

**“DEVELOPMENT AND QUALITY EVALUATION OF INSTANT WEANING FOOD
BASED ON VEGETABLES”**

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BY

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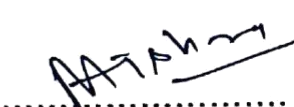
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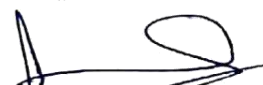
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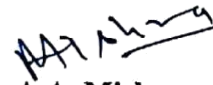
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DATE : / /2019


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LIST OF ABBREVIATIONS

1. ANOVA	:	Analysis of Variance.
2. et.al.	:	And Others / And all.
3. °C	:	Centigrade.
4. C.m.	:	Centimeter.
5. D.F.	:	Degree of Freedom.
6. E.S.S.	:	Error Sum of Square.
7. E.M.S.S.	:	Error Mean Sum of Squares.
8. Fig.	:	Figure.
9. F.tab.	:	Tabulated Value of F.
10. F.cal.	:	Calculated Value of F.
11. G	:	Grams.
12. Hrs.	:	Hours.
13. k.g.	:	Kilograms.
14. M	:	Microgram.
15. M.S.S.	:	Mean Sum of Square.
16. mg.	:	Miligram.
17. ml.	:	Mililitre.
18. Nm	:	Nanometer.
19. N.S.	:	Non – Significant.
20. %	:	Percentage.
21. S	:	Significant.
22. SSV	:	Sum of Square of Variety.
23. T.S.S.	:	Total Soluble Sugars.
24. Temp.	:	temperature.

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Khushbu

Date : KHUSHBU LATA

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ABSTRACT

The present research was carried out with the objective to develop weaning food using different levels of vegetable flour, corn flour and skim milk powder with respect to sensory quality, nutritional density and evaluated for its physico-chemical properties. Weaning foods were packed in glass jar, low density polyethylene (LDPE), and were stored at room temperature. Twelve blends, prepared using Carrot flour, Beetroot flour and Spinach flour in various ratios 5%, 10%, 15%, 20%. The result indicated that a blend of 5% beetroot flour with 95% corn flour was optimal incorporation. The optimal value of moisture content was 7.51%, fat content 1.83%, protein content 5.98%, carbohydrate 81.93% and fibre was 2.49% per 100g. During storage protein, fat, carbohydrate, and fibre decreases with increasing storage period. The sensory score of colour, flavor, taste, and texture was decreased slightly during storage. Study on shelf life of the product revealed that glass jar was the best barrier of moisture and air than LDPE because the significant decrease in fat, carbohydrate, protein and fibre content and increase in moisture content was lesser than LDPE.

Keywords: Weaning food, vegetables, Corn, Carrot, Beetroot and Spinach flour, Malnutrition, Glass jar and LDPE.

CHAPTER -I

INTRODUCTION

Good nutrition is major to infants' health however its importance in the early years of the development boosts many folds as there is sudden increase in the Childs weight expected between 3kg to 10 kg by the end of the year. Together with the physical growth some qualitative changes also takes place in the behavior of the child and social relationship which can be majorly affected by nutritional intake and utilization by the child. After crossing the first six months of life, an infant's nutrient demands start to expand and breast milk alone becomes insufficient to fuel the growing body. It is treated as a critical period in the infant's life and if care is not taken may lead to malnutrition and various health disorders (**Nicklaus 2011**). Malnutrition is the major problem in developing countries; and usually starts from the weaning period somewhat due to inadequate or inappropriate nutrients consumption (**Ali et al 2016**). This arouses the need for the formulations of complementary foods for the infant diet plan which can in turn meet the nutritional demands of the growing child. WHO recommended that weaning of the infant should be started as the child reached the age of 6 months; this will insure that the nutritional requirements are sufficient enough to fuel the body and mind of the toddler. Baby's usual milk supplemented with a nutritious and balanced diet i.e. rich in fruit and vegetables will help to provide all the essential nutrients that baby requires.

As soon as the baby crosses first 5 month of his life iron that is received in the womb and is stored in the infants body starts to deplete and needs a back up to maintain the iron level for healthy development of body and brain. The more diverse diet we provide to the baby will reduce the chances of becoming a fussy eater so it will prove to be a good initiative to offer a large range of tastes and textures. Small children learn eating habits that they maintain long-term. Focusing on their dietary intake around lower calorie vegetables with controlled amounts of fresh fruit is important so that they learn that vegetables are important and cannot be neglected from their daily nutritional requirement.

Studies conducted on malnutrition among Children of two groups revealed that introducing weaning at the recommended age of 4-6 months in the first group led to development of less malnourished children than those for whom weaning was introduced before or latter than the recommended age(**J Coll Physicians and Surg Pak, 2006 Aug**).The term "to wean" means "depending on something other than on what they are habitual of". It is the process of introducing the baby to rest of the foods apart from the milk. Weaning is recommended to start between 4 to 6 months. It is the best time to overcome the malnutrition and substitute child nutritional requirement with nutritious green vegetables. Weaning

can give a clear view of the child's status in terms of nutrition. Improper weaning habits during infancy and early childhood lead to malnutrition and contribute to impairment of cognitive and social development. Noticeable fall can be seen in school performance and productivity in later stages of life. India is facing major health problems in terms of malnutrition among the children under five. This problem is clearly supported by the fact that universality of under-weight children in India secures highest rank in the world which is nearly the double of Sub-Saharan Africa. According to UNICEF reports Malnutrition rates are still alarming and stunting is declining too slowly while wasting still affects the lives of far too many young children. Under nutrition is the main cause of half of the death under 5. Malnutrition contributes to approx 3 million losses of lives in a year. Undernourished children are very susceptible to common infections. It also increases the frequency and severity of such infections and delays recovery time. The interaction between under nutrition and infection can create a potentially lethal cycle of worsening illness and deteriorating nutritional status. Under nourished child in the first 3years of a child's life can lead to shrimp growth, which is associated with impaired intellectual ability and reduced school and work performance. The data published in December 2017 by UNICEF shows that today, more than one third of children in need are not receiving the life-saving benefits of vitamin A supplementation. All these deficiencies can be overcome by introducing nutrient rich diet in early ages.

Child's future dietary intake habits are determined by the food that they prefer in their early years of life. Fruit and vegetables of different colors contain differing amounts of vitamins, minerals and antioxidants. Relying only upon fruits will lead the child to miss out essential and vegetables in the diet so that the child doesn't miss out any essential nutrient. For example, looking at fruits and vegetables we find that most vegetables are rich in calcium, iron and folate. Moreover, numerous fruits are rich in calories compared to most vegetables. Overweight child consuming more fruits and replacing vegetables in their diet may add excess calories to their diet and may ultimately be able to result into more weight gain. Carrot is widely appreciated to be chosen as first vegetable for infants due to its rich nutritional properties along with great taste and texture. Carrots are easily digestible by infants. Carrot is sweet in nature and is very much liked by the babies as they have natural preference for sweets. Carrots are the major source of beta-carotene and are also called as storehouse of beta- carotene. When beta- carotene enters into the body it is transformed into Vitamin A. Vitamin A is very important for the eyesight of the baby. Carrots also aid in building

strong immune system and contain phytochemicals that may protect against heart disease and certain cancers, notes the Academy of Nutrition and Dietetics. Apart from these nutritional qualities carrots are rich source of fiber, which helps the infant to have normal bowel movements. Carrots contain some traces of iron, calcium and vitamin C.

Spinach is a good food for the baby because it's packed with nutrients vital to healthy growth and development. It's a good source of vitamins A and K and provides folate, vitamin C, iron, calcium, zinc, fiber and magnesium. Iron and zinc are important nutrients for child development. Iron is vital for proper brain, neurological and red blood cell development. Zinc is necessary for a healthy immune system, as well as tissue growth and healing. With ample amounts of dietary fiber, this leafy vegetable is often used as a natural laxative and helps in keeping the digestive system on track. This can be a blessing for babies who often get constipated. Spinach absorbs water and adds bulk to the stool, helping in easy bowel movement that can do wonders for a constipated baby. Spinach contains good amounts of antimicrobial elements which help in treating urinary infections that are very common with babies. As your baby's stomach and intestines are not fully matured, they can often get gastric issues. This can cause a lot of discomfort and uneasiness to small kids. Offering spinach to babies in such times can be helpful. Even though the liver is one of the strongest organs in the body, it can get subjected to infections too. Spinach has shown positive results in liver protection. Parasitic worms can often grow inside the delicate and sensitive stomach linings and intestines of babies. However, regular intake of spinach ensures removal of intestinal pests and worms that feed off the intestines and often make babies weak and sick. Spinach is naturally rich in water as 90% of it is water so it keeps your baby well hydrated. According to USDA beets are highly nutritious root vegetables that are a great source of vitamins and minerals such as potassium, sodium, iron, folate, phosphorus, magnesium, calcium, vitamin C, and group of B vitamins such as thiamin, niacin, and riboflavin. Beets are rich in antioxidants and acquire their deep color from the pigment betalain, known to have potent anti-inflammatory properties. They also have abundant quantity of phytochemical compounds such as anthocyanins, carotenoids, lutein/zeaxanthin, glycine, and betaine. Being a great source of dietary fiber, they are also low in fat, cholesterol, and calories. The second name of corn is starch and is well known for its bright yellow colour, sweetness and high protein content. Hence it can play as an important ingredient of the weaning food. It is a good source of protein and carbohydrates. Maize is rich in B- vitamins,

dietary fiber, minerals, magnesium and phosphorus in moderate level. Before proceeding with corn one should also check with the allergies of the baby. It is a great energy food as 100g of corn gives 350 calories. It supports the development of nerve and brain, increases metabolism of sugar, protein and fatty acids. Folate in corn helps in development of the new cell.

JUSTIFICATION

Children develop taste for food in their early age (weaning period). According to new research feeding babies first with variegated vegetables lets them to enjoy unfamiliar varieties. Introducing vegetable based weaning mix will help them to acquire taste for vegetable in long run which will cut down the extra calories and reduce obesity problem. A research published in British Journal of nutrition shows that infants feed with variety of vegetables in the first 15 days of weaning are more likely to accept, try & like new vegetables. Vegetables are a rich source of various nutrients, including fiber, potassium, folate (folic acid) and vitamins A, E and C. Apart from having rich source of nutrients it also helps to overcome malnutrition which is a major problem in India as well as across the world. Incorporating vegetables at early weaning can help to reduce malnutrition mortality rate. The above work of developing vegetable based weaning mix will help to accustom taste for vegetables & prove a way out to deal with malnutrition with minimal cost.

OBJECTIVES

To achieve the following aim, it is decided to work on following objectives:

- To develop low cost vegetable based weaning mix.
- To study the physicochemical properties of the developed product during storage.
- To study the change occurring in sensory properties of the developed product by comparing with the product available in market during storage.

CHAPTER –II

REVIEW OF LITERATURE

2.1 Increasing popularity of functional foods

Functional foods are gaining popularity all over the world due to the wide spectrum of health benefits they provide. Health consciousness is one of the dominant drives of consumer market in 21st century. In food markets no products can be marketed without addressing health concerns, and even basic foods must address issues of calorific content, additives, pesticides, organics, salt and sugar volumes. The rising awareness of consumers toward the health benefits of foods and their nutritional benefits for potential disease prevention and health enhancement is pushing the market of functional food to pay more attention towards nutritional contents and their affects on the consumer. Functional foods are the medicinal foods that provide health benefits along with energy and essential nutrients. In this sector more emphasis has been given especially with respect to children food. Weaning is the most important and critical stage in the growth and development of children. Hence there is a need to bestow keen attention in developing weaning food. The company manufacturing weaning foods at commercial scale have focused much on supplementing the balanced nutrition rather than emphasizing on health and well-being of children. In the above aspect a need arose for the manufacturing of functional weaning food which can fulfill the requirements of the growing children.

2.2 Weaning overview

In this chapter, the information related to weaning of foods and its importance, problems in weaning, components used in weaning food formulation along with processing methods are highlighted. The information related to the importance of whey protein concentrate and hydrolysates, bioactive peptides and their role in health maintenance have also been reviewed here under. The term “to wean” comes from an ancient phrase that means “to become habitual”. So weaning refers to the period during which an infant becomes accustomed to food other than milk

(Ambike D *et al.*, 2017). It is the process of extending toddlers' diet to include foods of liquid consistency other than breast milk as it is the period of infant susceptibility (Sajilata *et al.*, 2002). It impersonates a period of changeover with an increased nutritional demand for growth and brain development. Study on traditional child feeding practices in many developing countries proclaims that, weaning period is the whole period during which breast milk is gets replaced by other foods, usually starts when infant is 4-6 months old and is carried on the age of two to three years. Multicenter Growth Reference Study, which estimates severe malnutrition in children between 1 and 3 years of age to be 15.6%, much above the current estimate of 4.2%, based on the IAP(Indian Academy of Pediatrics) classification, and 13.7% among children between 3 and 5 years of age, again way higher than the current estimate of 2.9%(Ganesh Kumar S. *et al.*,2015). They also suggested that facility based services need to be given to children with severe acute malnutrition, those with poor appetite or acute medical complications. Promotional action should be taken for low-cost sustainable solutions like optimal infant and young child feeding practices for preventing the occurrence of severe acute malnutrition.

2.3 Importance of vegetables in the weaning

In a preparation of biscuit with carrot flour and cowpea flour it was found that the inclusion of carrot powder significantly improved the carotenoids content a potent antioxidants which helps in neutralizing the effects of free radicals. This could serve as an easiest mean of tackling and reducing vitamin A deficiency and improve the health status of the vulnerable groups (Olubunmi Phebean . *et. al.* 2017).

Beetroot juice is not only blessed with a beautiful color but also packed with nutrients. Individuals with a history of oxalate-containing kidney stones should limit their consumption of beets. As beetroot juice is very potent, do not consume too much, especially if your body is not yet accustomed to it. For a beginner, start with the juice of half a medium-sized beetroot once a week, slowly increasing to one whole beetroot a week. A harmless side effect of drinking beetroot juice is that your urine may turn pink or red. Beetroots are a good source of folic acid and vitamin C. It also contains small amounts of vitamins B1, B2, B3, and vitamin A in the form of beta-carotene. It is rich in calcium, magnesium, phosphorus, potassium, and sodium. Also, smaller amounts of iron, zinc, copper, manganese, and selenium. While raw beets are mostly water and carbohydrate, they

also contain small amounts of all the amino acids (protein). One 2" (5 cm) beetroot contains 35 calories. Its carotenoids and flavanoids can help reduce the oxidation of LDL cholesterol which could lead to damaged artery walls and ultimately heart attacks and strokes. The deep red color of beetroot comes from betacyanin. This prevents from colon cancer. The rich stock of silica in it does perfect utilization of calcium in the body and is also required for healthy skin, hair, nails and bones (**Kumar Y, 2015**).

Addition of Spinach in our daily life has great importance to prevent the health from many disease its antioxidative effect has active compounds and are highly available to the body, a powerful natural antioxidant mixture has been identified from spinach leaves with its main active compounds, these compounds are heat stable and non toxic when eaten its dietary invention is important in human. All compounds have antioxidant effect in body (**Miano, 2016**). Vegetable proteins have potential source of adequate protein for the formulation of weaning foods. It is an evident from many studies that attention should be paid to the mixture of vegetable proteins to meet the adequate nutritional quality needed for the promotion of growth of infants. It might be inferred from the result of the study that there was optimum nitrogen retention in animal tissue fed with control diets. Food consumption, nitrogen retention, average protein level and optimum growth rate were found to be inter-related. However, if economic cost and health benefits were put into consideration, newly formulated diets could be produced in a much cheaper rate than the commercial available product. This would mean that investigation of this nature will be useful to the industries and common people in general to alleviate protein energy malnutrition in developing countries (**Ibironke, 2014**).

