STUDIES IN DEVELOPMENT OF SUPPLEMENTARY FOOD FOR INFANTS

Dissertation II Report

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CERTIFICATE

This is to that **Vasundhara Gupta** (Registration No. 11718166) has personally completed M.Sc. Dissertation II entitled **"Studies in development of supplementary food for infants"** under my guidance and supervision. To the best of my knowledge, the present work is the result of her original investigation and study. No part of dissertation has ever been submitted for any other purpose at any University.

The project report is appropriate for the submission and the partial fulfillment of the conditions for the evaluation leading to the award of Master of Nutrition and Dietetics.

Date: 14-05-18

Signature of Supervisor

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DECLARATION

I thereby declare that the work presented in the dissertation II report entitled **“Studies in development of supplementary food for infant”** is my own and original. The work has been carried out by me at School of Agriculture, Lovely Professional University, Phagwara, Punjab, India under the guidance of Dr. Yogesh Gat, Assistant Professor (Food Technology) School of Agriculture, Lovely Professional University, Phagwara, Punjab, India, for the award of the degree of Masters of Science in Nutrition and Dietetics.

Date: 14-05-18

Place: Phagwara, Punjab, India   Registration No.: 11718166

I certify that the above statement made by the student is correct to the best of my knowledge and belief.

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1: INTRODUCTION

Good nutrition during childhood is essential for health and survival. Undernourished children are more prone to infections and are more likely to die from regular sickness such as diarrhea than well-nourished children (Huybregts et al., 2012). It has reported that around 50% deaths under five occur in response to malnutrition. Additionally, >25% children in the developing countries are moderately or severely malnourished. Moreover, the child nutrition is thought to be a major risk factor for the sickness and death of children, contributing >50% of child death over the globe (Cheah et al., 2010). According to current report, globally 50 million infants were wasted in 2014 (UNICEF, WHO, WORLD HEALTH GROUP, 2015). In India, about 20 percent of children under five years of age are wasted, 48 percent stunted and 43 percent underweight. In Punjab state of India, 17.3 per cent children under five years of age is stunted, and 8 per cent are underweight and 2.1 percent are wasted. Cereals and strained vegetables and fruits should be introduced at about 6 months of age to supply iron, vitamins and other nutrients and help to set up the new born child for differentiated eating routine.

Breastfeeding is highly recommended for infants up to 4 months of age, afterwards breast milk alone cannot provide adequate energy and nutrient requirements for the growing body. Therefore, in order to sustain normal growth and development, introduction of supplementary food products is required (Hejazi et al., 2017). An ideal supplementary food must be nutrient dense, easily digestible of suitable consistency and also affordable to consumers. Therefore, the development of homemade supplementary food based on locally available germinated cereals and legumes has been suggested by the Integrated Child Development Scheme (ICDS) and Food and Agriculture Organization to fight against malnutrition among children (Imtiaz et al., 2011).

Millets are known to play an important nutritional role especially in developing countries like India with low socioeconomic group. Millets are unique among the cereals because of their cheap and richness in calcium, polyphenols, dietary fiber and protein (Devi et al., 2014).

Pearl millet (*Pennisetum americanam*) is a low-cost food crop, which is considered as a substitute of wheat for low-income groups. Being rich in iron, pearl millet could be utilized as a base material for the development of fortified cereal-based weaning food. Pearl millet grains can be processed and consumed as ingredients in diversified foods (Sihag et al., 2016) They are called "nutri-cereals" because of their high protein, fiber, mineral, and fatty acids contents, as well as their antioxidant properties. (Dias-Martin et al., 2018). Pearl millet has a well-balanced protein, except for its lysine deficiency, with high concentration of threonine and lower (but adequate) leucine than sorghum protein.

