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STUDY AND DEVELOPMENT OF WEANING FOOD FORMULATIONS PREPARED FROM GERMINATED GRAINS.

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Abstract

Weaning food is a gradual introduction of solid and semisolid food to the infant. Along with breast milk infant requires more nourishment. Weaning food provided to the infant from the age of 5 months must include all the necessary nutrients, vitamins and minerals. It should be reach in protein, iron, calcium and calories to fulfill their daily energy requirement. Weaning food provides additional amount for the growth and development of the infant. This paper highlights the research work carried out on preparation of infant food using different raw materials and worked on various parameters such as nutritional values, sensory & analytical evaluation, physical characteristics and other important aspects.

Keywords: infants, weaning food, nutritional value.

INTRODUCTION

When a baby reaches four to six months of age, milk alone is no longer sufficient to meet its nutritional requirements. Calories and other nutrients are needed to supplement milk until the child is ready to eat only adult foods. This is the weaning stage. Weaning is the process of expanding the diet to include food and drinks other than breast milk or infant formula. Weaning is a time of nutritional vulnerability. It represents a period of dietary transition, just when nutritional requirements for growth and brain development are high. Introduction of different tastes and textures promotes biting and chewing skills [St. Louis, Mo, USA: CV Mosby, 1975]. Chewing improves mouth and tongue coordination, which is important for speech development. Failure to introduce different textures

and tastes by six to seven months can result in their rejection later. Developmentally, few infants are ready to handle anything but liquid food until 10 to 12 weeks of age. Any effort to force them earlier may result in a frustrating and unhappy feeding experience for both the mother and the child. The ability to handle foods other than milk also depends on the physiological development of the infant. The appearance of salivary amylase in the saliva between two and three months of age marks the time when the infant is ready to handle more complex carbohydrates, such as starch in cereals. By four to six months of age, most infants are able to handle most proteins. The kidney tubules become efficient by six to eight weeks, after which there is less concern over the use of a high-protein, high-sodium diet.

RAW MATERIAL

Raw materials required for the manufacturing of weaning food are as follows:-

1) Sorghum (Dadar),
2) Finger millet ,
3) Amaranth grain,
4) Moth Bean
5) SMP (skimmed milk powder),
6) Sugar

1) Sorghum (Dadar)

Sorghum is a self-pollinating plant. It is more drought and temperature resistant than maize (corn), soybeans, wheat and other crops. The height of the plant depends on the breed and growing conditions, varying between 60 to 460 centimeters. The long, wide leaves grow off the stalk. Sorghum seed is small and round. A seed head is usually between 25 to 36 centimeters, present on the top of the stalk of a mature sorghum plant.

Sorghum seed consists of three major anatomic sections - pericarp (outer layer), endosperm (storage organ) and the germ. The pericarp is made of three segments - epicarp, mesocarp and endocarp. The epicarp is the outermost layer covered with a thin waxy film. The mesocarp consists of a large amount of starch granules. Sorghum is claimed to be the only food staple that contains starch in this anatomical section of the seed. Sorghum's endosperm is composed of aleurone layer, peripheral, corneous and floury areas. The aleurone contains proteins (protein bodies and enzymes), ash (phytin bodies) and oil (spherosomes). The germ has two major parts: the embryonic axis and embryonic disc. The protein of the germ contains high levels of lysine and tryptophan that are of unusually good quality for human consumption, as well as for fodder.

2) Finger millet (Ragi)

Finger millet also known as ragi, nachani or nagli, is one of the important millet in India. Elesuine coracana is the scientific name of the finger millet, is an annual herbaceous plant widely grown in arid and semi-arid areas. It is a tetraploid and self-pollinating plant. Finger millet originated in East Africa. Main cultivation areas are Eastern and Southern African countries and southern Asia mainly India & Nepal. The annual production of finger millet is 2.8 million ton with productivity of around 1,500 kg ha-1. It is a small size seed and the bran is bound very tightly to the endosperm. When finger millet is germinated, enzymes are activated, which transfer starches into other carbohydrates such as sugars. Finger millet has a good malting activity. The malted finger millet can be used as a substrate to produce for easily digestible food for infants. Finger millet is rich source of Ca (300-350 mg/100g), Phosphorus is 283 mg\100g and Fe 3.9% (Gopalan et al., 2000). The finger millet a well-balanced amino-acid profile and is a good source of methionine, cysteine, and lysine. These essential amino acids are of special benefit to those who depend on plant food for their protein nourishment. Rich source of vitamins viz. thiamine, riboflavin, folic acid, and niacin. It can be ground and cooked into cakes, puddings or porridge. It is highly nutritive, rich in iron and fiber, and has better energy content than other cereals. These characteristics make it ideal for feeding to infants.

