40 to 45 °C for 2-3 h, 40 to 45 °C for 2-3 h and 40 to 45 °C for 3-4 h respectively and was grinded into a fine powder, the powder obtained was then packed in a clean air tight container.

Formulation of weaning food

Three composite weaning foods (WF1, WF2, WF3, WF4, WF5 and WF6) were formulated using varying amounts of raw materials (Table 1) by considering nutrient and caloric values of each ingredient in order to meet the nutrient requirement of toddlers according to the recommendations given by the World Health Organization in which 100 g portion of each weaning food enables to provide ⅓ of the daily energy and carbohydrate requirement, ⅔ of the daily protein requirement and ¼ of the daily fat requirement of a growing toddler.

Details of Treatments

Table 1: Composition of different composite weaning foods

Treatments	Soyabean flour (g)	Carrot flour (g)	Sweet potato flour (g)	Apple flour (g)	Wheat flour (g)
WF1	20	20	25	15	20
WF2	20	15	25	20	20
WF3	20	20	15	25	20
WF4	20	15	20	25	20
WF5	20	25	20	15	20
WF6	20	10	25	25	20

Sensory Evaluation

Each treatment mix was blended with the corresponding amounts of milk and the sensory evaluation of milk-based weaning foods in gruel form was conducted by 6 panelists of Ethelind College of Home Science, SHUATS in Allahabad. The penalists where in good health and are familiar with the taste, flavour and other attributes of weaning food. The prepared weaning food was served in sensory evaluation cups. The samples were assessed for colour, taste, flavour, aroma, texture and over all acceptability. The judges were instructed to sip water before and after assessing each product. The samples were assessed using a 9 point hedonic scale ranging between 7 (like extremely) to 1 (dislike extremely), like extremely =9, like very much = 8, like moderately=7, like slightly =6, neither like nor dislike = 5, dislike slightly = 4, dislike moderately= 3, dislike very much = 2, and dislike extremely = 1

Statistical Analysis

Sensory data were analysed by Complete Randomized Design (CRD) and one-way ANOVA (Analysis of variance) and means were separated by Least Significant Difference (LSD) procedure.

Shelf-life

All microbiological analyses were carried out based on procedures recommended in the International Commission on Microbiological Specification for Foods (1996). Appropriate serial dilutions of the formulated complementary foods were carried out and 0.1 ml of the selected dilution was spread on triplicate plates using sterile glass spreader. This technique was used for the enumeration of Total yeast and Molds counts on Nutrient Agar. Media used were prepared according to the manufacturers instructions and all cultures were incubated at 37°C for 24 h. Sensory evaluation of the

formulated blend was carried out at the interval of 15 and 30 days on the taste, appearance, aroma, texture, colour and overall acceptability by a 6 adult panelists in order to evaluate the changes occurred in the blend.

Determining the self-life of the best treatment

Organoleptic characteristics of the best treatment at 0, 15 and 30 days.

Table 2: Effect on sensory qualities of weaning food T_3 Treatment

Storage period	Colour & Appreance	Consistency	Flavor & Taste	Overall Acceptabilty
0 day	8.5±0.11	7.56±0.07	8.33±0.06	8.13±0.04
15 day	8.22±0.25	7.33±0.08	7.96±0.22	7.83±0.06
30 day	7.5±0.03	7.1±0.05	7.5±0.21	7.38±0.05

Results are mean±SD of three determinations

Flavor and taste is an important charaterstic of the weaning food. Flavor and taste changes can provide information about the extent of dehydration and roasting that take place during the process of making weaning powder. Above table shows the mean score of weaning food in relation to colour and appreance change during storage, which indicates that, decrease in the mean values from 8.5±0.11 to 7.5±0.03, consistency 7.56±0.07 to 7.1±0.05, flavor and taste 8.33±0.06 to 7.5±0.21, overall acceptability 8.13±0.04 to 7.38±0.05 respectively.

Table 3: Impact of storage on organoleptic characterstic of the weaning food

Characters	0 days	30 days	T. tab	T. Cal	Results
Colour appearance	8.50	7.50	2.776	-2.449	NS
Consistency	7.57	7.17	2.776	-1.395	NS
Flavour	8.33	7.50	2.776	-1.890	NS
Overall acceptability	8.13	7.39	2.776	-2.027	NS

The table 3 shows that the mean values for colour appearance of weaning food shows significant difference from 0 day to 30 day. The mean values for consistency was decreased from 0 to 30 day but the decreasing tend was not significant in relation to consistency when paired t test was applied. No significant difference was observed on flavor during storage. This non significant difference was the result of the dehydration process used in preparation of weaning food. The mean values of overall acceptability were 8.13 at 0 day and 7.39 on 30 day. The overall acceptability was also decreased during storage but the result was non significant.

Determining moisture and yeast mould count

Table 4: Moisture % of the organoleptically best treatment of weaning food at 0,15 and 30 days interval.

Days	T3	ISI Std. value (1993)
0day	0.33%	< 12%
15 day	2.6%	<12%
30 day	4.3%	<12%

Above table shows that moisture percentage of weaning food at 0,15 and 30 days. Result reveals that highest moisture percentage of the best treatment of weaning food is at 30 day (4.3%) followed by 15 day (2.6%) followed by 0 day (0.33%). On the basis of findings it is clear that the weaning food at the time of storage absorbed some moisture. Similar finding was also reported by Kent and Evers (1994) that moisture contents greater than 12%, risk of fat oxidation and development of rancidity increases as compared to flour containing lower levels of moisture i.e. 7.5%.

Table 5: Microbiological analysis (yeast molds count) of the organoleptically best treatment compared to ISI standards.

Days	Treatments	Dilution	Count	Dilution factor (D.F.)	Count X D.F.	Yeast-mold count(cfu/g)	ISI Std. value (1993)
0	T3	10^{-2}	0	10^2	0×10^2	0 cfu/g	$\leq1.0\times10^2$cfu/g
15	T3	10^{-2}	0.4	10^2	0.4×10^2	40 cfu/g	$\leq1.0\times10^2$cfu/g
30	T3	10^{-2}	1	10^2	1×10^2	100 cfu/g	$\leq1.0\times10^2$cfu/g

Above table shows that yeast- mold count of organoleptically best treatment at 0,15 and 30 days and is compared with the ISI standard value. Results reveals that there was no microbial growth at 0 but at 15 day and 30 day yeast-mold count was 0.4 and 1 respectively which is acceptable. It shows that the prepared weaning food can be kept till 30 days without any microbial growth.

Similar findings were reported by Pravin *et al.*, (2014) The distribution of micro-organisms and their amount of occurrence in the formulated baby food during storage period for three months it was analysed that the fungus count was increased due to increase moisture after few days which ranges from <10 to 200 cfu/gm.

Conclusion

On the basis of the above findings it is concluded that the weaning food can be prepared by using different flours. Sensory score of reconstituted weaning food with milk scored highest T_3 (soyabean flour 20g, carrot flour 20g, sweet potato flour 15g, apple flour 25g and wheat flour 20g) in relation to

colour, flavor, consistency and over all acceptability and the prepared weaning food can be stored for 30 days without any bacterial contamination.

Recommendations

The prepared weaning food is recommended for infants suffering from malnutrition in order to improve their nutritional status particularly of energy, carbohydrate, calcium, protein, carotene etc. so that malnutrition in early infancy can be prevented.

It is recommended to the children after 6 months of the birth in order to introduce them with the supplementary food so as to fulfil their nutritional requirement which is not fulfilled by the mothers milk alone after 6 months.

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