Pearl millet deficient in vitamin c and plantain green *(Musa paradisiaca*) rich in vitamin C, B6, dietary fiber and minerals (Nurhayati et al., 2017). In Nigeria, it is the third most important staple. It is a rich source of carbohydrates, iron, potassium and vitamin A, but low in fat and protein

(Odenigbo et al., 2013). Green banana can be consumed in the ripe or unripe forms as well as boiled, fried, roasted, or when processed into flour (Famakin et al., 2016). Processing of green bananas into flour is one of the means of post-harvest preservation of the crop.

Plantain flour is obtained by drying green fruit. The flour from ripe fruit has high sugar content which makes it a useful component of newborn child diet and the carbohydrate have been found to be easily digested than that of cereal (Olubunmi., 2013). Plantains not at all like bananas which are conventionally consumed raw as dessert are mostly eaten after cooking. Several processing methods are adopted for plantain fruit utilization, these include boiling, steaming, roasting and deep-frying (Robert et al., 2017).

Green plantain can be consumed by using different processing methods such as roasting, boiling with beans or tomatoes, baking and frying. The American Dietetic Association reviewed the evidence for low GI food in green plantain, and low GI food reduced the risk for obesity, diabetes and other chronic degenerative diseases (Oko et al., 2015)

2: PROBLEM BACKGROUND:

Infant nutrition is one of the most worrying aspects. Experts agree that weaning the transition time when parents stop exclusively feeding their infants on milk and move to introducing 'solid' foods, continues to cause more anxiety to mothers, nurses and doctors than almost any other issue in pediatric nutrition'. Parents often struggle to establish when to give additional food to their infants and what foods they should begin to feed them on. Introduce other food too early, before the age of 4 months, is associated with increased morbidity and the end of lactation. Conversely, delaying the introduction of solids beyond the age of 6 months has been associated with increased risk of malnutrition. Not surprisingly, therefore, research has found supplement feeding to be one of the aspects of parenting, which mothers, and first-time parents in particular, find most challenging. Absent of complementary food leads to poor nutrition. Subsequently, poor nutrition can impact weight gain, linear growth, and other functional health outcomes as well as cognitive development and emotional regulation.

3: REVIEW OF LITERATURE:

3.1 Health related problems of babies

Acute malnutrition, or wasting, affects large number of kids in developing countries. Low weight children have three times higher risk of death compared to well-nourished children. Wasting harmfully impacts the development of learning capacity and weakens future economic potential of both individuals and countries (Huybregts et al., 2012). When breast milk is no longer enough to meet the nutritional needs of the infant, supplementary foods should be added to the diet of the child. Hence, easily digestible, nutritionally balanced and energy dense additional foods are required as a substitute to breast milk and if the toddler are not substitute with other foods or exclusive breast feeding, babies may occur many health-related issues.

3.1.1 Protein energy malnutrition (PEM)

The problem of PEM begins when a child is introduced to additional foods known as supplementary foods. Infants are usually introduced additional foods around the age of six month, as breastfeeding is insufficient in some nutrients to maintain the fast growth and development. Therefore, a special attention is required to the nutritional and functional properties of the supplementary food (Tenagashaw et al., 2017). During this critical period children develop illnesses and multiple deficiencies such as protein energy and micronutrient deficiencies (Pobee et al., 2017)

3.1.2 Over weight

New born children who feed from a bottle are more likely than those who breastfeed to exhibit rapid rates of growth during the first year postpartum,1–3 a known hazard factor for childhood and adult obesity and other comorbidities. Exclusive breastfeeding for the first 6 months is associated with the greatest protection against major health problems for both mothers and infants, baby suffer from excess weight gain, because of excessive weight gain. Early supplementation with infant formula is associated with decreased exclusive breastfeeding rates in the first 6 months and an overall shorter duration of breastfeeding (Kellams et al., 2017.

3.1.3 Micronutrient deficiency in infants

Newborn children aged four-to-six months with low vitamin B12, vitamin A deficiency, Iron deficiency, Iodine, Zinc deficiency have a greater risk of developmental delays.