2.4 Blanching

Ralph P. Cavalieri (2015) in his research stated that blanching is a unit operation performed prior to freezing, drying or canning of fruits or vegetables. In this method vegetables or fruits are heated for the purpose of inactivating enzymes; modifying texture; preserving color, flavor, and nutritional value; and removing trapped air. Hot water and steam are frequently employed as the heating media. Apart from these microwave and gas blanching are some other methods of blanching. Blanching facilitates peeling and dicing, and is also accompanied by microbial load reduction.

For most processed fruits and vegetables, blanching is essential to inactive the enzymes responsible for quality deterioration of fruits and vegetables in storage. Blanching is an important heat process in preparation of vegetables and fruits before dehydration and packaging. Blanching is done to inactive enzymes and to destroy the peroxides. Blanching is the process of heating the food rapidly to a predetermined temperature, holding it at that temperature for a definite period and then either cooling a material or passing it to be subsequent processing without delay. Water blanching is performed in hot water at temperatures ranging typically from 60°C to 100°C. However, low temperature long time (LTLT) blanching and combinations of LTLT with high temperature short time (HTST) blanching have also been studied (**Rehman and Perera, 1999; Stanley et al., 1995 and Lin and Schyvens, 1995**). Water blanching usually results in a more uniform treatment, allowing processing at lower temperatures.

2.5 Drying

Keeping the product fresh is the best way to maintain its nutritional value, but most storage techniques require low temperatures, which are difficult to maintain throughout the distribution chain. On the other hand, drying is a suitable alternative for post harvest management especially in countries like India where exist poorly established low temperature distribution and handling facilities. It is noted that over 20% of the world perishable crops are dried to increase shelf-life and promote food security. It is the oldest and most effective method of lowering water content in order to slow down food spoilage by micro-organisms. Commonly three words are used to express the removal of water from a food product “drying” or “dehydration”, or “dewatering”. **Vega- Mercado et al. (2001)** explained that these words are used to differentiate the process according to the level of water removed (**Mulet, 2011**). “Drying” of food material occurs when water vapour is removed from its surface into the surrounding space, resulting in a relatively dried form of the material. In “dewatering”, liquid water is drained or squeezed out of the material. In “dehydration” evaporation of water takes place initially the surface water (external diffusion) then from interior surface of raw material (internal diffusion). If the rate of external diffusion is far greater than internal diffusion it leads to over dehydration i.e ‘case hardening’. When the water concentration in the interior is too high its water vapour pressure will be too high. This causes cracking of the more tender tissues and

thus the cracking of the surface with leaching of the soluble substances from the interior, affecting negatively the appearance and quality of the final product.

2.6 Flours

Malted sorghum based composite flours were developed using blanched soybean flours and blanched banana flour. These composite flours were used in different compositions to study and develop weaning food (**Varsha kumari.et.al. 2017**) Studies were also conducted for weaning food development from pulse flour, banana flour and pineapple pomace flour using different ratios of the ingredients and the product was evaluated for its physicochemical, sensory and microbial characteristics. The study concluded that it was found that the ash, protein, fat, and ascorbic acid content of weaning food packed in laminated aluminium foil, decreased with increase in storage period. From all the preparations, it was seen that the weaning food with 50% pulse flour, 30% banana flour and 20% pineapple pomace flour (Sample T4) was accepted by panel judges depending on sensory evaluation and was best according to nutritional value having moisture 3.87%, ash 4.28%, fat 2.1%, protein 22.51% and Vit.C 37.35 mg/100g.(**Mishra et.al.2014**)

2.7 Packaging Material

Another study on the weaning food preparation was conducted using banana –soy & sesame .All there three are very nutritious to be considered as the weaning food. In this study conventional dehydration technique was used to dry the ingredients. Study on the shelf life of the product has 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 due to the density difference in those two packaging materials. The product with the composition 67:16.5:16.5 was chosen as the best variant among the others. (**Mishra et.al.2013**).

The influence of flavour absorption by low-density polyethylene (LDPE), polycarbonate (PC) and polyethylene terephthalate (PET) on taste perception of a model solution containing seven flavour compounds and orange juice in glass bottles was studied with and without pieces of the respective plastic films after dark storage at 20 degrees C. Owing to absorption, the amount of flavour compounds in the model solution exposed to LDPE decreased substantially. From the model flavour solution valencene was almost completely absorbed by LDPE, followed to a lesser extent by decanal, hexyl acetate, octanal and nonanone. Less flavour compounds were absorbed from the model solution by PC and PET. In contrast to LDPE, valencene was absorbed in the lowest amounts

and decanal in the highest. Limonene was readily absorbed from orange juice by LDPE, while myrcene, valencene, pinene and decanal were absorbed in smaller quantities. Only three flavour compounds were absorbed from orange juice by PC and PET in very small amounts: limonene, myrcene and decanal. Although the flavour content between controls and polymer-treated samples differed substantially, the loss of flavour compounds due to absorption by LDPE, PC and PET did not influence taste perception of a model solution and orange juice significantly up to 29 days of dark storage at 20 degrees C as determined by triangular taste panel tests.(**Van Willige *et.al.*2003**)

This chapter deals with the materials and methodologies that will be used during formulation and acceptability of the product. The determination of various nutritional compositions of fresh vegetables and freshly prepared weaning mix is done using standard techniques.

3.1 Procurement of Raw materials:

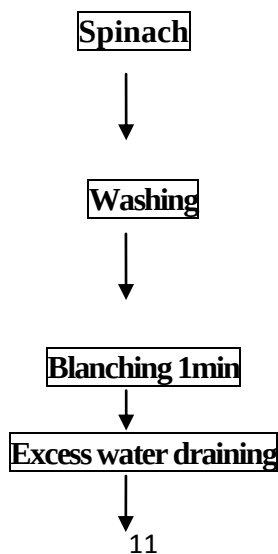
The raw materials has been purchased from the local market of Prayagraj, which includes corn, beetroot, spinach, carrot & skimmed milk powder which is added with the composition in a fixed amount.

3.2 Site of Experiment:

The present investigation was carried out in the Research Laboratory of the Department of Food process engineering, Vaugh Institute of Agricultural Engineering & Technology, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh.

3.3 Preparation of the flours:

3.3.1 Spinach flour: Fresh green spinach is washed and the roots are cut apart. Next the spinach was blanched using hot water bath maintained at temperature greater than 95°C for 1 min. Blanching preserves color and texture of the product. Immediate after 1 min. of blanching the spinach was soaked in ice water to stop cooking. After cooling down the spinach extra water is removed using filter paper. Now the leaves are placed in the tray of tray drier and are allowed to dry for a period of 3-4 hrs at the temperature between 60°C - 70°C as the spinach doesn't have constant drying rate(**Bhavani . et al.2018**). The dried product is then grinded using mixer grinder and is sieved for fine powder texture.



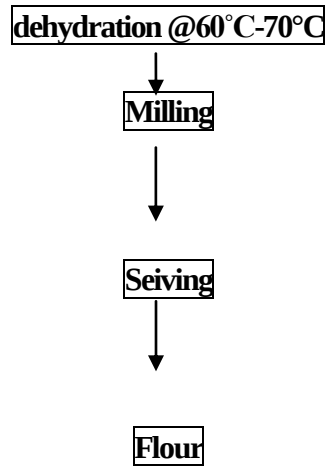
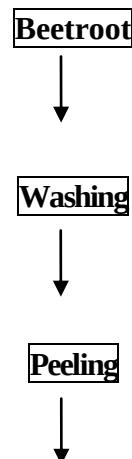


Fig.3.4: Flow chart for processing of spinach flour, **rao et. al.**(2017)

3.3.2. Beetroot flour: - Tray dryer (TD) is popular for drying beetroot due to a relatively short drying time, uniform heating and more hygienic characteristics. The temperature ranges from 65 to 80°C (**Kamalakar.et al. 2016**). This temperature range gives maximum color values and minimizes the loss of volatile oils and discoloration. Beetroot was thoroughly washed and peeled and cut into thin slices of equal sizes (approx 1mm). After cutting the blanching was carried out at a temperature above 95°C for 2-3 min. This blanching will help in retaining color after drying. The blanched beetroot is then transferred to the trays of the tray drier keeping in mind that no slice should overlap one another for uniform drying. The temperature of the tray drier was set to 70°C and was allowed to dry for a time period of 9 hr. Then the dried sample was collected and grinded in the grinder and sieved for fine powder consistency.



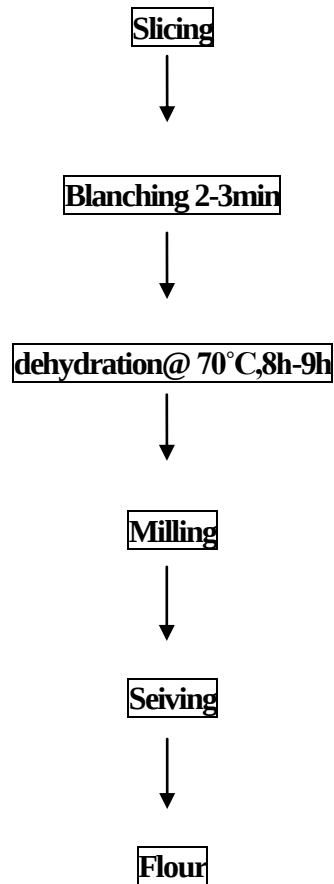


Fig. 3.5:Flow chart for preparation of beetroot flour, **Tumwine Gerald *et.al.* (2018).**

- 3.3.3. Carrot flour:** Fresh carrot was collected and washed thoroughly in the running tap water to wash of the sand and dust. The carrot is then peeled and cut off into small and uniform slices (1mm approx.) and Carrots was tied in muslin cloth and dipped in 95°C for 2-3 minutes(**Gupta and Shukla, 2017**). After blanching it was cooled to room temperature. Free surface moisture was removed by sieving. In blanching of carrots, leaching was found along with enzyme inactivation. So, slight weight loss obtained. It was then transferred to the tray drier same as the beetroot was done and is allowed to dry for 7-8 hrs. at an temperature 70°C. Latter the dried sliced was collected, grinded and sieved for fine consistency

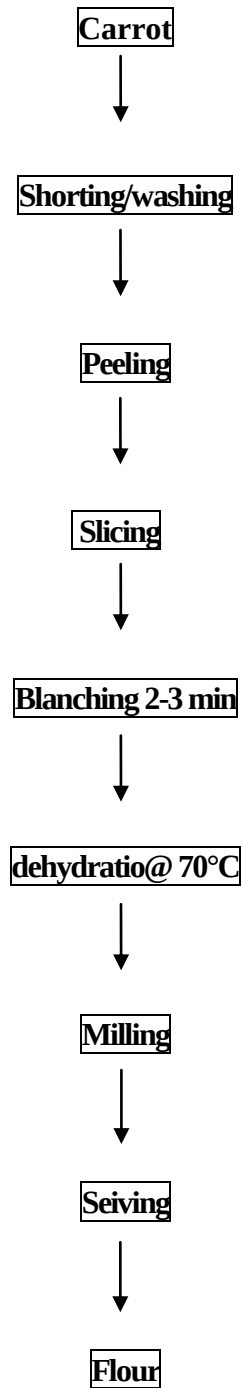


Fig.3.6: Flow chart for preparation of carrot flour, **Purificación *et. al.* (2017)**

3.3.4. Chemicals

All the chemicals used was of analytical grade procured from E.MERCK, (India) Ltd., Mumbai, India. Petroleum ether, Concentrated Sulphuric acid, Concentrated Hydrochloric acid, Sodium Hydroxide, Sodium sulphate, Copper sulphate, Ascorbic acid, Meta-phosphoric acid, 2,6 dichlorophenol indophenols dye, sodium meta-bisulphite.

3.4 Equipments used

3.4.1. Electronic balance

Electronic weighing balance is a measuring instrument used for determining the weight or mass of an object. An electronic balance (model no-LCB4A) was used to weigh all the ingredients required for the preparation of weaning food. A measure pan of 1mg precision was placed inside. The maximum limit of this balance was 300 g.



Fig 3.7: Electronic balance

3.4.2.Grinder

Grinder was used for grinding the raw material such as Amaranth and flaxseed and sugar. Grinding was carried out to reduce particle size of the ingredients.



Fig 3.8: Grinder

3.4.3. Dehydrator

A dehydrator is an appliance that removes moisture from food to aid in its preservation. It uses heat and air flow to reduce the water content of foods. The water content of food is usually very high, typically 80% to 95% for various fruits and vegetables. Removing moisture from food restrains various bacteria from growing and spoiling food. Further, removing moisture from food dramatically reduces the weight of the food. Thus, food dehydrators are used to preserve and extend the shelf life of various foods. A food dehydrator's basic parts usually consist of a heating element, a fan, air vents allowing for air circulation and food trays to lay food upon. A dehydrator's heating element, fans and vents simultaneously work to remove moisture from food. A dehydrator's heating element warms the food causing its moisture to be released from its interior.



Fig 3.9: Dehydrator

3.4.4. Hot air oven

Hot air oven under the brand name of “Alpine” was used for the determination of moisture content of Bengal gram flakes. It was operated from 50 to 300 °C. There is digital thermostat to control the temperature. It has double walled insulation to keep the heat in and conserve energy, the inner layer being a poor conductor and outer layer being metallic. There is also an air filled space in between to aid insulation. An air circulating fans helps in uniform distribution of heat



Fig 3.10: Hot air oven

3.4.5. Soxhlet apparatus

A soxhlet extractor of model “ICON” was used to determine fat content of the product. It was originally designed for the extraction of lipid from a solid material. However a soxhlet extractor is not limited to the extraction of lipids. Typically a soxhlet extraction is only required where the desire compound has a limited solubility in a solvent, and the impurity is insoluble in that solvent. If the desire compound has a significant solubility in a solvent then a simple filtration can be used to separate the compound from the insoluble substance.



Fig 3.11: Soxhlet apparatus

3.4.6. Kjeldhal apparatus

Protein can be determined by kjeldhal's method. Kjeldhal's method is used for determining total nitrogen involves first heating with conc. Sulphuric acid. The reaction rate is accelerated by adding sodium sulphate to raise the boiling point. The catalyst used is copper sulphate. The oxidation causes nitrogen to be converted into ammonium sulphate. After making alkaline with conc. NaOH, the liberated ammonia is obtained by multiplying the total nitrogen by an empirical factor.



Fig 3.12: Kjeldahl Distillation Unit

3.4.7. Muffle furnace

Ash content can be determined by Muffle furnace. Its range is between 0 to 800⁰C. These compact muffle furnaces are perfect for many applications in the laboratory. Quality features like the double-walled furnace housing of rust-free stainless steel, their compact, lightweight constructions, or the heating elements encased in quartz glass tubes make these models reliable partners for your application.



Fig 3.13: Muffle furnace

3.4.8. Desiccator

Desiccators are glass jars which are used to store samples in order to bring the temperature of the sample down without the absorption of moisture by the same. It includes a lower layer of silica crystals which absorbs moisture. It is a close container. It was used to cool heated. Sample and keep the moisture out of a substance place inside vessel.



