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Development of an Indigenous, Nutritional and Economically Viable Baby Food Product

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Abstract: ***According to Global Nutrition Report 2020, India is among 88 countries which are likely to miss global nutrition targets by 2025 and also identified as country one with highest rate of domestic inequalities in malnutrition (UNICEF/World bank/WHO report, 2019). Despite India's 50% increase in GDP since 1991(The economist, 2012) more than one third of the world's malnourished children live in India. Among these, half of the children under three years old are underweight and a third of wealthiest children are over-nutriented (The economist, 2012).One of the major causes for malnutrition in India is economic inequality. Poor diet, irregular diet, lack of physical activity these are some causes of malnutrition. Due to the low social status of some population groups, their diet often lacks in both quality and quantity. Women who suffer malnutrition are less likely to have healthy babies. Deficiencies in nutrition inflict long-term damage to both individuals and society. Good nutrition is the bedrock of child survival and child development. Well-nourished children are better able to grow and learn, to participate in their communities, and to be resilient in the face of disease or disaster. Market survey was conducted and obtained results showed that the government provided food product to "Anganwadi" children i.e. "Sukadi" was not acceptable. Infants require high energy and nutrient dense foods because of their high growth velocity. Feeding fortified complementary blended foods is one of the options to treat malnourished infants. Grainylac contain milled germinated legumes and cereals with dates, sugar, soy chunks, haliv, cardamom and beet root powder. This product is low cost version of baby food with all required nutritional components. It is rich source of protein, iron, calcium, carbohydrate, different vitamins. The product signifies with low cost and high nutrition.***

IndexTerms: Anganwadi, Malnutrition, Germinated grains, Fortification, GDP.

I. INTRODUCTION

Malnutrition could be related to a complexity of factors, causing inadequate feeding practices during the most vulnerable period of life, the weaning period, the age between 6 and 24 months in which the infant changes from breast-feeding to the family meal. It can categorize to be under-nutrition and over-nutrition. Undernourishment to children is the curse for the future generation as they are not efficient in workforce. The brain patterning processes are almost completed at birth but some biological developments occurs during preschool years and roughly quadruple in weight and 90% it's adult volume before age 6 (Timothy T. Brown et al, 2012). Hence nutritional satisfaction in those years of age is very important. India has the highest number of low birth weight babies per year at an estimated 7.4millon (UNICEF- Indian children nutritional scenario).In India 20 per cent of children under five years of age suffer from wasting due to acute under-nutrition. More than one third of the world's children who are wasted live in India. Forty three per cent of Indian children under five years are underweight and 48 per cent (i.e. 61 million children) are stunted due to chronic under-nutrition, India accounts for more than 3 out of every 10 stunted children in the world. Under-nutrition is substantially higher in rural than in urban areas. Short birth intervals are associated with higher levels of under-nutrition. The percentage of children who are severely underweight is almost five times higher among children whose mothers have no education than among children whose mothers have 12 or more years of schooling. Under-nutrition is more common for children of mothers who are undernourished themselves (i.e. body mass index below 18.5) than for children whose mothers are not undernourished (UNICEF- Indian children nutritional scenario). By considering different factors of product development (external -social, cultural and environmental and Intrinsic factors like physical, textural, sensory) and also market acceptability, we prepare product from germinated multigrain which includes green gram, moth bean, Ragi etc. Then sugar, dried date powder, wheat flour, soy chunks flour, rice flour, beet powder as iron source, haliv and different flavors. In market different infant foods are available but because of high price poor people are not able to buy that product for their children and by focusing more on that factor we used low cost ingredients. According to the survey which we did, found that government is providing different type of food to children, there is absence of proper taste and intended use of that product. People feed that product to cattle or in other way it got wasted and even children are not accepting that product because of taste.

In commercial food products, the manufacturers add extra ingredients to minimize the price but it affects the quality of the product. At best, these extra ingredients are nutritionally empty, and at worst, they are nutritionally dangerous, particularly when consumed by infants (Suresh et al,2015). For instance, many FBFs (fortified blended food) are high in sugar. Every calorie taken up by these ingredients is a lost opportunity for infant to eat a nutrient rich food that will facilitate proper growth and development.

II. LITERATURE REVIEW

According to reports Global nutrition report, 2018, 50.8 million children are stunted, 50.5 and 38.3 million children are wasted and overweight respectively. Children can also experience multiple forms of malnutrition: 3.62% of children under five (15.95 million children) are both stunted and wasted, while 1.87% of under-fives globally (8.23 million children) experience both stunting and overweight (Global nutrition report, 2019).

