DEVELOPMENT OF TRADITIONAL RECIPES USING BLUE PEA FLOWER POWDER-INCORPORATED EXTRUDED MILLET AND MILK PROTEIN-BASED PRODUCTS AND THEIR SENSORY ACCEPTABILITY

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(Dietetics)

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Family and Community Sciences
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By

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CERTIFICATE

This is to certify that the research work presented in this thesis has been carried out independently by Ms. Riddhi Vichare under the guidance of Dr. Kanchi Baria in pursuit of a Master's degree in Foods and Nutrition (Dietetics) and this is her original work.

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– Albert Schweitzer

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-Riddhi Vichare

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATION

A.O.A.C	*:*	Association of Official Analytical Collaboration
%	*:*	Percent
°C	*:*	Degree Celsius
9-PHS	*:*	9-Point Hedonic Scale
AIB	*:*	American Institute of Baking
BPF	*:*	Blue Pea Flower
BPMMPE	*:*	Blue Pea-Millet-Milk Protein Extruded
CHO	*:*	Carbohydrates
FDA	*:*	Food and Drug Administration
g	*:*	Gram/s
HTST	*:*	High Temperature, Short Time
IFCT	*:*	Indian Food Composition Tables
ISP	*:*	Isolated Soy Protein
Kcal	*:*	Kilo Calories
KJ	*:*	Kilo Joules
LDPE	*:*	low-density polyethylene
min	*:*	Minute/s
Mm	*:*	Millimetres
MOFPI	*:*	Ministry of Food Processing Industries
MP	*:*	Milk Protein
MPC	*:*	Milk Protein Concentrate

MPI	*:*	Milk Protein Isolate
NIFTEM	*:*	National Institute of Food Technology, Entrepreneurship and Management
NIN	*:*	National Institute of Nutrition
PPI	*:*	Pea Protein Isolate
SD	*:*	Standard Deviation
TSE	*:*	Twin Screw Extruder
UK	*:*	United Kingdom
w/w	*:*	Weight by Weight
WPC	*:*	Whey Protein Concentrate
WPC-70	*:*	Whey Protein Concentrate-70
WPC-80	*:*	Whey Protein Concentrate-80
WPH	*:*	Whey Protein Hydrolysate
WPI	*:*	Whey Protein Isolate

ABSTRACT

ABSTRACT

This study was conceived with the overarching aim of enhancing traditional Indian food recipes by enriching them with a nutritionally superior composite flour known as Blue Pea-Millet-Milk Protein Extrudate (BPMMPE). In a time where non-communicable diseases, micronutrient deficiencies, and lifestyle-related disorders are on the rise, the need for developing functional foods that also respect culinary heritage becomes increasingly vital. This research responds to this call by integrating millets, whey protein concentrate (WPC-80), and blue pea flower powder (*Clitoria ternatea*) into familiar Indian recipes, thereby bridging the gap between tradition and innovation. The study unfolded in three sequential phases: development and standardization of BPMMPE-incorporated recipes, sensory evaluation of the enriched dishes, and the creation of a user-friendly recipe booklet. Each phase contributed to the central value proposition of the study: the development of functional, acceptable, and sustainable foods that nourish both body and culture.

In the first phase, 18 traditional recipes were selected from a diverse array of Indian cuisines. These recipes, including Dosa, Idli, Phirni, Thepla, Appam, and Modak, were strategically chosen to represent a range of meal types and preparation techniques such as fermentation, steaming, shallow and deep frying. The substitution of 15% of the original flour with BPMMPE flour in three formulations (0%, 5%, and 10% blue pea flower) aimed to assess both nutritional improvement and culinary compatibility. The extrudate flour was formulated using finger millet (ragi), kodo millet (kodri), whey protein concentrate, and blue pea flower, each known for its rich nutritional and functional profile. Proximate analysis of raw materials confirmed the high protein, energy, and ash content of blue pea flower powder. Finger and kodo millet added value in terms of fiber and micronutrient content, while WPC-80 ensured a substantial protein boost.

The recipes underwent rigorous standardization in laboratory conditions to ensure consistency in taste, texture, yield, and cooking time. Nutritional compositions were calculated using the Indian Food Composition Tables (IFCT, 2017). The results of this phase revealed that most recipes retained their cultural authenticity while gaining in

protein, dietary fiber, and micronutrients like calcium and iron. Additionally, the incorporation of blue pea flower gave a visual enhancement through a unique blue-violet hue, especially in the 5% and 10% formulations. Importantly, the integrity of traditional cooking methods was preserved, confirming that BPMMPE flour can be seamlessly incorporated without disrupting the original preparation formats. This phase established a nutritionally strong and culturally grounded base for the next stage: consumer sensory evaluation.

The second phase focused on the sensory evaluation of BPMMPE-enriched recipes, conducted with 30–35 semi-trained panelists comprising faculty and postgraduate students from the Department of Foods and Nutrition. Panelists evaluated three variants of each recipe (0%, 5%, and 10% blue pea flower) based on the 9-point Hedonic Scale, scoring attributes such as appearance, taste, texture, aroma, and overall acceptability. Consistently, the 5% BPF variant emerged as the most accepted in terms of sensory appeal. Recipes like Idli, Dosa, Phirni, and Mathri received the highest ratings in this formulation, indicating that a moderate level of fortification was ideal for balancing nutrition and taste. Although the 10% BPF formulation offered higher nutritional enrichment, its intensified color and flavor slightly reduced acceptability, especially in recipes where consumers were accustomed to lighter visual and taste profiles. The evaluation was supported by a demographic and awareness questionnaire, which revealed that while most panelists were familiar with millets and whey protein, blue pea flower and the concept of extrusion were relatively novel. Nevertheless, participants responded positively to the innovation and expressed a willingness to include these value-added recipes in their regular diets, especially if health benefits and taste preferences were met. This phase confirmed that consumer acceptability could be maintained and even enhanced with moderate fortification using culturally acceptable food formats.

The third phase focused on the development of a user-friendly recipe booklet designed for nutrition education and practical use. Based on the sensory evaluation results, the top-performing recipes (primarily those incorporating 5% blue pea flower) were curated into a structured and illustrated guide. The booklet aimed to support the integration of functional foods into everyday diets by providing clear, accessible instructions alongside nutritional information per serving. It also included educational content highlighting the benefits of ingredients such as millets, WPC, and blue pea

flower. Each recipe was presented with standardized measurements, preparation time, cooking instructions, and visual appeal to make them feasible for home use. The language and format were kept simple to appeal to a wide audience including homemakers, educators, students, and health professionals.

The recipe booklet stands as a testament to the value-driven focus of the study. It promotes health through nutritional enhancement, supports cultural preservation by retaining traditional recipes, and encourages sustainability through the use of climate-resilient crops like millets and locally available functional ingredients. It also contributes to the growing movement of "back to roots" food philosophies, emphasizing the need to diversify diets with local, seasonal, and minimally processed foods.

The study reflects five overarching values: health promotion, sustainability, culinary heritage, consumer-centric innovation, and educational outreach. Health promotion is achieved through the incorporation of functional ingredients that enrich traditional dishes without alienating taste preferences. Sustainability is addressed through the use of locally sourced, drought-resistant millets and natural plant-based ingredients like blue pea flower. Culinary heritage is preserved by embedding these innovations within well-loved Indian dishes, ensuring that modernization does not override tradition. Consumer-centric innovation is demonstrated through the careful balance of nutrition, sensory appeal, and cultural relevance. Lastly, educational outreach is realized through the creation of the recipe booklet, translating scientific findings into everyday practice.

In conclusion, the study illustrates how traditional Indian recipes can serve as powerful vehicles for nutrition improvement when fortified with functional ingredients like BPMMPE. The findings affirm that such integration does not necessitate a compromise in taste, familiarity, or feasibility. Rather, it opens new pathways for dietary diversity, improved nutrient intake, and enhanced culinary experiences. The optimal level of 5% blue pea flower was identified as the most acceptable and beneficial, offering a harmonious blend of visual appeal, taste, and nutritional value. The systematic approach adopted from recipe development to sensory validation and public dissemination ensures that the research holds relevance across academic, clinical, and community domains. The study serves as a blueprint for future research in functional food development, public health nutrition, and sustainable dietary practices, contributing meaningfully to the larger discourse on food, health, and culture.

INTRODUCTION

CHAPTER 1

INTRODUCTION

Food consumption patterns globally have witnessed significant shifts in recent decades, reflecting changes in lifestyle, urbanization and economic transitions. This dietary transition is notably pronounced in India, characterized by a growing preference for convenience foods, processed snacks and high-calorie diets, often at the expense of traditional nutrient-dense foods. Traditional Indian diets, once rich in diverse cereals and millets, have gradually been replaced by refined staples such as polished rice and wheat flour, leading to compromised nutritional diversity and contributing to escalating rates of non-communicable diseases (NCDs), such as diabetes, obesity, cardiovascular diseases and various metabolic disorders (Patil et al., 2021; Singh et al., 2022).

Despite urban dietary shifts, rural populations still widely consume traditional grains like pearl millet (bajra), finger millet (ragi) and kodo millet (kodri), highlighting regional variations in diet and culture. However, urban consumption of these nutritious grains has drastically declined, driven by changing lifestyles, convenience preferences and reduced awareness about the nutritional benefits of millets. These factors have adversely impacted dietary quality, nutrient diversity and overall health status in urban populations, particularly in metropolitan cities (Ramakrishnan et al., 2019).

Furthermore, busy work schedules, long working hours and irregular dietary habits have resulted in widespread meal skipping among urban residents. Habitual meal skipping often leads to unhealthy snacking and reliance on energy-dense, nutrient-poor foods between meals, exacerbating nutritional deficiencies and associated health issues (Zhou et al., 2021). Therefore, there exists an urgent need to reintroduce traditional, nutritious and sustainable food choices that can adapt to modern urban lifestyles, enhancing both dietary diversity and overall health outcomes.

In response to these dietary challenges, food scientists and nutritionists have increasingly turned to the concept of functional foods—foods that deliver additional health benefits beyond basic nutrition. Functional foods, enriched with bioactive compounds, fibers, proteins and antioxidants, offer considerable potential in preventing

diet-related chronic diseases and improving overall public health (Azima et al., 2017). The utilization of functional ingredients in commonly consumed traditional Indian dishes can effectively combine cultural heritage and nutritional innovation, making such interventions both socially acceptable and nutritionally beneficial.

Significance of Functional Ingredients Blue Pea Flower (Clitoria ternatea)

One notable functional ingredient gaining popularity is the Blue Pea Flower (BPF), scientifically known as *Clitoria ternatea* and locally referred to as "Aparajita." This flower is a powerful source of anthocyanins, potent antioxidants known to neutralize free radicals, reduce oxidative stress and offer protective effects against chronic diseases such as diabetes, cardiovascular diseases and certain cancers (Singh et al., 2022). Additionally, BPF is an excellent source of dietary fiber, contributing positively to digestive health, satiety and weight management. Its striking natural blue pigment enhances the aesthetic appeal of foods, aligning with the contemporary consumer's preference for visually attractive, nutrient-dense and functional food products (Azima et al., 2017; Singh et al., 2022).

Millets as Nutrient Powerhouses

Millets have traditionally formed the nutritional backbone of Indian diets. As climate-resilient crops, they require minimal water and thrive in semi-arid regions, contributing significantly to food security, agricultural sustainability and environmental resilience. Millets such as pearl millet, finger millet and kodo millet possess high dietary fiber content, abundant proteins and essential minerals like calcium, iron, magnesium and potassium. These grains are naturally gluten-free and have a low glycemic index, making them particularly beneficial in the dietary management of diabetes and obesity (Radhai Sri, 2022; Das et al., 2024).

Kodo Millet (Paspalum scrobiculatum)

Kodo millet is traditionally consumed after dehusking and cooking similarly to rice. Its nutritional profile includes approximately 65–72% carbohydrates, 8–9% protein and significant amounts of dietary fiber and minerals. The slow starch digestion and low

glycemic index of kodo millet support controlled blood sugar release, beneficial for diabetic patients and individuals managing weight or metabolic disorders (Geetha et al., 2014).

Finger Millet (*Eleusine coracana*)

Finger millet or ragi stands out due to its exceptionally high mineral content, dietary fiber and unique nutritional properties. It contains significantly more calcium, fiber and iron compared to common cereals such as rice, wheat and maize, making it particularly beneficial for populations with nutritional deficiencies. Its high fiber and phenolic content also enhance antioxidant capacity, supporting health and longevity (Das et al., 2024; Kumar et al., 2016).

Whey Protein Concentrate (WPC)

Protein is an essential nutrient for growth, maintenance and repair of body tissues. Whey Protein Concentrate (WPC), derived from milk, is especially noted for its high-quality amino acid profile and excellent digestibility. It is increasingly incorporated into foods to boost nutritional profiles, enhance muscle mass and improve overall protein intake, particularly valuable in populations with limited access to quality protein sources (Tang et al., 2009; Silva et al., 2011). The inclusion of WPC in extruded products can notably improve their nutritional density, satiety value and consumer appeal, making it ideal for integration into breakfast cereals and snackproducts (Zhou et al., 2021).

Extrusion Technology and its Application

Extrusion technology has emerged as a valuable processing method in modern food manufacturing. It involves forcing raw ingredients through an extruder under high temperature and pressure, transforming them into expanded, crunchy, shelf-stable products. Extrusion enhances digestibility, palatability, nutritional quality and food safety. Furthermore, extruded foods are attractive to modern consumers seeking convenience, variety and enhanced nutrition in their diet (Guy, 2001; Baria et al., 2023).

By combining millets, blue pea flower and whey protein concentrate through extrusion, a novel flour with superior nutritional and sensory characteristics can be developed. This extrudate flour offers numerous opportunities for fortifying traditional Indian recipes, making them nutritionally rich and culturally appealing and responding effectively to modern consumer preferences for convenient yet health-promoting foods.

Considering the nutritional and sensory potential of extruded functional ingredients, this study aims to develop traditional Indian recipes by incorporating extruded flour prepared from kodo millet, finger millet, whey protein concentrate and blue pea flower powder. This combination targets enhancing the nutritional density, protein content, antioxidant capacity and dietary fiber levels of traditional dishes, thus meeting the dietary needs of contemporary Indian consumers.

Expected Outcomes

The expected outcome of this study is the development of nutritionally enhanced, sensory-acceptable traditional recipes. The research aims to demonstrate the feasibility of incorporating extruded functional ingredients into familiar traditional foods, offering consumers nutritious, convenient and appealing meal options. The resulting products can potentially increase consumer acceptance of millets and functional ingredients like whey protein and blue pea flower, ultimately contributing to dietary diversity, improved nutritional status and better overall public health.

This research addresses a significant gap in the Indian food market by combining traditional culinary practices with modern nutritional science and processing technologies. By leveraging extruded millets, whey protein and blue pea flower powder, the study introduces innovative food products capable of meeting contemporary dietary demands, improving nutritional outcomes and sustaining traditional dietary practices. Ultimately, the successful incorporation of these ingredients into everyday diets through sensory-acceptable traditional recipes can significantly enhance nutritional intake and positively impact public health, particularly within urban and nutritionally at-risk populations.

Rationale of the Study

The contemporary dietary shift away from nutrient-dense traditional foods toward convenience-oriented, processed alternatives has resulted in a significant reduction in dietary diversity and nutritional quality, particularly in urban populations. Traditional Indian cereals and millets, historically crucial for their nutritional benefits, are now underutilized due to changing consumer preferences, limited awareness and evolving lifestyles. Concurrently, there is increasing recognition of the health-promoting potential of functional ingredients such as Blue Pea Flower (*Clitoria ternatea*), known for its antioxidant, anti-inflammatory and therapeutic properties, alongside whey protein concentrate (WPC), valued for its superior protein quality and digestibility. Incorporating these functional components with nutrient-rich millets through advanced food processing techniques, such as extrusion, offers an innovative pathway to enhancing nutritional quality, sensory appeal and convenience.

Extrusion technology uniquely addresses these consumer demands by improving the digestibility, shelf-life and sensory attributes of millets and protein sources. However, integrating extruded functional ingredients like millet, WPC and Blue Pea Flower into traditional Indian recipes has yet to be systematically explored. Evaluating the sensory acceptability and nutritional enhancement resulting from these integrations could effectively bridge the gap between traditional dietary practices and modern nutritional needs. Thus, this study aims to scientifically explore and validate the feasibility and consumer acceptability of incorporating Blue Pea Flower powder-enriched extruded millet and milk protein-based flour (BPMMPE flour) into popular traditional Indian recipes.

Broad Objective

The broad objective of this study is to develop and standardize traditional Indian recipes incorporating BPMMPE flour (Blue Pea-Millet-Milk Protein Extrudates) enriched with Blue Pea Flower powder and to evaluate their sensory acceptability.

Specific Objectives

- To standardize the blue pea flowers, millets and milk protein extrudates flour incorporated recipes.
- To carry out sensory evaluation of the blue pea flowers, millets and milk protein extrudates flour incorporated recipes by semi trained members of the Department of Foods and Nutrition.
- To develop a booklet from the acceptable blue pea flowers, millets and milk protein extrudates flour incorporated recipes subjected to sensory evaluation.

REVIEW OF LITERATURE

CHAPTER 2

REVIEW OF LITERATURE

A review of literature serves as a critical and comprehensive examination of existing scholarly work relevant to the research topic, offering a strong foundation for understanding and contextualizing the present study (Gurumani, 2019). In the field of food science and nutrition, where product development, innovation and improvement are key, such reviews help in identifying research gaps, assessing methodologies and synthesizing existing knowledge to guide future studies. The current study titled *"Development of Traditional Recipes Using Blue Pea Flower Powder-Incorporated Extruded Millet and Milk Protein-Based Products and Their Sensory Acceptability"* aims to evaluate the sensory appeal of traditional recipes enhanced with an extruded product made from blue pea flower powder, kodo millet, finger millet and milk protein. The specific objectives include standardizing recipes using these ingredients, conducting sensory evaluations with semi-trained panellists from the Department of Foods and Nutrition and developing a recipe booklet based on the most acceptable formulations. This literature review chapter will explore previous research relevant to blue pea flower, millets, milk proteins, extrusion technology and sensory evaluation methods, setting the stage for informed and meaningful research.

The relevant literature pertaining to this topic has been organized into the following categories:

2.1 Indian Knowledge System (IKS) and Traditional Recipes
2.2 The Forgotten Grains Millets
2.3 Blue Pea Flower (Clitoria ternatea)
2.4 Milk Proteins and Whey Protein Concentrates (WPC)
2.5 Extrusion Technology in Food Product Development
2.6 Functional Ingredient Integration in Traditional Dishes
2.7 Sensory Evaluation and Recipe Documentation
2.8 Traditional Indian recipes

India's traditional food systems, deeply rooted in the Indian Knowledge System (IKS), offer a wide repository of time-tested recipes that align with seasonality, sustainability and wellness. With increasing urbanization, dietary transitions and reliance on processed foods, traditional meals have often been replaced with convenient but less nutritious options. Against this backdrop, the revival of traditional Indian recipes through the integration of novel ingredients and modern food processing technologies such as extrusion offers a pathway to merge nutrition, culture and convenience.

2.1 Indian Knowledge System (IKS) and Traditional Recipes

India, known as "*Bharat*", in Sanskrit, is one of the world's most ancient civilizations with a rich legacy of cultural heritage, biodiversity and culinary traditions. The country embraces immense ethnic and geographical diversity, leading to a mosaic of languages, climates, religions and communities. This diversity is mirrored in India's traditional foods, which are deeply rooted in cultural customs and prepared using methods passed down through generations. Traditional foods are typically home-cooked or made in community settings, reflecting regional identity and ancestral wisdom (Tamang, 2020).

Ethnic foods in India are not merely about taste or tradition; they represent a sophisticated understanding of health and nutrition. Since the Rig Vedic period (1500 BCE to 1000 BCE), ancient Indian texts have referenced the concept of bioactively enriched, balanced diets tailored to well-being. Archaeological findings suggest that even the Harappan civilization practiced methods like baking wheat seeds into chapati, indicating an early understanding of staple food preparation (Achaya, 1994).