Vitamin B12 – Stu dies have discovered that women deficient in vitamin B12 have lower concentrations of vitamin B12 in their breastmilk, possibly influencing the vitamin B12 status of their breastfed infant. Studies have shown that premature and low-birth-weight babies have bring down levels of vitamin B12 compared to full-term newborn children and those with normal birth weight (Bellows et al., 2017).

Vitamin A – Vitamin A is a fat- soluble vitamin that has multiple roles in the body including cell separation, vision, reproduction, resistant capacity, and helps in bone development and growth. Vitamin A insufficiency has been associated with increased rates and severity of infections and is a primary cause of childhood morbidity and mortality in the developing world, particularly in Africa and Southeast Asia. The WHO appraises that 250–500 million children are blind because of Vitamin A deficiency(VAD), and half of these children will die within a year of vision loss. VAD is the main cause of preventable blindness in youngsters. Vitamin A supplementation in developing countries, continued emphasis should be placed on vitamin A supplementation programs in Southeast Asia given the clearly documented consequences for visual wellbeing and mortality (Bailey et al., 2015). VAD is the primary driver of preventable visual impairment in youngsters.

Iron- Iron deficiency (ID) is the most common single nutrients deficiency in the world. Owing to rapid growth and poor iron stores, infants and young children are at risk. Iron deficiency anemia (IDA) during first 6 months of life if not supplemented from 1 to 2 months of age, an iron supplements are prescribed for them (Berglund et al., 2015). The World Health Organization (WHO) prescribed continuation of breastfeeding for up to 2 years of old or past, in addition to nutritionally adequate and safe complementary foods. The 6- to 24-month age period coincides with the maximal risk of ID, because iron requirements during the second half-year of life are higher than some other time of life. However, there is debate about the iron needs of breastfed infants (Chandyo et al., 2016).

3.2 RDA for 6-12 months infants

In India, expert committee of ICMR recommends the dietary requirements of the infants. 1.2 g/kg body weight of protein is required for proper physical development. Micro-nutrients like calcium, iron, Vitamin A, Vitamin B complex etc. are essential for carrying out various metabolic processes. All the nutrient requirements should be adequately met to avoid any nutritional deficiencies which hinder their growth and development

The recommended dietary allowances for 6-12 months infant as suggested by ICMR as shown in table 1

TABLE 1: RDA of infants

Nutrients	Value
Energy(kcal/d)	80
Protein(g/d)	1.69
Visible fats(g/d)	19
Calcium(mg/d)	500
Iron (mg/d)	5
Vitamin A(μg/d)	350
Β-carotene(μg/d)	2800
Thiamine (mg/d)	0.3
Riboflavin (mg/d)	0.4
Ascorbic acid(mg/d)	25
Dietary folate (μg/d)	25
Vitamin B12 (μg/d)	0.2
Magnesium (mg/d)	45
Pyridoxine (mg/d)	0.4
Niacin (mg/d)	650

3.3 Pearl Millet (*Pennisetum americanam L.*)

Pearl millet (bajra) is an important cereal crop in western India (Gujarat, Rajasthan and Haryana). It is the most generally developed and with superb yield capability of all millets, even under dry spell and warm anxieties (Akinol et al., 2017). Pearl Millet known to possess high nutritional potential with high level of fat content, iron, calcium, zinc and is highly nutritious and underutilized in developed countries due to non-availability in convenient/ ready to eat form (Mehra et al., 2017). In India, pearl millet known as variety of names bajra, bajrou, sajje, milheto-pérola, capimcharuto and pasto-italiano (Southern Brazil) while in the United States- pearl millet, bulrush millet, cattail millet, candle millet and dark millet (Europe), mil du Soudanou petit mil (France), and in Spain and Arabic countries-mijo perla and duhun, respectively. India is the largest producer of pearl millet both in terms of area and production (Sehag et al., 2015) and is consumed in the form of various foods depending on the region and their food habits. The percentage of crude protein, fat, crude fiber and ash content of pearl millet as reported in various analytical studies ranges from 7.02 to 13.67, 4.02 to 7.80, 0.54 to 3.00 and 0.25 to 2.54 per cent, respectively. Besides, the total quantity of protein, their amino acid composition is important for better nutritional quantity. The amino acids profile of pearl millet is better than that of sorghum and maize and is comparable to wheat, barley and rice (Mehra et al., 2017). It is impermeable to dry season, low soil fertility and high temperature resilience. These qualities are expected to its broad root framework, which permits powerful water and supplements extraction from more deep soil layers (Dias-Martin et al., 2018).