India experiences a malnutrition burden among its under-five population. As of 2015, the national prevalence of under-five overweight is 2.4%, which has increased slightly from 1.9% in 2006. The national prevalence of under-five stunting is 37.9%, which is greater than the developing country average of 25%. India's under-five wasting prevalence of 20.8% is also greater than the developing country average of 8.9 %(Global nutrition report 2019).

Near about 45% deaths among children under 5 years of age group are undernourished and most of them are from middle or low economy countries. Generally the term malnutrition is classified into three groups- 1.Under-nutrition which means (low weight for height) and underweight means (low weight for age), 2. Micronutrient related malnutrition which includes vitamin and mineral deficiency or in excess amount, 3.Overweight, obesity and other non-communicable diseases (World health Organization).

According to the reports, when children crossed six months age most of them are going through a wrong diet habits. Near about 45% of children are far from fruits and vegetable at the age of six months to 2 years.

And 60% of do not eat dairy, fish, meat or egg worldwide (UNICEF, 2019). According to the data released, throughout the last decade highest malnutrition was in year 2001 to 2005 later on it decreases but problem is still very dangerous for India. Taking in consideration current data of malnutrition in India, our country bears 23.8% of the global malnourishment (Food and Agricultural Organization Report, 2018).

All WHO members including India adopted the United Nations' 17 Sustainable Development Goals, which is to achieve Zero hunger by 2030. But according to current analysis, India is not on right of WHO nine nutrition goals those are reduce child overweight, stunting wasting and diabetes among women and men, anemia in women reproductive age, increased exclusive breast feeding and obesity in both men and women (World health Organization and indiaspend, 2018).While focusing on different states India, highest malnutrition problems was observed in Jharkhand, Bihar, Uttar Pradesh, Madhya Pradesh, Gujarat and Maharashtra. According to analysis out of total stunted children 43.6% belong to the scheduled tribes, 42.5%from scheduled castes, and 38.6% from other backwards.

III. RESEARCH METHODOLOGY

A. Materials

1) Raw Material: Good quality of Moong, Moth beans, Ragi, Sugar, Dry dates, Wheat, Soy chunks, Rice, Haliv, Cardamom, Beetroot powder were purchased from local market of Loni-Kalbhor.

a) Moong Bean (Vigna Radiata): Moong has different biologically important properties like antioxidant, antimicrobial, anti-inflammatory, antidiabetic, antitumor antisepsis (Dongyan Tang et al, 2014). Sprouted beans contain more free amino acids and antioxidants than unsprouted ones. Sprouting reduces levels of phytic acid, which is an antinutrient which can reduce the absorption of minerals like zinc, magnesium and calcium (Kumar Ganesan et al,, 2018).

b) Moth Beans (Vigna Aconitifolia): Sprouting and cooking of moth bean lead to increase a protein efficiency ratio (PER) and food efficiency ratio (FER) (K. Mankotia et al, 2017). Pulses provide protein, fibre, vitamins and minerals, such as iron, zinc, folate, and magnesium. In addition, the phytochemicals, saponins, and tannins found in pulses possess antioxidant and anti-carcinogenic effects, indicating that pulses may have significant anti-cancer effects (Kavita Dipnaik et al, 2017).

c) Finger millet (Eleusine Coracana): Finger millet contains high amount of calcium 344 mg 100 g. Ragi processed food products are good for people who need more calcium and iron in their diet(Verma, V. and Patel, S.2012). Finger millets reduces the risk of diabetes by slow releasing of sugar in body. It also contain high fiber content which helps to avoid constipation, intestinal cancer and blood cholesterol. It contain higher Sulphur containing amino acid, dietary fiber and mineral content than white rice(S.shanmugam et al, 2013).

d) *Wheat (Tritium):* In the endosperm of the wheat there is 72% of the protein is stored, which forms 8-15% of total protein per grain weight. Wheat grains are also rich in pantothenic acid, riboflavin and some minerals, sugars etc(P.Kumar et al, 2011). The bran layer is rich in fiber, potassium, phosphorus, magnesium, calcium, and niacin. Wheat reduce the risk of type 2 diabetes. Wheat bran contain different type of bioactive components like Phytic acid, Ferulic acid, Alkylresorcinols, Lutein, Iron, Manganese, Zinc, Selenium, Vitamin E, Betaine, Choline, Niacin, Panthothenic acid, Riboflavin, Biotin, Pyridoxine etc. wheat nutritional components prevents Cardio vascular diseases (CVD) and Wheat bran and irritable bowel syndrome (IBS) also (Chalamacharla R.B. et al, 2018).