India's culinary traditions have evolved through influences from Vedic, Mughal and British cuisines. The result is a diverse and dynamic food system across more than 2,000 ethnic groups (Kulkarni, 2002), each contributing unique food habits and recipes. Agroclimatic variations and the availability of local produce influence dietary patterns—rice and dal form staples in the east and northeast; fermented rice-legume combinations like idli and dosa are integral to South Indian diets; while wheat-based chapatis with dal dominate the north, west and central Indian plates. These core dishes are enriched by a variety of complementary items such as pickles, fermented products, dairy, vegetables and papads, served in a holistic thali system.

Each region boasts distinctive preparations—Punjab is celebrated for its lassi and makki di roti with sarson ka saag; South India for its idli, dosa, vada and sambhar; Gujarat for undhiyo and thepala; and Maharashtra for bhakri, thalipeeth and chakli. Staple ingredients like rice and wheat are commonly used, while millets such as sorghum (jowar), pearl millet (bajra) and finger millet (ragi/nachani) are prevalent in areas where they are locally grown, supporting dietary diversity and sustainable agriculture (Ananthanarayan, et al., 2019).

Collectively, these studies and historical insights reinforce the importance of traditional knowledge, ethnic foods and biodiversity as interconnected pathways toward achieving sustainable food security. They highlight the urgent need for structured efforts to revive and integrate traditional wisdom into modern food systems, thereby promoting nutritional well-being, ecological balance and cultural preservation.

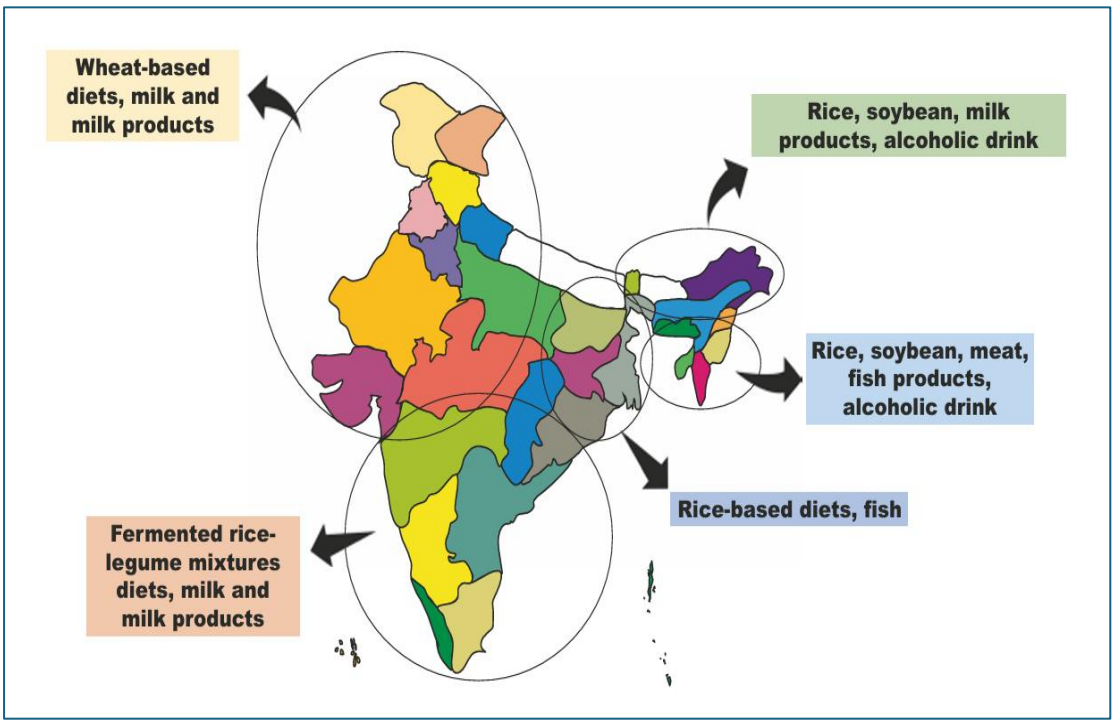

Figure 2.1 Gastronomical map of India showing geographical distribution of food habits

2.2 The Forgotten Grains Millets

Millets, often referred to as "nutri-cereals," are nutrient-dense grains known for their richness in micronutrients and their potential to address malnutrition, particularly in resource-limited settings. The Chand & Thapak (2023) reports that millets contribute up to 60% of the total energy intake in rural Indian diets, underscoring their dietary

importance. Jagati et al. (2021) highlighted that finger millet contains significantly higher levels of calcium and iron compared to commonly consumed staples such as rice and wheat. Further, studies by Hassan et al. (2021) and Patil et al. (2023) emphasized that incorporating millets into traditional recipes enhances dietary diversity and improves nutritional adequacy.

In addition to their nutritional value, millet-based foods have demonstrated functional benefits. Amadou (2022) identified their prebiotic properties, which can contribute to improved gut health. According to Rotela et al. (2021), blending millets with pulses significantly enhances the overall protein quality of the meal. Despite the extensive research on millets, there remains limited exploration into their integration with novel ingredients in processed food forms, presenting opportunities for innovation in food product development.

Millets belong to the grass family Poaceae and are among the earliest crops cultivated by humans (Jagati et al., 2021). Often categorized as minor cereals, they hold major significance as both animal fodder and human food, particularly in regions of the Eastern Hemisphere where traditional agriculture predominates. Their adaptability to grow in nutrient-deficient soils with minimal water or fertilizer input has earned them the moniker “food for the poor.”

These hardy and climate-resilient cereals are well-suited to tropical and subtropical climates and are primarily cultivated under rainfed conditions, making them ideal for dryland agriculture. Due to their low input requirements and high adaptability, millets are central to sustainable agricultural practices and contribute substantially to food and nutrition security.

Historically, millets were first domesticated in Asia and Africa and later disseminated globally as essential food crops for early civilizations. Their short cropping cycle (2–4 months), tolerance to drought and ability to withstand unpredictable environmental conditions make them highly suitable for modern-day agricultural challenges. Generally grown as kharif crops, millets thrive during the monsoon season but can also yield effectively in warmer climates and areas receiving over 450 mm of rainfall.

Traditional cultivation practices continue to be used for millet farming and the crop is typically grown in pest-free conditions. Certain millet varieties, such as foxtail millet, exhibit natural pest resistance and are even used as bio-preservatives in storing pulses

like green gram. The absence of a need for chemical fumigants adds ecological value to millet cultivation. Although millets currently occupy a relatively modest share among staple food crops in Indian agriculture, their role in enhancing regional and farm-level food security is increasingly being recognized (Prasanthi & Sireesha, 2022).

Finger Millet

Taxonomical Classification

Kingdom	: Plantae
Order	: Poales
Family	: Poaceae
Genus	*: Eleusine*
Species	*: E.coracana*
Botanical Name	*: Eleusine coracana (L.) Gaertn*

Common Name:

Finger millet is known by various local names across different countries and cultures. In India, it is referred to as Ragi or Mandua; in Germany, it is called Fingerhirse; and in Nepal, it is known as Kaddo. In France, it goes by names such as Petit mil, Éleusine cultivée, Coracan and Koracan. Across parts of Africa, it is called Kambale, Lupoko, Mawele, Amale and Bule in Zambia; Bulo in Uganda; and Poho, Rapoko, Zviyo, Njera and Mazhovole in Zimbabwe. In England, it is recognized as Finger millet, African millet, or Koracan. In Ethiopia, it is known as Degussa, Tokuso, or Barankiya, while in Kenya, it is referred to as Wimbi or Muhimbi (Gahalawat et al., 2024).

Figure 2.2 Finger Millet- Plant and Seed

Nutritional Profile

Finger millet is recognized for having the highest calcium content among all cereals. It also serves as a good source of iron, the essential amino acid methionine and phosphorus (Maharajan et al., 2022). Its nutritional richness has gained increased attention in recent years, particularly due to its high dietary fiber, favorable starch composition and elevated levels of calcium and iron (Devi et al., 2014).

The proximate composition of finger millet includes crude protein (10.28%), crude fat (0.83%), ash (2.37%), crude fiber (3.10%) and carbohydrates (76.43%). In terms of mineral content, it contains potassium (14.19 mg/g), sodium (6.86 mg/g), calcium (1.13 mg/g), magnesium (6.25 mg/g), copper (0.10 mg/g), manganese (0.32 mg/g), zinc (0.22 mg/g), iron (0.11 mg/g) and trace amounts of lead (0.001 mg/g).

The oil extracted from millets is rich in essential fatty acids such as linoleic, oleic and palmitic acids, along with tocopherols. Additionally, it contains complex lipid compounds in bound form, including monogalactosyl diacylglycerols, digalactosyl diacylglycerols, phosphatidyl serine, phosphatidylethanolamine and phosphatidyl choline. Trace levels of other fatty acids such as arachidic, behenic and erucic acids are also present.

Millets are naturally gluten-free and are considered alkaline-forming grains. They are also a source of B-complex vitamins such as niacin, folacin, riboflavin and thiamine, along with phosphorus—nutrients that play a vital role in energy metabolism and overall physiological function (Bwai et al., 2014).

Kodo Millet

Taxonomical Classification

Kingdom	: Plantae
Order	: Poales
Family	: Poaceae
Genus	*: Paspalum*
Species	*: Paspalum scrobiculatum*
Botanical Name	*: Paspalum scrobiculatum L.*

Common Name:

Kodo millet is known by various names across different regions and languages. In India, it is commonly referred to as Kodo, Kodon, or Varagu (especially in Tamil Nadu). In Hindi-speaking regions, it is called Kodon; in Telugu, it is known as Arikelu; in Kannada, Harka; and in Malayalam, Koovaragu. In Nepal, it is referred to as Kodo dhan, while in Sri Lanka, it is known as Varagu. Internationally, although less commonly cultivated outside South Asia, it may be recognized simply as Kodo millet or cow grass millet in some African and Southeast Asian agricultural references (Gahalawat et al., 2024).

Figure 2.3 Kodo Millet- Plant and Seed

2.3 Blue Pea Flower (Clitoria ternatea)

Taxonomical Classification of Blue Pea Flower

- **Kingdom**: Plantae
- **Order**: Fabales
- **Family**: Fabaceae
- **Genus**: *Clitoria*
- **Species**: *Clitoria ternatea*
- **Botanical Name**: *Clitoria ternatea* L.

Common Names

Blue pea flower is known by a variety of names around the world. In India, it is commonly called Aparajita in Hindi, Shankhpushpi or Gokarna in Sanskrit and Sangu Pushpam in Tamil. In English, it is referred to as Butterfly Pea, Asian Pigeonwings, or simply Blue Pea Flower. In Thailand, it is known as Dok Anchan, where it is widely used for making herbal tea. In Malaysia and Indonesia, it is called Bunga Telang. The flower is popular for its vibrant blue color, which is often used as a natural food colorant and in traditional medicines due to its antioxidant properties.

Figure 2.4 Blue Pea Flower fresh and Dried

The consumption of edible flowers has witnessed a resurgence in recent years, driven by changing dietary preferences and increasing awareness of their safety and nutritional value. Historically used in culinary traditions across cultures, edible flowers are now gaining prominence for their health-enhancing properties and potential as functional food ingredients. They are particularly rich in bioactive compounds such as anthocyanins, flavonoids and antioxidants, contributing to their nutraceutical profile (Gamage et al., 2024).

The blue pea flower, also known as Clitoria ternatea, has been revered for centuries across various Asian cultures for its vivid color, therapeutic properties and culinary versatility. Traditionally cultivated in tropical and subtropical regions, it is widely recognized in Ayurveda, traditional Chinese medicine and Southeast Asian cuisines. The deep blue pigment of the flower due to the presence of anthocyanins, primarily

ternatins has made it a favored natural coloring agent in traditional recipes and beverages (Gamage et al., 2023).

Traditional Uses in Culinary Preparations

Southeast Asia (Thailand, Malaysia, Indonesia)

In Thai cuisine, the flower is famously used to prepare "Nam Dok Anchan", a herbal infusion made by steeping the flowers in hot water, which produces a bright blue tea. When lime or lemon juice is added, the color changes to purple due to its pH sensitivity—a feature celebrated in both culinary art and food science education. In Malaysia and Indonesia, "Nasi Kerabu" is a traditional rice dish colored naturally with blue pea flower extract, lending a vibrant hue and cultural symbolism to festive meals (Maneechot et al., 2023).

Myanmar and Vietnam

The flower is also used in traditional sweet preparations and jellies. In Myanmar, the extract is used to tint glutinous rice for celebratory dishes and in Vietnam, it is incorporated into layered desserts and beverages (Thuy, et al., 2022).

India

In Indian traditional recipes, particularly in South India, the flower is often used during religious rituals and temple offerings. In recent times, it is being reintroduced in the form of herbal teas, infused buttermilk, flavored rice and laddoos, especially in health-conscious households and Ayurvedic kitchens. It is commonly added to rice batters for idlis, dosas, or appams, where its color, subtle earthy flavor and antioxidant properties are appreciated (Singh, et al., 2022).

Extensive data exists on millets in traditional recipes, but little is known about their synergistic potential when combined with milk proteins or bioactive botanicals like blue pea flower in extruded formats.

2.4 Milk Proteins and Whey Protein Concentrates (WPC)

The incorporation of milk proteins, particularly whey protein concentrate (WPC), whey protein isolate (WPI) and milk protein concentrate (MPC), into extruded cereal products has gained considerable attention for enhancing nutritional quality, especially protein content. Whey, a by-product of cheese manufacturing, is rich in essential and

branched-chain amino acids that support muscle synthesis and metabolic health (Shankar & Bansal, 2013; Hayes & Cribb, 2008). Among its forms, WPC retains more bioactive components, while WPI offers ≥90% protein with minimal lactose, making it suitable for lactose-intolerant consumers (Hoffman & Falvo, 2004).

When incorporated into extruded cereals, milk proteins improve not only the protein profile but also functional properties such as texture, expansion and mouthfeel. Hydrolyzed whey proteins, with enhanced digestibility and bioavailability, are particularly valuable in formulations targeting athletes, children and health-conscious consumers. MPCs, combining casein and whey, offer balanced protein delivery and are used to fortify cereals without compromising sensory appeal.

Processing techniques like ultrafiltration and dry blending aid in achieving the desired protein concentration and product stability. Overall, the strategic inclusion of milk proteins in extrusion technology supports the development of high-protein, value-added breakfast cereals with improved health benefits and consumer acceptance.

Extrusion technology, traditionally used for cereals and snack foods, has recently been explored for its potential in processing milk proteins into innovative, high-protein food products. The process modifies the physicochemical properties of proteins such as casein and whey, enhancing their functionality in various applications. Studies suggest that extruded whey proteins improve the nutritional and textural qualities of puffed snacks, while casein-rich materials can form anisotropic, fibrous structures resembling cheese, offering potential in dairy analogues (Lorenzen & Ahrné, 2023). Moreover, co-extrusion with plant-based ingredients can enhance the protein content and affordability of functional foods, aligning with the growing demand for clean-label, protein-rich products. Micro-particulates formed during extrusion may also serve as fat mimetics in low-fat formulations, supporting calorie reduction without compromising mouthfeel. Despite these promising developments, literature on milk protein extrusion remains limited, highlighting the need for further research to unlock the full potential of this technique in creating nutrient-dense, affordable and sustainable dairy-based products. Whey protein is widely incorporated in extruded premixes due to its superior nutritional, functional and processing properties, making it ideal for developing high-protein, value-added products (Liu, et al., 2024 & HewaNadungodage, et al., 2022).

2.5 Extrusion Technology in Food Product Development

Lakshmi Devi et al. (2012) explored the use of extrusion technology to develop millet-based complementary foods using sorghum, rice, legumes and soybeans. A twin-screw extruder was employed to prepare extrudates, which were later powdered and enriched with 15% malted ragi flour. The study evaluated physical properties, including bulk density and expansion ratio and conducted acceptability trials. Formulas with malted ragi exhibited lower viscosity, forming a smooth, easily digestible porridge suitable for infants. The complementary mixes were well accepted by both children and their mothers, highlighting extrusion as an effective method for producing nutrient-rich, low-viscosity weaning foods.

Extrusion technology offers versatility in creating shelf-stable, nutrient-rich, ready-to-eat (RTE) foods. Faliarizao et al. (2017) described extrusion as ideal for integrating functional ingredients without compromising nutrient integrity. Kumar et al. (2016) optimized extrusion parameters for millet-based blends and noted improved texture and nutrient availability. Recent studies (Baria et al., 2023) showcased successful extrusion of maize, soy and millet blends for crispies with good sensory appeal. Patel et al. (2016) explored high-fiber, high-protein extrudates using regional grains. However, traditional recipes remain largely untouched by this innovation. While extrusion is established for cereals and snacks, its application to enhance traditional dishes remains underutilized.

2.6 Functional Ingredient Integration in Traditional Dishes

Functional foods are designed to deliver health benefits beyond basic nutrition, often addressing public health concerns like malnutrition, non-communicable diseases (NCDs) and lifestyle-related disorders (Bigliardi & Galati, 2013). Recent studies emphasize the importance of not only incorporating functional ingredients—such as proteins, dietary fiber, antioxidants and plant bioactives—but also ensuring that these are embedded within culturally familiar formats to enhance consumer acceptance (Poddar, 2024; Sen & Chakraborty (2017).

A major challenge yet remains sensory acceptability. Even nutritionally rich foods may fail if texture, taste and appearance do not align with consumer expectations (Martins et al., 1997). Functional ingredients such as whey protein, milled flaxseed, or blue pea flower, while offering excellent nutritional profiles, can alter the mouthfeel, color, or aroma of the product. Hence, achieving a synergistic balance between health benefits and sensory quality is crucial.

Despite the rising demand, few studies have explored the multi-ingredient integration (such as combinations of protein, fiber and botanicals) within traditional food matrices in a way that assesses both functional properties and sensory acceptability. Most available literature either focuses solely on nutritional enhancements or on culinary appeal, rarely bridging both.

Emerging research supports the need for cross-disciplinary approaches—involving food scientists, nutritionists and culinary experts—to develop value-added traditional products that are both functionally beneficial and organoleptically pleasing (Gokhale et al., 2021). This integrated approach could redefine public health nutrition through localized, culturally acceptable functional food innovations.

Table 2.1 Departmental Studies on Recipe Development

Author	Study	Results
Mehta and Shah, 2010	Supplementation of Ragi laddu combined with shankhpushpi was given for four weeks to elderly individuals living in institutional settings.	Increased hemoglobin and calcium levels, improved HDL cholesterol, and reduced LDL cholesterol and TC/HDL ratio. Joint pain and lethargy decreased, while appetite, cognitive performance, and memory retention improved.
Nambiar and Sareen, 2012	Assessment of pearl millet-based foods processed using methods such as roasting, soaking, and milling to evaluate iron bioavailability.	Significant improvement in the bioavailability of iron from pearl millet after processing.
Iyer and Dhruv et al., 2012	Kodo millet-based recipes were supplemented to 30 subjects with Type 2 diabetes mellitus for a duration of 28 days.	Recipes showed high acceptability. Participants experienced stable glycemic status (normal FBS and HbA1c), reduction in microalbuminuria (from 37.5% to 21.4%), improved Apo A levels,

		decreased Apo A/B ratio, and normalization of lipid profile (TC, TG, LDL, VLDL).
Nambiar and Patwardhan, 2013	Study on millet consumption patterns among patients with non-communicable diseases (NCDs) in Pune, along with glycemic index evaluation of traditional Maharashtrian millet recipes.	Millet consumption was reported by 85% of males and 88% of females but with low daily frequency (<16%). Bajra Vada was most frequently consumed. Bajra Cheela exhibited the lowest GI, whereas Bajra Bhakri had the highest GI.
Nambiar et al., 2015	Exploration of the potential health benefits and functional properties of pearl millet in preventing chronic degenerative diseases.	Pearl millet polyphenols showed protective effects against chronic degenerative diseases.
Gandhi and Parmar, 2017	Survey conducted to understand the importance and consumption patterns of millets in the Panchmahal district.	Awareness primarily limited to Bajri and Kodri. Awareness levels varied: 15% urban, 31% rural, and 27% tribal respondents recognized millet health benefits.
Dhruv and Thite, 2021	Development and sensory evaluation of recipes incorporating foxtail millet.	All developed recipes received good sensory acceptance. Among them, Sev, Chakri, and Idada were especially favored.
Dhruv and Sharma, 2022	Sensory evaluation and product development of recipes containing little millet.	Recipes were widely acceptable, with Bisi Bele Bhaat showing the highest acceptance.
Dhruv and Sharma, 2022	Sensory evaluation and formulation of recipes using Brown Top millet.	All recipes had good sensory acceptability, with Veg Khichdi rated the highest.