3) Amaranth grain (Rajgira):-

Amaranth grain is a pseudo cereal with great nutritional potential due to its high content of good quality protein and it is an alternative to gluten-containing grains in diets of people with celiac disease. Amaranth grain is popularly known as rajgira in Maharashtra. Amaranth grain is a species of annual flowering plant. It goes by common names such as love-lies-bleeding, pendant amaranth, tassel flower, velvet flower, and foxtail amaranth and quieted. Many parts of the plants, including the leaves and seeds, are edible and are frequently used as a source of food in India and South America. Malting is beneficial approach to improve the nutritional value of cereals used in infant preparation. For this germination for 48hrs at 26°C was preferable, resulting in 8% increase in protein availability, 11% increase in total energy, 70% reduction in resistant starch and 10% increase in the linoleic acid. The sprouted beans taste somewhat sweet.

Rajgira is very popular in Maharashtra cuisine. The seeds are soaked overnight to make them sprout. These sprouted seeds are used for salad. In addition to its nutritive value, amaranth grain contains bioactive compounds with health promoting effects that make amaranth a promising plant as a high quality food source.

4) Moth bean

Vigna aconitifolia is a drought-resistant legume, commonly grown in arid and semi-arid regions of India. It is commonly called mat bean, moth bean, matki, Turkish gram or dew bean. The seeds of these pods contain approximately 22–24% protein. The rectangular seeds exist in a variety of colors including, yellow-brown, whitish green and mottled with black. Moth bean, a short-day crop, is one of the most drought resistant pulses in India. Optimum production of moth bean occurs between 24–32°C, but has been shown to tolerate up to 45°C during the day. Growth is optimal at a constant temperature.

The moth bean is one of the most drought resistant pulses in India, requiring little irrigation for production.100g of raw, uncooked moth bean seeds contain 343 calories, 23 g of protein, 62 g of carbohydrate and 1.6 g of fat. Soaking and cooking moth beans before consumption helps to break down anti-nutritional factors and makes the protein more digestible. They contain B vitamins, too, which help in fueling the body. Moth beans also yield good amounts of magnesium, calcium, potassium, phosphorous, manganese, iron, copper, sodium and zinc. One of the nicest things about moth beans is they are highly versatile as super foods.