e) *Garden Cress Seeds (Lepidium Sativum):* According to national family health survey, now days iron deficiency anemia (IDA) is one of the major problem in Indian women and it can be recovered through iron and folic acid supplementation. IDA in india decreased by only 3.5 percentage points from(56.5% in 2005-2006 to 53.0% in 2015 to 2016) for women aged 15 to 49 years (Rai RK et al, 2018) Consumption of these seeds by lactating women will help to increase production and secretion of milk because of its high protein and iron content. Garden seeds contain vitamin A and C as a fee radicle. This helps to prevent diabetes, cancer and improves blood circulation(Chandra Shekhar Singh and Vinod Kumar Paswan,2017).

f) *Rice (Oryza Sativa):* Rice, which contains 80% carbohydrates, 7–8% protein, 3% fat, and 3% fiber. Rice has physiological compatibility with lesser toxic effect. Rice carbohydrates are broken down to glucose which is used as energy for exercise and fuel for the brain with slow starch digestion and low glycemic index. Unpolished rice reduces the risk of diabetes (type 1 and type 2 both) because of having low starch digestibility. Rice is the cereal with low fat, salt and cholesterol. It has high protein digestibility with high proportion of lysine. Bran contains anti-oxidants like tocopherols and tocotrienols and oryzanols, which has anti-cancerous properties (Prabha R Chaudhari et al, 2018).

g) *Soya Chunks/ Soybean Nuggets:* Soybean is high in protein and is to the equivalent to animal food in terms of the quality of the protein. It contains 43 g of protein per 100 g. It also contains 19.5 g of fat, 21 g of carbohydrate and provides 432 kcal per 100 g (Maria John Newton.A et al 2008). It contain highest protein content among all pulses. Soy phytoestrogens are isoflavones, genistein and daidzein which are adsorbed on to soy protein are suggested as the agent reducing serum cholesterol levels. The benefits could potentially reduce the risk of atherosclerosis and other cardiovascular diseases (Simvastatin:G. Swami et al, 2010).

h) *Dry Dates (Phoenix Dactylifera):* Dates can provide fiber, fat and cholesterol free. Dates also contain vitamin A, thiamine and complex of vitamin B, folate, vitamin C and vitamin E, vitamin K, along with minerals like calcium, iron, magnesium, manganese, phosphorus, potassium, sodium and zinc. Dates contain a lot of vitamins and minerals including contain sodium, potassium, calcium, magnesium, iron, sulphur, phosphorus and chlorine, as well as vitamins A, beta-carotene, B1, B2, B3 and B6 (A.B.M. Sharif Hossain, 2015).

i) *Beetroot powder (Beta Vulgaris):* Beetroot is therapeutic treatment in a range of clinical pathologies associated with oxidative stress and inflammation. Its constituents, most notably the betalin pigments, display potent antioxidant, anti-inflammatory and chemo-preventive activity in vitro and in vivo (Tom Clifford et al, 2015). Beetroot consumption is have significant effect on oxidative stress, cognition and endothelial function (Diego dos S. Baião et al,2017).

2) *Chemicals:* Chemicals required during this process are made available from MIT College of Food Technology,Pune.

B. Method

1) *Formulation of Raw Materials per 100gm*

Sr no	Ingredients	S1	S2	S3
1.	Germinated flour	30	33	36
2.	Sugar	27	25	23
3.	Dry Dates	12	11	10
4.	Wheat	10	10	10
5.	Soy chunks	6	6	6
6.	Rice	6	6	6
7.	Beetroot	4	4	4
8.	Haliv	1	1	1
9.	Cardamom	4	4	4

Table 1: Formulation of trial samples of product

2) Standardized Formulation of Product

Sr no	Name of ingredients	Amount (%)
1	Germinated legume and millets (Moong, Moth bean, Ragi)	33
2	Sugar	25
3	Dry dates	11
4	Wheat	10
5	Soy chunks	6
6	Rice	6
7	Beet root	4
8	Haliv	1
9	Cardamom	4