2.7 Sensory Evaluation and Recipe Documentation

Sensory evaluation plays a crucial role in food product development, offering a structured means of assessing consumer preferences and product acceptability. It becomes even more critical when traditional foods are modified by incorporating novel or functional ingredients such as plant-based proteins, fiber, or bioactive-rich extracts. These ingredients, while beneficial nutritionally, may affect flavor, texture, color and overall sensory appeal, thus requiring rigorous testing (Lawless & Heymann, 2010).

Standard methodologies such as hedonic tests (for liking) and discriminative tests (for detecting differences) are recommended for evaluating ready-to-eat (RTE) and functional foods, especially when the end-user is the general consumer. Studies show that semi-trained panels and consumer testing are highly effective in capturing meaningful feedback to refine formulations (Stone et al., 2020; Meilgaard et al., 2016). However, in many research projects involving ethnic or traditional recipes enhanced with functional ingredients, systematic sensory evaluation remains underutilized. Often, acceptability is inferred without a comprehensive sensory protocol, leading to limited product refinement and scalability.

Furthermore, documentation and dissemination of these product formulations—especially those proven acceptable through empirical sensory results—are rarely prioritized. Developing recipe booklets, sensory-based scorecards and consumer-friendly guidelines can bridge the gap between research and practice. These tools can facilitate technology transfer to small-scale producers, community kitchens and startups, while also promoting consumer education on healthier alternatives rooted in traditional practices (Ghosh et al., 2012; Ananthanarayan et al., 2019).

Such efforts also align with the goals of public health nutrition and sustainable food systems, where culturally relevant and nutritionally superior foods are made accessible and appealing to the larger population. Encouraging systematic sensory studies along with proper documentation enhances product reproducibility, supports policymaking for school and community feeding programs and builds consumer trust in functional versions of traditional foods.

2.8 Traditional Indian recipes

Dosa, a traditional South Indian fermented food, is rich in carbohydrates, proteins, B-vitamins and bioavailable minerals. Prepared from rice and black gram, its fermentation enhances nutritional value by increasing amino acids, antioxidants and reducing antinutrients. It is gluten-free, suitable for those with wheat allergies and has a low glycemic index. Dosa also offers therapeutic benefits, supporting digestion, fertility and lactation, making it a nutritious and culturally significant functional food (Palanisamy et al. 2012, Blandino et al. 2003; Gupta and Tiwari 2014).

Idli, a traditional cereal–pulse-based fermented breakfast food, is widely consumed in South India and has gained global popularity. Market studies show high daily consumption rates in cities like Chennai and Bangalore (Koh & Singh, 2009). Several studies have explored ingredient substitution and fermentation enhancement to improve the nutritional and sensory quality of idli. Sathe and Mandal (2016) demonstrated that incorporating soybeans and mung beans increases protein, amylase and B-vitamin content, while maintaining consumer acceptability. Iyer and Ananthanarayan (2008) successfully reduced fermentation time using exogenous amylase enzymes. Substituting rice with sorghum or millets improved protein, fiber and mineral content (Nazni & Shalini, 2010; Chelliah et al., 2017). Additionally, XOS incorporation promoted LAB growth and improved texture (Aachary et al., 2011). Use of curry leaf powder enhanced both shelf life and dietary fiber (Chelliah et al., 2016). These studies highlight the growing focus on value addition, fermentation efficiency and health benefits in idli innovation.

Appam, a traditional South Indian fermented dish, is made using rice, coconut milk and a fermenting agent like toddy or yeast. It is light, easily digestible and nutritionally balanced, offering carbohydrates, dietary fiber, protein and essential micronutrients like calcium, iron, folate and B-vitamins. With its soft texture and mild flavor, appam serves as a wholesome meal option, particularly valued for its cultural relevance and health-promoting properties (Roy et al., 2007; Ray & Swain, 2013).

Dhokla, a traditional fermented food from Gujarat, is made from Bengal gram and rice. It is versatile in consumption—served as breakfast, snack, or side dish. Fermentation enhances its nutritional value by increasing B-vitamins, tocopherols and folic acid. It also develops antioxidant properties beneficial in managing oxidative stress and age-

related diseases. With its low glycemic profile, dhokla is considered suitable for diabetic individuals (Joshi et al., 1989; Moktan et al., 2011).

Khakhra, a traditional roasted snack from Gujarat, is made using whole wheat or millet flours, offering high dietary fiber, low fat and good satiety (Ananthanarayan et al., 2019). It is often seasoned with methi or jeera, enhancing its micronutrient content and aiding digestion. Due to its low moisture content, khakhra has an extended shelf life, making it suitable for travel and urban snacking. When prepared with millets, it contributes to diabetic-friendly and heart-healthy diets (Passi, ICMR-NIN, 2024). Bhakhri, a thick flatbread consumed widely in Gujarat and Maharashtra, is made from whole wheat or millet flours like jowar and bajra. It is rich in iron, magnesium and fiber, supporting digestive and cardiovascular health (Ankita & Seth 2025)). Bhakhri's sturdy texture and simplicity make it ideal for community and elderly diets.

Mathri is a popular traditional North Indian snack typically made from refined or whole wheat flour and deep-fried, contributing to high fat intake (Shirhatti et al., 2023). Modified versions using baking techniques and pulse flours improve its nutritional profile. Incorporating fenugreek, flaxseeds, or sesame adds fiber and essential fatty acids, transforming it into a functional snack suitable for occasional consumption within a balanced diet (Verma & Sagar, 2018).

Kutki (Little millet) soup is a nutrient-rich, gluten-free functional dish, ideal for individuals with metabolic disorders. Kutki is rich in dietary fiber, iron, magnesium and antioxidants and has a low glycemic index, making it suitable for diabetic and elderly diets (Saleh et al., 2013). The addition of vegetables and mild spices further enhances its therapeutic potential. Kutki soup is easy to digest, supports gut health and is increasingly recommended in sustainable millet-based diets (Dayakar Rao et al., 2017).

Sattu, made by roasting and grinding Bengal gram or barley, is a traditional high-protein flour widely consumed in Bihar, Jharkhand and Uttar Pradesh. It provides protein, calcium, iron and dietary fiber and is known for its cooling and hydrating properties, especially in summer (Passi, ICMR-NIN, 2024). Consumed as a drink or used in stuffed flatbreads, sattu is gaining popularity for its functional and satiety-inducing benefits, particularly among laborers, rural populations and health-focused urban consumers (Sharma et al., 2015).

Chila is a protein-rich, pulse-based pancake, made using gram flour or lentil flours, often combined with chopped vegetables. It is a quick-to-make, low-fat meal ideal for breakfast or dinner. Chila is gluten-free, fiber-rich and supports blood sugar regulation, especially in its millet- or moong dal-based versions (Platel, 2020). When paired with chutney or curd, it makes a complete, balanced meal, suitable for both urban and rural households aiming for healthy eating without compromising tradition.

Tikki, a popular North Indian snack, is traditionally made from boiled potatoes, spices and sometimes lentils or vegetables. It is shallow or deep-fried, offering a crispy texture and savory taste. Though rich in carbohydrates and fats, its nutritional value can be enhanced using sweet potatoes, oats, or millet flours, adding fiber and micronutrients (Verma & Sagar, 2018). Baked or air-fried versions significantly reduce oil content, making tikkis a healthier street food alternative suitable for children, diabetics and weight-conscious individuals (Gokhale et al, 2021).

Halwa, a traditional Indian dessert, is commonly made using semolina, lentils, or vegetables like carrot. While often high in sugar and ghee, it can be transformed into a nutrient-rich sweet by using jaggery, nuts and minimal fat (Kumar et al., 2016). Variants such as moong dal or gajar halwa offer vitamin A, protein and antioxidants, making them beneficial in moderation, especially for maternal nutrition and recovery diets (Passi, ICMR-NIN, 2024). Halwa thus serves as both a festive and functional food.

Upma is a traditional South Indian breakfast dish primarily prepared using semolina (95%) and black gram dal (5%), often seasoned with spices and vegetables. It is a high-moisture, low-fat and moderate-protein food, offering a good balance of macronutrients. As per Dhumketi, Singh and Agrawal (2018), its nutritional profile includes 40.21% moisture, 6.30% total fat, 11.82% protein, 2.05% ash and 38.44% carbohydrates, making it a light, easily digestible meal ideal for all age groups, particularly when enriched with vegetables and pulses.

Phirni is a traditional North Indian milk-based dessert made from ground rice, sugar and milk, often flavored with cardamom, saffron and dry fruits. It is typically served chilled in earthen pots, enhancing its sensory appeal. Rich in calcium, protein and simple carbohydrates, phirni offers quick energy and satiety (Gokhale et al, 2021). While traditionally energy-dense, substituting sugar with jaggery or stevia and using

low-fat milk can make it more diabetic-friendly, aligning with modern functional dessert trends (Gokhale et al, 2021).

Modak is a traditional sweet dumpling associated with Maharashtrian and South Indian festivals, especially Ganesh Chaturthi. Typically made with rice flour (outer shell) and jaggery-coconut filling, modak is steamed or fried. It is naturally gluten-free and provides iron, healthy fats and dietary fiber, especially when steamed (ukdiche modak). The use of jaggery enhances antioxidant and mineral content, while coconut contributes medium-chain fatty acids and immunity-supportive properties. Modak is increasingly being adapted with millets, nuts, or dry fruits for better nutritional balance (Maheshwari, 2023).

In today's fast-paced lifestyle, there is an increasing demand for convenient, nutritious and shelf-stable food options that do not compromise on health or cultural relevance. Value-added premixes made from millets and milk proteins present a promising solution, especially when developed through extrusion technology. These premixes not only retain the nutritional richness of traditional Indian staples like bajra, ragi and jowar but also offer improved digestibility, extended shelf life and ease of preparation. Their versatility allows them to be incorporated into a variety of traditional Indian recipes such as upma, thalipeeth, dosa, or laddoos—without requiring extensive preparation time. By offering a modern format for age-old food wisdom, such extruded premixes bridge the gap between traditional dietary patterns and contemporary food practices, supporting health, sustainability and cultural continuity in Indian households.

MATERIALS AND METHODS

CHAPTER 3

MATERIALS AND METHODS

"Methodology is the philosophical framework within which the research is conducted or the foundation upon which the research is based."

(Brown, 2006)

This chapter outlines the structured methodology adopted for the development and sensory evaluation of traditional recipes incorporating blue pea flower powder-enriched extruded millet and milk protein-based products. The materials and methods were meticulously chosen to align with the research objectives and ensure reliability, clarity and reproducibility. The study involved standardization of extruded flour made from blue pea flowers, finger millet, kodo millet and milk protein, which was then substituted into selected traditional recipes. These recipes were subjected to sensory evaluation by semi-trained panellists from the Department of Foods and Nutrition. The methodology also includes the selection of ingredients, product development techniques and recipe formulation procedures. Sensory analysis was conducted using structured scorecards to assess acceptability. The methodological framework further supports the compilation of an informative recipe booklet based on acceptable formulations. This systematic approach enhances the scientific rigor and replicability of the study while ensuring the credibility of the findings.

The study was conducted in the following three phases:

PHASE I Standardization and development of blue pea flower powder, millets and milk protein extrudates flour incorporated recipes.

PHASE II Sensory Evaluation of the blue pea flower powder, millets and milk protein extrudates flour incorporated recipes.

PHASE III Development of a blue pea flower powder, millets and milk protein extrudates flour incorporated recipes booklet.

Study Locale

The extrusion process was conducted at SMC College of Dairy Science, Kamdhenu University, Anand. The proximate analysis of the raw ingredients utilized in the preparation of extrudates was carried out at the National Institute of Food Technology, Entrepreneurship and Management (NIFTEM), an autonomous institute under the Ministry of Food Processing Industries (MOFPI), Government of India, located in Kundli, Sonipat, Haryana. Standardization of recipes, product development and sensory evaluation were undertaken at the Department of Foods and Nutrition, Faculty of Family and Community Sciences, The Maharaja Sayajirao University of Baroda, Vadodara.

Statutory Clearance of the Study

The research study received ethical approval from the Institutional Medical Ethics Committee of the Department of Foods and Nutrition, The Maharaja Sayajirao University of Baroda. Clearance was granted under Ethical Clearance Number: IECHR/FCSc/M.Sc./10/2024/45 (Annexure I).

The different phases of the study, along with the study design and the tools and techniques used are discussed below in the following sections.

3.1 Standardization and Development of Recipes

3.1.1 Selection of Traditional Recipes

3.1.2 Selection and Procurement of Ingredients for Traditional Recipes

3.1.3 Standardization of Traditional Recipes

3.1.4 Selection of Ingredients for preparation of BPMMPE

3.1.5 Proximate Analysis of Raw Materials

3.1.6 Preparation of Extrusion Process

3.1.7 Standardization and Development of BPMMPE Flour (0% BPF, 5% BPF and 10% BPF) Incorporated Traditional Recipes

3.2 Sensory Evaluation of BPMMPE Flour (0% BPF, 5% BPF and 10% BPF) Incorporated Traditional Recipes

3.2.1 Selection of Panellists'

3.2.2 Data Recording and Analysis

3.3 Development of Recipe Booklet

3.1 Standardization and Development of Recipes

In the present study, eighteen traditional Indian recipes were thoughtfully selected and standardized for individual serving portions. Each recipe was reformulated to incorporate 15% of Blue Pea-Millet-Milk Protein Extruded (BPMMPE) flour. The chosen recipes encompassed a range of meal categories, including breakfast items, snacks, beverages and desserts and involved diverse cooking methods such as pan-roasting, steaming, shallow frying, boiling, simmering, fermentation and deep frying.

3.1.1 Selection of Traditional Recipes

The selection of the 18 traditional recipes was based on four primary criteria: cultural significance, variety in culinary techniques, suitability across different meal occasions and widespread consumer acceptability. These recipes were chosen for their strong cultural roots, frequent household use and familiarity among the target population. The objective was to uphold traditional food heritage while enhancing nutritional value through the incorporation of BPMME flour.

3.1.2 Selection and Procurement of Ingredients for Traditional Recipes

For the selection and procurement of ingredients, 18 traditional Indian recipes were chosen based on standardized recipes available in literature, as detailed in Table 3.1. The selection considered cultural significance, culinary diversity and suitability for various meal occasions. Ingredients were locally procured, ensuring acceptability and inclusion of varied cooking methods like fermentation, steaming, roasting and frying.

Table 3.1: Traditional Indian Recipes with Ingredients, Sensory Traits, Region and References

Sr. No.	Recipe Name	Agro-produce and ingredient	Description of Sensory character	State/region	Literature Reviewed
1.	**Dosa**	Rice and black gram	Thin, crisp pancake; shallow fried; staple	Tami Nadu, Kerala, Karnataka, Andhra Pradesh, Telangana	Regubalan and Ananthanarayan, 2019
2.	**Idli**	Rice and black gram	Mild acidic, soft, moist, spongy; breakfast	Tamil Nadu, Kerala, Karnataka, Andhra Pradesh, Telangana, Pondicherry	Regubalan and Ananthanarayan, 2019
3.	**Idada**	Rice and black gram	Soft, savory steamed cake; similar to white dhokla	Gujarat	Joshi, et al., 1989
4.	**Dhokla**	Bengal gram and rice	Mild acidic, slightly salty-sour taste, spongy; snack	Gujarat	Joshi, et al., 1989
5.	**Pudla/ Chilla**	Semolina (sooji)	Savory, thin pancake; soft texture; sautéed	Gujarat	Joshi, et al., 1989

6.	**Upma**	Semolina (sooji)	Soft, moist, mildly spiced; breakfast dish	Gujarat, Rajasthan	Balasubramanian, et al., 2014
7.	**Bhakri**	whole wheat flour	Thick, unleavened, slightly coarse texture; staple flatbread	Maharashtra, Gujarat, Rajasthan	Gajmal, et al., 2021
8.	**Thepla**	Whole wheat flour and fenugreek leaves	Thin, soft, spiced flatbread; incorporates leafy vegetables	Gujarat	Gajmal, et al., 2021
9.	**Khakhra**	whole wheat flour	Thin, crispy cracker; roasted; often flavored with spices	Gujarat	Giridhar, 2019
10.	**Mathri**	Wheat flour	Crisp, flaky biscuit; savory; deep-fried	Rajasthan, Uttar Pradesh	Kavya, et al., 2023
11.	**Appam/ Appe**	Rice and coconut milk	Soft, spongy center with crisp edges; slightly sweet; fermented pancake	Kerala, Tamil Nadu	Pal, et al., 2005

12.	**Veg cutlet**	Mixed vegetables (potato, carrot, peas)	Crisp exterior, soft interior; spiced vegetable patty; deep-fried	Pan-India	Mirajkar & Patil, 2023
13.	**Sattu Sherbet**	Roasted gram flour (sattu)	Nutty flavor; used in beverages; cooling effect	Bihar, Uttar Pradesh	Shakeb, et al., 2022
14.	Little Millet (**Kutki**) **Soup**	Little Millet (Kutki), Various vegetables and/or legumes	Warm, savory, smooth texture with mild millet aroma; light and nutritious	Karnataka, Tamil Nadu	Bisht 2022
15.	**Ambil**	Fermented millet (e.g., finger millet)	Thin porridge; slightly sour; consumed as a cooling drink	Maharashtra	Hirdyani, H. (2015)
16.	**Phirni**	Rice and milk	Creamy, smooth pudding; flavored with cardamom; served chilled	Punjab, Jammu, Kashmir	Bhat, et al., 2012
17.	**Halwa**	Semolina (sooji), ghee, sugar	Soft, moist, sweet pudding; rich	Pan India	Itagi, et al., 2013

			flavor; garnished with nuts		
18.	**Modak**	Rice flour, coconut, jaggery	Sweet dumpling; soft outer shell with moist, sweet coconut filling; steamed	Maharashtra	Saxena & Tiwari, 2024

3.1.3 Standardization of Traditional Recipes

The standardization of these traditional Indian recipes was carried out through a systematic process involving ingredient consistency, cooking methods and sensory validation. Each recipe was documented with its core components, typical cooking times and traditional preparation techniques, ensuring authenticity. Regional variations were considered while maintaining nutritional integrity and culinary identity on the basis of the literatures mentioned in the Table 3.2.