3.3.1 Nutrition composition of Pearl Millet

Pearl millet is superior to major cereals with reference to energy value, high value proteins, fat and minerals such as calcium, zinc, iron. Besides, it is also a rich source of dietary fiber and micro-nutrients. While, broad data is available on proximate composition and mineral accessibility, information on antioxidant activity (Pushparaj et al., 2014).

Table 2. Nutritional composition of Pearl millet

Components	
Moisture (%)	12.6±0.2
Protein (g)	12.6±0.2
Crude fiber (g)	2.0±2.6
Fat (g)	4.2±0.5
Ash (%)	2.3±0.2
Carbohydrates (g)	69
Mineral content	
Calcium (mg)	39.3±1.3
Iron (mg)	6.7±0.4

(Mehra et al., 2017)

Studies have shown the composition of pearl millet which include moisture (12.6±0.2%), protein (12.6±0.2g), crude fiber (2.0±2.6g), fat (4.2±0.5g), ash (2.3±0.2%), carbohydrates (69g), calcium (39.3±1.3mg), iron (6.7±0.4mg).

3.3.2 Anti - nutritional factors

Wholesome nature of pearl millet is reduced by the presence of anti-nutritional factors such as polyphenols and phytic acid, which interfere with mineral bioavailability and also inhibit proteolytic enzymes (that catalyze hydrolysis of proteins) and amylolytic enzymes (involved in degradation of starch), and thus lessen the absorbability of proteins and starch. Their content can be decreased or eliminated by soaking, cooking, boiling, roasting, blanching (Jukanti et al.,2016 &Dias et al., 2018).

Table 3: Anti- nutritional properties of pearl millet

Anti-nutritional factor		References
Phytic acid (mg)	647.8±0.1	Singh et al.,2017
Polyphenol (mg)	606±0.2	Singh et al.,2017

Studies shown that pearl millet contain anti-nutritional factor which include phytic acid (647.8±0.1mg), polyphenol (606±0.2mg) as it lessens the absorbability of protein and starch.

3.3.3 Health potential of pearl millet

Globally, pearl millet is consumed in different forms: unleavened bread, porridge, dessert etc. It is often referred to as a "poor man's bread". Pearl millet is rich in vitamin B, but does not contain vitamin C. The absorption of different vitamins in pearl millet grain contain: thiamine (B1) [0.27–0.38 mg/100 g], riboflavin (B2) [0.15–0.25 mg/100 g], pyridoxine(B6) [0.27], niacin [0.89–2.7 mg/100 g], folic acid [34.9–45.5 μg/100 g] and pantothenic acid [1.09–1.40 mg/100 g] (Nambiar et al., 2011).