5) Powdered milk:-

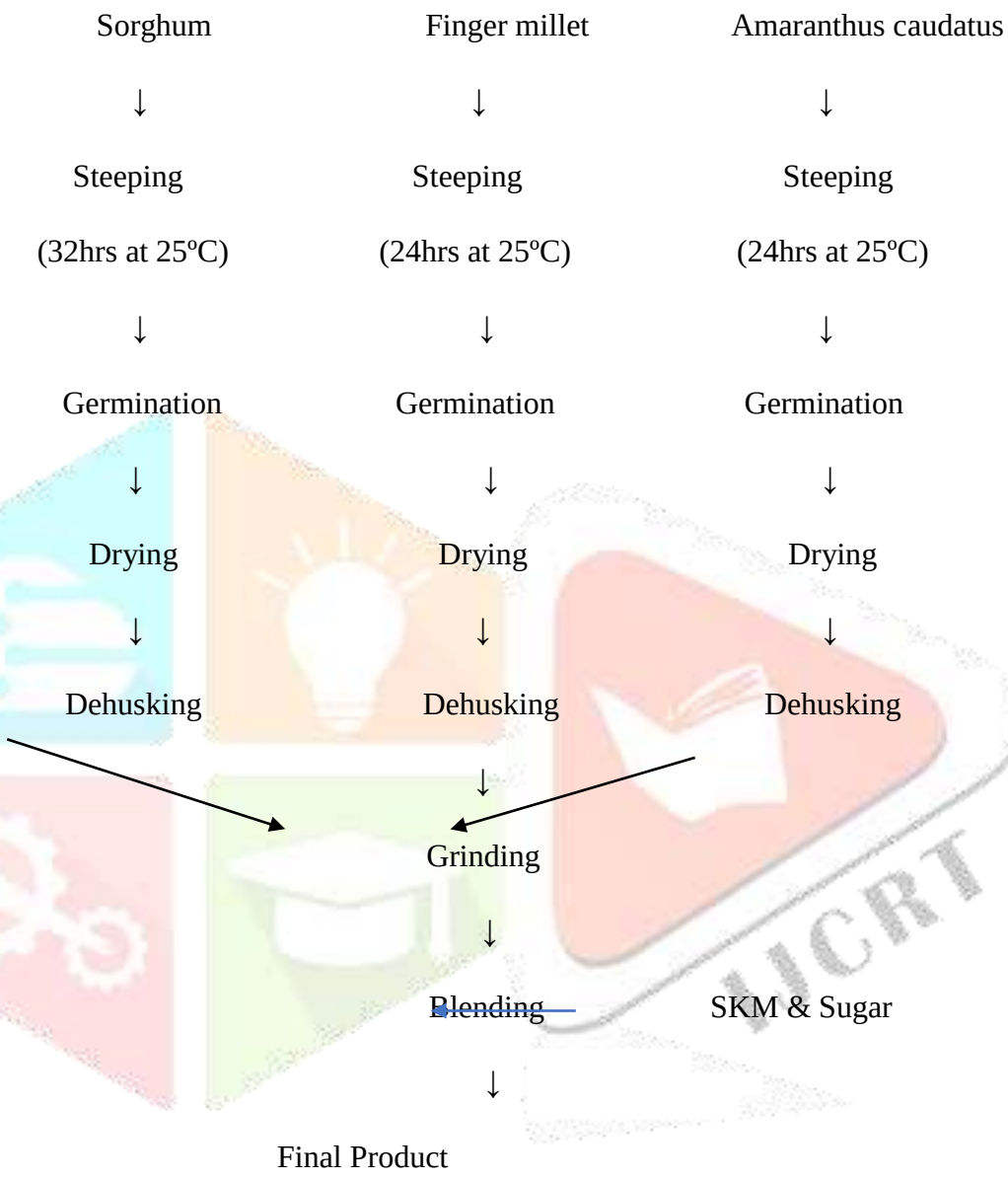
Powdered milk is a manufactured dairy product made by evaporating milk to dryness. One purpose of drying milk is to preserve it; milk powder has a far longer shelf life than liquid milk and does not need to be refrigerated, due to its low moisture content. Another purpose is to reduce its bulk for economy of transportation. Powdered milk and dairy products include such items as dry whole milk, nonfat dry milk, dry buttermilk, dry whey products and dry dairy blends. Many dairy products exported conform to standards laid out in Codex Alimentarius.

Powdered milk is used for food and health (nutrition), and atypically also in biotechnology (saturating agent).

6) Sugar:-

Sugar is the generalized name for a class of sweet-flavored substances used as food. They are carbohydrates and as this name implies, are composed of carbon, hydrogen and oxygen. There are various types of sugar derived from different sources. Simple sugars are called mono-saccharides and include glucose, fructose and galactose. The table or granulated sugar most customarily used as food is sucrose, a disaccharide. Other disaccharides include maltose and lactose.

Process of the weaning food preparation : Flow Chart



RESULT AND OBSERVATION

Following are the conditions which we observed while preparing our home-made formulated weaning food.

1. **Steeping:** In this step, grains are immersed in water and allowed to absorb it at its optimum condition. It's observed that the grain size doubles after soaking. The Amaranth grain seems to be partially hydrophobic in nature but absorbs water during steeping. Before and after results were observed. Below table shows the details:

Table No.1: Optimum steeping conditions

Content	Time (hrs.)	Temp. (°C)	Raw weight (in gm.)	Weight after soaking (in gm.)
Sorghum	32	25	100	160
Finger Millet	24	25	50	130
Amaranth grain	24	25	25	100

Sorghum Finger Millet Amaranth grain

Fig.No.3.1: Steeping of grains.

3.2 Germination: The time required and growth of the sprouts during germination was keenly observed for all the selected grains. It is observed that sorghum requires longer time for germination as compared to other grains. Sprouting of amaranth grain is delicate in nature and gets spoil earlier in comparison with other sprouting grains. Below table mention the details with photographs :

Table No.3.2: Optimum condition of germination

Content	Time (hrs.)	Temp.(°C)
Sorghum	72	30°C
Finger millet	48	30°C
Amaranth grain	48	30°C

After 24hrs after 48hrs after 72hrs

Fig no.3.2: Germination of Sorghum after 24, 48, & 72hrs respectively.

After 12hrs after 24hrs after 48hrs

Fig.No.3.3: Germination of Finger Millet after 12, 24 & 72hrs respectively.