Table 2: Standardized formulation of Grainylac product

3) Process Flow Diagram

Selection of good quality raw material
↓
Cleaning of ingredients
↓
Soak the ingredients Moong, Moth bean, and Ragi
(12 hrs. in warm water)
↓
Allow for germination
(24 hrs. At room temperature)
↓
Drying of germinated ingredients
(70ºC for 30 min)
↓
Roasting of all ingredients
(for 5 min)
↓
Milling
↓
Mixing all ingredient
(As per the formulation)
↓
Packaging
↓
Storage (at room temperature)

C. Analytical Methods

1) Sensory Analysis of Grainylac: Sensory analysis of Grainylac is calculated on the the basis of 9 point hedonic scale with 9 as a like extremely, 5 as neither like or dislike and 1as dislike extremely. For Grainylac we used parameters like Appearance, colour, Texture, Flavor, sweetness, Aroma, Mouthfeel and overall acceptance. From that score we decided which sample is best to formulate standardized recipe.

2) Proximate analysis of Grainylac

St.no.	Parameter	Analytical Method
1.	Energy	Calculation
2.	Ash	Muffle furnace
3.	Moisture	Dry oven Method
4.	Carbohydrate	Difference Method
5.	Protein	Micro-kjeldahl Method
6.	Fat	Soxhlet Method
7.	Dietary fiber	IS: 11062:2010
8.	Calcium	Atomic Absorption Spectroscopy
9.	Iron	Atomic Absorption Spectroscopy
10.	magnesium	Atomic Absorption Spectroscopy
11.	potassium	Atomic Absorption Spectroscopy
12.	sodium	Atomic Absorption Spectroscopy
13.	Zinc	Atomic Absorption Spectroscopy
14.	copper	Atomic Absorption Spectroscopy

Table3: Analytical methods used for proximate analysis

IV. RESULTS AND DISCUSSION

A. Sensory Evaluation of Grainylac

Results of Sensory evaluation of Grainylac lac is presented in Table 3, which shows sample 2 is good in all parameters compared to other two. Results shows that S1 is lack in flavor and sweetness and S2 is lack in overall acceptability and flavour too. This variation is because of differences in quantities of sprouted ingredients, sugar and dry dates.

Sr no	Appearance	Color	Texture	Flavor	Sweetness	Aroma	Mouthfeel	Overall acceptability
S1	7.1	7	6.6	6.6	6.5	7	7	6.8
S2	8.1	8.1	8.5	8.6	8.8	8.6	8.6	8.6
S3	7.7	7.9	7.5	7.1	7.5	7.5	7.5	6

Table4: Sensory evaluation

B. Proximate Analysis of Grainylac

Nutritional parameters are shown in Table 4 which calculated by proxate analysis. This product has Energy 380.42 Kcal with carbohydrates 60.09. Grainylac products is rich in iron with 2.80 g beacuse of iron rich ingredients in it like ragi, dry dates and beetroot powder. Protein and fat content is 29.66g and 2.38g respectively.Protein content is mainly because of different ingredients mainly soya chunks and also Moong, moth bean and ragi. Dietary fibres are present in good quantity 38.3 g which helps in completion of digestion process properly. According to chemical analysis Grainylac contains moisture and ash content 4.90% and 2.97% respectively.

Sr.no.	Parameter	Amount (per 100 ml)
1.	Energy	380.42 Kcal
2.	Ash content	2.97 %
3.	Moisture	4.90%
4.	Carbohydrate	60.09 g
5.	Protein	29.66 g
6.	Fat	2.38 g
7.	Dietary fiber	38.3 g
8.	Calcium	265 mg
9.	Iron	2.80 mg
10.	Magnesium	35.5 mg
11.	potassium	380 mg
12.	sodium	112 mg
13.	Zinc	2.10 mg
14.	Copper	0.24 mg

Table5: Nutritional composition of Grainylac

This Grainylac product is also rich in other minerals like magnesium (35.5mg), potassium (380mg), zinc (2.10mg) etc. Ingredients in grainylac products are rich in many minerals those ingredients include ragi, wheat, rice, beetroot powder, soya chunks etc.

V. CONCLUSION

Today, parents are ready to spend on high-quality, expensive baby foods to ensure the well-being of their infants. Rising health concerns towards the overall development of the baby and growing number of malnutritional cases are the key factors driving the growth of the market. Furthermore, increasing awareness among people about the various health benefits of feeding baby foods to infants and young babies is fueling the demand for baby foods across the globe. Increasing number of working women and the need for convenient and portable nutrition for their babies has created a large market for baby foods and infant formula.