Studies have shown some beneficial effects of the chemical composition of pearl millet grain, it reduces the cause of celiac diseases, Cancer, Coronary heart disease (Jukanti et al., 2016). It also reduced the risk of diabetes, inflammatory bowel disease (Dias et al., 2018)

3.4 Green Plantain (*Musa paradisiaca*)

Plantain is belonging to the family Musaceae referred to in India as coarse banana (Auta et al.,2015). Plantains are one of the commercially important tropical fruits being produced in more than 120 countries in the world. India is the largest producer in the world. Green plantain is important staple food in many developing countries especially in Indonesia. Plantains are rich in carbohydrates, vitamin C, vitamin B6, minerals, dietary fiber but poor in protein, people who eat much of plantain product are prone to malnutrition. The proteins of plantain could be supplemented with cereals or pulses (Nurhyati et al.,2017 & Yadav et al., 2012). Green Plantain flour (GPF) is a gluten-free raw material and is also inexpensive. It is rich in non-starch polysaccharides, especially dietary fiber (6.0–15.5%) (Sarawong et al., 2014).

Plantain flour is obtained by drying green fruit and can be used as diluents of bread flour. In some areas, the peel of plantain fruit is used in making of soap and as animal feed when dried (Olubunmi et al., 2013).

3.4.1 Nutritional composition of green plantain flour

As shown in table 4 green plantain flour contains moisture content (8.8±0.07%), ash (2.4±0.03%), protein (3.0±0.11%), crude fiber (3.6±0.05%), fat (1.4±0.03%), starch (70.16 ± 0.12%) and also contain minerals such as calcium (70.0 ± 1.6), iron (1.5± 0.1), sulfur (100.00 ± 3.6), copper (0.4±0.0), zinc (0.8± 0.1), phosphorous (130± 2.5), magnesium (80.0± 3.1), potassium (102± 5.7) and also contain vitamin c (0.09 mg) in green plantain flour

3.4.2 Anti-nutritional factor

Antinutrients influence nourishment absorbability and assimilation. It basically forms complexes with dietary minerals, for example, zinc and iron, along these lines keep their retention from the sustenance. Despite the fact that tannins have been found to form complex protein and a few metals prompting decreased ingestion, finish disposal is however not fitting as it has additionally been accounted for to be successful in bringing down glucose level by postponing intestinal glucose assimilation along these lines deferring the beginning of insulin-subordinate diabetes mellitus (Odebode et al., 2017). Anti-nutrients present in unripe plantain are listed in table 5:

Table 4: Nutritional composition of Green plantain flour

Components	Plantain flour	References
Moisture (%)	8.8±0.07	(Nurhayati et al., 2017)
Ash (%)	2.4 ±0.03	
Crude fiber (%)	3.6±0.05	
Protein (%)	3.0±0.11	
Fat (%)	1.4±0.03	
Starch (%)	70.16 ± 0.12	(Yadav et al., 2012)
Fiber (%)	0.34	(Salih et al., 2017)
Minerals		
Calcium	70.0 ± 1.6	
Iron	1.5± 0.1	
Sulfur	100.00 ± 3.6	
Copper	0.4±0.0	
Zinc	0.8± 0.1	
Phosphorous	130± 2.5	
Magnesium	80.0± 3.1	
Potassium	102± 5.7	(de Angelis et al., 2016)
Vitamins		
Vitamin C (mg/100g)	0.09	
Total sugar (%)	3.96	
Reducing sugar (%)	3.21	(Salih et al., 2017)

Table 5: Anti-nutritional factors in Green plantain

Anti-nutrients	Unripe Plantain	Reference
Tannin mg/g	5.39 ± 0.02	Akinyemi et al., 2015
Saponin mg/g	7.73 ± 0.03	Akinyemi et al., 2015
Phytate mg/g	9.88 ± 0.05	Akinyemi et al., 2015
Oxalate mg/g	0.81 ± 0.07	Akinyemi et al. ,2015

Removal of anti-nutrients

Both pearl millet and green plantain are known to contain anti-nutrients which limit their consumption in diet despite having high health potential. Several processing methods are adopted to reduce or eliminate the anti-nutrients present in green plantain. These include soaking, germination, cooking, roasting and fermentation. There is significant reduction in the amount of anti-nutrients when these processing techniques are conducted. It improves the quality of food (Eromosele et al., 2017).