Table 3.2: Standardization Techniques of the Traditional Indian Recipes

Recipe Name	Major Ingredients	Major Steps in Preparation	Common Accompaniments
Dosa	Batter: Rice, skinless black urad daal; salt, oil	Batter preparation [soaking rice and urad daal (3:1), grinding, fermentation]; Dosa preparation (cooking batter as thin pancakes on dosa tava, folding it in half or rolled, shallow frying till crisp golden brown)	Sambhar, coconut chutney

Idli	Rice, skinless black urad daal, salt	Soaking rice and urad daal (3:1), grinding, fermentation, pouring into greased idli moulds, steaming for 12–15 minutes until soft and spongy	Coconut chutney, sambhar
Idada	Rice, urad dal, green chili, ginger paste, coriander, black pepper (ground) salt, mustard and sesame seeds oil	Soak rice and dal, grind to thick batter, ferment overnight. Add ginger-chili paste, salt. Pour into greased tray, steam 12–15 minutes, temper with mustard seeds and sesame seeds and oil, garnish with black pepper (ground)	Coriander chutney
Dhokla	Chana dal and Udad dal, curd, turmeric, mustard seeds, curry leaves, green chilies, salt, oil	Make a thick batter with lentils, curd, turmeric, salt; ferment 4–6 hours; pour into greased tray and steam; temper with mustard seeds, curry leaves, green chilies in oil	Green chutney
Pudla/Chilla	Wheat flour, besan, rice flour and bajra flour chopped vegetables (bottle gourd), chili, salt, oil	Make a medium-thick batter, pour on hot tawa, spread, cook both sides with little oil till golden brown	Chutney/ Pickle
Upma	Semolina (rava), mustard seeds,	Roast rava. In a pan, heat oil, add	Curd/ Raita

	curry leaves, onion, green chili, ginger, ground nut, udad and chana dal, salt, oil	mustard seeds, curry leaves, chili, ginger, onion. Add water, boil, stir in rava slowly. Cook until fluffy	
Bhakri	Coarse wheat flour, water, salt, oil/ghee	Knead flour to a stiff dough, roll thick discs, cook on tawa both sides, press to puff if needed	Jaggery, ghee, chutney
Thepla	Wheat flour, methi leaves, curd, turmeric, chili powder, ajwain, sesame seeds, jaggery, salt, oil	Make a soft dough with all ingredients, roll thin discs, cook on tawa with oil both sides till golden	Curd, pickle
Khakhra	Wheat flour, turmeric, chili powder, ajwain, sesame seeds, fenugreek leaves, salt, oil	Knead dough, roll thin, roast slowly on tawa pressing until crisp	Chutney, tea
Mathri	Whole wheat, semolina, besan, ajwain, onion seeds, ghee, salt	Make stiff dough, roll into discs, prick, deep fry on medium heat until golden	Pickle, tea
Appam	Rice, udad dal, salt, onion, green chilli-ginger paste, salt, oil	Soak and grind rice & dal, ferment overnight. Pour into greased appe pan, cook both sides till golden	Coconut chutney
Veg Cutlet	Boiled potato, mixed vegetables, poha, corriander, garam masala, chili, salt, oil	Mash boiled veggies, mix with spices and poha. Shape, coat with rava or crumbs, shallow-fry till golden	Chutney

Sattu Drink	Sattu flour, lemon juice, black salt, cumin, chopped coriander, mint	Mix all ingredients with cold water, stir well	As a sole beverage
Kutki Soup	Kutki, onion, carrot, peas, tender corn kernels, garlic, pepper, salt, oil	Boil vegetables, blend, simmer with spices and butter	Khakhra
Ambil	Buttermilk, ragi flour, chopped green chilli-ginger, coriander leaves	Mix flour with buttermilk, boil with spices, simmer until slightly thick	Nouring dring any time as sole beverage
Phirni	Rice, milk, sugar, cardamom, saffron, nuts	Coarsely grind soaked rice, cook in milk with sugar and flavorings till thick, chill	Sweets/dessert
Halwa	Semolina or flour, ghee, sugar, cardamom, nuts	Roast in ghee, add hot water and sugar, cook till thick and glossy	Sweets/dessert
Modak	Rice flour, coconut, jaggery, cardamom, milk, ghee	Make filling of coconut-jaggery, prepare soft rice flour dough, stuff and shape modaks, steam until glossy	Sweets/dessert

3.1.4 Selection of Ingredients for preparation of BPMMPE

A preliminary market survey was conducted to procure high-quality raw materials, including millets, lyophilized Blue Pea Flower (BPF) and whey protein concentrate (WPC). Consequently, superior varieties of Ragi (*Eleusine coracana*) and Kodri (*Paspalum scrobiculatum*) were sourced from the Miltop brand, sourced from online market. WPC-80 was acquired online from NAKPRO Nutrition, Bengaluru, while the Blue Pea Flower (*Clitoria ternatea*) was purchased under the brand name ‘Online of Quality Store’ (Butterfly Pea Flower Herbal Tea), India. Previous studies have emphasized that millet-based extruded products are nutrient-rich and high in fibers,

making them ideal for using it as a raw ingredient for the development of protein-energy bars owing to diversity of ingredients in one product (Baria et al., 2023).

3.1.5 Proximate Analysis of Raw Materials

All selected raw ingredients were subjected to proximate analysis to evaluate their nutritional composition. The proximate analysis of Ragi, Kodri and Blue Pea Flower was carried out using standard protocols prescribed by the Association of Official Analytical Chemists (AOAC), as detailed in Table 3.3.

Table 3.3 Chemical Quality Analysis of Raw Materials

Sr. No.	Parameters Analyzed	Method of Analysis
1.	Moisture	AOAC, 21st Edn, 2019 (George & Latimer, 2019), (Gupta & Sridevi, 2022)
2.	Protein	AOAC, 21st Edn, 2019, (George & Latimer, 2019), (Gupta & Sridevi, 2022)
3.	Ash	AOAC, 21st Edn, 2019, 923.03; Cha 32.1.05; Vol II; Pg: 2, (George & Latimer, 2019), (Gupta & Sridevi, 2022)
4.	Crude Fat	AOAC, 21st Edn, 2019, (George & Latimer, 2019), (Gupta & Sridevi, 2022)
5.	Carbohydrate	By difference method. (Menezes et al., 2004)
6.	Energy	Food Labeling – Requirements for FDA Regulated products, by James L. Vetter, E. M. Melran, Ed., AIB International. Manhattan, K.S, 2007 (Vetter & Meloan, (2007)

3.1.6 Preparation of Extrusion Process

The levels of Blue Pea Flower (BPF) incorporation and extrusion temperatures selected for this study were guided by the findings of Singh et al. (2022). In their research, BPF was blended with Yellow Pea (YP) at 0%, 5% and 10% (w/w) concentrations and extruded at two temperature levels, 30°C and 150°C. Their results demonstrated that higher extrusion temperatures led to extrudates with greater expansion, lower dry hardness and improved crispiness. Additionally, BPF inclusion significantly intensified the blue color and resulted in a darker appearance compared to extrudates without BPF.

Feed Mixture Preparation Protocol:

Millet flour, milk protein powder and milled BPF were combined at varying BPF levels of 0%, 5% and 10% (w/w), then moistened with water amounting to 10% of the total flour weight. The raw materials used for BPMMPE development are illustrated in Figure 3.1. The conditioned flour blends (Figure 3.1) were subjected to a double sieving process to remove any coarse particles or foreign matter that could obstruct the extrusion process, thereby promoting uninterrupted operation. The resulting flour blend was then packed in low-density polyethylene (LDPE) pouches and allowed to equilibrate at room temperature for two hours. Table 3.4 presents the formulation of BPMMPE developed via extrusion.

Table 3.4 Formulation of BPMMPE

Sr. No.	Ragi (*Eleusine coracana*)	Kodri (*Paspalum scrobiculatum*)	WPC-80*	Blue Pea Flower (*Clitoria ternatea*) *	Salt*	Vanila Extract*
1.	70 %	30 %	10 %	0 %	1 %	0.4 %
2.	70 %	30 %	10 %	5 %	1 %	0.4 %
3.	70 %	30 %	10 %	10 %	1 %	0.4 %

*** On flour basis**

The twin-screw extruder (TSE) utilized for the development of BPMMPE was a co-rotating laboratory model (BTPL, EB-10, manufactured in Kolkata, India), featuring three primary zones: the feeding zone, heating zone and die zone. The extruder barrel measured approximately three feet in length with a diameter of 40 mm and was equipped with a smooth barrel configuration, precise temperature control system, variable-speed motor and an integrated cutter for shaping the product. The extrusion process of BPMMPE and the extruder setup are depicted in Figures 3.3, 3.4 and 3.5, respectively. The final extruded product is shown in Figure 3.6, while the complete flow diagram for feed preparation and extrusion is illustrated in Figure 3.7.

Post-extrusion, the BPMMPE were subjected to air drying in a hot air oven at 100°C for 30 minutes to reduce residual moisture content. The detailed operational parameters followed during the extrusion process are documented in Annexure II and the proximate composition of the developed extrudates is summarized in Table 4.2.1 in the following chapter.

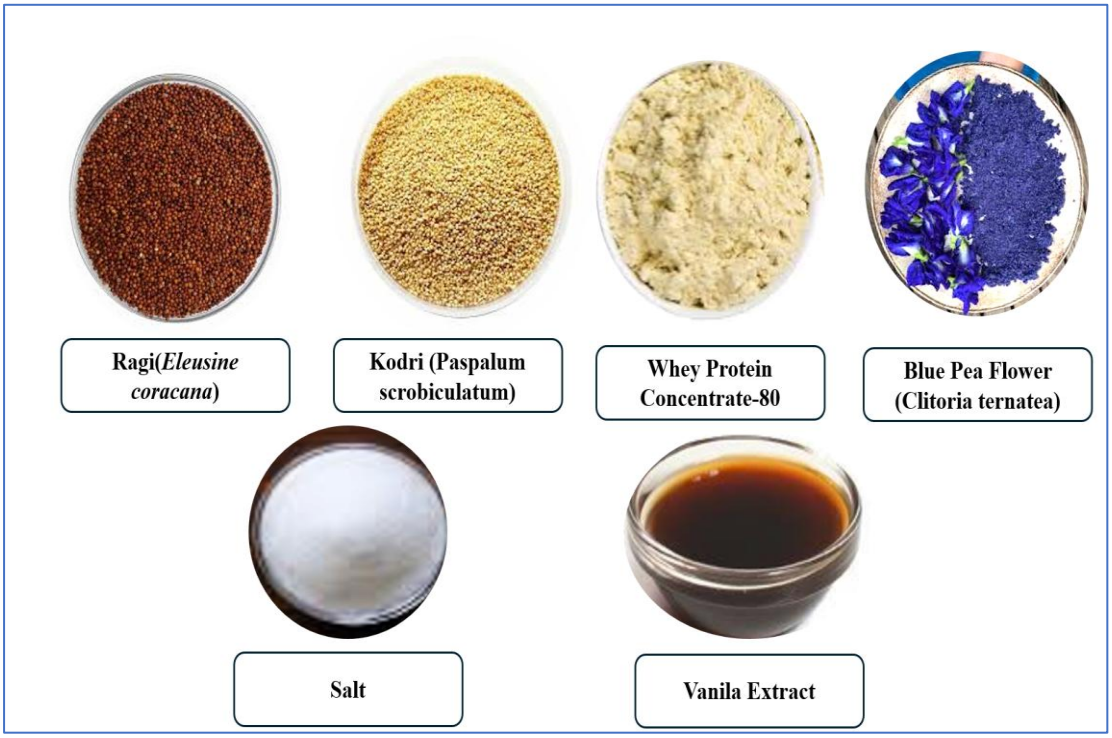

Figure 3.1 Raw Materials for the preparation of BPMMPE

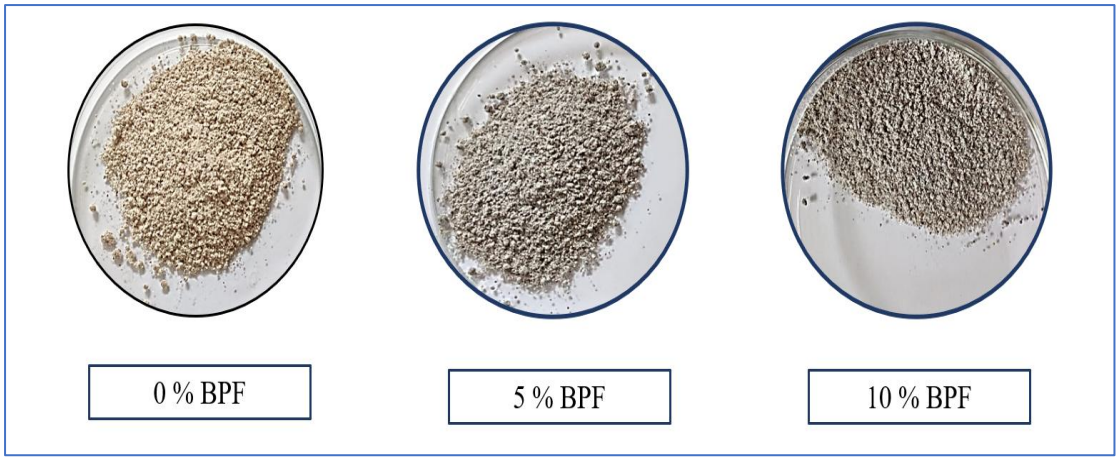

Figure 3.2 Conditioned Feed Materials for the preparation of BPMMPE

Figure 3.3 Preparation of Feed Material for Extrusion of BPMMPE

Figure 3.4 Extrusion of BPMMPE

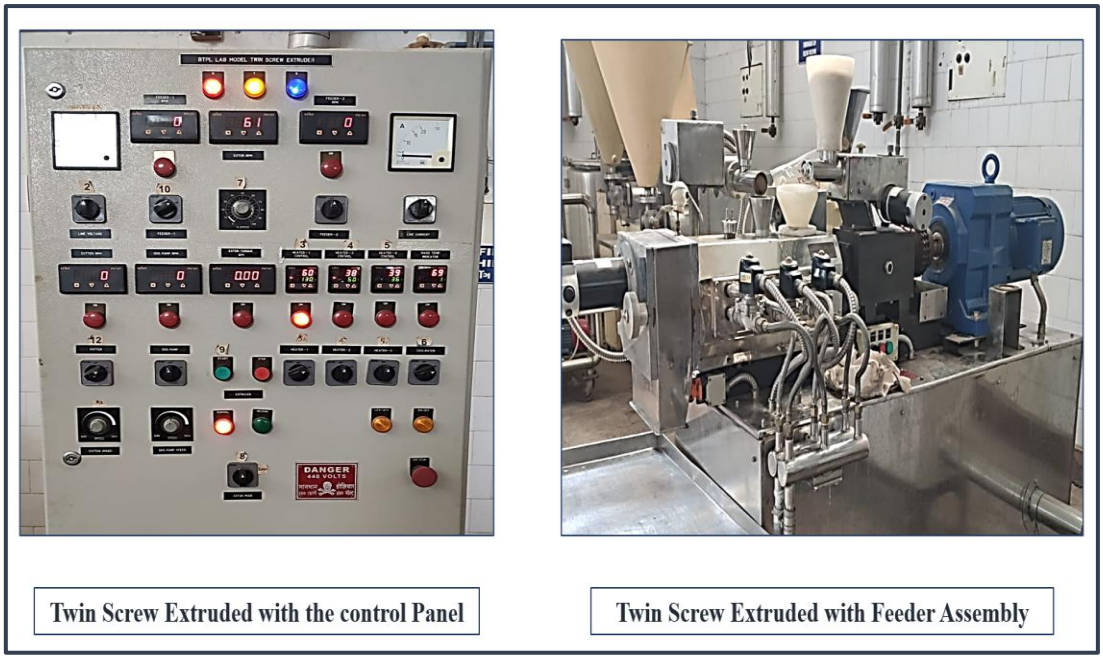

Figure 3.5 Twin Screw Extruder with Control Panel and Feeder Assembly

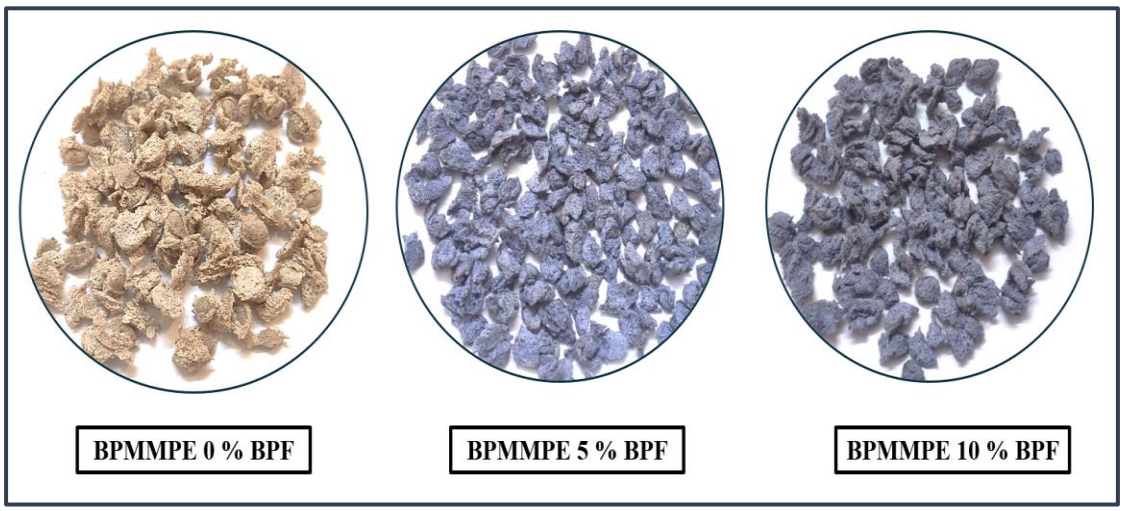

Figure 3.6 BPMMPE at the various levels of BPF

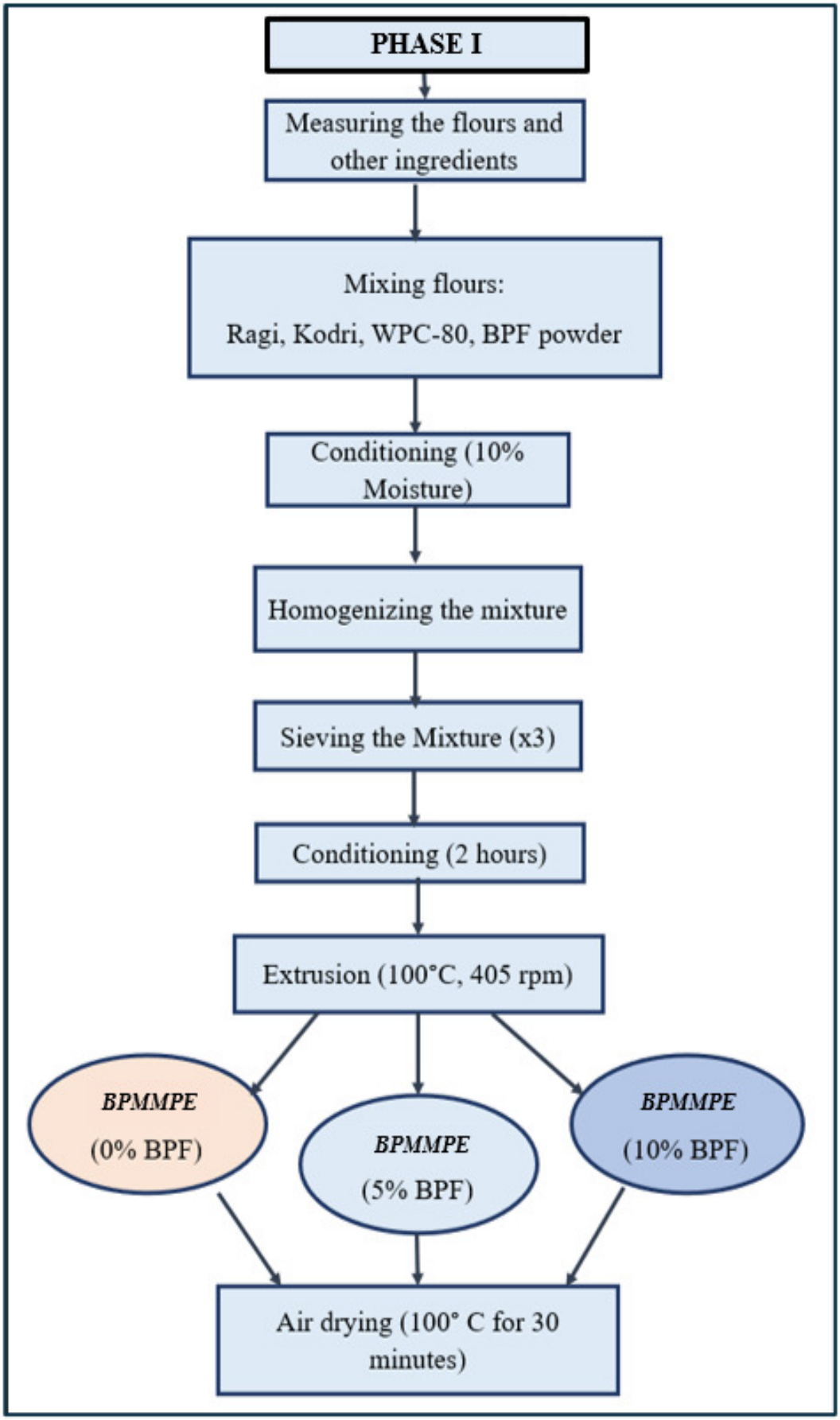

Figure 3.7 Procedure for Extrusion of BPMMPE

3.1.7 Standardization and Development of BPMMPE Flour (0% BPF, 5% BPF and 10% BPF) Incorporated Traditional Recipes

The standardization and development of traditional recipes incorporated with BPMMPE (Blue Pea Millet Milk Protein Extrudate) flour were systematically carried out using three variations of the flour: 0% BPF, 5% BPF and 10% BPF. A total of 18 traditional Indian recipes including *dosa, idli, dhokla, thepla, upma* and others—were selected to assess the sensory acceptability of BPMMPE flour within their formulations. For each variation, the BPMMPE flour was added at a consistent incorporation level of 15% by weight, replacing an equivalent portion of the main flour or base ingredient in the original recipe (Table 3.3). This ensured uniformity across trials and allowed a comparative evaluation of how varying levels of blue pea flower influenced acceptability of the dishes on the likeness scale.