We are prepared product from the locally available low cost ingredients, includes germinated legumes which is source of protein vitamin B, C, K and folates. Ragi is important ingredient because it content calcium, iron, essential amino acids and very good gluten free source of protein. Germination make it easier to digest. Dry dates powder as a rich source of iron, minerals and dietary fibers. It is good for heart, improves digestion, reduce problem of constipation and energy booster. Wheat and rice flour as source of different amino acids and vitamin B. Major source of protein in this powder of soy chunks which is also a low cost ingredients. Haliv used as source of calcium and iron and other micronutrients. Feeding nutritious food to babies help for proper brain development and body growth. Instead of taking nutritious food in adult age it's always better to take nutritious food at starting period of life.

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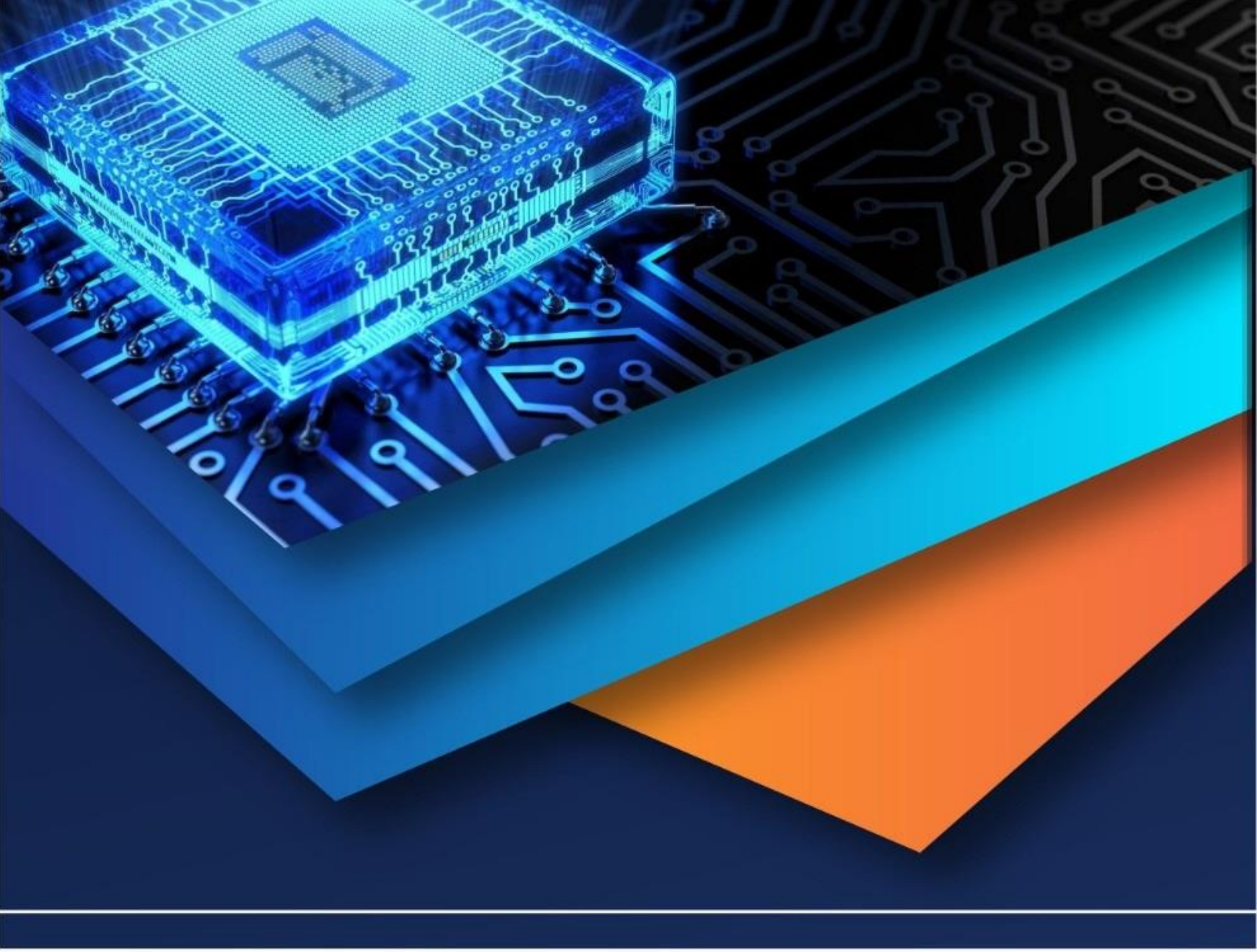

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