Fig 3.14. Dessicator

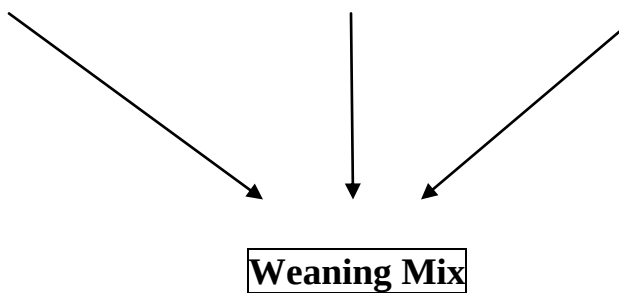
3.4.9. Sieves

80 mesh sieves was used for sieving dry ingredients such as flour, sugar and Green gram flour. This sieving processes was carried out to separate impurities, foreign particle etc. from dry ingredients as well as for their proper mixing.



Fig 3.15. Sieves

3.5 Development of product: Corn flour + Vegetable flour + Milk powder



1. Firstly, all the ingredients e.g. Vegetable flour, corn flour and SMP was weighed with the help of an electronic balance.
2. All the ingredient viz. Vegetable flour, corn flour and SMP was mixed in different proportion to enhance nutritional quality.

3.6 Treatments and replications of developed products: Spinach, carrot and beetroot along with SMP and corn flour was used to develop the product. The whole experiment was replicated three times with treatments T1, T2, T3, T4, T5, T6, T7, T8, T9, T10, T11, T12, and T13.

Table 3.6.1. Details of formulation of weaning food sample blends in different ratios

Treatments	corn flour (g)	beetroot flour (g)	carrot flour (g)	spinach flour (g)	SMP (g)	Total (g)
T0	100	-	-	-	-	100
T1	95	5	-	-	-	100
T2	90	10	-	-	-	100
T3	85	15	-	-	-	100
T4	80	20	-	-	-	100
T5	95	-	5	-	-	100
T6	90	-	10	-	-	100
T7	85	-	15	-	-	100
T8	80	-	20	-	-	100
T9	95	-	-	5	-	100
T10	90	-	-	10	-	100
T12	85	-	-	15	-	100
T13	80	-	-	20	-	100

**TABLE.3.6.2 COMBINATION OF INGREDIENTS USED IN SPINACH WEANING MIX
(BEST TREATMENT T10):**

INGREDIENTS	BEETROOT FLOUR	CORN FLOUR	SMP	TOTAL
AMOUNT (g)	10	90	40	140

**TABLE.3.6.3 COMBINATION OF INGREDIENTS USED IN BEETROOT WEANING MIX
(BEST TREATMENT T1):**

INGREDIENTS	BEETROOT FLOUR	CORN FLOUR	SMP	TOTAL
AMOUNT (g)	5	95	40	140

**TABLE.3.6.4 COMBINATION OF INGREDIENTS USED IN CARROT WEANING MIX
(BEST TREATMENT T7):**

INGREDIENTS	CARROT FLOUR	CORN FLOUR	SMP	TOTAL
AMOUNT (g)	15	85	40	140

3.7 ORGANOLEPTIC ANALYSIS OF THE PREPARED PRESERVED PRODUCTS:

Sensory evaluation of developed product namely weaning mix made by using spinach, beetroot and carrot flour, was done by the panel of students and teachers, who were selected from the faculty of the Department of Food Process engineering, Vaugh Institute of Agricultural Engineering & Technology. The panel members were requested to analyze the prepared products with the help of nine points Hedonic Scale Score Card, purposefully made for analysis.

3.8. Chemical analysis: Ingredients and products were analyzed chemically by the Standardized Procedure of AOAC (1980).

3.8.1. DETERMINATION OF MOISTURE CONTENT.

Principle : Moisture content was determined by evaporating off the moisture from a known amount of sample.

Procedure :

1. Thoroughly wash and dried the aluminium dish in the hot air oven at 100° C for 15mins.
2. Allow it to cool down in desiccator and weighed (W).
3. Weighed accurately about 5 gs. Of the sample in a tarred porcelain dish (W₁ g).
4. Placed the dish in an hot air oven maintained the temp. at 105°C $\pm$ 120°C and dried for atleast 2 hrs.
5. Dish was cooled in desiccator and weighed.
6. Re – dried and weighed to a constant weight (W₂).
7. The difference in weight was the moisture lost by the sample.

Observations :

1. Tare weight of dish = W g.
2. Weight of dish with sample = W₁g.
3. Weight of dish + sample after keeping in hot air oven (in grms) = W₂g.

Calculations :

Moisture % = loss in weight / initial weight of the sample $\times$ 100.

$$= (W_1 - W_2) / (W_1 - W) \times 100$$

3.8.2.DETERMINATION OF TOTAL ASH.

Principle : Ash comprises the mineral constituents of the foods and feeding stuffs, which can be determined by igniting a known amount of dried sample in a muffle furnace.

Procedure :

1. After moisture determination dried sample is obtained.
2. Ignite on a blue flame of burner unless until it smokes off.
3. The porcelain dish was kept in the muffle furnace maintained temp. at $500^{\circ}\text{C} \pm 50^{\circ}\text{C}$ for 1 – 2 hrs.
4. Allow it to cool in the dessicator and weighed (W_3 g).

Observation :

Weight of dish + sample after drying = W_2 g.

Weight of dish + sample after ignition = W_3 g.

Calculations :

$$\begin{aligned}\text{Weight of ash} &= \text{Weight of dish after ignition} - \text{tare weight of the dish} \\ &= (W_3 - W_2)\end{aligned}$$

$$\begin{aligned}\text{Ash \%} &= \text{weight of ash} / \text{weight of sample} \times 100 \\ &= (W_3 - W_2) / (W_1 - W_2) \times 100\end{aligned}$$

3.8.3. DETERMINATION OF CRUDE FAT BY SOXHLET METHOD.

Principle : The dried sample was placed in a continuous fat extractor (Soxhlet) and subjected to extraction with ether. The ether soluble substances thus collected in the flask and removed, dried and weighed. The material extracted includes phospholipids, sterols, essential oils, pigments, etc, besides triglycerides, hence termed as “ crude fat ”. If the sample contains water soluble sugars such as molasses, the weighed sample should be washed with water and dried before extraction.

Apparatus :

Soxhlet Extractor is basically used. The extractor consists of :

1. The extraction flask.
2. The extractor carrying thimble, and
3. The condenser.

These parts are fitted together through strong ground glass joints.

Reagents used :

Petroleum ether (at boiling point 40°C - 60°C).

Procedure :

1. Extraction flask was weighed carefully and accurately (W_1 g).
2. Accurately weighed 2g of the dried sample was transferred into the extraction thimble and placed the thimble carefully in the extractor, so that it was within its siphon height.
3. Weighed the extraction flask, connected to the extractor carrying thimble.
4. Sufficient amount of the petroleum ether was poured into the extractor to start the siphon and then filled about the half of the extraction flask.
5. Extraction flask was connected to the condenser and heated the flask on a water bath or electric mantle for atleast 6 hrs. There was continuous cold water circulation in the condenser.
6. The heat vaporized the solvent and was condensed in the condenser. The condensed solvent fell drop by drop into the thimble or the packets. The solvent extracts the fat present in the foodstuff. When the level of the solvent reaches the siphon height, the whole of the ether flow down back into the flask below taking along with its extracted fat. Again, it was further evaporated from the flask leaving the extracted fat behind and the process repeats several times.
7. At the end of 6hrs, at least 25 – 30 siphoning was taken, the flask was removed carefully.
8. The flask was transferred in a tared conical flask and the solvent was evaporating at 30°C in the electric mantle for 10-15mins.
9. If any solvent was remaining in the flask, kept it in oven at about 100° C or in the open to drive off the last traces of the solvent and dry it.

Observations :

Weight of sample = W .

Weight of flask = W_1 .

Weight of flask + fat = W_2 .

Calculations :

Calculate the percentage of ether extract by multiplying the increase in weight of the extraction flask by 100.

$$\% \text{ of Fat present in sample} = (W_2 - W_3) / W \times 100. .$$

3.8.4. DETERMINATION OF TOTAL CARBOHYDRATE :

Total carbohydrate content of a food can be determined by difference method which was calculated by subtracting the sum of percentage of protein, fat, ash and moisture. Carbohydrates are divided into two groups, crude Fibre and nitrogen free extract. Total carbohydrate includes crude Fibre also but nitrogen free extract (NFE) is calculated by subtracting the sum of percentage of ash, crude Fibre, ether extract, protein and moisture from 100.

Calculation:

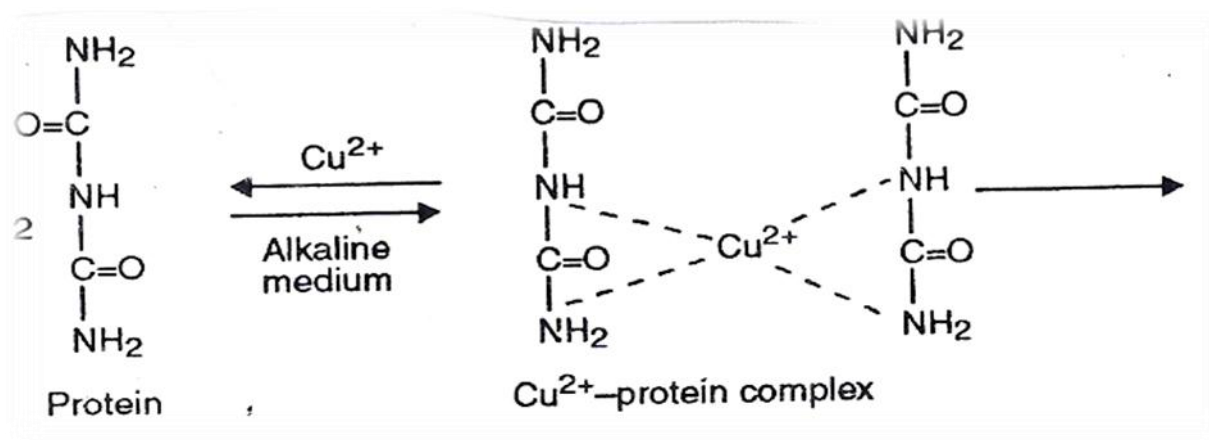
$$\text{Carbohydrate \%} = 100 - \{\text{Moisture (\%)} + \text{Ash (\%)} + \text{Fat (\%)} + \text{Protein (\%)}\}$$

$$\text{Carbohydrate (NFE)} = 100 - (\% \text{ moisture} + \% \text{ fat} + \% \text{ protein} + \% \text{ ash} + \% \text{ crude fibre})$$

3.8.5. DETERMINATION OF PROTEIN BY LOWRY'S METHOD:

The Lowry's reaction for protein estimation is an extension of the Biuret Method. The method developed by **Lowry *et al.* (1951)** is about 10 times more sensitive than the Biuret method. Hence, it is largely followed to determine the protein content of enzyme extracts.

Principle : Protein reacts with the Folin-Ciocalteu Reagent (FCR) to give a blue coloured complex. The colour so formed is due to the reaction of the alkaline copper with the protein as in the biuret test and the reduction of phosphomolybdic - phosphotungstate components in FCR by amino acids tyrosine and tryptophan present in the protein. The intensity of the blue colour is measured colorimetrically at 660nm. The intensity of the colour depends on the amount of these aromatic amino acids present and will vary for different proteins.



$\downarrow$ + FCR (Phosphomolybdic-phosphotungstate)
Blue coloured complex
 $\downarrow$
Directly proportional of protein in solution

Reagents:

1. **Solution A:** 2% sodium carbonate (anhyd.) in 0.1N Sodium hydroxide (NaOH).
2. **Solution B:** 0.5% Copper Sulphate ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$) in 1% potassium sodium tartrate.
3. **Solution C:** (Alkaline copper Solution) Mix 50ml of solution with A 1ml of solution just B prior to use.
4. **Folin-Ciocalteu reagent (FCR):** Diluted the commercial reagent (2N) with an equal volume of water on the day of use or it can be prepared in the laboratory as follows:

Refluxed gently for 10 hours a mixture containing 10g of sodium tungstate ($\text{Na}_2\text{WO}_4 \cdot 2\text{H}_2\text{O}$), 25g of sodium molybdate ($\text{Na}_2\text{MoO}_4 \cdot 2\text{H}_2\text{O}$) 700 ml water, 50 ml of 85% phosphoric acid, and 100ml of concentrated hydrochloric acid in 1.5 litre ml flask. 150 g of lithium sulphate in 50ml water and a few drops of bromine water was added into it. The mixture is boiled for 15 minute without condensor to remove excess bromine. Cooled, diluted to 1 litre and filtered. The reagent should not have greenish tint. The acid concentration of the reagent was determined by titration with 1 NaOH to a Phenolphthalein end point.

5. Stock standard protein solution 50mg of bovine serum albumin and dissolved in 50ml distilled.
6. Working standard solution 10 ml of the stock solution to 50 ml with distilled water to obtain 200µg protein/ml.

Procedure:

Extraction of protein from sample :

1. Ground 0.5 g of the sample with a suitable solvent system (water or buffer) in a pestle and mortar.
2. The sample was centrifuged and the supernatant was used for protein estimation.

Notes :

1. Extraction of proteins is usually carried out with buffers for enzyme assay.
2. In case of enzyme, the entire process should be done in cold.

Estimation of Protein :

1. Pipetted out 0.2, 0.4, 0.6, 0.8 and 1.0 ml of the working standard solution into series of test tubes.
2. Pipetted out 0.1ml and 0.2 ml of the sample extract into two other test tubes.
3. Made up the volume to 1 ml with water in all the tubes. A tube with 1 ml of water served as a blank.
4. Added 5ml of solution C mixed well and incubated at room temperature for 10 min.
5. Added 0.5ml of solution FCR mixed well immediately and incubated at room temperature in dark for 30 minutes.
6. Read the absorbance at 660 nm against the blank.

Drew a standard graph, calculated the amount of protein in the sample and expressed the results as mg/g or mg/100g Sample or percentage.

3.8.6. DETERMINATION OF CRUDE FIBER:

Principle : The defatted sample was boiled successively with dilute acid and alkali for a specified time period and filtered (1.25% H₂SO₄ and 1.25% NaOH). The insoluble residue collected by filtration, dried, weighed and ashed to correct for mineral contamination of Fibre residue. Crude fibre consisted chiefly of cellulose and lignocelluloses.

Apparatus :

- Reflux water condenser
- Conical flask(1 litre capacity)
- Gooch crucible prepared with thin but compact layer of ignited asbestos.

Reagents :

- Dilute sulphuric acid – 1.25 % (0.25 N), accurately prepared
- Dilute sodium hydroxide solution - 1.25% (0.313 N), accurately prepared
- Ethyl alcohol - 95%

Procedure :

- Weigh accurately about 2g of the dried feedstuff and extract the fat using a soxhlet extractor, or use the fat free residue obtained after crude fat determination.
- Transfer the fat free residue into the 1 litre conical flask.
- In a beaker, bring to boil the 200ml dilute sulphuric acid and pour the boiling acid into the flask.
- Boil the contents of the flask for exactly 30 minutes maintaining the liquid level during boiling.
This may be done in any of the following 3 ways:
 - i) By connecting the flask to a reflux water condenser.
 - ii) By marking the liquid level and adding boiling water from time to time.
 - iii) By substituting the conical flask a tall form spoutless beaker of 600 to 800ml capacity and placing over it a round bottom flask containing cold water to act as condenser. The flask may be replaced by another flask containing cold water if the water in it becomes hot.
- Rotate frequently the flask on the beaker in which the material is being digested and remove particles from the side.
- At the end of 30 minutes remove the flask and filter its content through fine linen pad (18 threads to a Cm) held in a funnel and wash with boiling water until the washing are no longer acid to litmus.
- Transfer back the entire residue to the original digestion flask or beaker with a spatula.