3.2 Sensory Evaluation of the Recipes

BPMMPE (Blue Pea-Millet-Milk Protein Extrudates) were incorporated as a key ingredient in eighteen standardized traditional recipes, including *dosa, idli, idada, dhokla, pudla/chilla, upma, bhakri, thepla, khakhra, mathri, appam, veg cutlet, sattu, soup, ambil, phirni, halwa* and *modak*. These recipes were developed and standardized using common kitchen tools to ensure practical applicability.

3.2.1 Selection of Panellists and Evaluation Method

Sensory evaluation was conducted to assess the acceptability of BPMMPE-based traditional Indian recipes using a 9-point Hedonic Scale (9-PHS) (Annexure III). Informed consent was obtained from all panel members, and an information sheet was provided to them prior to participation (Annexure IV and V). A panel of 30–35 semi-trained faculty members from the Department of Foods and Nutrition, Faculty of Family and Community Sciences, The Maharaja Sayajirao University of Baroda, voluntarily participated in the study. The evaluation aimed to determine the sensory appeal of the recipes formulated with 0% (standard), 5% and 10% incorporation of BPMMPE. A semi-structured questionnaire was also administered to collect baseline data on the panellists' general information, medical or medication history and awareness of the product and its ingredients (Annexure VI). The Hedonic Rating Test

ranged from "Like extremely" to "Dislike extremely," with "Neither like nor dislike" serving as the midpoint score.

Inclusion criteria:

- Semi-trained panel members who have provided informed consent to participate
- Individuals with sound health

Exclusion criteria:

- Individuals who decline participation
- Individuals having allergy any allergy used in the recipes.

3.2.2 Data Recording and Analysis

Data Analysis

All data collected through the questionnaires was systematically entered into a Microsoft Excel spreadsheet for organization and analysis. The responses were categorized according to different recipes, sensory attributes and corresponding scorecards. Once compiled, statistical analysis was conducted using Microsoft Excel to interpret the results. The key statistical tools employed included the calculation of mean values to determine average scores, standard deviation to assess the variability in responses and percentages to understand the distribution and proportion of preferences across various attributes and recipe variations. This analysis provided a comprehensive understanding of the sensory performance of the developed products.

3.3 Development of Recipe Booklet

This phase involved the structured development of a recipe booklet featuring innovative formulations incorporating BPMME flour enriched with Blue Pea Flower as a key functional ingredient. The main objective was to compile recipes that demonstrated high sensory acceptability among the three levels of blue pea flower incorporated extrudates (0%, 5% and 10%). The recipe booklet comprised three key sections: an Introduction to functional foods, a detailed methodology for recipe development and the nutrient composition of the recipes included in the booklet.

3.3.1 Selection of Recipes for Documentation

The selection of recipes for inclusion in the booklet was based on the sensory evaluation results obtained in Phase II. Recipes that achieved a minimum benchmark of acceptability across various sensory attributes (9-PHS) among the three levels of blue pea flower incorporated extrudates (0%, 5% and 10%) were shortlisted.

3.3.2 Introduction of Functional Foods

The booklet included a concise and informative overview of functional foods to help the end user understand their importance in enhancing health beyond basic nutrition. It specifically highlighted the nutritional and therapeutic properties of Blue Pea Flower and its integration into BPMME flour as a key ingredient in the recipes.

3.3.3 Methodology of the Recipes

Recipes included in the booklet were selected based on their sensory acceptability scores from Phase II. Standardization was carried out for portion size, ingredients and cooking methods. Each recipe underwent repeated trials to ensure consistency. Household measures were converted to standard weights for accuracy. Clear, step-by-step procedures were documented for user convenience, ensuring the recipes could be easily replicated at the household level.

3.3.4 Nutrient Composition of the Recipes

The nutritional values of the recipes were included in the booklet to enable the end user to make informed dietary choices and understand the health benefits of each preparation. The calculation of proximate principles such as energy, protein, fat, carbohydrates, fiber, calcium, iron, sodium and potassium were carried out using data from the Indian Food Composition Tables (Longvah. et al, 2017).

RESULTS AND DISCUSSION

CHAPTER 4

RESULTS AND DISCUSSION

This chapter presents the results of the study, highlighting the development and evaluation of traditional recipes formulated using an extruded product enriched with blue pea flower powder, kodo millet, finger millet and milk protein. The focus of this investigation was to assess the sensory acceptability and nutritional potential of these value-added formulations. The study was undertaken with the following specific objectives: to standardize traditional recipes by incorporating extrudate flour made from blue pea flower powder, millets and milk protein; to evaluate the sensory attributes of the developed recipes through a panel of semi-trained members from the Department of Foods and Nutrition; and to compile a recipe booklet featuring the most acceptable formulations based on sensory outcomes. The findings presented in this chapter are discussed with reference to sensory scores and overall suitability of the developed products for regular consumption.

The study was conducted in the following three phases:

PHASE I Standardization and development of blue pea flower powder, millets and milk protein extrudates flour incorporated recipes.

PHASE II Sensory Evaluation of the blue pea flower powder, millets and milk protein extrudates flour incorporated recipes.

PHASE III Development of a blue pea flower powder, millets and milk protein extrudates flour incorporated recipes booklet.

This chapter begins with the standardization of 18 traditional Indian recipes representing diverse ethnic culinary practices from across the country. The selected recipes included thepla, idada, methi khakhra, modak, mathri, vegetable cutlet, kutki soup, sattu drink, sheera and ambil, among others. The nutrient composition of each standardized recipe was calculated using the Indian Food Composition Tables (IFCT), 2017. The core functional ingredient used in this study was an extruded product,

referred to as BPMMPE (Blue Pea-Millet-Milk Protein Extrudate), developed using ragi (finger millet), kodri (kodo millet), Whey Protein Concentrate and Blue Pea Flower (BPF) powder (locally known as *Aparajita*). The extrudates were prepared with three different levels of blue pea flower incorporation: 0%, 5% and 10%. These extrudates were then incorporated at a 15% substitution level in the 18 standardized recipes.

Each recipe was prepared in three variants based on the level of blue pea flower in the incorporated Blue Pea-Millet-Milk Protein Extruded. The sensory evaluation of these experimental recipes was conducted by a panel of 30 semi-trained members from the Department of Foods and Nutrition, which included faculty members, research scholars, graduate and postgraduate students using a 9-Point Hedonic Scale (9-PHS). A semi-structured questionnaire was administered to gather baseline demographic information and to obtain the perception of the developed formulations.

The results offer insights into how incorporating blue pea flower powder and millet-milk protein extrudates influences the sensory appeal and nutritional quality of traditional recipes. The discussion highlights the most preferred formulations, showcasing innovative ways to enhance traditional dishes with functional ingredients for improved visual appeal and health benefits.

The results are presented under the following sections:

4.1 Standardization and Development of Recipes

4.1.1 Selection of Traditional Recipes

4.1.2 Standardization of Traditional Recipes

4.1.2.1 Breakfast Recipes

4.1.2.2 Snack Recipe

4.1.2.3 Soups and Beverages Recipes

4.1.2.4 Sweets and Desserts Recipes

4.1.3 Selection of Ingredients for preparation of BPMMPE

4.1.3.1 Proximate Analysis of Raw Materials for the Preparation of BPMMPE

4.1.3.2 Standardization and Development of BPMMPE Flour (0% BPF, 5% BPF and 10% BPF) Incorporated Traditional Recipes

4.2 Sensory Evaluation of BPMMPE Flour (0% BPF, 5% BPF and 10% BPF) Incorporated Traditional Recipes

4.1 Standardization and Development of Recipes

4.1.1 Selection of traditional Indian recipes

The table 4.1 showcases 18 traditional Indian recipes categorized by cooking time, method and type. Recipes like Dosa, Idli and Upma are common breakfast items, while others like Khakhra and Mathri serve as snacks. Cooking techniques vary, fermentation, steaming, pan-cooking, frying and boiling are all represented. This diversity highlights the rich culinary heritage and forms the basis for incorporating BPMMPE flour to enhance the nutritional profile without altering traditional preparation methods.

Table: 4.1 Traditional Indian Recipes with Cooking Methods, Time and Type

Sr. No.	Recipe Name	Cooking Time	Cooking Method	Type
1.	**Dosa**	15-20 min	Fermentation + Pan Cooking	Breakfast
2.	**Idli**	12-15 min	Fermentation + Steaming	Breakfast
3.	**Idada**	12-15 min	Fermentation + Steaming	Breakfast / Snack
4.	**Dhokla**	12-15 min	Fermentation + Steaming	Breakfast / Snack
5.	**Pudla/ Chilla**	10-12 min	Pan Cooking (Tawa)	Breakfast
6.	**Upma**	15-20 min	Stir-Frying + Simmering	Breakfast
7.	**Bhakri**	10-12 min	Pan Cooking (Tawa)	Breakfast
8.	**Thepla**	15-20 min	Pan Cooking (Tawa)	Bread
9.	**Khakhra**	15-20 min	Pan Roasting (Tawa)	Snack
10.	**Mathri**	15-20 min	Frying	Snack
11.	**Appam**	15-20 min	Fermentation +Pan Cooking (Appe Pan)	Breakfast/ Snack

12.	**Veg cutlet**	15-20 min	Shallow-Frying	Snack
13.	**Sattu**	15- 20 min	Boiling + cooling	Drink
14.	**Soup**	15-20 min	Boiling + Simmering	Soup/ Drink
15.	**Ambil**	20-25 min	Boiling + Simmering	Soup/ drink
16.	**Phirni**	20-25 min	Boiling + Simmering	Dessert / Sweet
17.	**Halwa**	15-20 min	Roasting + Simmering	Dessert / Sweet
18.	**Modak**	20-25 min	Steaming	Dessert / Sweet

4.1.3 Standardization of the 18 Traditional Indian Recipes:

Eighteen traditional Indian recipes, referenced from existing literature, were reconstructed and standardized under controlled laboratory conditions in the Food Labs of the Department of Foods and Nutrition. This ensured accurate documentation of procedures, ingredient consistency and reproducibility for further incorporation of BPMMPE flour in subsequent development phases.

The standardized recipes, along with their corresponding nutrient compositions, are detailed in Tables 4.3 to 4.20. Figures 4.1 to 4.18 showcase the visual presentation of each prepared dish. These recipes were systematically categorized into four groups: breakfast items, snacks, soups and beverages and desserts, for clarity and comparative analysis. Table 4.2 shows the categories of the recipes.

Table: 4.2 Categories of the Recipes

Breakfast Recipes	Snack Recipes	Soups and Beverages	Dessert Recipes
Upama, Dhokla, Appam, Idli, Dosa, Idada, Bhakri, Thepla, Pudla	Mathri, Methi Khakhra, Veg Cutlet	Ambil, Kutki Soup, Sattu Drink	Ukadiche Modak, Sheera, Phirni

4.1.2.1 Breakfast Recipes

Upma

Figure 4.1 Upma

Table 4.3 Nutritive value of Standard Upma

Energy (kcal)	174
Protein (g)	5
CHO (g)	23.58
Fat (g)	6
Fiber (g)	13
Calcium (mg)	15
Iron (mg)	1.2
Potassium (mg)	152
Sodium (mg)	203

The standardized Upma recipe, shown in Figure 4.1, was developed using 15% BPMMPE flour with 5% Blue Pea Flower and evaluated for one serving size of 1 cup. As presented in Table 4.3, the Upma provided 174 kcal energy, 5 g protein and 13 g dietary fiber, highlighting its digestive benefits. It also contained 6 g fat and 23.58 g carbohydrates, making it a nutrient-dense breakfast choice. In terms of micronutrients, it contributed 15 mg calcium, 1.2 mg iron, 152 mg potassium and 203 mg sodium per serving. These values indicate that the product not only meets energy requirements but also provides essential minerals for bone strength, blood health and electrolyte balance.

Dhokla

Figure 4.2 Dhokla

Table 4.4 Nutritive Value of Dhokla

Energy (kcal)	190
Protein (g)	11.01
CHO (g)	23.89
Fat (g)	3
Fiber (g)	6
Calcium (mg)	37
Iron (mg)	3.1
Potassium (mg)	501
Sodium (mg)	212

The standardized Dhokla recipe, as illustrated in Figure 4.2, was developed with the inclusion of 15% BPMMPE flour containing 5% Blue Pea Flower. As shown in Table 4.4, it provides 190 kcal energy, making it a light yet nutritious snack. With 11.01 g protein and 6 g fiber, it supports both satiety and digestive health. The carbohydrate content is 23.89 g, complemented by a low fat value of 3 g, making it suitable for calorie-conscious diets. Micronutrient contributions include 37 mg calcium, 3.1 mg iron, 501 mg potassium and 212 mg sodium, suggesting that the fortified Dhokla not only meets basic energy needs but also contributes significantly to bone health, hemoglobin synthesis and electrolyte balance.

Appam

Figure 4.3 Appam

Table 4.5 Nutritive Value of Appam

Energy (kcal)	**212**
Protein (g)	**15.73**
CHO (g)	**34.79**
Fat (g)	**4.9**
Fiber (g)	**2**
Calcium (mg)	**28**
Iron (mg)	**1**
Potassium (mg)	**220**
Sodium (mg)	**206**

The standardized Appam, shown in Figure 4.3, was prepared using 15% BPMMPE flour with 5% Blue Pea Flower and analyzed per 100 g serving. As presented in Table 4.5, it delivers 212 kcal energy, 15.73 g protein and 34.79 g carbohydrates, making it a protein-rich and energy-dense breakfast or snack option. The product contains 4.9 g fat and 2 g fiber, contributing to moderate satiety. It also provides essential micronutrients—28 mg calcium, 1 mg iron, 220 mg potassium and 206 mg sodium—supporting bone health, hemoglobin levels and electrolyte balance. This fortified version of Appam combines traditional appeal with enhanced nutritional benefits.

Idli

Figure 4.4 Idli

TABLE 4.6 Nutritive Value of Idli

Energy (kcal)	**225**
Protein (g)	**6.6**
CHO (g)	**43.2**
Fat (g)	**2.1**
Fiber (g)	**2**
Calcium (mg)	**14**
Iron (mg)	**0.9**
Potassium (mg)	**194**
Sodium (mg)	**204**

The standardized Idli, as shown in Figure 4.4, was developed using 15% BPMMPE flour enriched with 5% Blue Pea Flower. According to the nutritional analysis in Table 4.6, it delivers 225 kcal energy, 43.2 g carbohydrates and 6.6 g protein, making it a nourishing breakfast option. With low fat content (2.1 g) and 2 g dietary fiber, it supports both lightness and digestive wellness. The presence of key micronutrients such as 14 mg calcium, 0.9 mg iron, 194 mg potassium and 204 mg sodium enhances its nutritional profile, contributing to bone strength, hemoglobin formation and fluid balance.

Dosa

Figure 4.5 Dosa

Table 4.7 Nutritive Value of Dosa

Energy (kcal)	**234**
Protein (g)	**6.66**
CHO (g)	**43.2**
Fat (g)	**3.1**
Fiber (g)	**2**
Calcium (mg)	**14**
Iron (mg)	**0.9**
Potassium (mg)	**194**
Sodium (mg)	**204**

The standardized Dosa, shown in Figure 4.5, was developed using 15% BPMMPE flour enriched with 5% Blue Pea Flower. As indicated in Table 4.7, it provides 234 kcal of energy along with 43.2 g carbohydrates and 6.66 g protein, offering a balanced macronutrient profile. The dosa contains 3.1 g fat and 2 g dietary fiber, making it both satiating and light. Essential micronutrients include 14 mg calcium, 0.9 mg iron, 194 mg potassium and 204 mg sodium, contributing to bone strength, iron status and electrolyte balance. This fortified dosa is a nutritious alternative to the traditional version without compromising on taste or texture.

Idada

Figure 4.6 Idada

Table 4.8 Nutritive Value of Idada

Energy (kcal)	**221**
Protein (g)	**46.3**
CHO (g)	**40.59**
Fat (g)	**1.2**
Fiber (g)	**6**
Calcium (mg)	**27**
Iron (mg)	**5**
Potassium (mg)	**172**
Sodium (mg)	**204**

The standardized Idada, as shown in Figure 4.6, was developed using 15% BPMMPE flour with 5% Blue Pea Flower. As per Table 4.8, it offers 221 kcal energy and is notably rich in protein (46.3 g), making it a high-protein snack or meal component. It contains 40.59 g carbohydrates, 6 g fiber and only 1.2 g fat. Additionally, it contributes 27 mg calcium, 5 mg iron, 172 mg potassium and 204 mg sodium—enhancing its functional and nutritional appeal.

Bhakri

Figure 4.7 Bhakri

Table 4.9 Nutritive Value of Bhakri

Energy (kcal)	**154**
Protein (g)	**3.59**
CHO (g)	**21.8**
Fat (g)	**5.5**
Fiber (g)	**3**
Calcium (mg)	**11**
Iron (mg)	**1.4**
Potassium (mg)	**106**
Sodium (mg)	**81**

The standardized Bhakri, shown in Figure 4.7, was developed by incorporating 15% BPMMPE flour enriched with 5% Blue Pea Flower. As reflected in Table 4.9, it provides 154 kcal energy, 21.8 g carbohydrates and 3.59 g protein, making it a modest yet nutritious meal component. The product contains 5.5 g fat and 3 g fiber, offering a balance of satiety and energy. Its micronutrient profile includes 11 mg calcium, 1.4 mg iron, 106 mg potassium and 81 mg sodium, contributing to bone health and mineral balance. This enriched version of Bhakri supports traditional food intake with enhanced nutritional benefits.

Thepla

Figure 4.8 Thepla

Table 4.10 Nutritive Value of Thepla

Energy (kcal)	**205**
Protein (g)	**5.93**
CHO (g)	**27.64**
Fat (g)	**7.6**
Fiber (g)	**4**
Calcium (mg)	**87**
Iron (mg)	**2.5**
Potassium (mg)	**199**
Sodium (mg)	**210**

The standardized Thepla, as presented in Figure 4.8, was formulated using 15% BPMMPE flour containing 5% Blue Pea Flower. According to Table 4.10, it provides 205 kcal energy, 27.64 g carbohydrates and 5.93 g protein, making it a balanced and wholesome flatbread option. It is moderately high in fat (7.6 g) and contains 4 g dietary fiber, promoting digestive health and satiety. Rich in micronutrients, Thepla contributes 87 mg calcium, 2.5 mg iron, 199 mg potassium and 210 mg sodium. These values highlight its potential to enhance nutritional intake while preserving the traditional appeal of this widely consumed Indian bread.