4: RESEARCH GAP

The researchers regularly measured the children's weights and heights, recorded illnesses reported by caregivers, and measured each child's blood hemoglobin level before and after the intervention to assess their risk of anemia, an indicator of poor nutrition. The addition of RUSF to the household food rations did not significantly reduce the cumulative incidence of wasting. That is, although fewer children in the intervention group became wasted during the trial than in the control group, this difference was not statistically significant - it could have happened by chance.

5: PROPOSED RESEARCH OBJECTIVE

1.To screen the ingredients.

2.To prepare supplementary food product.

3.To evaluate quality of prepared product.

4. To study the shelf life of final product.

6: PROPOSED RESEARCH METHODOLOGY

6.1 Detailed plan work

6.1.1 To screen the ingredients

The effect of different processing techniques on the antinutritional factors of pearl millet will be investigated for the following processing techniques:

Soaking: Pearl millet will be soaked in deionized water [water ratio-1:2 and 1:5 (w/v)] for variable time viz: 12 hours and 24hours at room temperature (Thorat et al., 2017)

Germination: The soaked millets will be allowed to germinate in sterile petri dishes lined with filter paper for 48 hours at 50 degrees Celsius in dark and will moistened at regular interval of 3hours (James et al.,2018).

Detection of anti-nutrients by FTIR

- ✓ Phytic acid (Gull et al.,2016)
- ✓ Polyphenol (Nour et al.,2015)
- ✓ Tannin (Nour et al.,2015)

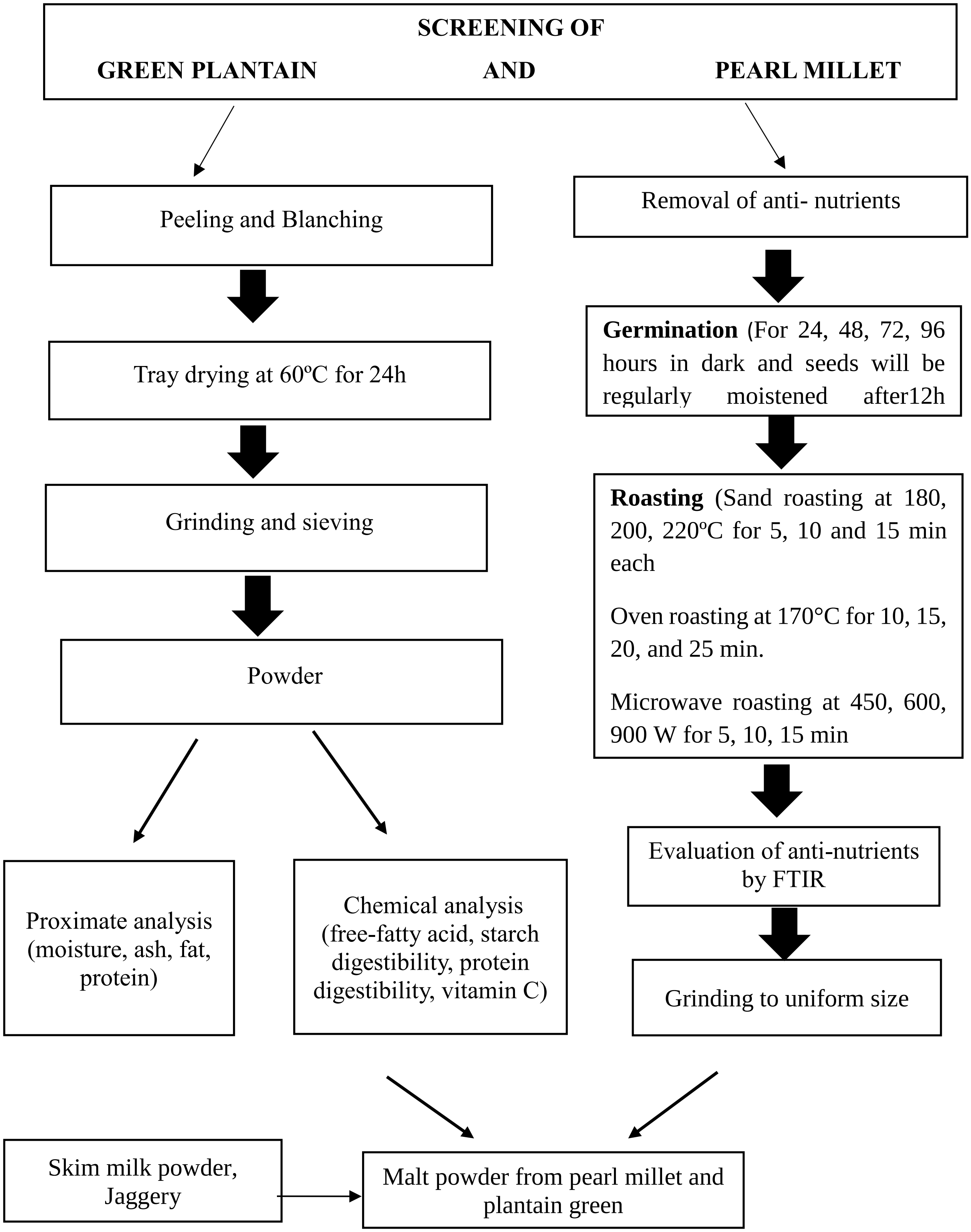
The effect of different processing techniques on the antinutritional factors of green plantain flour will be investigated for the following processing techniques:

1. **Proximate analysis**

    i. Moisture content
    ii. Ash content
    iii. Fat content
    iv. Protein content
    v. Fiber content
    (Determined by AOCO 2016)

2. **Chemical analysis**

    i. Free fatty acid test (Balogun et al., 2012)
    ii. Starch digestibility test (Gibert et al., 2015)
    iii. Protein digestibility test ()
    iv. Vitamin C (Akinyemi et al.,2015)


SCREENING OF
GREEN PLANTAIN
AND
PEARL MILLET
Peeling and Blanching
Tray drying at 60ºC for 24h
Grinding and sieving
Powder
Proximate analysis (moisture, ash, fat, protein)
Chemical analysis (free-fatty acid, starch digestibility, protein digestibility, vitamin C)
Removal of anti- nutrients
Germination (For 24, 48, 72, 96 hours in dark and seeds will be regularly moistened after12h
Roasting (Sand roasting at 180, 200, 220ºC for 5, 10 and 15 min each
Oven roasting at 170°C for 10, 15, 20, and 25 min.
Microwave roasting at 450, 600, 900 W for 5, 10, 15 min
Evaluation of anti-nutrients by FTIR
Grinding to uniform size
Skim milk powder, Jaggery
Malt powder from pearl millet and plantain green

Detection of anti-nutrients by FTIR

- ✓ Tannin (Ogofure et al.,2016)
- ✓ Saponin (Ogofure et al.,2016)
- ✓ Oxalate
- ✓ Phytate
  (Eromosele et al.,2017)

6.1.2 Objective 2: To prepare supplementary food product

A. Physical analysis

1. Solubility (Obadina et al., 2016)
2. Flowability (Emesu et al. 2013)
3. Wettability (Olawuni et al. 2013)
4. Bulk density (Adebiyi et al.,2016)
5. Dispersibility (Jaya et al. 2004)
6. Foaming properities (Yadav et al.,2012)

B. Chemical analysis:

a) Moisture content (Olawuni et al. 2013)
b) Free fatty acid content (FFA) (Balogun et al. 2012)
c) Hydroxymethylfurfural content (HMF) (Capuano et al. 2009)
d) Thiobarbituric acid value (Ozvural et al. 2011)
e) Starch digestibility (Gibert et al., 2015)
f) Protein digestibility (Nkama et al., 2015)
g) Vitamin C content (Salih et al.,2017)

C. Sensory analysis:

A 9- point hedonic scale will be used to evaluate the experimental samples using 100 semi trained panelists. Healthy male and female of suitable age will be selected for the evaluation.