- Bring to the boil 200ml of the dilute NaOH and wash the residue on the linen into the digestion flask with the boiling NaOH.
- Boil for exactly 30 minutes maintaining the liquid level as before.
- Rotate the digestion container frequently.
- At the end of the period, remove the digestion flask through the same linen cloth.
- Wash the residue thoroughly with boiling water till free from alkali.
- Transfer residue to the prepared Gooch crucible dried to constant weight at 105°C in an air oven (w g).
- Wash the residue with 15ml of ethyl alcohol.
- Dry the Gooch crucible and contents at 105°C, cool in a dessicator and weigh to constant weight. Note the weight (w₁g).
- Transfer the Gooch crucible and contents in a muffle furnace and ignite at 600° ± 20° C for 1 hour, until all carbonaceous is burnt.
- Cool the Gooch crucible containing the ash in a dessicator and weigh (w₂g).

Observation :

Tare weight of Gooch crucible = (Wg)

Weight of Gooch crucible after washing with the ethyl alcohol = (W₁g)

Weight of Gooch crucible + sample (ash) = (W₂g)

Weight of residue = (W₂ – W)g

Calculation : Subtracted the weight of the ash from the weight of the residue dried at 105°C to obtained the weight of the crude Fibre, calculated its percentage on moisture free basis.

$$\text{Percentage of crude Fibre present} = \frac{(w_1 - w) - (w_2 - w)}{2} \times 100.$$

3.5 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 will be selected and sample will be serving to them. The expert panelist will be 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 ACCEPTIBILITY	REMARKS
A					
B					
C					
D					
E					

Sensory Evaluation card (1-9 Hedonic scale)

9- Like very much

4- Slightly dislike

8- Like much

3- Dislike moderately

7- Like moderately

2- Dislike much

6- Slightly like

1- Dislike very much

5- Neither like nor dislike

3.9. NUTRIENT ESTIMATION OF THE RAW MATERIALS OF DEVELOPED PRODUCTS :

The nutrient calculation of raw materials of the products developed, was done by using the food composition table by C. Gopalan (1994) and Verma (1997).

The following nutrients of the developed products was calculated :

- 3.9.1. Energy
- 3.9.2. Fat.
- 3.9.3. Carbohydrates.
- 3.9.4. Protein
- 3.9.5. Fiber.
- 3.9.6. Ash

3.10. COST CALCULATION:

Costs of the raw materials was calculated on the basis of per Kg of products purchased from the market.

3.11. STATISTICAL ANALYSIS:

The data achieved from the experiments was statistically analyzed by using analysis of variance

techniques. One-way classification with 'n' observations per cell. In addition, critical difference was also found.

3.12. PERIOD OF STUDY:

The time taken for this experimental study was from January 2019 – June 2019.

3.13. EXPERIMENTAL PLAN

S.no.	Variable/ Parameter	Levels	Description
1	Raw materials	1	Com , Beetroot, Spinach, Carrot, Milk powder
2	Drying , Grinding		Tray drier, Microwave, grinder
3	Treatments	13	5%,10%,15%,20% vegetable flour
4	Replications	3	
5	Packaging Material	1	LDPE ,Glass jars
6	Analysis		Physicochemical properties , sensory analysis
7	Storage	1	Room temperature
8	Statistical Analysis		ANOVA-F test

CHAPTER –IV

RESULT AND DISCUSSION

According to the famous statistician Aaron Levenstein, “Data are like outfits, what they reveal is suggestive but what they conceal is vital”, In the brightness of this saying, the data obtained from different aspects during this study, entitled as, “**DEVELOPMENT OF PROCESS FOR INSTANT WEANING FOOD BASED ON VEGETABLES**”, have been analyzed and tabulated statistically to find out the relevant informational facts, and also the factual meaning behind them.

The present investigation was under taken to evaluate the quality as well as acceptability of utilization of Spinach, beetroot and carrot powder for the preparation of weaning food. The physical, chemical and sensory evaluation of the product had been carried out. Studies on quality was based on Physico-chemical analysis (i.e. moisture, fat, protein, ash and fibre content) and sensory properties, which was determined for developed weaning food were influenced by packaging material, storage of environmental condition and chemical constituents of the product. Weaning food was packed in LDPE bags and Glass Jarss and stored at room temperature. The shelf life studies were conducted at the interval of 30 days up to 120 days. The results of the study are being presented and discussed in following section. Chemical composition of the ingredients were analyzed and tabulated to study the property of the weaning mixes with respect to the ingredients.

Development of product: Vegetable based weaning mixes was developed in three different variants namely Spinach weaning mix, Beetroot weaning mix, and Carrot weaning mix. These mixes were developed using different vegetable flours, corn flour as base and SMP as sweetening agent. These vegetable flours were studied in different concentration to find the best composition.



Fig.4.1.: Carrot flour



Fig.4.2.: Beetroot flour



Fig.4.3.: Spinach flour

Table 4.1. Chemical composition of ingredients corn/spinach/carrot/beetroot flour / 100g:

Parameter	Corn	Spinach	Beetroot	Carrot
Moisture (g)	14.3	1.3	4.7	1.6
Crude protein (g)	10.8	3.1	1.4	0.6
Crude fat (g)	2.59	0.6	0.18	0.21
Crude fibre (g)	3.01	0.5	0.7	1.5
Carbohydrate (g)	85.36	2.86	8.96	10.91
Ash content (g)	1.36	1.47	1.28	1.21
Energy (Kcal)	345	30	43	49

4.1. Physico-chemical characteristics of weaning foods are influenced by packaging material, storage period and different proportion of Spinach, Carrot & Beetroot content.

4.1.1. Effect on moisture content of weaning food packed in packaging material (LDPE/Glass jar) during storage

The effect of packaging material, storage period and different contents on moisture content of weaning food packed in LDPE and Glass Jars are presented in Table 4.2& 4.3 respectively. Moisture content of weaning food packed in LDPE and Glass Jars increases considerably with increase in storage period. However, the increase in moisture content with increase in storage

period was less in weaning food packed in Glass Jars than that of LDPE due to low permeation of air and water (Makhal et al., 2003).

Table 4.2. Moisture content (%) of weaning food packed in LDPE packaging during storage

Product	0 th day	30 th day	60 th day	90 th day	120 th day
Spinach weaning food	6.82%	7.14%	7.93%	8.74%	9.41%
Beetroot weaning food	7.51%	7.60%	7.92%	8.39%	9.63%
Carrot weaning food	6.78%	7.21%	8.72%	9.63%	10.26%

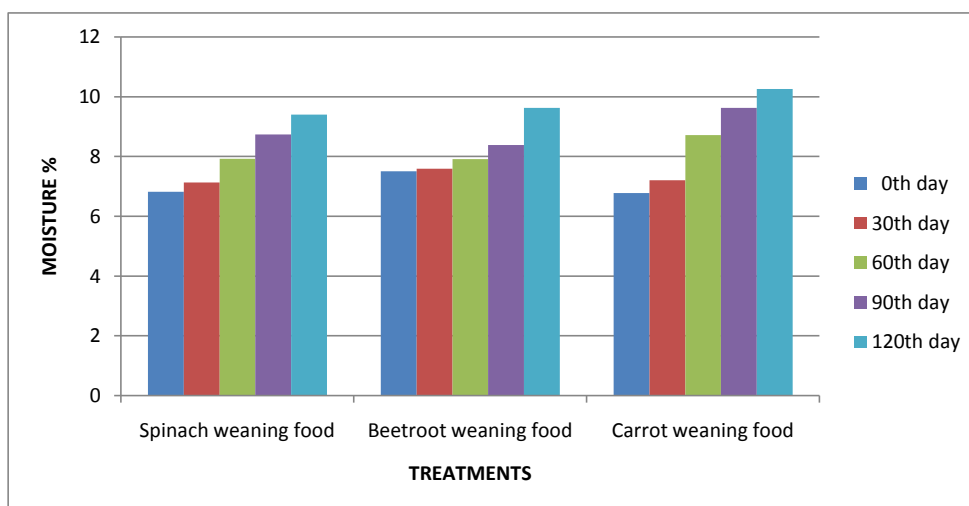


Fig. 4.1. Moisture content (%) of weaning food packed in LDPE packaging during storage

Table. 4.3. Moisture content (%) of weaning food packed in Glass Jars during storage

Product	0 th day	30 th day	60 th day	90 th day	120 th day
Spinach weaning food	6.82%	6.98%	7.64%	8.12%	8.37%
Beetroot weaning food	7.51%	7.6%	7.71%	7.98%	8.57%
Carrot weaning food	6.78%	6.91%	7.43%	8.56%	9.12%

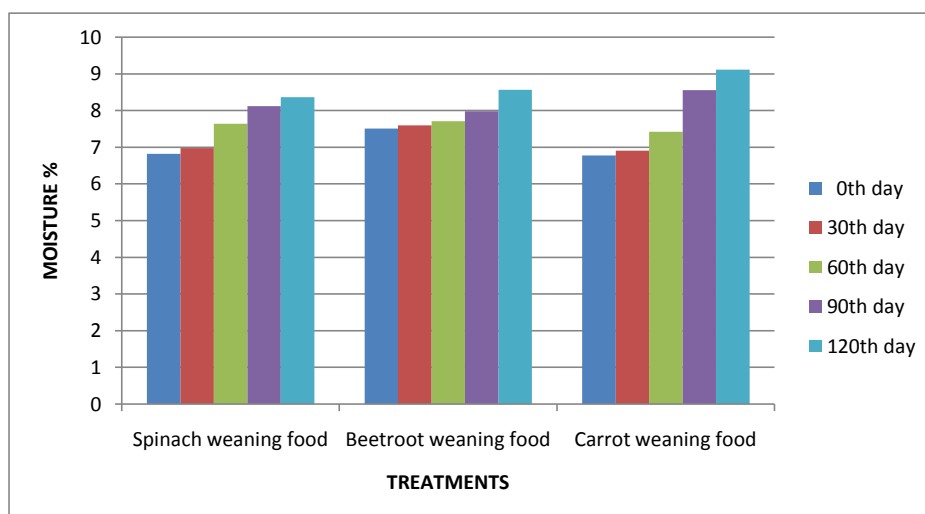


Fig. 4.2. Moisture content (%) of weaning food packed in Glass Jars during storage

4.1.2. Effect of storage on FAT content of weaning food packed in packaging material (LDPE/ Glass Jar)

The effect of packaging material, storage period and different contents on fat content of weaning food packed in LDPE and Glass Jars are presented in Table 4.4 and 4.5 respectively. On critical evaluation of result it was found that fat content of weaning food was considerably reduced during storage. Maximum fat content was found in Beetroot based weaning sample (Beetroot flour 5% and 95% corn flour). The overall results clearly revealed fat content of weaning food

packed in LDPE and Glass Jars decreases considerably with increase in storage period. Furthermore the Glass Jars was found to be a better packaging material as compared to LDPE as it has very low oxygen transmission rate

Table 4.4. FAT content of weaning food packed in packaging material (LDPE) during storage

Product	0 th day	30 th day	60 th day	90 th day	120 th day
Spinach weaning food	1.39%	1.28%	1.24%	1.10%	1.18%
Beetroot weaning food	1.83%	1.79%	1.68%	1.61%	1.51%
Carrot weaning food	1.81%	1.63%	1.58%	1.41%	1.32%

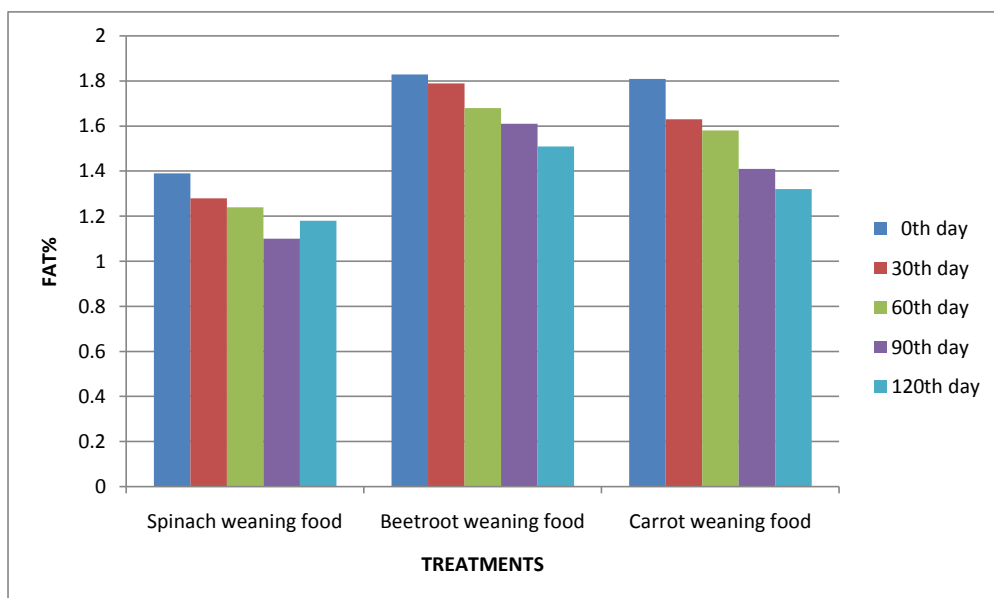


Fig. 4.3. Fat content (%) of weaning food packed in LDPE during storage

Table 4.5. Fat content (%) of weaning food packed in Glass Jars packaging during storage

Product	0 th day	30 th day	60 th day	90 th day	120 th day
Spinach weaning food	1.39%	1.34%	1.29%	1.25%	1.23%
Beetroot weaning food	1.83%	1.80%	1.78%	1.72%	1.67%
Carrot weaning food	1.81%	1.78%	1.63%	1.56%	1.41%

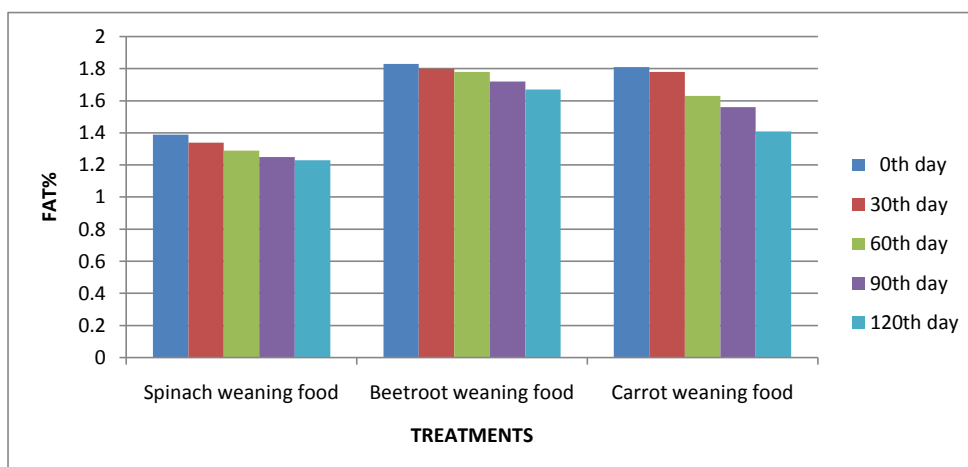


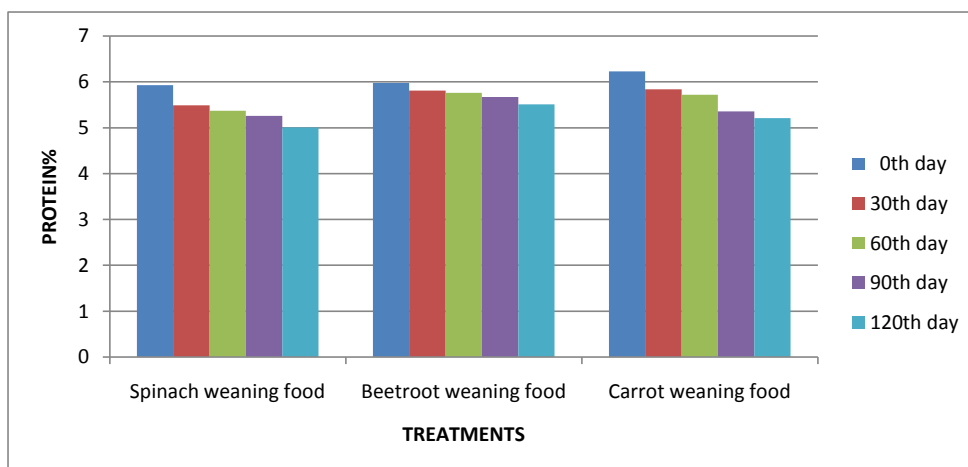
Fig. 4.4. Fat content (%) of weaning food packed in Glass Jars during storage

4.1.3. Effect of packaging materials and ambient storage on protein content of weaning food.

The effect of packaging material, storage period and different contents on protein content of weaning food packed in in LDPE and Glass Jars are presented in Table 4.5 and 4.6 respectively. The result showed that protein content was maximum in sample Carrot based weaning mix (corn flour 85%,and carrot flour15%).The overall results clearly revealed fat content of weaning food packed in Glass Jars and LDPE decreases considerably with increase in storage period. Furthermore the Glass Jars was found to be a better packaging material as compared to LDPE as the permeation of air and water is low in Glass Jars followed by LDPE.