Pudla

Figure 4.9 Pudla

Table 4.11 Nutritive Value of Pudla

Energy (kcal)	**223**
Protein (g)	**7.05**
CHO (g)	**32.87**
Fat (g)	**6.6**
Fiber (g)	**6**
Calcium (mg)	**64**
Iron (mg)	**2.7**
Potassium (mg)	**299**
Sodium (mg)	**206**

The standardized Pudla, depicted in Figure 4.9, was prepared using 15% BPMMPE flour enriched with 5% Blue Pea Flower. As per Table 4.11, it delivers 223 kcal energy, 7.05 g protein and 32.87 g carbohydrates, making it a nutrient-dense and fulfilling meal. The recipe contains 6.6 g fat and a significant 6 g fiber, supporting satiety and digestive function. Additionally, it is rich in micronutrients—providing 64 mg calcium, 2.7 mg iron, 299 mg potassium and 206 mg sodium. This enhanced Pudla not only retains its traditional taste and appeal but also serves as a nutritious addition to a balanced diet.

4.1.2.2 Snack Recipe

Mathri

Figure 4.10 Mathri

Table 4.12 Nutritive Value of Mathri

Energy (kcal)	**170**
Protein (g)	**3.55**
CHO (g)	**19.18**
Fat (g)	**8.6**
Fiber (g)	**3**
Calcium (mg)	**9.7**
Iron (mg)	**1.2**
Potassium (mg)	**109**
Sodium (mg)	**202**

The standardized Mathri, displayed in Figure 4.10, was prepared by incorporating 15% BPMMPE flour with 5% Blue Pea Flower. As outlined in Table 4.12, it provides 170 kcal energy, 19.18 g carbohydrates and 3.55 g protein, making it a light yet energy-rich snack. It contains 8.6 g fat and 3 g dietary fiber, offering satiety and aiding digestion. Additionally, the recipe contributes valuable micronutrients—9.7 mg calcium, 1.2 mg iron, 109 mg potassium and 202 mg sodium. The fortified Mathri maintains its traditional crisp texture while enhancing nutritional quality, making it a healthier option for snacking without compromising taste.

Methi Khakhra

Figure 4.11 Methi Khakhra

Table 4.13 Nutritive Value of Methi Khakara

Energy (kcal)	**76**
Protein (g)	**2.37**
CHO (g)	**12.83**
Fat (g)	**1.5**
Fiber (g)	**2**
Calcium (mg)	**24**
Iron (mg)	**1.1**
Potassium (mg)	**73.5**
Sodium (mg)	**82**

The standardized Methi Khakhra, as depicted in Figure 4.11, was prepared with 15% BPMMPE flour containing 5% Blue Pea Flower. Table 4.13 highlights its nutritional profile, providing 76 kcal energy, 12.83 g carbohydrates and 2.37 g protein, making it a light and healthy snack option. With just 1.5 g fat and 2 g fiber, it supports digestive well-being and satiety without excess calories. It also delivers essential minerals including 24 mg calcium, 1.1 mg iron, 73.5 mg potassium and 82 mg sodium. This fortified khakhra combines traditional crunch and flavor with improved nutritional value, making it a suitable choice for health-conscious consumers.

Veg Cutlet

Figure 4.12 Veg Cutlet

Table 4.14 Nutritive Value of Veg Cutlet

Energy (kcal)	**98**
Protein (g)	**1.94**
CHO (g)	**11.3**
Fat (g)	**5**
Fiber (g)	**0.97**
Calcium (mg)	**6.67**
Iron (mg)	**0.51**
Potassium (mg)	**145.65**
Sodium (mg)	**227.62**

The standardized Veg Cutlet, shown in Figure 4.12, was developed using 15% BPMMPE flour enriched with 5% Blue Pea Flower. As per Table 4.14, it provides 98 kcal energy, 11.3 g carbohydrates and 1.94 g protein, making it a light and savory snack option. With 5 g fat and 0.97 g fiber, it delivers moderate satiety. The cutlet is a source of essential micronutrients, including 6.67 mg calcium, 0.51 mg iron, 145.65 mg potassium and 227.62 mg sodium. This fortified version retains its traditional taste while improving its nutritional profile, making it suitable for health-conscious individuals seeking flavorful yet balanced snacking alternatives.

4.1.2.3 Soups and Beverages Recipes

Ambil

Figure 4.13 Ambil

Table 4.15 Nutritive Value of Ambil

Energy (kcal)	**104**
Protein (g)	**3.26**
CHO (g)	**15.16**
Fat (g)	**3.3**
Fiber (g)	**73**
Calcium (mg)	**162**
Iron (mg)	**1**
Potassium (mg)	**167**
Sodium (mg)	**100**

The standardized Ambil, as shown in Figure 4.13, was prepared using 15% BPMMPE flour with 5% Blue Pea Flower. Table 4.15 indicates that it delivers 104 kcal energy, 15.16 g carbohydrates and 3.26 g protein, making it a light yet nourishing beverage. It contains 3.3 g fat and an exceptionally high 73 g fiber, supporting gut health and digestion. Ambil is also rich in minerals, offering 162 mg calcium, 1 mg iron, 167 mg potassium and 100 mg sodium. This nutrient-dense traditional drink, when fortified, provides excellent hydration along with significant nutritional benefits, especially for digestive and bone health.

Little Millet (Kutki) Soup

Figure 4.14 Little Millet (Kutki) Soup

Table 4.16 Nutritive Value of Little Millet (Kutki) Soup

Energy (kcal)	**97**
Protein (g)	**2.56**
CHO (g)	**14.86**
Fat (g)	**2.84**
Fiber (g)	**2**
Calcium (mg)	**17.16**
Iron (mg)	**0.34**
Potassium (mg)	**107**
Sodium (mg)	**208**

The standardized Little Millet (Kutki) Soup, as seen in Figure 4.14, was developed using 15% BPMMPE flour enriched with 5% Blue Pea Flower. According to Table 4.16, it provides 97 kcal of energy, 14.86 g carbohydrates and 2.56 g protein, making it a light and nourishing beverage. With 2.84 g fat and 2 g fiber, the soup supports satiety and digestive wellness. It also offers essential micronutrients—17.16 mg calcium, 0.34 mg iron, 107 mg potassium and 208 mg sodium—contributing to hydration, bone strength and electrolyte balance. This fortified traditional soup presents a balanced, comforting option with enhanced nutritional benefits.

Sattu Drink

Figure 4.15 Sattu Drink

Table 4.17 Nutritive Value of Sattu Drink

Energy (kcal)	**47**
Protein (g)	**2.28**
CHO (g)	**8.27**
Fat (g)	**0.5**
Fiber (g)	**2**
Calcium (mg)	**8.2**
Iron (mg)	**0.9**
Potassium (mg)	**135**
Sodium (mg)	**82**

The standardized Sattu Drink, as shown in Figure 4.15, was prepared with the incorporation of 15% BPMMPE flour enriched with 5% Blue Pea Flower. As detailed in Table 4.17, it provides 47 kcal energy, 8.27 g carbohydrates and 2.28 g protein, making it a light yet nourishing beverage option. With just 0.5 g fat and 2 g fiber, it supports hydration and digestion. Additionally, the drink supplies important micronutrients—8.2 mg calcium, 0.9 mg iron, 135 mg potassium and 82 mg sodium. This traditional preparation, enhanced nutritionally, is ideal for refreshment and nutrient replenishment, especially in hot climates or during fasting.

4.1.2.4 Sweets and Desserts Recipes

Ukadiche Modak

Figure 4.16 Ukadiche Modak

Table 4.18 Nutritive Value of Ukadiche Modak

Energy (kcal)	**157**
Protein (g)	**2.21**
CHO (g)	**20.82**
Fat (g)	**7.21**
Fiber (g)	**1**
Calcium (mg)	**9.4**
Iron (mg)	**1.5**
Potassium (mg)	**77.6**
Sodium (mg)	**3.3**

The standardized Ukadiche Modak, shown in Figure 4.16, was developed using 15% BPMMPE flour with 5% Blue Pea Flower. As per Table 4.18, it provides 157 kcal energy, 20.82 g carbohydrates and 2.21 g protein, making it a moderate-calorie sweet option. With 7.21 g fat and 1 g fiber, it supports both energy needs and mild satiety. It also contributes essential minerals—9.4 mg calcium, 1.5 mg iron, 77.6 mg potassium and a very low sodium content of 3.3 mg. This nutritionally enriched version of the traditional festive sweet maintains cultural authenticity while improving its micronutrient content.

Sheera

Figure 4.17 Sheera

Table 4.19 Nutritive Value of Sheera

Energy (kcal)	**215**
Protein (g)	**4.84**
CHO (g)	**26.66**
Fat (g)	**9.8**
Fiber (g)	**2**
Calcium (mg)	**75**
Iron (mg)	**0.9**
Potassium (mg)	**155**
Sodium (mg)	**18**

The standardized Sheera, presented in Figure 4.17, was prepared using 15% BPMMPE flour with 5% Blue Pea Flower. As shown in Table 4.19, it offers 215 kcal energy, 26.66 g carbohydrates and 4.84 g protein, making it a rich and satisfying traditional dessert. The high fat content (9.8 g) enhances flavor and texture, while 2 g fiber contributes to mild satiety. Sheera also provides essential micronutrients including 75 mg calcium, 0.9 mg iron, 155 mg potassium and only 18 mg sodium. This enhanced version of Sheera combines indulgence with improved nutritional value, making it a suitable sweet option for occasional consumption.

Phirni

Figure 4.18 Phirni

Table 4.20 Nutritive Value of Phirni

Energy (kcal)	**248**
Protein (g)	**7.41**
CHO (g)	**27.07**
Fat (g)	**12**
Fiber (g)	**1**
Calcium (mg)	**191**
Iron (mg)	**0.3**
Potassium (mg)	**217**
Sodium (mg)	**46**

The standardized Phirni, as displayed in Figure 4.18, was developed using 15% BPMMPE flour enriched with 5% Blue Pea Flower. According to Table 4.20, it delivers 248 kcal energy, 27.07 g carbohydrates and 7.41 g protein, making it a nutrient-rich traditional dessert. Its high fat content (12 g) enhances taste and energy density, while 1 g fiber supports mild digestive benefits. Phirni also offers significant micronutrients—191 mg calcium, 0.3 mg iron, 217 mg potassium and 46 mg sodium—supporting bone health and electrolyte balance. This fortified Phirni blends cultural authenticity with improved nutritional content, making it a wholesome and indulgent sweet dish.

4.1.3 Selection of Ingredients for preparation of BPMMPE

A preliminary market survey was carried out to procure high-quality raw materials, including millets, lyophilized Blue Pea Flower (BPF) and whey protein concentrate (WPC). Premium varieties of Ragi (Eleusine coracana) and Kodri (Paspalum scrobiculatum) were sourced online from the Miltop brand. WPC-80 was obtained from NAKPRO Nutrition, Bengaluru and Blue Pea Flower (Clitoria ternatea) was purchased as Butterfly Pea Flower Herbal Tea from 'Online of Quality Store', India. The selection of pearl millet (Pennisetum glaucum) and WPC was guided by earlier studies (Yadav et al., 2014) highlighting their complementary role in improving the nutritional and sensory qualities of extruded snack products.

4.1.3.1 Proximate Analysis of Raw Materials for the Preparation of BPMMPE

Table 4.21 summarizes the proximate analysis of raw ingredients—Finger millet, Kodo millet and Blue Pea Flower (BPF) powder. Among them, BPF powder demonstrated the highest energy value (398.72 kcal/100g), almost double the protein content (20.52g) compared to the millets and the highest fat content (7.84g). It also had the highest total ash (6.07%), indicating rich mineral content, though its carbohydrate content (61.52%) was lower than that of Finger millet (74.78%) and Kodo millet (74.21%). Finger millet contributed the most carbohydrates and had a notable crude fiber content (2.68%) and the highest moisture level (12.78%).

Table 4.21 Nutrition Analysis of Raw Ingredients for the Preparation of BPMMPE

Nutrients	Finger millet (g %)	Kodo millet (g %)	WPC-80 (g %)	BPF powder (g %)
Energy (kcal)	345	358	371	399
Protein (g)	9.08	10.91	79.04	20.52
Carbohydrates (g)	74.78	74.21	28.59	61.52
Crude fiber (g)	2.68	0.92	-	0.1
Fat (g)	1.02	1.94	1.70	7.84
Moisture (g)	12.78	12.69	4.72	4.05
Total Ash (g)	2.34	0.25	5.15	6.07

4.1.3.2 Standardization and development of BPMMPE flour (0% BPF, 5% BPF and 10% BPF)

The standardization and development of traditional Indian recipes using BPMMPE (Blue Pea Millet Milk Protein Extrudate) flour were conducted with three flour variations: 0% BPF, 5% BPF and 10% BPF. A total of 18 recipes—such as dosa, idli, dhokla, thepla and upma were selected to evaluate sensory acceptability. For each variation, BPMMPE flour was incorporated at a consistent level of 15% by weight, replacing a proportionate amount of the primary flour or base ingredient in the original formulation. This approach ensured consistency across all trials and enabled a comparative analysis of the impact of BPF levels on product acceptability.

Upma

0% BPF Upma **5% BPF Upma** **10% BPF Upma**

FIGURE 4.19 BPMME Flour Incorporated Upma

TABLE 4.22 Nutritive Value of 0%, 5% and 10% BPF (BPMMPE) Incorporated Upma

Nutrients	0% BPF	5% BPF	10%BPF
Energy (kcal)	175	175	175
Protein (g)	5.05	5.08	5.1
CHO* (g)	24.16	24.17	24.12
Fat (g)	5.97	6	5.97
Fiber (g)	12.93	13	12.93
Calcium (mg)	13.58	14	13.58
Iron (mg)	1.04	1	1.04
Potassium (mg)	87.91	87.9	87.91
Sodium (mg)	202.45	202	202.45

The nutritional analysis of Upma with 0%, 5% and 10% Blue Pea Flower (BPF) extrudate flour showed minimal changes in energy, carbohydrates and fat content. Protein and iron content slightly increased with higher BPF levels, while fiber content improved from 1.04 g (0% BPF) to 1.34 g (10% BPF), enhancing its dietary benefits. Mineral levels, including calcium, potassium and sodium, remained stable. The incorporation of BPF extrudate did not significantly alter macronutrient composition but contributed to a fiber boost and potential antioxidant benefits. The blue coloration may enhance consumer appeal, making this variation a nutritionally enriched, visually appealing option.

Dhokla

0% BPF Dhokla **5% BPF Dhokla** **10% BPF Dhokla**

Figure 4.20 BPMME Flour Incorporated Dhokla

Table 4.23 Nutritive Value of 0%, 5% and 10% BPF (BPMMPE) Incorporated Dhokla

Nutrients	0% BPF	5% BPF	10%BPF
Energy (kcal)	195	194.1	194.1
Protein (g)	10.47	10.51	10.54
CHO* (g)	26.44	26.44	26.34
Fat (g)	2.63	2.6	2.63
Fiber (g)	5.34	5	5.43
Calcium (mg)	34.05	34	34.05
Iron (mg)	2.69	2.7	2.69
Potassium (mg)	437	437	437.34
Sodium (mg)	211	211	210.51

The nutritional analysis of Dhokla with 0%, 5% and 10% Blue Pea Flower (BPF) extrudate flour showed minimal variations in energy, fat and carbohydrate content. Protein content increased slightly from 10.47 g (0% BPF) to 10.54 g (10% BPF), while fiber improved from 1.43 g to 1.63 g, indicating enhanced dietary benefits. Calcium and iron content also increased, with iron rising from 2.11 mg to 2.43 mg. Potassium and sodium levels remained stable across variations. These findings suggest that incorporating BPF extrudate flour improves the nutritional profile of Dhokla, particularly in terms of fiber and mineral content.

Appam

0% BPF Appam **5% BPF Appam** **10% BPF Appam**

FIGURE 4.21 BPMME Flour Incorporated Appam

Table 4.24 Nutritive Value of 0%, 5% and 10% BPF (BPMMPE) Incorporated Appam

Nutrients	0% BPF	5% BPF	10%BPF
Energy (kcal)	213	213	213
Protein (g)	5.79	5.8	5.79
CHO* (g)	35.03	35.09	35.03
Fat (g)	4.88	4.9	4.88
Fiber (g)	1.98	2	1.98
Calcium (mg)	26.98	27	26.98
Iron (mg)	0.93	0.9	0.93
Potassium (mg)	197	197	197
Sodium (mg)	205	205	205

The nutritional analysis of Appam with 0%, 5% and 10% Blue Pea Flower (BPF) extrudate flour showed no significant changes in energy, protein, carbohydrate, fat, or mineral content. Protein remained around 15.79 g, while carbohydrates and fat showed

minimal fluctuations. However, fiber content increased slightly from 1.98 g (0% BPF) to 2.1 g (10% BPF), indicating improved dietary benefits. Calcium, iron, potassium and sodium levels remained stable across variations. These findings suggest that BPF extrudate flour can be incorporated into Appam without altering its nutritional profile while providing potential functional benefits such as increased fiber content. The incorporation of BPF extrudate flour into Appam does not significantly impact energy, protein, carbohydrate, fat, or mineral content. However, a slight increase in fiber content is observed, making the BPF-enriched Appam a nutritionally improved option. While BPF incorporation enhances the visual appeal with a distinct color, the minimal changes in macronutrient composition suggest that it can be integrated into traditional Appam without altering its fundamental nutritional profile.

Dosa

0% BPF Dosa **5% BPF Dosa** **10% BPF Dosa**

FIGURE 4.22 BPMME Flour Incorporated Dosa

TABLE 4.25 Nutritive Value of 0%, 5% and 10% BPF (BPMMPE) Incorporated Dosa

Nutrients	0% BPF	5% BPF	10%BPF
Energy (kcal)	234	234	234
Protein (g)	6.78	6.8	6.85
CHO* (g)	44	44.1	44
Fat (g)	2.98	3	2.98
Fiber (g)	1.58	2	1.58
Calcium (mg)	12.47	12	12.47
Iron (mg)	0.75	0.8	0.75
Potassium (mg)	165.31	165	165.31
Sodium (mg)	203	204	203.68

The nutritional analysis of dosa with 0%, 5% and 10% Blue Pea Flower (BPF) extrudate flour showed no significant changes in energy, fat, or carbohydrate content. Protein remained stable, slightly increasing from 6.78 g (0% BPF) to 6.85 g (10% BPF). Fiber content improved from 1.58 g to 1.63 g, while iron increased from 0.75 mg to 0.83 mg, enhancing its nutritional profile. Calcium, potassium and sodium levels showed minimal variation. These results suggest that BPF incorporation enhances fiber and iron content without altering the dosa's overall nutritional composition, making it a visually appealing, functional food option.

The incorporation of BPF extrudate flour into dosa does not significantly affect macronutrient composition, with minimal variations in protein, carbohydrates, fat and minerals. However, a slight increase in fiber and iron content suggests a small nutritional advantage. The dosa retains its energy value while gaining functional benefits from the fiber and potential antioxidant properties of BPF. Additionally, the distinct blue coloration at higher BPF levels may influence consumer perception, making it a visually appealing yet nutritionally enriched variation of traditional dosa.