- Color and appearance
- Flavor and sweetness
- Body and texture
- Mouthfeel
- Overall acceptability

Expression	Points to be assigned
Liked extremely	9
Liked very much	8
Liked moderately	7
Liked slightly	6
Neither liked nor disliked	5
Disliked slightly	4
Disliked moderately	3
Disliked very much	2
Disliked extremely	1

/

Optimized product will be obtained using the above experimental setup.

- ✓ **Mean Sensory score on composite sensory scale for malt powder**

Sample code	Color and appearance	Flavor and sweetness	Body and texture	Mouthfeel	Overall acceptability	Remarks (if any)

6.1.3 Objective 3: To evaluate quality of prepared product

A. Proximate composition

a. Moisture (Olawuni et al. 2013)
b. Protein (Mundi et al. 2012)
c. Fats (Olawuni et al. 2013)
d. Ash (Elezabeth and Subhramnian, 2013)
e. Crude fiber *(*AOAC 2000*)*
f. Dietary fiber (Salih et al.,2017)

B. Bioactive compounds

g. Phytates (Eromosele et al.,2017)
h. Oxalates (Moureau & Savage 2009)
i. Tannins (Ricci et al. 2015)
j. Total phenols (Sakakibara et al. 2003)

6.1.4 Objective 4: To study the shelf life of the developed product.

The developed an optimized, ready to eat product for infant will be packed using different packaging material viz. LDPE, HDPE and Metalized polyester. Further, stored at three different temperature 10, 25 and 37 °C. The packaged products will be stored for 3 months and analysed for following parameters at regular intervals of 7 days.

Physical analysis

1) Solubility (Wani et al.2013)
2) Flowability (Emesu et al. 2013)
3) Wettability (Olawuni et al. 2013)
4) Bulk density (Adebiyi et al.,2016)
5) Dispersibility (Jaya et al. 2004)
6) Foaming properities (Mundi et al. 2012)

Chemical analysis:

a) Moisture content (Olawuni et al. 2013)
b) Free fatty acid content (FFA) (Balogun et al. 2012)
c) Hydroxymethylfurfural content (HMF) (Capuano et al. 2009)
d) Thiobarbituric acid value (Ozvural et al. 2011)
e) Vitamin C content (Baba et al. 2016)

Sensory analysis:

A 9 -point hedonic scale will be used to evaluate the experimental samples using 100 semi trained panelists. Healthy male and female of suitable age will be selected for the evaluation.

- Color and appearance
- Flavor and sweetness
- Body and texture
- Mouthfeel
- Overall acceptability

Expression	Points to be assigned
Liked extremely	9
Liked very much	8
Liked moderately	7
Liked slightly	6
Neither liked nor disliked	5
Disliked slightly	4
Disliked moderately	3
Disliked very much	2
Disliked extremely	1

- ✓ **Mean Sensory score on composite sensory scale for the supplementary food product**

Sample code	Color and appearance	Flavor and sweetness	Body and texture	Mouthfeel	Overall acceptability	Remarks (if any)

7. TIME-LINES

STAGE	JAN-APRIL	MAY-JUNE	JULY- OCT	NOV-FEB	MARCH-JUNE
Approval of topic	→				
Review of literature	→	→	→	→	→
Selection of ingredients	→	→			
Screening of ingredients	→	→	→		
Preparation of products			→	→	
Product analysis			→	→	→
Product approval			→	→	→
Shelf life			→	→	→
Write-up			→	→	→

8: EXPECTED RESEARCH OUTCOME

- Process parameters will be optimized to prepare supplementary food product
- Supplementary food products will be developed with improved nutritional properties
- Supplementary food product will be developed with improved therapeutic value

9: REFERENCES

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