Table 4.6. Protein content (%) of weaning food packed in LDPE during storage

Product	0 th day	30 th day	60 th day	90 th day	120 th day
Spinach weaning food	5.93%	5.49%	5.37%	5.26%	5.01%
Beetroot weaning food	5.98%	5.81%	5.76%	5.67%	5.51%
Carrot weaning food	6.23%	5.84%	5.72%	5.36%	5.21%

**Fig. 4.5.** Protein content (%) of weaning food packed in LDPE during storage**Table 4.7.** Protein content (%) of weaning food packed in Glass Jars during storage

Product	0 th day	30 th day	60 th day	90 th day	120 th day
Spinach weaning food	5.93%	5.79%	5.63%	5.56%	5.38%
Beetroot weaning food	5.98%	5.92%	5.81%	5.73%	5.49%
Carrot weaning food	6.23%	6.01%	5.97%	5.93%	5.86%

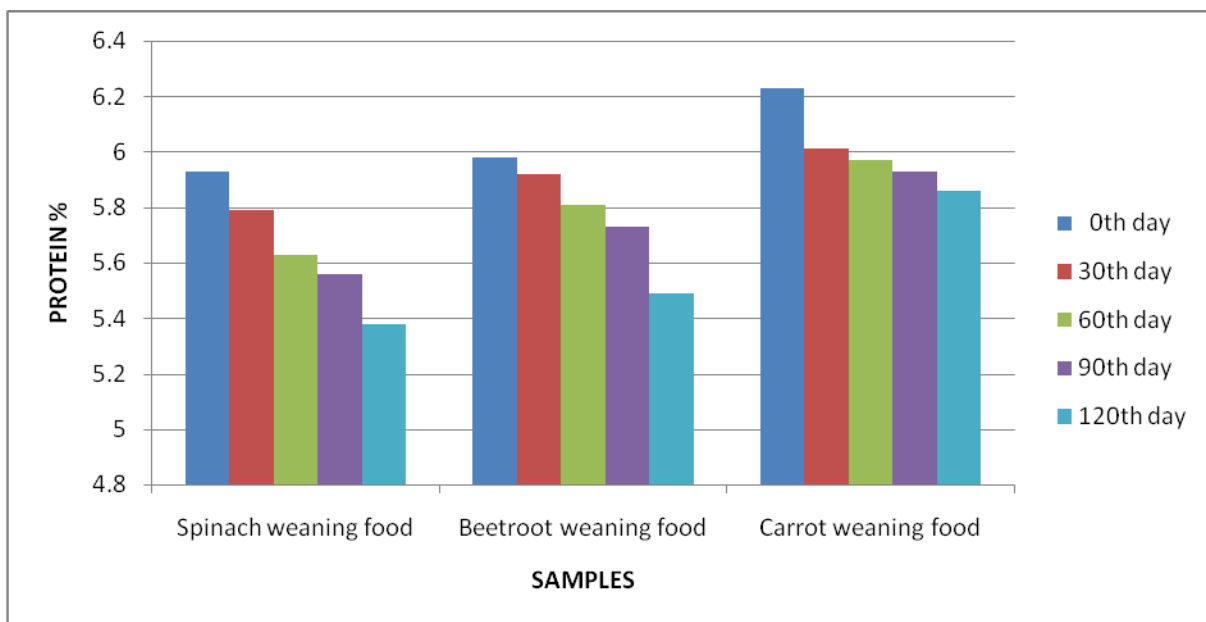


Fig. 4.6. Protein content (%) of weaning food packed in Glass Jars during storage

4.1.4. Effect on fibre content of weaning food packed in packaging materials during storage.

The effect of packaging material, storage period and different contents on fibre content of weaning food packed in in LDPE and Glass Jars are presented in Table 4.8 and 4.9 respectively. The result showed that fibre content was maximum in sample Carrot based weaning mix (corn flour 85%,and carrot flour15%) .The overall results clearly revealed fibre content of weaning food packed in Glass Jars and LDPE decreases considerably with increase in storage period. Furthermore the Glass Jars was found to be a better packaging material as compared to LDPE as the permeation of air and water is low in Glass Jars followed by LDPE.

Table 4.8. Fibre content (%) of weaning food packed in LDPE during storage

Product	0 th day	30 th day	60 th day	90 th day	120 th day
Spinach weaning food	3.15%	2.75%	2.58%	2.39%	2.01%
Beetroot weaning food	2.49%	2.41%	2.32%	2.24%	2.20%
Carrot weaning food	3.42%	3.18%	3.11%	2.97%	2.93%

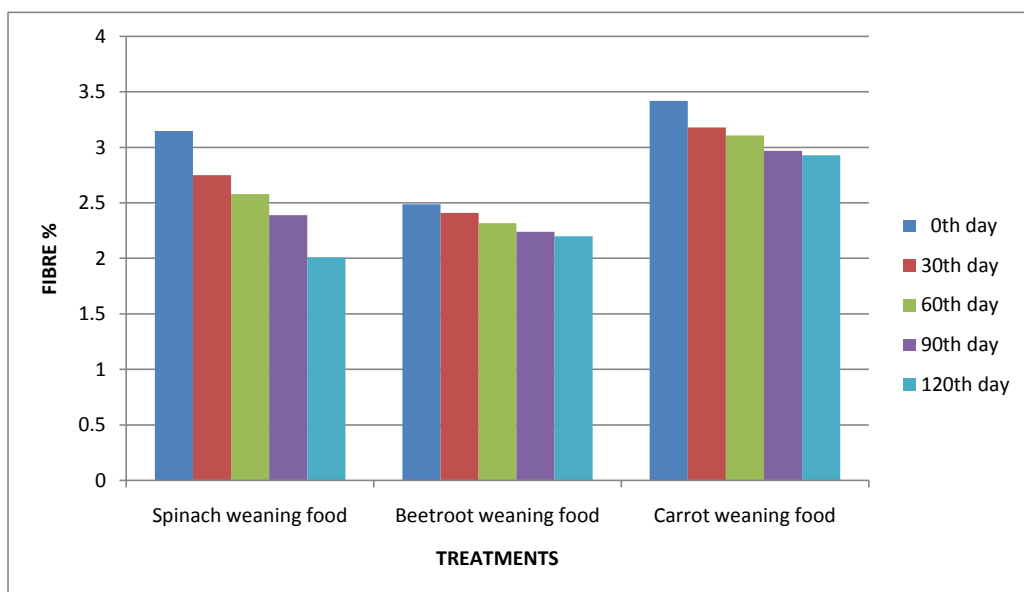


Fig. 4.7. Fibre content (%) of weaning food packed in LDPE during storage

Table 4.9. Fibre content (%) of weaning food packed in Glass Jars during storage

Product	0 th day	30 th day	60 th day	90 th day	120 th day
Spinach weaning food	3.15%	3.02%	2.97%	2.83%	2.64%
Beetroot weaning food	2.49%	2.43%	2.39%	2.31%	2.28%
Carrot weaning food	3.42%	3.39%	3.32%	3.19%	3.08%

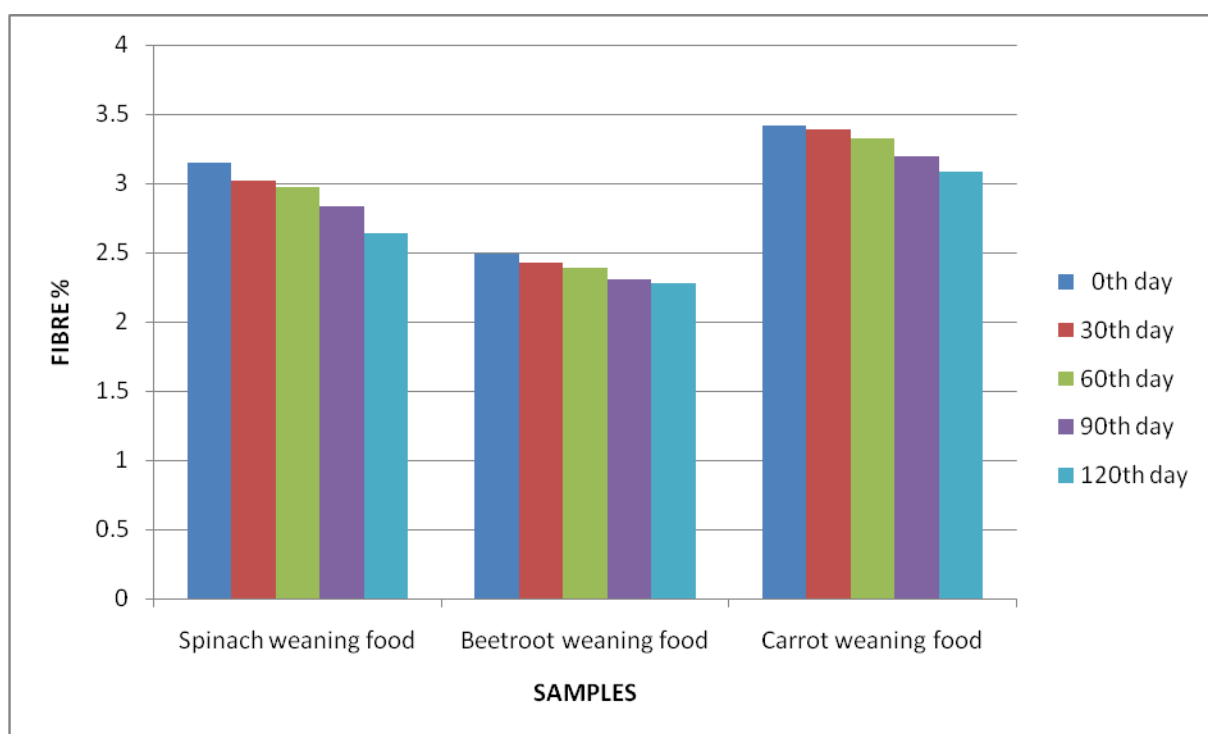


Fig. 4.8. Fibre content (%) of weaning food packed in Glass Jars during storage

4.1.5. Effect on Carbohydrate content of weaning food packed in packaging (LDPE/ Glass jar) materials

The effect of packaging material, storage period and different contents on carbohydrate content of weaning food packed in in LDPE and Glass Jars are presented in Table 4.10 and 4.11 respectively.

The result showed that carbohydrate content was maximum in sample Carrot based weaning mix (corn flour 85%,and carrot flour15%).The overall results clearly revealed carbohydrate content of weaning food packed in Glass Jars and LDPE decreases considerably with increase in storage period. Furthermore the Glass Jars was found to be a better packaging material as compared to LDPE as the permeation of air and water is low in Glass Jars followed by LDPE.

Table 4.10. Carbohydrate content (%) of weaning food packed in LDPE storage

Product	0 th day	30 th day	60 th day	90 th day	120 th day
Spinach weaning food	82.19%	81.75%	80.93%	80.41%	80.12%
Beetroot weaning food	81.93%	80.76%	80.46%	80.38%	80.25%
Carrot weaning food	81.24%	80.61%	80.33%	79.64%	79.25%

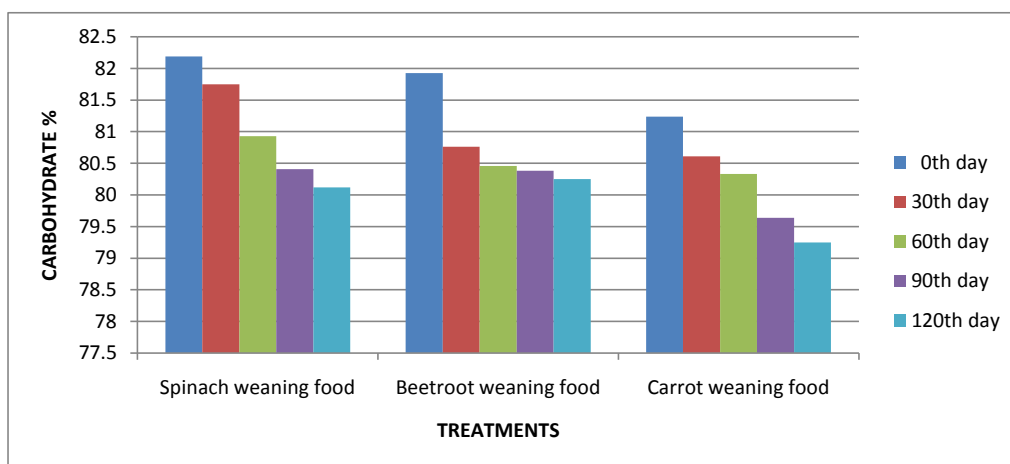


Fig. 4.9. Carbohydrate content (%) of weaning food packed in LDPE during storage

Table 4.11. Carbohydrate content (%) of weaning food packed in Glass Jars during storage

Product	0 th day	30 th day	60 th day	90 th day	120 th day
Spinach weaning food	82.19%	81.12%	80.91%	80.73%	80.62%
Beetroot weaning food	81.93%	81.41%	81.36%	80.97%	80.81%
Carrot weaning food	81.24%	80.79%	80.62%	79.12%	79.89%

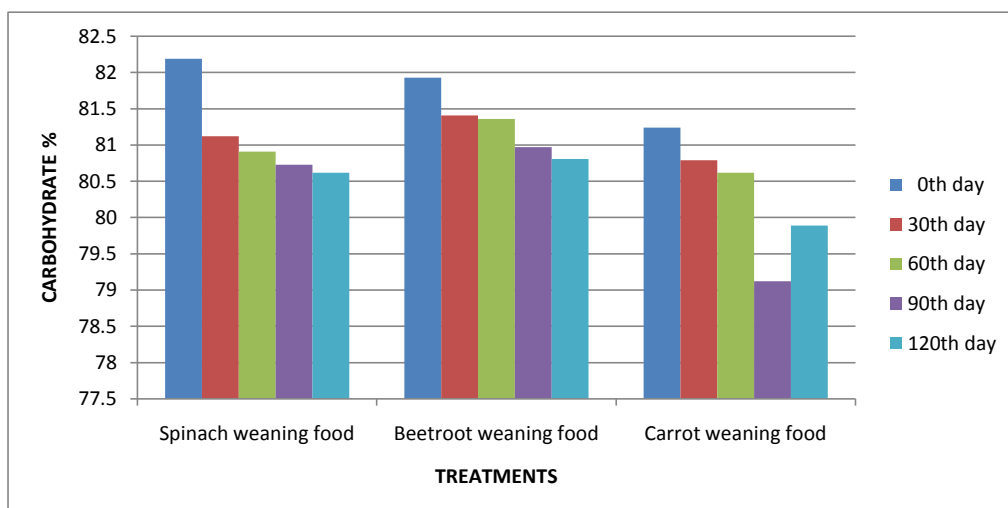


Fig. 4.10. Carbohydrate content (%) of weaning food packed in Glass Jars during storage

4.2 Effect on sensory attributes of weaning food during storage

Sensory attributes of weaning foods were evaluated for fresh condition and at 30 days interval upto 120 days of ambient storage. Nine point hedonic rating test method was used for the evaluation of different samples of weaning food. Different attributes color, taste, aroma and overall acceptability were evaluated

4.2.1 Effect on color of weaning food during storage (mean of 5 judges)

The color of weaning food is not an important sensory attributes for weaning food. The variation in color of weaning food due to variation in flour color of vegetable and corn was studied. On the evaluation of results, the highest score on color was achieved by sample of beetroot based weaning mix (Beetroot flour 5%,and Corn flour 95%). The color of weaning food reduced slightly with storage period. The color of all the sample of weaning food was similar and acceptable.