Pudla

0% BPF Pudla **5% BPF Pudla** **10% BPF Pudla**

FIGURE 4.23 BPMME Flour Incorporated Pudla

TABLE 4.26 Nutritive Value of 0%, 5% and 10% BPF (BPMMPE) Incorporated Pudla

Nutrients	0% BPF	5% BPF	10%BPF
Energy (kcal)	225	225	225
Protein (g)	7.04	7.06	7.11
CHO* (g)	33.84	33.84	33.74
Fat (g)	6.34	6.3	6.34
Fiber (g)	4.95	5	4.95

Calcium (mg)	61.76	62	61.76
Iron (mg)	2.37	2.4	2.37
Potassium (mg)	267.72	268	267.7
Sodium (mg)	205.2	205	205.2

The incorporation of BPF extrudate flour into Pudla does not significantly alter its macronutrient composition, with energy, fat, fiber and mineral content remaining largely unchanged. A minor increase in protein suggests a potential nutritional benefit, while carbohydrate and fat levels remain stable. The results indicate that BPF can be incorporated into Pudla without compromising its nutritional integrity, while offering potential functional and aesthetic benefits. The distinct blue hue from BPF may enhance its visual appeal, making it an innovative and nutritious variation of traditional Pudla.

Bhakri

0% BPF Bhakri **5% BPF Bhakri** **10% BPF Bhakri**

FIGURE 4.24 BPMME Flour Incorporated Bhakri

TABLE 4.27 Nutritive Value of 0%, 5% and 10% BPF (BPMMPE) Incorporated Bhakri

Nutrients	0% BPF	5% BPF	10%BPF
Energy (kcal)	175	176	175
Protein (g)	4.33	4.34	4.38
CHO* (g)	26.4	26.4	26.3
Fat (g)	5.52	5.5	5.52
Fiber (g)	3.31	3	3.31
Calcium (mg)	10.5	11	10.5
Iron (mg)	1.39	1.4	1.39
Potassium (mg)	105.74	106	105.7
Sodium (mg)	80.69	80.69	80.69

The nutritional analysis of Bhakri with 0%, 5% and 10% Blue Pea Flower (BPF) extrudate flour shows minimal variations in macronutrients. The energy content remains stable at approximately 175–176 kcal across all variations. Protein content shows a negligible difference, ranging from 4.33 g (0% BPF) to 4.34 g (5% BPF), with no significant impact at 10% BPF. Carbohydrates and fat remain nearly unchanged, while fiber content is constant at 2 g. Minerals such as calcium, iron, potassium and sodium exhibit minimal fluctuations. These results indicate that BPF can be incorporated into Bhakri without compromising its nutritional profile.

Idli

0% BPF Idli **5% BPF Idli** **10% BPF Idli**

FIGURE 4.25 BPMME Flour Incorporated Idli

Table 4.28 Nutritive Value of 0%, 5% and 10% BPF (BPMMPE) Incorporated Idli

Nutrients	0% BPF	5% BPF	10%BPF
Energy (kcal)	225	225	225
Protein (g)	6.78	6.8	6.85
CHO* (g)	44	44.1	44
Fat (g)	1.98	2	1.98
Fiber (g)	1.58	2	1.58
Calcium (mg)	12.47	12	12.47
Iron (mg)	0.75	0.8	0.75
Potassium (mg)	16.31	165	165.3
Sodium (mg)	203.68	203.68	203.6

The nutritional analysis of Idli with 0%, 5% and 10% Blue Pea Flower (BPF) extrudate flour reveals that energy, fat, fiber and mineral content remain largely unchanged. The energy value stays constant at 225 kcal across all variations. Protein content increases

slightly from 6.75 g (0% BPF) to 6.85 g (10% BPF), while carbohydrates remain stable. Calcium, iron, potassium and sodium show minimal fluctuations, indicating that BPF incorporation does not significantly impact the overall nutrient profile. The slight protein enhancement and retention of nutritional integrity suggest that BPF Idli offers functional benefits without altering its fundamental composition.

Thepla

0% BPF Thepla **5% BPF Thepla** **10% BPF Thepla**

FIGURE 4.26 BPMME Flour Incorporated Thepla

Table 4.29 Nutritive Value of 0%, 5% and 10% BPF (BPMMPE) Incorporated Thepla

Nutrients	0% BPF	5% BPF	10%BPF
Energy (kcal)	208	209	209
Protein (g)	6	6.01	6.05
CHO* (g)	28.5	28.5	28.45
Fat (g)	7.4	7.4	7.44
Fiber (g)	3.65	4	3.65
Calcium (mg)	85.21	85	85.21
Iron (mg)	2.24	2.2	2.24
Potassium (mg)	179.1	179	179.17
Sodium (mg)	209.85	210	209.85

The nutritional analysis of Thepla with different levels of BPF (0%, 5% and 10%) incorporation shows minimal variation in energy content, ranging from 208 to 209 kcal. Protein content increases slightly from 6 g in 0% BPF to 6.05 g in 10% BPF, indicating a marginal improvement in protein quality. Carbohydrates remain stable at around 28.5 g, while fat content is 7.4-7.45 g, suggesting no significant impact of BPF on fat levels. Fiber content remains consistent at 3.65 g, supporting digestion. Calcium and iron

values also remain largely unchanged. Potassium levels decrease slightly and sodium content remains stable across all variations.

Idada

0% BPF Idada **5% BPF Idada** **10% BPF Idada**

FIGURE 4.27 BPMME Flour Incorporated Idada

Table 4.30 Nutritive Value of 0%, 5% and 10% BPF (BPMMPE) Incorporated Idada

Nutrients	0% BPF	5% BPF	10%BPF
Energy (kcal)	221	222	222
Protein (g)	6.42	6.42	6.52
CHO* (g)	40.87	40.87	40.78
Fat (g)	1.17	1.2	1.17
Fiber (g)	5.582	6	5.58
Calcium (mg)	25.48	25	25.48
Iron (mg)	4.852	4.9	4.85
Potassium (mg)	146.98	147	146.98
Sodium (mg)	203	203	203

Incorporating Butterfly Pea Flower (BPF) in Idada slightly enhances its nutritional profile. Energy remains stable at around 221-222 kcal, while protein increases marginally from 6.42 g to 6.52 g with 10% BPF. Carbohydrates and fat remain nearly unchanged, while fiber shows a slight rise from 5.58 g to 5.62 g. Calcium stays constant at 25.48 mg, but iron improves from 4.85 mg to 4.92 mg. Potassium and sodium levels remain stable. Overall, BPF incorporation boosts protein, fiber and iron content, making Idada a nutritionally enriched option without altering its core composition, ensuring both health benefits and traditional taste.

Methi Khakra

0% BPF Methi Khakra **5% BPF Methi Khakra** **10% BPF Methi Khakra**

Figure 4.28 BPMME Flour Incorporated Methi Khakra

Table 31 Nutritive Value of 0%, 5% and 10% BPF (BPMMPE) Incorporated Methi Khakra

Nutrients	0% BPF	5% BPF	10%BPF
Energy (kcal)	77	77	77
Protein (g)	2.42	2.45	2.4
CHO* (g)	12.3	12.3	12.2
Fat (g)	1.47	1.5	1.47
Fiber (g)	1.78	2	1.78
Calcium (mg)	22.63	23	22.63
Iron (mg)	1.1	1.1	1.1
Potassium (mg)	64.21	64.2	64.21
Sodium (mg)	82	82	82

The incorporation of Butterfly Pea Flower (BPF) into Methi Khakhra has minimal impact on its nutritional composition. The energy content remains 77 kcal, while protein shows a slight increase from 2.42 g to 2.45 g at 5% BPF and 2.44 g at 10% BPF. Carbohydrates stay nearly the same, ranging from 12.3 g to 12.5 g and fat remains constant at 1.47 g. Fiber slightly increases from 1.3 g to 1.5 g, while calcium and iron levels show minor variations. Potassium and sodium remain unchanged. Overall, BPF fortification slightly enhances protein and fiber content without altering the taste or texture significantly.

Veg-Cutlet

0% BPF Veg-Cutlet **5% BPF Veg-Cutlet** **10% BPF Veg-Cutlet**

Figure 4.29 BPMME Flour Incorporated Veg-Cutlet

Table 4.32 Nutritive Value of 0%, 5% and 10% BPF (BPMMPE) Incorporated Veg-Cutlet

Nutrients	0% BPF	5% BPF	10%BPF
Energy (kcal)	84	98	98
Protein (g)	1.41	1.94	2.05
CHO* (g)	8.39	11.3	11.38
Fat (g)	5	5	8.22
Fiber (g)	1	1	091
Calcium (mg)	7.2	6.7	6.69
Iron (mg)	0.6	0.5	0.42
Potassium (mg)	164	146	137
Sodium (mg)	228	228	227

The inclusion of Butterfly Pea Flower (BPF) in veg-cutlets results in slight nutritional improvements. Energy content increases from 84 kcal (0% BPF) to 98 kcal (5% and 10% BPF) and protein content rises from 1.41 g to 2.05 g at 10% BPF. Carbohydrates remain relatively stable, while fat remains constant at 5 g. Fiber content increases marginally from 1 g to 1.5 g and calcium improves from 6.12 mg to 6.69 mg at 10% BPF. Iron and potassium levels show slight enhancements, while sodium remains consistent. These findings suggest that BPF incorporation enhances the nutritional profile without significantly altering key macronutrients.

Mathri

0% BPF Mathri **5% BPF Mathri** **10% BPF Mathri**

Figure 4.30 BPMME Flour Incorporated Mathri

Table 4.33 Nutritive Value of 0%, 5% and 10% BPF (BPMMPE) 5% and 10% BPF INCORPORATED Mathri

Nutrients	0% BPF	5% BPF	10%BPF
Energy (kcal)	170	170	170
Protein (g)	3.58	3.58	3.61
CHO* (g)	19.61	19.61	19.51
Fat (g)	8.5	8.5	8.48
Fiber (g)	2	2	2.19
Calcium (mg)	8.2	8.2	8.21
Iron (mg)	1	1	1.04
Potassium (mg)	92.2	92.2	92.2
Sodium (mg)	202	202	202

The incorporation of Butterfly Pea Flower (BPF) in Mathri maintains a consistent energy value of 170 kcal across all variations (0%, 5% and 10% BPF). Protein content remains relatively stable, increasing slightly from 3.58 g to 3.61 g at 10% BPF. Carbohydrates also show a minor rise from 19.61 g to 19.83 g. Fat content remains largely unchanged, with a slight increase at 10% BPF. Notably, fiber content increases from 2 g to 2.19 g, which enhances its dietary benefits. Calcium, iron, potassium and sodium levels remain constant. These results suggest that BPF incorporation provides slight nutritional improvements without compromising Mathri's core composition.

Kutki Soup

0% BPF Kutki Soup **5% BPF Kutki Soup** **10% BPF Kutki Soup**

Figure 4.31 BPMME FLOUR INCORPORATED Kutki Soup

Table 4.34 Nutritive Value of 0%, 5% and 10% BPF (BPMMPE) Incorporated Kutki Soup

Nutrients	0% BPF	5% BPF	10%BPF
Energy (kcal)	97	97	97
Protein (g)	2.55	2.56	2.57
CHO* (g)	14.86	14.86	14.76
Fat (g)	2.84	2.84	2.84
Fiber (g)	1.95	2	1.95
Calcium (mg)	17.16	17.16	17.16
Iron (mg)	0.34	0.34	0.34
Potassium (mg)	107	107	107
Sodium (mg)	207	207	207

The nutritional analysis of Kutki Soup with 0%, 5% and 10% Butterfly Pea Flower (BPF) incorporation reveals that the energy content remains constant at 97 kcal across all variations. Protein content increases slightly from 2.55 g to 2.57 g, while carbohydrates remain consistent at around 14.86 g to 14.76 g. Fat content shows a minor rise from 2.84 g to 2.85 g. Fiber remains unchanged at 1.95 g and calcium levels exhibit a marginal increase from 17.16 mg to 17.18 mg. Other minerals such as iron, potassium and sodium remain constant. These findings suggest that BPF incorporation does not significantly alter the nutritional composition of Kutki Soup but may offer additional health benefits due to its bioactive compounds.

Sattu Drink

0% BPF Sattu DrinK

5% BPF Sattu Drink

10% BPF Sattu Drink

Figure 4.32 BPMME Flour Incorporated Sattu Drink

Table 4.35 Nutritive Value of 0%, 5% and 10% BPF (BPMMPE) Incorporated Sattu Drink

Nutrients	0% BPF	5% BPF	10%BPF
Energy (kcal)	47	47	47
Protein (g)	2.13	2.14	2.14
CHO* (g)	8.67	8.67	8.67
Fat (g)	0.45	0.5	0.45
Fiber (g)	1.46	1.46	1.46
Calcium (mg)	7.5	7.5	7.5
Iron (mg)	0.76	0.8	0.76
Potassium (mg)	120.35	120	120.35
Sodium (mg)	82	82	82

The nutritional evaluation of Sattu Drink with 0%, 5% and 10% Butterfly Pea Flower (BPF) incorporation shows that energy content remains stable at 47 kcal across all variations. Protein content increases slightly from 2.13 g to 2.17 g, while carbohydrates remain consistent at around 8.67 g to 8.65 g. Fat content remains constant at 0.45 g across all variations and fiber content is also stable at 0.45 g. Calcium levels remain at 7.5 mg and iron content shows a minor increase from 0.76 mg to 0.78 mg. Potassium content is consistent, ranging from 120.35 mg to 120.38 mg, while sodium remains at 82 mg. These results suggest that adding BPF to Sattu Drink does not significantly impact its macronutrient composition but could enhance its functional properties due to the potential antioxidant benefits of BPF.

Ambil

0% BPF Ambil **5% Ambil** **10% BPF Ambil**

Figure 4.33 BPMME Flour Incorporated Ambil

Table 4.36 Nutritive Value of 0%, 5% and 10% BPF (BPMMPE) Incorporated Ambil

Nutrients	0% BPF	5% BPF	10%BPF
Energy (kcal)	175	175	175
Protein (g)	5.05	5.08	5.1
CHO* (g)	24.16	24.17	24.12
Fat (g)	5.97	6	5.97
Fiber (g)	12.93	13	12.93
Calcium (mg)	13.58	14	13.58
Iron (mg)	1.04	1	1.04
Potassium (mg)	87.91	87.9	87.91
Sodium (mg)	202.45	202	202.45

The incorporation of Butterfly Pea Flower (BPF) in Ambil enhances its nutritional and functional properties without drastically changing its core composition. The addition of BPF may contribute to improved fiber content and potential antioxidant benefits while maintaining the traditional taste and texture. The slight variations in protein, carbohydrates and minerals suggest that BPF does not compromise the drink's overall nutritional value. This makes it a promising ingredient for enriching Ambil with natural plant-based compounds, potentially offering health benefits such as improved digestion and enhanced bioactive properties while preserving its traditional appeal.

Modak

0% BP Modak **5% Modak** **10% BPF Modak**

Figure 4.34 BPMME Flour Incorporated Modak

Table 4.37 Nutritive Value of 0%, 5% and 10% BPF (BPMMPE) Incorporated Modak

Nutrients	0% BPF	5% BPF	10%BPF
Energy (kcal)	157	157	157
Protein (g)	2.34	2.37	2.36
CHO* (g)	20.7	20.7	20.67
Fat (g)	7.21	7.21	7.21
Fiber (g)	1.3	1	1.3
Calcium (mg)	9.2	9.2	9.2
Iron (mg)	1.47	1.47	1.47
Potassium (mg)	74.38	74.4	74.38
Sodium (mg)	3.2	3.2	3.2

The incorporation of Butterfly Pea Flower (BPF) in Modak enhances its visual appeal with a vibrant blue hue while maintaining its traditional taste and texture. The presence of BPF does not significantly alter the overall nutritional value, ensuring that the delicacy remains a rich source of carbohydrates and fats. Additionally, the inclusion of BPF may provide added health benefits due to its antioxidant properties, making Modak not just a festive treat but also a functional food. This modification presents an innovative way to integrate natural plant-based ingredients into traditional recipes while preserving their cultural significance.

Sheera

0% BPF Sheera **5% BPF Sheera** **10% BPF Sheera**

Figure 4.35 BPMME Flour Incorporated Sheera

Table 4.38 Nutritive Value of 0%, 5% and 10% BPF (BPMMPE) Incorporated Sheera

Nutrients	0% BPF	5% BPF	10%BPF
Energy (kcal)	216	216	216
Protein (g)	4.86	4.89	4.9
CHO* (g)	26.9	26.9	26.8
Fat (g)	9.76	9.8	9.76
Fiber (g)	1.53	1.53	1.53
Calcium (mg)	73.69	73.69	73.69
Iron (mg)	0.77	0.8	0.77
Potassium (mg)	146.94	147	146.94
Sodium (mg)	17.43	17.43	17.43

The incorporation of Butterfly Pea Flower (BPF) in Sheera enhances its aesthetic appeal by giving it a distinct blue color without altering its rich, traditional texture and taste. Despite the addition of BPF, the core nutritional profile remains consistent, ensuring that Sheera remains a good source of carbohydrates, fats and proteins. Additionally, the antioxidant properties of BPF may offer potential health benefits, making this variation a more functional dessert option. This adaptation successfully blends innovation with tradition, offering a visually unique and nutritionally balanced twist to a well-loved dish.

Phirni

0% BPF Phirni **5% BPF Phirni** **10% BPF Phirni**

Figure 4.36 BPMME Flour Incorporated Phirni

Table 4.39 Nutritive Value of 0%, 5% and 10% BPF (BPMMPE) Incorporated Phirni

Nutrients	0% BPF	5% BPF	10%BPF
Energy (kcal)	247	247	247
Protein (g)	7.48	7.5	7.6
CHO* (g)	26.92	26.92	26.92
Fat (g)	12.4	12	12.4
Fiber (g)	0.71	1	0.71
Calcium (mg)	191.28	191	191.28
Iron (mg)	0.28	0.3	0.28
Potassium (mg)	215.95	216	215.95
Sodium (mg)	45	45	45

The incorporation of Blue Pea Flower (BPF) in Phirni slightly increased protein (7.49% to 7.6%), fiber (0.71 g to 1.1 g) and potassium (215 mg to 215.93 mg) while maintaining energy (247 kcal) and fat (12.4 g). Carbohydrates increased slightly (76.29% to 76.92%). Calcium and iron showed minimal changes. The color darkened with increasing BPF due to anthocyanins, potentially enhancing antioxidant properties. Sensory acceptability may vary due to appearance changes. Overall, BPF incorporation improved nutritional quality without compromising Phirni's core attributes, making it a promising ingredient for functional food applications.

4.2 Sensory Evaluation of BPMMPE Flour (0% BPF, 5% BPF and 10% BPF) Incorporated Traditional Recipes

BPMMPE (Blue Pea-Millet-Milk Protein Extrudates) were utilized as a core ingredient in the formulation of eighteen traditional Indian recipes, including dishes such as dosa, idli, idada, dhokla, pudla/chilla, upma, bhakri, thepla, khakhra, mathri, appam, veg cutlet, sattu, soup, ambil, phirni, halwa and modak. These recipes were carefully developed and standardized using everyday kitchen tools to ensure practical relevance and ease of replication. Sensory evaluation was carried out using the 9-point Hedonic Scale (9-PHS) to determine overall acceptability. A panel of 30–35 semi-trained faculty members from the Department of Foods and Nutrition, Faculty of Family and Community Sciences, The Maharaja Sayajirao University of Baroda, participated voluntarily. Additionally, a semi-structured questionnaire was used to gather baseline data on the panellists, including general details, medical or medication history and awareness regarding the product and its components.