After 12hrs after 24hrs after 48hrs

Fig.No.3.4 : Germination of Amaranth Grain after 12, 24, 48hrs, resp.

3.3 Kilning: In this step, the germinated grains are exposed to high temperature for complete removal of water contents. Roasting dehydrates the grains making it easier for grinding. The grains are continuously stirred while roasting until the sprouts shrinks completely and turns brown in colour. It also develops addition aroma and flavour.

Table No.3.3: Optimum condition of Kilning

Content	Time (hrs.)	Temp.(°C)
Sorghum	20	80°C
Finger millet	15	80°C
Amaranth grain	10	80°C

Fig.No.3.5: Before kilning process

Fig.No.3.6: Germinated Grains after Kilning process

3.4 De-husking: This step is followed by kilning process, the sprouts shrinks and turned brown in colour. In this step these sprouts are removed through rubbing the kilned grains with hands. The sprouts content high amount of fibre and are heavy to digest for 6 months old.

FORMULATIONS

Formulation (F1):

Table No. 3.4: Weaning Food formulation (F1)

Ingredients	Composition (in gm)
Sorghum	400
Finger millet (Ragii)	200
Amaranth grain (Rajgira)	100
Skimmed milk powder	150
Powdered sugar	150
Total	1000

Comparison of malted weaning food with branded weaning food per 100 gm.

Table no. 3.5: Comparison between F1 formulation with branded product

Parameters	Cerelac	Sample (F1)
Moisture (%)	2.6	2.5
Ash (%)	5.4	5.5
Reducing sugar (mg)	-	5.50
Non-reducing sugar (mg)	-	3.75
Crude fibre (%)	2.75	2.8
Crude fat (%)	9.0	6.0
Crude protein (%)	**12.25**	**5.2**
Sugar (%)	6.5	8.0
Energy	413 kcal	380 kcal

Formulation (F2):

Table No. 3.6: Weaning Food formulation (F2)

Ingredients	Composition (in gm.)
Sorghum	200
Moth bean	200
Finger millet (Ragi)	200
Amaranth grain (Rajgira)	100
Skimmed milk powder	150
Powdered sugar	150
Total	1000

In the F2 formulation, some significant changes were done. The quantity of sorghum was reduced from 400gms to 200gms. Additional 200gms moth bean is added. The kilning process is replaced with sun-drying, the result obtained found significantly low in protein percentage in Formulation (F1). After studying every step used in procedure, it was found that grains exposed at consistently high temperature lead to denaturation of protein. An easy and better option over it was chosen of Sun-drying over kilning process. The grains were exposed to bright sunlight for 1-2 days until it gets completely dry. Rest of the process was similar as performed before.

3.5 Sun-drying: In the formulation (F2) the kilning process is replaced with sun-drying. As roasting of grains caused denaturation of proteins. Without skipping the step the better option over it was chosen of sun-drying. The sprouted grains were allowed to sun-dry for 1-2 days. Before and after result was studied. The sprouts become shrinking and grains get dehydrated completely.

Fig.no.3.7: Before sun-drying

Fig.No.3.8: After sun-drying

Moth bean: To increase the protein content in the formulation F2 moth bean was added. Following are the optimum conditions used while preparation of weaning food.

Table no. 3.7: Optimum conditions for moth bean

Moth bean	Time	Temperature
Steeping	12hrs	25℃
Germination	12hrs	30℃
Sun-drying	24hrs	40-42℃

Comparison of malted weaning food with branded weaning food per 100 gm.

Proximate Analysis of the F2 formulation was done compared with the branded product which mostly used by the common people and easily available in the market. The resulted value was more or less similar with the branded product values. Below is the table shows the comparison:

Table No. 3.8 : Comparison between Formulation (F2) with branded product

Parameters	Cerelac	Sample (F2)
Moisture (%)	2.6	2.13
Ash (%)	5.4	8.5
Reducing sugar (mg)	-	6.50
Non-reducing sugar (mg)	-	2.75
Crude fibres (%)	2.75	2.05
Crude fat (%)	9.0	7.5
Crude protein (%)	12.25	9.2
Sugar (%)	6.5	7.65
Energy	413 kcal	400 kcal

Conclusion

Weaning foods with good protein quality and energy density can be prepared by processing a variety of raw materials. WFs prepared using home appliances in inexpensive manner with low cost of production. The main criterion is to satisfy the daily requirements of an infant receiving two or three feelings body while at the same time meeting the quality standards prescribed by the legislation of the concerned country.

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