Table. 4.12. Color of weaning food during storage.

Product	0 th day	30 th day	60 th day	90 th day	120 th day
Spinach weaning food	6.53%	6.4%	6.4%	6.37%	6.3%
Beetroot weaning food	7.46%	7.39%	7.01%	6.92%	6.7%
Carrot weaning food	8.06%	7.91%	7.84%	7.7%	7.5%

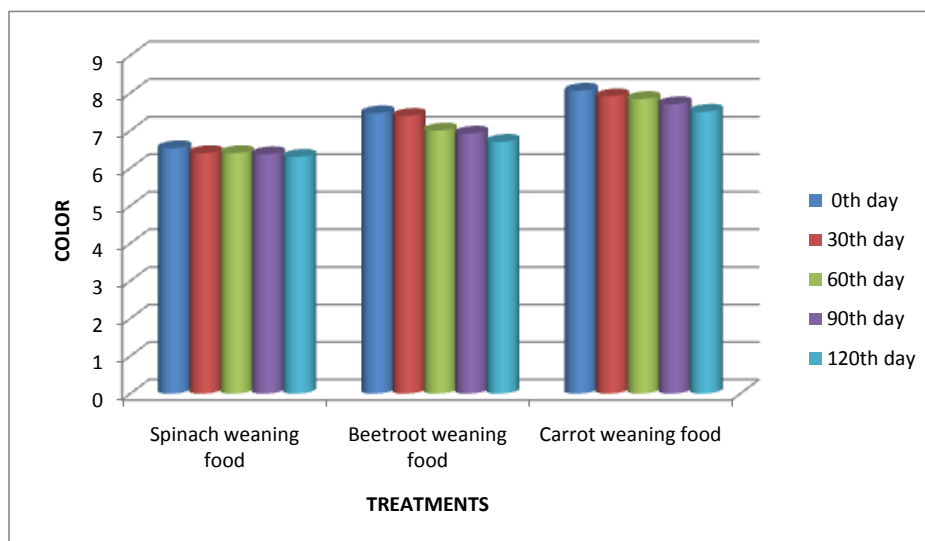


Fig. 4.11. Color of weaning food during storage

4.2.2 Effect on taste of weaning food during storage (mean of 5 judges)

The effect of storage period and different contents of on taste of weaning food is presented in Table 4.12. The taste of weaning food varied due to variation in vegetable flour. The result of sensory evaluation showed that highest score for taste of weaning food was found in three samples T1, T10 & T12 and the minimum score for taste was observed in sample T0 perhaps due to no vegetable content. The taste of weaning food was slightly reduced with increase in storage period. The taste of weaning foods was reduced may be due to increase in moisture content with storage period.

Table. 4.13. Taste of weaning food during storage

Product	0 th day	30 th day	60 th day	90 th day	120 th day
Spinach weaning food	6.8%	6.7%	6.54%	6.49%	6.32%
Beetroot weaning food	7.66%	7.52%	7.41%	7.23%	7.1%
Carrot weaning food	8.02%	7.97%	7.92%	7.87%	7.73%

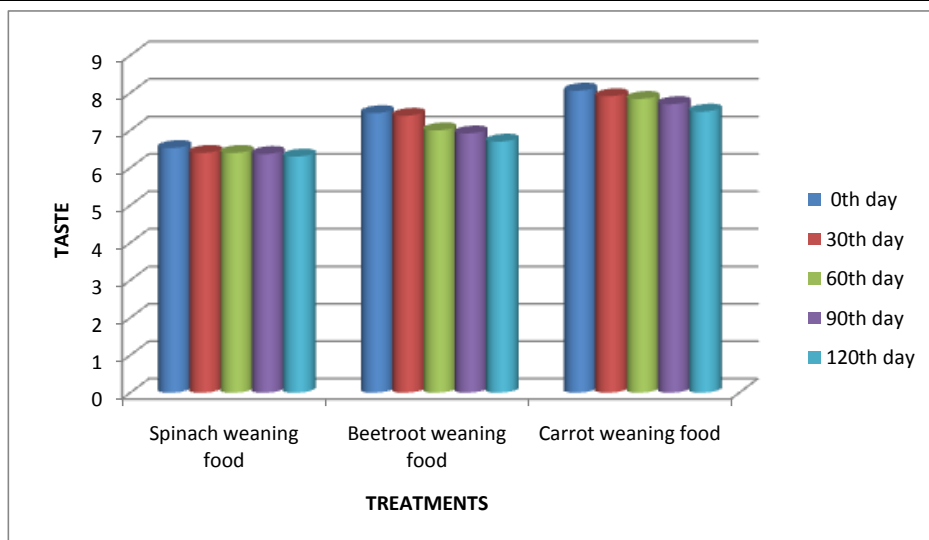


Fig. 4.12. Taste of weaning food during storage

4.2.3 Effect on aroma of weaning food during storage on aroma (mean of 5 judges).

The effect of storage period and different contents on aroma of weaning foods is presented in table no 4.14. The highest score for aroma was observed in Carrot based sample (Carrot 15% and corn flour 85%), perhaps due to presence of some fatty acids or aromatic compounds. The aroma of weaning foods slightly reduced with increase in storage period. Perhaps packaging materials had no significant effect on aroma of weaning food.

Table. 4.14. Aroma of weaning food during storage

Product	0 th day	30 th day	60 th day	90 th day	120 th day
Spinach weaning food	7.06%	7.01%	6.95%	6.91%	6.88%
Beetroot weaning food	7.6%	7.56%	7.52%	7.5%	7.47%
Carrot weaning food	7.9%	7.87%	7.85%	7.82%	7.8%

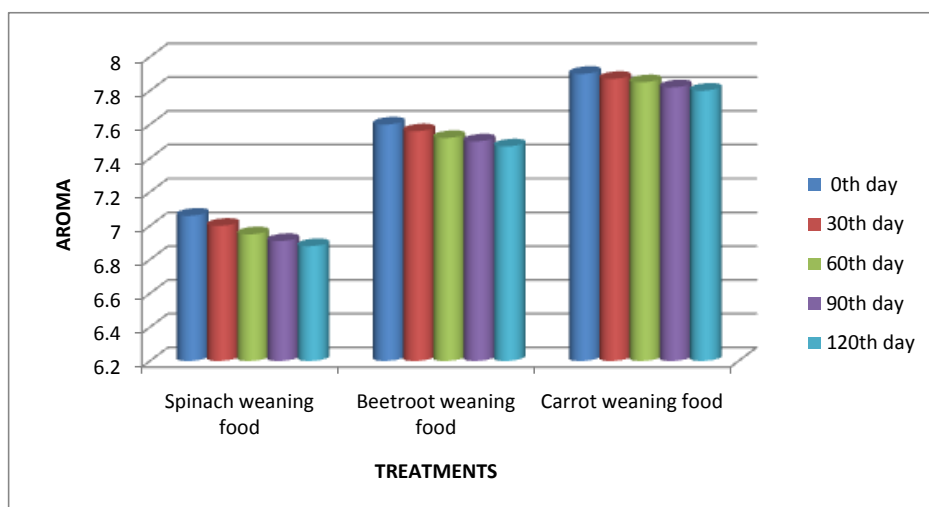


Fig. 4.13. Aroma of weaning food during storage

4.2.4 Effect on overall acceptability (mean of 5 judges) of weaning foods during storage.

The effect of storage period and different contents on aroma of weaning foods is presented in table no 4.15. The highest score for overall acceptability was obtained for sample T1, T10 and T12 due to its better color and taste and moderate aroma. The overall acceptability of weaning food decreases slightly with increase in storage period.

Table. 4.15. Overall Acceptability of weaning food during storage

Product	0 th day	30 th day	60 th day	90 th day	120 th day
Spinach weaning food	7.8%	7.3%	6.98%	6.7%	6.4%
Beetroot weaning food	7.2%	6.93%	6.7%	5.9%	5.5%
Carrot weaning food	7.6%	7.21%	7.03%	6.87%	6.7%

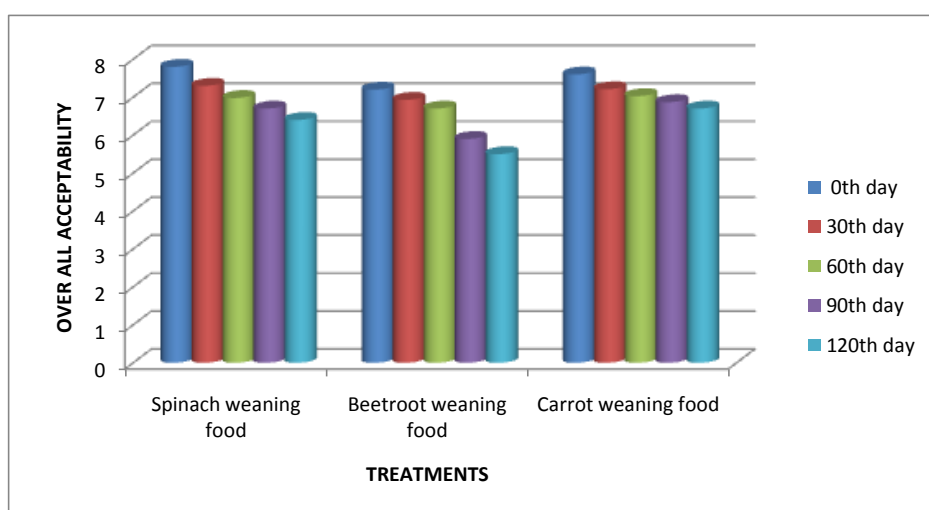


Fig. 4.14. Aroma of weaning food during storage

4.2. Stastical Analysis of sensory properties of weaning food:

4.2.1. Spinach weaning food.

4.2.1.1. COLOR

Analysis of variance test was performed for the component of color in the spinach weaning mix with various compositions of spinach and corn flour. The number of treatments used in this test was 5 namely T_0 , T_1 , T_2 , T_3 and T_4 . The number of replications i.e. 3 (R_1 , R_2 , R_3) was done.

The ANOVA table 4.2.1. Indicates that calculated value of F i.e. 6.03, due to treatments is greater than the tabulated value of F i.e. 3.49 at 5 % level of probability. Hence the result is significant and hypothesis is accepted. Now we can say that there is significant difference among the color of different treatments. In the analysis treatment T_2 came out as the best treatment for the color with mean 7.06.

4.2.1.2. TEXTURE:

Analysis of variance test was performed for the component of texture in the spinach weaning mix with various compositions of spinach and corn flour. The number of treatment used in this test was 5 namely T_0 , T_1 , T_2 , T_3 and T_4 . The number of replications done was 3(R_1 , R_2 , R_3). **Table 4.2.2** Indicates that calculated value of F i.e. 6.08, due to treatments is greater than the tabulated value of F i.e. 3.49 at 5 % level of probability. Hence the result is significant and hypothesis is accepted. Now we can say that there is significant difference among the texture of different treatments. In the analysis treatment T_2 came out as the best treatment for the texture with mean 7.46

4.2.1.3. ODOUR:

Analysis of variance test was performed for the component of Odour in the spinach weaning mix with various compositions of spinach and corn flour. The number of treatment used in this test was 5 namely T_0 , T_1 , T_2 , T_3 and T_4 . The number of replications done was 3(R_1 , R_2 , R_3).

Table 4.2.3 Indicates that calculated value of F i.e. 6.05, due to treatments is greater than the tabulated value of F i.e. 3.49 at 5 % level of probability. Hence the result is significant and hypothesis is accepted.

Now we can say that there is significant difference among the odour of different treatments. In the analysis treatment T_2 came out as the best treatment for the odour with mean 7.06.

4.2.1.4. TASTE:

Analysis of variance test was performed for the component of taste in the spinach weaning mix with various compositions of spinach and corn flour. The number of treatment used in this test was 5 namely T_0 , T_1 , T_2 , T_3 and T_4 . The number of replications done was 3 (R_1 , R_2 , R_3). **Table 4.2.4** Indicates that calculated value of F i.e. 6.02, due to treatments is greater than the tabulated value of F i.e. 3.49 at 5 % level of probability. Hence the result is significant and hypothesis is accepted. Now we can say that there is significant difference among the taste of different treatments. In the analysis treatment T_2 came out as the best treatment for the taste with mean 6.8.

4.2.1.5. OVERALL ACCEPTABILITY:

Analysis of variance test was performed for the component of overall acceptability in the spinach weaning mix with various compositions of spinach and corn flour. The number of treatment used in this test was 5 namely T_0 , T_1 , T_2 , T_3 and T_4 . The number of replications done was 3 (R_1 , R_2 , R_3). **Table 4.2.5** Indicates that calculated value of F i.e. 6.07, due to treatments is greater than the tabulated value of F i.e. 3.49 at 5 % level of probability. Hence, the result is significant and hypothesis is accepted. Now, we can say that there is significant difference among the overall acceptability of different treatments. In the analysis, treatment T_2 came out as the best treatment for the acceptability with mean 7.8.

4.2.2. Beetroot weaning food.

4.2.2.1. COLOR

Analysis of variance test was performed for the component of color in the Beetroot weaning mix with various compositions of Beetroot and corn flour. The number of treatments used in this test was 5 namely T_0 , T_1 , T_2 , T_3 and T_4 . The number of replications i.e. 3 (R_1 , R_2 , R_3) was done. The ANOVA table 4.2.6. Indicates that calculated value of F i.e. 6.05, due to treatments is greater than the tabulated value of F i.e. 3.49 at 5 % level of probability. Hence the result is significant and hypothesis is accepted. Now we can say that there is significant difference among the color of

different treatments. In the analysis treatment T₃ came out as the best treatment for the color with mean 8.06

4.2.2.2. TEXTURE:

Analysis of variance test was performed for the component of texture in the Beetroot weaning mix with various compositions of Beetroot and corn flour. The number of treatment used in this test was 5 namely T₀, T₁, T₂, T₃ and T₄. The number of replications done was 3(R₁, R₂, R₃). **Table 4.2.7** Indicates that calculated value of F i.e. 6.08, due to treatments is greater than the tabulated value of F i.e. 3.49 at 5 % level of probability. Hence the result is significant and hypothesis is accepted. Now we can say that there is significant difference among the texture of different treatments. In the analysis treatment T₃ came out as the best treatment for the texture with mean 8

4.2.2.3. ODOUR:

Analysis of variance test was performed for the component of Odour in the Beetroot weaning mix with various compositions of Beetroot and corn flour. The number of treatment used in this test was 5 namely T₀, T₁, T₂, T₃ and T₄. The number of replications done was 3(R₁, R₂, R₃). **Table 4.2.8** Indicates that calculated value of F i.e. 6.08, due to treatments is greater than the tabulated value of F i.e. 3.49 at 5 % level of probability. Hence the result is significant and hypothesis is accepted. Now we can say that there is significant difference among the odour of different treatments. In the analysis treatment T₃ came out as the best treatment for the odour with mean 7.6.

4.2.2.4. TASTE:

Analysis of variance test was performed for the component of taste in the Beetroot weaning mix with various compositions of Beetroot and corn flour. The number of treatment used in this test was 5 namely T₀, T₁, T₂, T₃ and T₄. The number of replications done was 3(R₁, R₂, R₃). **Table 4.2.9** Indicates that calculated value of F i.e. 6.05, due to treatments is greater than the tabulated value of F i.e. 3.49 at 5 % level of probability. Hence the result is significant and hypothesis is accepted. Now we can say that there is significant difference among the taste of different treatments. In the analysis treatment T₁ came out as the best treatment for the taste with mean 7.6.

4.2.2.5. OVERALL ACCEPTABILITY:

Analysis of variance test was performed for the component of overall acceptability in the Beetroot weaning mix with various compositions of Beetroot and corn flour. The number of treatment used in this test was 5 namely T_0 , T_1 , T_2 , T_3 and T_4 . The number of replications done was 3 (R_1 , R_2 , R_3). **Table 4.2.10** Indicates that calculated value of F i.e. 6.11, due to treatments is greater than the tabulated value of F i.e. 3.49 at 5 % level of probability. Hence, the result is significant and hypothesis is accepted. Now, we can say that there is significant difference among the overall acceptability of different treatments. In the analysis, treatment T_1 came out as the best treatment for the acceptability with mean 8.

4.2.3. Carrot weaning food.

4.2.3.1. COLOR

Analysis of variance test was performed for the component of color in the Carrot weaning mix with various compositions of and corn Carrot flour. The number of treatments used in this test was 5 namely T_0 , T_1 , T_2 , T_3 and T_4 . The number of replications i.e. 3 (R_1 , R_2 , R_3) was done. The ANOVA table 4.2.11. Indicates that calculated value of F i.e. 6.05, due to treatments is greater than the tabulated value of F i.e. 3.49 at 5 % level of probability. Hence the result is significant and hypothesis is accepted. Now we can say that there is significant difference among the color of different treatments. In the analysis treatment T_3 came out as the best treatment for the color with mean 8.06

4.2.2.2. TEXTURE:

Analysis of variance test was performed for the component of texture in the Carrot weaning mix with various compositions of Carrot and corn flour. The number of treatment used in this test was 5 namely T_0 , T_1 , T_2 , T_3 and T_4 . The number of replications done was 3 (R_1 , R_2 , R_3). **Table 4.2.12** Indicates that calculated value of F i.e. 6.16, due to treatments is greater than the tabulated value of F i.e. 3.49 at 5 % level of probability. Hence the result is significant and hypothesis is accepted. Now we can say that there is significant difference among the texture of different treatments. In the analysis treatment T_3 came out as the best treatment for the texture with mean 8.

4.2.2.3. ODOUR:

Analysis of variance test was performed for the component of Odour in the Carrot weaning mix with various compositions of Carrot and corn flour. The number of treatment used in this test was

5 namely T_0 , T_1 , T_2 , T_3 and T_4 . The number of replications done was 3(R1, R2, R3). **Table 4.2.13** Indicates that calculated value of F i.e. 6.12, due to treatments is greater than the tabulated value of F i.e. 3.49 at 5 % level of probability. Hence the result is significant and hypothesis is accepted. Now we can say that there is significant difference among the odour of different treatments. In the analysis treatment T_3 came out as the best treatment for the odor with mean 7.9.

4.2.2.4. TASTE:

Analysis of variance test was performed for the component of taste in the Carrot weaning mix with various compositions of Carrot and corn flour. The number of treatment used in this test was 5 namely T_0 , T_1 , T_2 , T_3 and T_4 . The number of replications done was 3(R1, R2, R3). **Table 4.2.14** Indicates that calculated value of F i.e. 6.11, due to treatments is greater than the tabulated value of F i.e. 3.49 at 5 % level of probability. Hence the result is significant and hypothesis is accepted. Now we can say that there is significant difference among the taste of different treatments. In the analysis treatment T_3 came out as the best treatment for the taste with mean 8.

4.2.2.5. OVERALL ACCEPTABILITY:

Analysis of variance test was performed for the component of overall acceptability in the Carrot weaning mix with various compositions of Carrot and corn flour. The number of treatment used in this test was 5 namely T_0 , T_1 , T_2 , T_3 and T_4 . The number of replications done was 3(R1, R2, R3). The ANOVA table 4.2.15. Indicates that calculated value of F i.e. 6.02, due to treatments is greater than the tabulated value of F i.e. 3.49 at 5 % level of probability. Hence the result is significant and hypothesis is accepted. Now we can say that there is significant difference among the color of different treatments. In the analysis treatment T_3 came out as the best treatment for the color with mean 7.6

Table 4.3. Comparison of the samples with the market standard product

SAMPLES COMPONENTS	Spinach weaning mix	Beetroot weaning mix	Carrot weaning mix	Standard mix
Fat(g)	1.39	1.83	1.81	9.0
Carbohydrate(g)	82.19	81.93	81.24	68.0
Fibre(g)	3.15	2.49	3.42	1.0
Protein(g)	5.93	5.98	6.23	15.0

On comparing our developed product with the market product(Cerelac) , we can see the difference in the above characteristics. The lowest fat content is found in the spinach weaning mix i.e. 1.39g. Whereas the highest fat content is found in the Carrot weaning mix i.e.1.81g. But all the three variant of the weaning mix has lower content of fast than the market product chosen as standard to compare the develop product. While coming to Carbohydrate all the three variants have greater values than the market standard i.e. 68g.The highest carbohydrate content is present in spinach weaning mix i.e.82.19g, followed by Beetroot weaning mix i.e.81.93 and Carrot weaning mix i.e.81.24g. Carrot weaning mix showed the highest fiber content i.e. 3.42, when compared with the remaining samples. The least fiber content is present in the market sample i.e. 1g. Beetroot and carrot weaning mix also showed fibre content more than market product i.e. 2.49g, 3.15 g. Protein the developed products is found less than the market sample i.e. 15g.The least amount of protein is found in the sample of spinach weaning mix i.e. 5.93g, followed by Beetroot weaning mix i.e. 5.98g and carrot weaning mix i.e.6.23g.

COST CALCULATION OF RAW MATERIALS FOR SPINACH WEANING MIX (T₂) :

INGREDIENTS	COST OF AMOUNT 100g(Rs.)	AMOUNT USED (g)	COST OF AMOUNT USED (Rs.)
Spinach Flour	440	10	44
Corn Flour	4	90	4
SMP	42	40	17
TOTAL(Rs.)	486/-	140	65/-

COST CALCULATION OF RAW MATERIALS FOR BEETROOT WEANING MIX (T₁) :

INGREDIENTS	COST OF AMOUNT 100g(Rs.)	AMOUNT USED (g)	COST OF AMOUNT USED (Rs.)
Beetroot Flour	190	5	10
Corn Flour	4	90	4
SMP	42	40	17
TOTAL	236/-	140	31/-

COST CALCULATION OF RAW MATERIALS FOR CARROT WEANING MIX (T₃) :

INGREDIENTS	COST OF AMOUNT 100g(Rs.)	AMOUNT USED (g)	COST OF AMOUNT USED (Rs.)
Carrot Flour	243	15 g	37
Corn Flour	4	90 g	4
SMP	42	40 g	17
TOTAL	289/-	140 g	58/-

SUMMARY

Weaning is introducing your baby to solid foods along with his milk feeds. Feeding the baby with the variety of healthy foods at a proper time plays an important role. Starting early with the good eating habits will ensure the baby a healthy eating pattern throughout the life. Babies fed with fruit based weaning foods are often seen to hate or avoid vegetables at the latter stage of life. This problem can be cured by introducing them to vegan weaning foods in the first year of their life.

This study was conducted with the aim of developing a method for vegetable based weaning mix. In this study there variants of weaning food was developed namely SPINACH WEANING MIX, BEETROOT WEANING MIX, and CARROT WEANING MIX. Weaning mix was prepared by different concentrations i.e. 5%, 10%, 15%, 20% of vegetable flour using corn flour as base and SNP (constant 40 g) as sweetener. Corn is a good source of carbohydrate whereas Carrot is rich in Vit-A. Spinach is a rich source of iron and Beetroot is rich in folic acid, fibre, manganese and various vitamins. These are known to prevent and lower the risk of several diseases in kids including, diarrhea, night blindness, beriberi, angular stomatitis, rickets, glossitis, osteomalacia, etc. No external sweetening agent was added.

There were 13 treatments namely T0, T1, T2, T3, T4, T5, T6, T7, T8, T9, T10, T11, T12 and T13. These treatments were then subjected to sensory analysis based on 9 point hedonic scale rating from 0-9. The best treatment from each variant was chosen. The chosen treatments were packed in two different packaging material i.e. glass jar and LDPE at room temperature. The packed samples are then subjected to physic-chemical analysis for a period of 120 days on an interval of 30 days.

The results from the physic- chemical analysis showed that the moisture content was between 6.78 & 7.51 and keep on increasing with the storage period. Samples stored in the LDPE was absorbing moisture more frequently from the surrounding than the samples stored in glass jar.

The fat content of the weaning food decreased considerably with increase in the storage period. Fat content of weaning food was in range of 2.49 to 3.42%. The protein content of weaning food was ranging from 5.93 to 6.23%, was maximum in sample of Beetroot weaning mix and was decreasing

with the storage period. The fibre content of weaning food was ranging from 2.49 to 3.42%, was maximum in sample of Beetroot weaning mix and was decreasing with the storage period. Carbohydrate readings lied in between 81.24-82.19% and was noted highest in the sample of spinach. Also the highest sensory score was given on the basis of color, taste, texture and overall acceptability. The taste of weaning food improved as the flour content increased in case of spinach and carrot weaning mix but decreased for beetroot weaning mix. But the nutritional density was high in sample of beetroot weaning mix among all the variants. Thus, this sample (vegetable flour 5% & corn flour 95%) was found to be the best sample among all the variants of weaning food. The developed weaning food product is found to be satisfactory on the nutritional scale. When compared with the market product chosen as standard.

CONCLUSION

The utilization of vegetable to make weaning mix can prove to be a boon for infants in short term as well as in long term goals. These varieties of vegetable can provide a range of nutrients along with the healthy eating habits which will benefit in later stages of life. These weaning mixes are a good source of fibre and other nutrients. On critical evaluation of the result during storage, it was found that the protein, fat, carbohydrate and crude fiber content of weaning sample packed in glass jar & LDPE decreased with increase in storage period. From all the preparations, it was seen that the weaning food with 5% beetroot flour & 95% corn flour was accepted by panel judges as best variant depending on sensory evaluation and was best according to nutritional value. Glass jar was found to be a better packaging material when compared to LDPE for packaging the weaning food as the deterioration in the quality of product was found to be less in glass jar samples. On the basis of above results revealed in the present study it might be concluded that this formulation of weaning food was possible to satisfy consumer taste and preferences and will be accepted in the market.

APPENDIX – A

Basic steps involved in the Preparation of Vegetables (Spinach, Beetroot and Carrot):

Before to start any processing, make sure that the surface should be kept clean, dried and free from flies and nits.

By the strict follow up of these basic steps for the preparation of fruits for product development, one can achieve hygienically safe and long duration product.

1. Sorting out of Vegetables :

Vegetables were taken out from the plastic bags, compressed and rotten ones are discarded completely. Vegetables free from and mechanical and physical damages were chosen for further processing.

2. Washing and Blanching of Vegetables :

The selected Vegetables were washed under the running tap water for the removal of dirt and dust from the outer surfaces. After washing, blanching was done in hot water for 1 min to 2 mins

.

3. Cutting and Slicing of Vegetables :

The Vegetables bearing part, mechanical and physical damage parts were removed completely with the help of stainless steel knife. The Vegetables were then peeled if necessary, sliced into small pieces and core were removed fully.

APPENDIX – B**STANDARD RECIPE FOR SPINACH WEANING MIX :**

A Nutritious healthy weaning mix was prepared by using Spinach flour, corn flour and SMP.

INGREDIENTS :AMOUNT (g)

Spinach flour	5/ 10/15/20 g
Corn flour	95/ 90/85/80 g
SMP	40gs

PROCEDURE :

1. Wash the vegetables thoroughly to avoid any dust and grit.
2. Remove the discolored, spoiled leaves .
3. Perform blanching using a muslin cloth in a hot water bath maintained at temperature more than 95°C for 1-2 min.
4. Immediately put the blanched spinach into ice cold water to stop the cooking.
5. Now, remove the excess water with the help of the filter paper and allow to air dry for few minutes.
6. Arrange the blanched spinach in the tray of tray drier and put the tray in the tray drier cabinet.
7. Allow the tray drier to run at the temperature of 65°C for 4-5 hrs.
8. Check the spinach for moisture after the estimated time. If the spinach becomes crisp remove the spinach and grind it in the mixer grinder.
9. Separate the fine flour using sieve.
10. Now using electronic weighing machine weigh the required amount of spinach flour , corn flour and SMP.
11. Mix all the three ingredients according to requirement.
12. Store the product in different packaging material.

APPENDIX - B(2)

BEETROOT WEANING MIX :

A Nutritious healthy weaning mix was prepared by using Spinach flour, corn flour and SMP.

INGREDIENTS :AMOUNT (g)

Beetroot flour	5/ 10/15/20 gs
Corn flour	95/ 90/85/80 gs
SMP	40gs

PROCEDURE :

1. Wash the vegetables thoroughly to avoid any dust and grit.
2. Remove any spoiled, mechanically damaged piece, peel and cut in pieces of uniform size approx 2mm size.
3. Perform blanching using a muslin cloth in a hot water bath maintained at temperature more than 98°C for 1-2 min.
4. Remove the excess water with the help of the filter paper and allow to air dry for few minutes.
5. Arrange the blanched Beetroot in the tray of tray drier and put the tray in the tray drier cabinet.
6. Allow the tray drier to run at the temperature of 65°C for 8-9 hrs.
7. Check the Beetroot for moisture after the estimated time. If the beetroot becomes crisp remove the beetroot and grind it in the mixer grinder.
8. Separate the fine flour using sieve.
9. Now using electronic weighing machine weigh the required amount of Beetroot flour , corn flour and SMP.
10. Mix all the three ingredients according to requirement.
11. Store the product in different packaging material.

APPENDIX - B (3)

STANDARD RECIPE FOR CARROT WEANING MIX :

The following steps were described for the preparation of the Carrot weaning mix below:

INGREDIENTS :AMOUNT (g)

Carrot flour	5/ 10/15/20 g
Corn flour	95/ 90/85/80 g
SMP	40g

PROCEDURE :

1. Wash the vegetables thoroughly to avoid any dust and grit.
2. Remove any spoiled, mechanically damaged piece, peel and cut in pieces of uniform size approx 2mm size.
3. Perform blanching using a muslin cloth in a hot water bath maintained at temperature more than 98°C for 1-2 min.
4. Remove the excess water with the help of the filter paper and allow to air dry for few minutes.
5. Arrange the blanched Carrot in the tray of tray drier and put the tray in the tray drier cabinet.
6. Allow the tray drier to run at the temperature of 65°C for 8-9 hrs.
7. Check the Carrot for moisture after the estimated time. If the Carrot becomes crisp remove the Carrot and grind it in the mixer grinder.
8. Separate the fine flour using sieve.
9. Now using electronic weighing machine weigh the required amount of Carrot flour , corn flour and SMP.
10. Mix all the three ingredients according to requirement.
11. Store the product in different packaging material.

APPENDIX - C

Name of the product :

Date of preparation :

Kindly evaluate the developed products based on the following scores.

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
Dislike extremely	1

PRODUCTS	COLOR / APPEARENCE	CONSISTENCY / TEXTURE	FLAVOR / TASTE	OVERALL ACCEPTABILITY
T ₀				
T ₁				
T ₂				
T ₃				

Name :

Signature

APPENDIX – D

STATISTICAL ANALYSIS

The data examined from the experimental study was subjected to analyse statistically by using analysis of variance and critical difference techniques. The formulas used are briefly described below :

Skeleton of ANOVA table for different attributes of the Products made :

Sources of variation	D.F.	S.S	M.S.S	F-cal	f-tab	Result
Due to treatment	t - 1	S.S	$\frac{\text{M.S.S}}{t-1}$	$\frac{\text{M.S.S}}{\text{E.M.S.S}}$		
Due to replication	r - 1	R.S.S	$\frac{\text{M.R.S.S}}{r-1}$	$\frac{\text{M.R.S.S}}{\text{E.M.S.S}}$		
Due to error	rt(m-1)	E.S.S	E.M.S.S			
Total	rmt - 1	T.S.S				

ANALYSIS OF VARIANCE

Formulae used :

$$\begin{aligned} G &= T_1 + T_2 + T_3 + \text{-----} + T_n. \\ &= R_1 + R_2 + R_3 + \text{-----} + R_n. \end{aligned}$$

1. $C.F. = \frac{G^2}{Rt}$

$$2. \text{ Replication S.S.} = \frac{R_1^2 + R_2^2 + R_3^2 + \dots + R_n^2}{T}$$

$$3. \text{ Treatment S.S.} = \frac{T_1^2 + T_2^2 + T_3^2 + \dots + T_n^2}{R}$$

$$4. \text{ Total S.S.} = \text{Sum of Square of each observation} - \text{C.F.}$$

$$5. \text{ Error S.S.} = \text{Total S.S.} - \text{S.S. due to replication} - \text{S.S. due to treatment} = \sum x_{ijk}^2 - \text{C.F.}$$

G = Grand Total.

R = Replication.

T = Treatment.

S.S. = Sum of Square.

$$\text{S.E.} = \frac{\sqrt{2 \times \text{E.M.S.S}}}{R}$$

$$\text{C.D.} = \text{S.D.} \times t_{(5\% \text{ or error D.F.})}$$

Where,

S.E.M. = Standard Mean Error.

E.M.S.S = Error Mean Sum of Square.

Table 4.2.1

Source	d.f.	S.S.	M.S.S.	F-cal	F tab.	Result	T 5%
Replication	4	325.468	81.367	15.1624946	3.25916673	*N S	2.1788128
Treatment	3	-97.06	-32.35	6.03	3.49	*S	
Error	12	-64.40	-5.37				
Total	19	164.008					

Table 4.2.1 ANOVA of color *S = Significant (5% level of significance); *NS = Non Significant.

Table 4.2.2

Source	d.f.	S.S.	M.S.S.	F-cal	F tab.	Result	T 5%
Replication	4	320.74	80.185	15.7009986	3.25916673	Non Signi	2.1788128
Treatment	3	-93.10	-31.03	6.08	3.49	Signi	
Error	12	-61.28	-5.11				
Total	19	166.36					

Table 4.2.2 ANOVA of texture, *S = Significant (5% level of significance) ; *NS = Non Significant.

Table 4.2.3

Source	d.f.	S.S.	M.S.S.	F-cal	F tab.	Result	T 5%
Replication	4	290.992	72.748	15.4651361	3.25916673	*NS	2.1788128
Treatment	3	-85.40	-28.47	6.05	3.49	*S	
Error	12	-56.45	-4.70				
Total	19	149.142					

Table 4.2.3 ANOVA of odour, *S = Significant (5% level of significance) ; *NS = Non Significant.

Table 4.2.4

Source	d.f.	S.S.	M.S.S.	F-cal	F tab.	Result	T 5%
Replication	4	320.18	80.045	15.1018804	3.25916673	*N S	2.1788128
Treatment	3	-95.74	-31.91	6.02	3.49	*S	
Error	12	-63.60	-5.30				
Total	19	160.84					

Table 4.2.4 ANOVA of taste, *S = Significant (5% level of significance) ; *NS = Non Significant.

Table 4.2.5

Source	d.f.	S.S.	M.S.S.	F-cal	F tab.	Result	T 5%
Replication	4	299.808	74.952	16.1071633	3.25916673	* NS	2.1788128
Treatment	3	-84.76	-28.25	6.07	3.49	* S	
Error	12	-55.84	-4.65				
Total	19	159.208					

Table 4.2.5 ANOVA of acceptability, *S = Significant (5% level of significance) ; *NS = Non Significant.

Table 4.2.6

Source	d.f.	S.S.	M.S.S.	F-cal	F tab.	Result	T 5%
Replication	4	354.14	88.535	15.3786694	3.25916673	*NS	2.1788128
Treatment	3	-104.51	-34.84	6.05	3.49	*S	
Error	12	-69.08	-5.76				
Total	19	180.55					

Table 4.2.6 ANOVA of color , *S = Significant (5% level of significance) ; *NS = Non Significant.

Table 4.2.7

Source	d.f.	S.S.	M.S.S.	F-cal	F tab.	Result	T 5%
Replication	4	320.74	80.185	15.7009986	3.25916673	*NS	2.1788128
Treatment	3	-93.10	-31.03	6.08	3.49	*S	
Error	12	-61.28	-5.11				
Total	19	166.36					

Table 4.2.7 ANOVA of texture, *S = Significant (5% level of significance) ; *NS = Non Significant.

Table 4.2.8

Source	d.f.	S.S.	M.S.S.	F-cal	F tab.	Result	T 5%
Replication	4	342.972	85.743	15.5003917	3.25916673	*N S	2.1788128
Treatment	3	-100.89	-33.63	6.08	3.49	*S	
Error	12	-66.38	-5.53				
Total	19	175.702					

Table 4.2.8 ANOVA of odour, *S = Significant (5% level of significance) ; *NS = Non Significant.

Table 4.2.9

Source	d.f.	S.S.	M.S.S.	F-cal	F tab.	Result	T 5%
Replication	4	354.14	88.535	15.3786694	3.25916673	*N S	2.1788128
Treatment	3	-104.51	-34.84	6.05	3.49	*S	
Error	12	-69.08	-5.76				
Total	19	180.55					

Table 4.2.9 ANOVA of taste, *S = Significant (5% level of significance) ; *NS = Non Significant.

Table 4.2.10

Source	d.f.	S.S.	M.S.S.	F-cal	F tab.	Result	T 5%
Replication	4	354.682	88.6705	15.7828176	3.25916673	*N S	2.1788128
Treatment	3	-103.01	-34.34	6.11	3.49	*S	
Error	12	-67.42	-5.62				
Total	19	184.25					

Table 4.2.10 ANOVA of acceptability, *S = Significant (5% level of significance) ; *NS = Non Significant.

Table 4.2.11

Source	d.f.	S.S.	M.S.S.	F-cal	F tab.	Result	T 5%
Replication	4	376.508	94.127	15.5094744	3.25916673	Non Signi	2.1788128
Treatment	3	-110.12	-36.71	6.05	3.49	Signi	
Error	12	-72.83	-6.07				
Total	19	193.558					

Table 4.2.11 ANOVA of color, *S = Significant (5% level of significance) ; *NS = Non Significant.

Table 4.2.12

Source	d.f.	S.S.	M.S.S.	F-cal	F tab.	Result	T 5%
Replication	4	345.613	86.40325	16.1197587	3.25916673	*NS	2.1788128
Treatment	3	-99.11	-33.04	6.16	3.49	*S	
Error	12	-64.32	-5.36				
Total	19	182.178					

Table 4.2.12 ANOVA of texture, *S = Significant (5% level of significance) ; *NS = Non Significant.

Table 4.2.13

Source	d.f.	S.S.	M.S.S.	F-cal	F tab.	Result	T 5%
Replication	4	373.703	93.42575	15.8449438	3.25916673	*N S	2.1788128
Treatment	3	-108.25	-36.08	6.12	3.49	*S	
Error	12	-70.75	-5.90				
Total	19	194.698					

Table 4.2.13 ANOVA of odour, *S = Significant (5% level of significance) ; *NS = Non Significant.

Table 4.2.14

Source	d.f.	S.S.	M.S.S.	F-cal	F tab.	Result	T 5%
Replication	4	354.635	88.65875	15.8340403	3.25916673	*N S	2.1788128
Treatment	3	-102.55	-34.18	6.11	3.49	*S	
Error	12	-67.19	-5.60				
Total	19	184.89					

Table 4.2.14 ANOVA of taste, *S = Significant (5% level of significance) ; *NS = Non Significant.

Table 4.2.15

Source	d.f.	S.S.	M.S.S.	F-cal	F tab.	Result	T 5%
Replication	4	364.837	91.20925	15.2794243	3.25916673	*N S	2.1788128
Treatment	3	-107.80	-35.93	6.02	3.49	*S	
Error	12	-71.63	-5.97				
Total	19	185.402					

Table 4.2.15 ANOVA of acceptability, *S = Significant (5% level of significance) ; *NS = Non Significant

REFERENCES

- **A.O.A.C. (1970).** Official methods of analysis of the Association of official Agricultural Chemists. A.O.A.C 11th ED. Washington D.C.
- **Ambike D *et al.*(2017)** A study on the awareness of the weaning practices and the determinants affecting them in a rural hospital based pediatric outpatient clinic of Maval Taluka, Maharashtra.Int Contemp Pediatr;4(1):206-209.
- **Cowbrough K(2010).**Complementary feeding for infants 6 to 12 months. The journal of family health care. 20(1):20-3
- **Cavalieri Ralph P. *et.al.*(2015).**Blanching of foods. research gate-267220018
- **CFTRI, Mysore,** journal of food sciences and technology about Weaning Foods (1988).
- **Delia - Gabriela Dumbrava *et al.*(2011).** Antioxidant activity of some fresh vegetables and fruits juices. Journal of Agroalimentary Processes and Technologies 2011, 17(2), 163-168.
- **Ibironke,SI (2014).** Formulation of Infant Weaning Foods from Vegetable Proteins and Cereal.ajft.ISSN 1557-4571
- **Ibidapo Olubunmi Phebean, Akinyele O.*et.al.*(2017).**Development and Quality Evaluation of Carrot Powder and Cowpea Flour Enriched Biscuits, Ijfsb doi: 10.11648/j.ijfsb.20170203.15
- **Krebs NF, Hambidge KM (2007).** Complementary feeding: clinically relevant factors affecting timing and composition. Am J Clin.Nutr. 85: 639S-645S.
- **Mishra, AA, Shukla R.N, Guggi, PC, Singh S (2013).** Development of Banana-soy Sesame Based Weaning Food for Malnourished Children. Inter. J. Agric. & Food Sci. Technol. 4: 221-226.
- **Mulet, A. (2011) Book Review:** Modern Drying Technology, Vol 3 Product quality and formulation, edited by Tsotsa E and Mujumdar A.S, pp 244-245.
- **Mennella & Beauchamp (1997).** Mothers' milk enhances the acceptance of cereal during weaning. Pediatric Research, 41, 188–192.

- **Nora M. Al-aboud (2018).** Effect of red beetroot (*Beta vulgaris* L.) intake on the level of some hematological tests in a group of female volunteers. *ISABB. J. Food Agric. Sci.* Vol.8 (2) pp. 10-17 doi: 10.5897/ISABB-JFAS2017.0070, DC9907956091.
- **Ozumba, Olatunji and Odunfa (2002).** Development and quality evaluation of semi-instant home made weaning foods. *Journal of Applied Science*, vol.5 (4): 3124-3138.
- **Purificación et. al. (2017).**Effect of Replacement Wheat Flour by a Composite Mix Flour in Sponge Cakes. *Jr. of Culinary Science & Technology*, Volume 15, 2017-Issue2.
- **Rao et.al.(2017).** Nutritional, textural and sensory quality of biscuits supplemented with spinach (*Spinacia oleracea* L.).*j.ijgfs* Volume 7, April 2017, Pages 20-26.
- **Stanley. D.W.et.al.(1995).**Blanching effects of chemistry, Firmness and structure of canned green beans and carrots. *Journal of food science*.60:327-333
- **Sajilata, G. et al.(2002).** Weaning foods: a review of the Indian Experience, *Food Nutr. Bull.*, PubMed 23: 208-226.
- **Swaroop Kumar Sahu, Ganesh Kumar S. et al. (2015).** Malnutrition among under-five children in India and strategies for control, *J Nat Sci Biol Med.* 6(1): 18–23.doi: 10.4103/0976-9668.149072
- **Sloan, Gildea, Stewart, Sneddon, & Iwaniec (2008).** Early weaning is related to weight and rate of weight gain in infancy. *Child Care, Health and Development*, 34, 59–64.
- **Samson Ishola Ibironke(2014).**Formulation of Infant Weaning Foods from Vegetable Proteins and Cereal,*Ajft* ,Volume 9 (2): 104-110.
- **Savage, Fisher & Birch (2007).** Parental influence on eating behavior. Conception to adolescence. *Journal of Law, Medicine & Ethics*, 35, 22–34.
- **Ting Zhou, Qian kong, Jingrong Huang et al. (2007).** Characterisation of nutritional components and utilization of pumpkin. *Global science books*.

- **Temesgen M (2013).** Nutritional Status of Ethiopian Weaning and Complementary Foods: A Review. 2: 621doi:10.4172/scientificreports.621.
- **Tahseen Fatima Miano (2016).** Nutritional value of spinach oleracea spinach- an overview, IJLSR, Vol. 2(12): 172-174.
- **Tumwine Gerald *et.al.* (2018).** Effect of skimmed milk and vegetable powders on shelf stability of millet-based composite flour. Jsfa.9482/doi 10.1002.
- **Usha R, Lakshmi M, Ranjani M (2010).** Nutritional, Sensory and Physical Analysis of Pumpkin Flour Incorporated into Weaning Mix. Mal J Nutr 16(3):379-387.
- **UNICEF (1998).** *The State of World's Children* – Focus on Nutrition p.9-10.
- **Varsha Kumari *et.al.*(2017).** Development and Nutritional Evaluation of weaning Foods from malted Sorghum incorporated with Mungbean and Raw banana flour. Res J. Chem. Environ. Sci. Vol [2] April 2017:17-21
- **Van Willige *et.al.*(2003).** Influence of flavour absorption by food-packaging materials (low-density polyethylene, polycarbonate and polyethylene terephthalate) on taste perception of a model solution and orange juice. Food Addit Contam. 2003 Jan;20(1):84-91.
- **Wang Y *et al.*(2005).** Dietary supplementation with blueberries, spinach, or spirulina reduces ischemic brain damage. Experimental Neurology 193(1): 75–84.
- **WHO (2003).** Complementary feeding. Report of the global consultation. Summary of guiding principles for complementary feeding of the breastfed child. p. 24
- **Yashwant Kumar (2015)** .Beetroot: A Super Food. IJESTA ISSN No. 2395-0900.