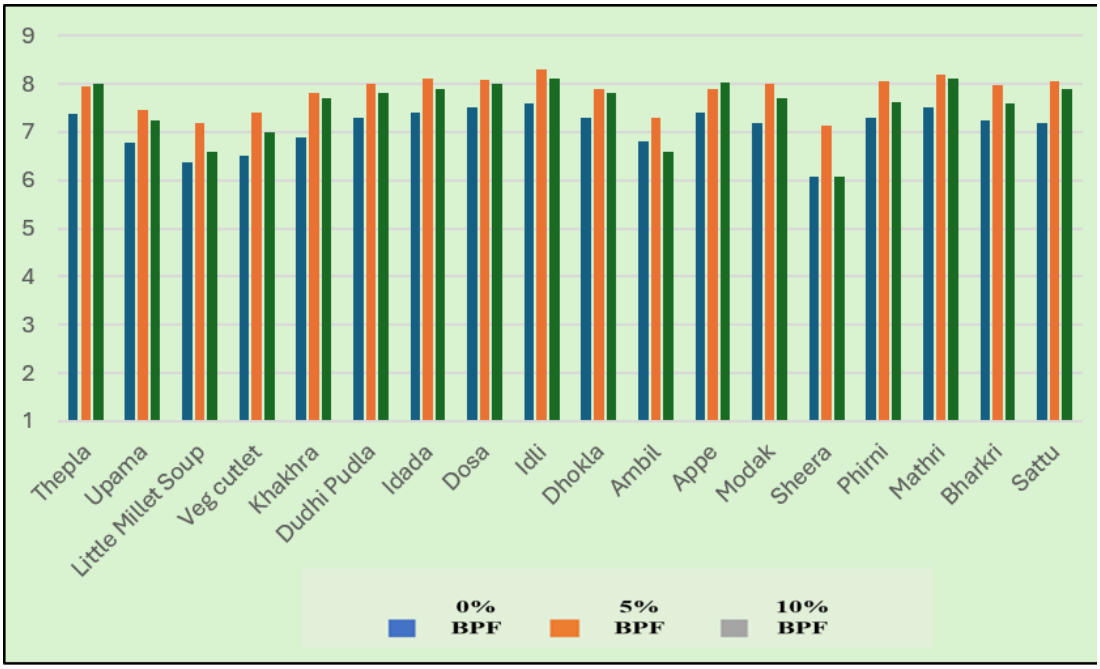

Figure 4.37 Mean Scores of the Hedonic Test of the Recipes

Table 4.40 Overall Acceptability Of The BPMME Flour Incorporated Recipes (Mean± SD)

Recipes	BPMMPE INCORPORATED RECIPES		
	0% BPF	**5% BPF**	**10%BPF**
Thepla	7.39± 1.02	7.96±0.76	8±0.90
Upama	6.78±0.97	7.46±0.94	7.25±0.98
Little Millet Soup	6.36±0.74	7.18±0.84	6.6±0.95
Veg cutlet	6.5±1.1	7.4±0.85	7±0.94
Khakhra	6.9±1.32	7.8±1.08	7.7±1.14
Dudhi Pudla	7.3±0.66	8±0.9	7.8±0.83
Idada	7.4±0.97	8.1±0.87	7.9±0.93
Dosa	7.5± 0.93	8.09±0.76	8±0.82
Idli	7.6±0.91	8.3±0.77	8.1±0.80
Dhokla	7.3±1.17	7.9±0.78	7.8±0.92
Ambil	6.8±6.84	7.3±1.15	6.6±1.56
Appe	7.4± 1.09	7.9±0.87	8.03±0.91
Modak	7.2±1.14	8±0.94	7.7±0.915
Sheera	6.08±1.18	7.13±1.27	6.08±1.63
Phirni	7.3±0.91	8.06±0.98	7.63±1.03
Mathri	7.5±0.99	8.2±0.67	8.1±0.78
Bharkri	7.26±0.9	7.97±0.71	7.6±0.93
Sattu	7.23±1.04	8.06±0.73	7.9±0.92

The overall acceptability of 18 traditional recipes incorporated with BPMMPE flour at 0%, 5% and 10% Blue Pea Flower (BPF) levels was evaluated using a 9-point Hedonic Scale. As shown in Table 4.22 and Figure 4.19, recipes with 5% BPF consistently received the highest mean acceptability scores, indicating it was the most preferred variation across most dishes. Notably, Idli (8.3±0.77), Dosa (8.09±0.76) and Phirni (8.06±0.98) scored the highest under the 5% BPF condition. Upma (7.46±0.94) and Little Millet Soup (7.18±0.84) showed improved acceptability with 5% BPF compared to 0% BPF, though acceptability dropped slightly at 10% BPF.

Similar trends were observed in most recipes, such as Thepla, Appam, Modak and Sattu, where 5% BPF scored higher than both 0% and 10% BPF. However, a slight decline in mean scores was generally noted at the 10% BPF level, possibly due to changes in color, flavor, or texture attributed to the higher concentration of Blue Pea Flower. For example, Sheera maintained a lower acceptability score across all variations, while recipes like Phirni and Idada maintained good acceptability even at 10%. In conclusion, 5% BPF incorporation in BPMMPE flour demonstrated optimal sensory acceptability across a wide range of traditional recipes, supporting its suitability as a functional ingredient without compromising consumer preference.

4.2.1 Semi-Trained Panel Questionnaire for Recipe Evaluation

This phase focused on gathering baseline data from 39 semi-trained panelists to support the sensory evaluation of BPMMPE flour-incorporated traditional recipes. The objective was to assess their demographic profile, interest level and awareness regarding millets, functional ingredients and processing methods, thereby ensuring the reliability of sensory feedback.

General information of the semi trained panellists required for the sensory evaluation.

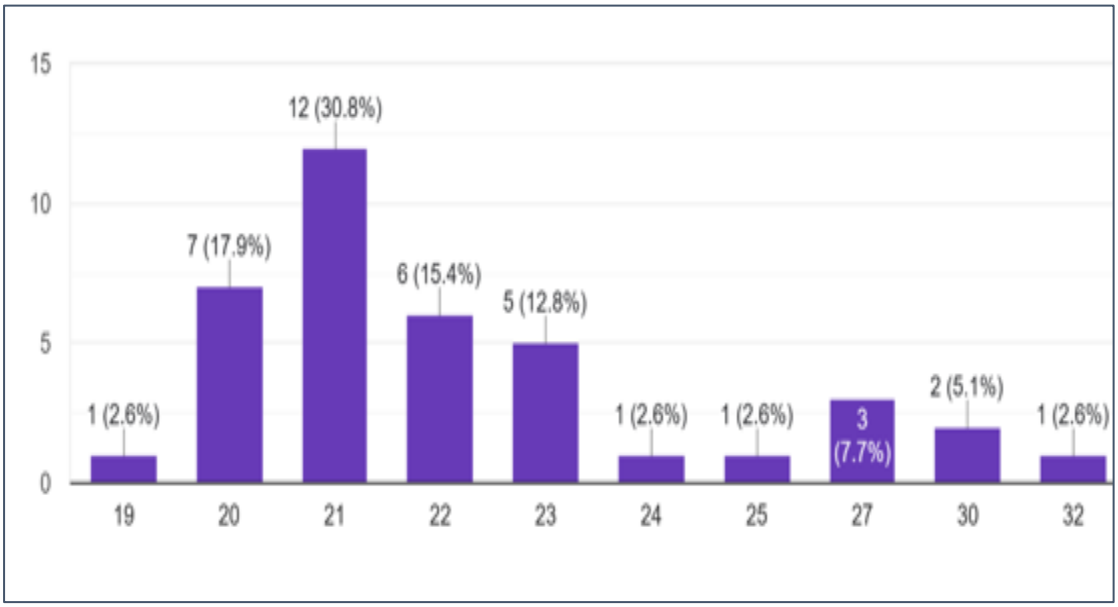

Figure 4.38 Age Distribution of Respondents (N= 39, %)

The age-wise distribution indicates that the panel consisted of adult individuals across various age groups, ensuring mature and relevant responses during sensory trials. This

diversity strengthens the reliability of the evaluation, reflecting a broader range of taste preferences.

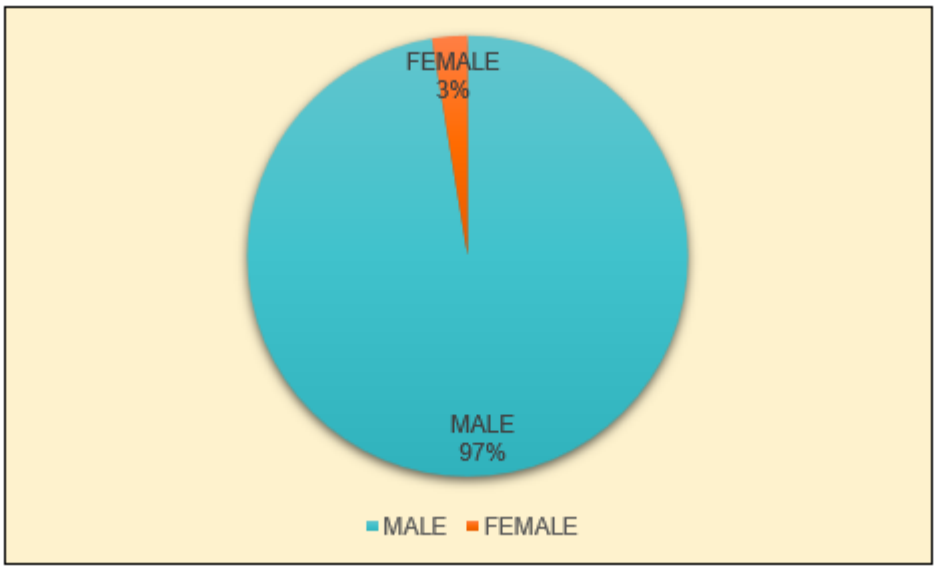

Figure 4.39 Gender of the Respondents

Figure 4.39 showsGender distribution highlights a mixed representation of both male and female panelists, promoting balanced sensory responses. This is important in understanding gender-based differences in perception and acceptability of new food products.

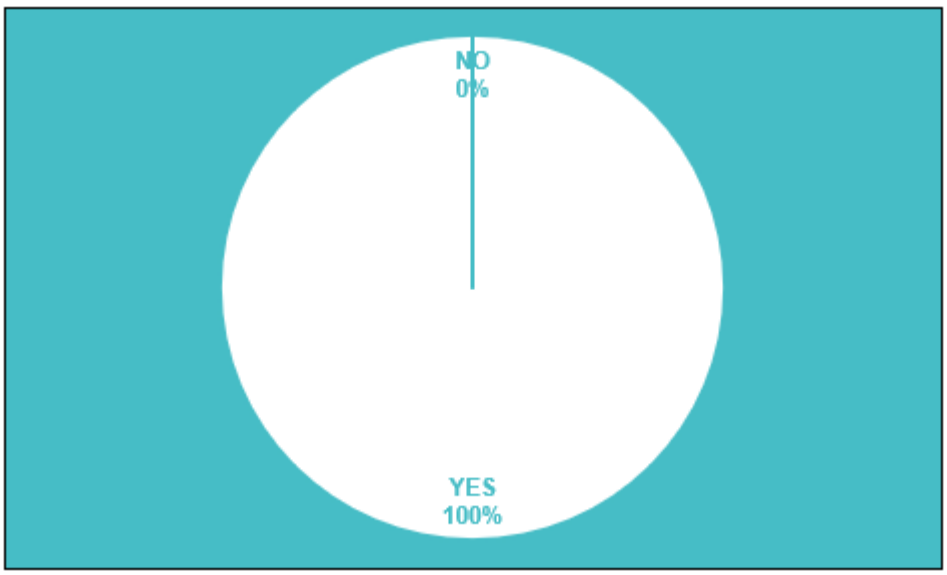

Figure 4.40 Interest in Sensory Evaluation

A majority of respondents showed willingness to participate in the sensory evaluation of extruded flour-incorporated recipes. This indicates high engagement and curiosity toward functional food development and innovation.

Table 4.41 Consumption Pattern of Millets Among the Panelists

MILLETS	Awareness [N (%)]
Pearl millet- Bajra	34 (87.2)
Sorghum- Jowar	24 (61.5)
Finger millet- Ragi	21 (53.8)
Amaranth- Rajgira	16 (41)
Kodo millet- Kodri	13 (33.3)
Buckwheat- Kuttu	6 (15.4)
Banyard millet- Sama	4 (10.3)
Little millet- Gajro	3 (7.7)
Foxtail millet- Kang	3 (7.7)
Proso millet- Cheno	2 (5.1)
None	1 (2.6)

The table 4.41 highlights the varying degrees of awareness and familiarity with different millets among the panelists. Among the highly familiar millets, Pearl millet (Bajra) was the most recognized, with 87.2% of the panelists indicating familiarity, followed by Sorghum (Jowar) at 61.5% and Finger millet (Ragi) at 53.8%. Moderately known millets included Amaranth (Rajgira) with 41% awareness and Kodo millet (Kodri) at 33.3%. In contrast, Buckwheat (Kuttu) (15.4%), Barnyard millet (Sama) (10.3%) and Little millet (Gajro) and Foxtail millet (Kang) (each at 7.7%) were less familiar to the respondents. Proso millet (Cheno) was the least recognized, with only 5.1% awareness. Notably, a very small fraction of respondents (2.6%) reported being completely unaware of any of the listed millets, indicating a general level of familiarity with at least one type of millet among the majority. This data reflects strong awareness of commonly consumed millets like bajra, jowar and ragi, but limited knowledge of underutilized millets, indicating a scope for nutrition education and promotion of diverse grains.

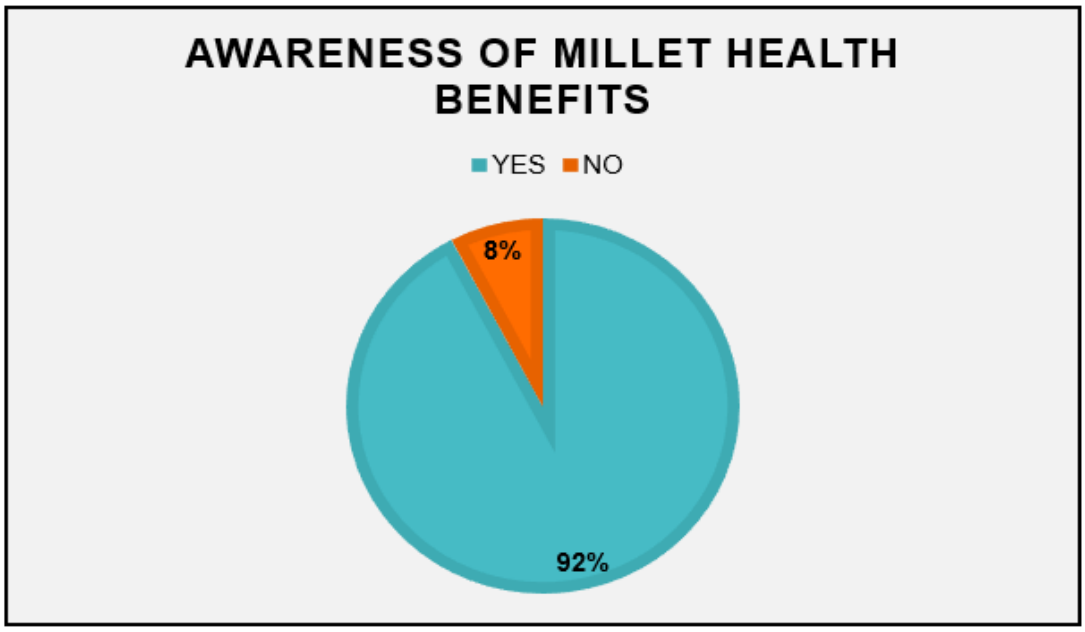

Figure 4.41 Awareness of Millet Health Benefits Among the Respondents

A significant portion of panelists acknowledged the health benefits of millets, reinforcing their acceptance as a nutritional base for product development.

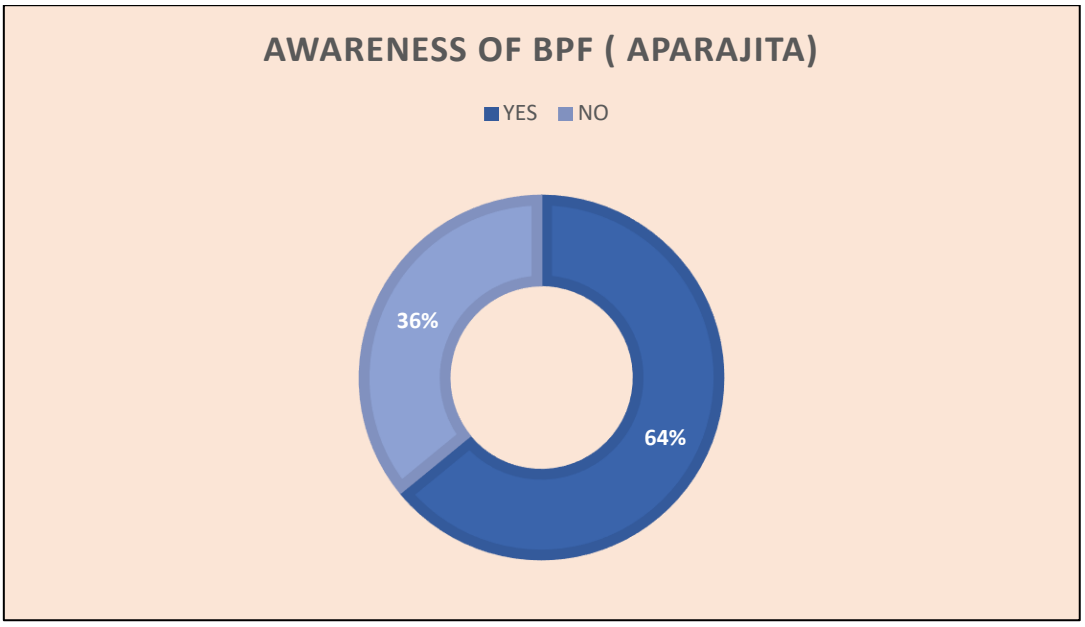

Figure 4.42 Awareness of Butterfly Blue Pea Flower (BPF)

While some panelists were familiar with BPF, awareness remained moderate. This highlights the novelty of BPF as an ingredient, requiring awareness efforts regarding its antioxidant and health-promoting properties.

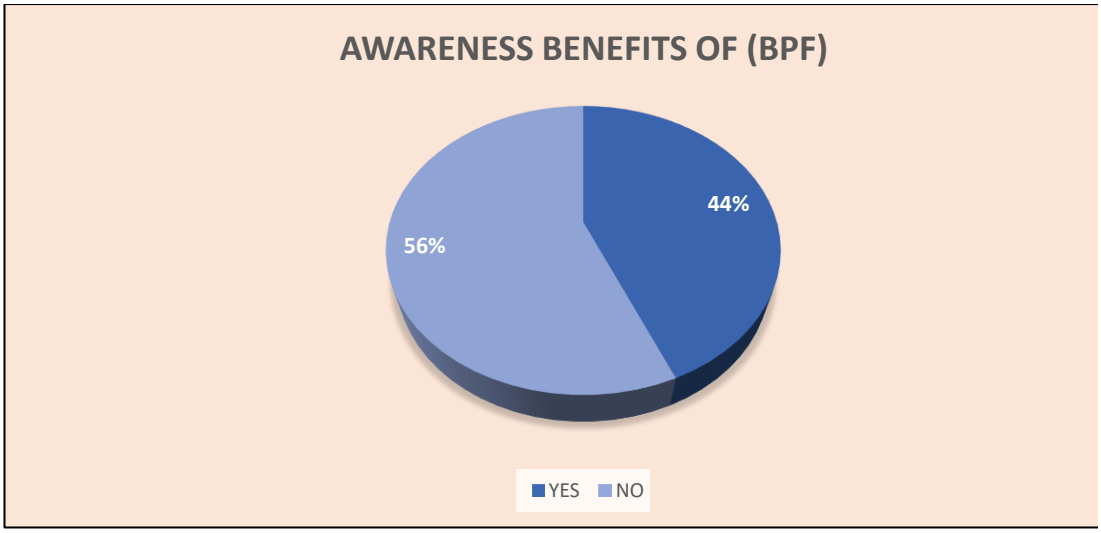

Figure 4.43 Awareness of Blue Pea Flower Health Benefits

Knowledge of its health benefits was limited to moderately high, suggesting that though BPF is recognized, its functional value is not fully understood among general consumers.

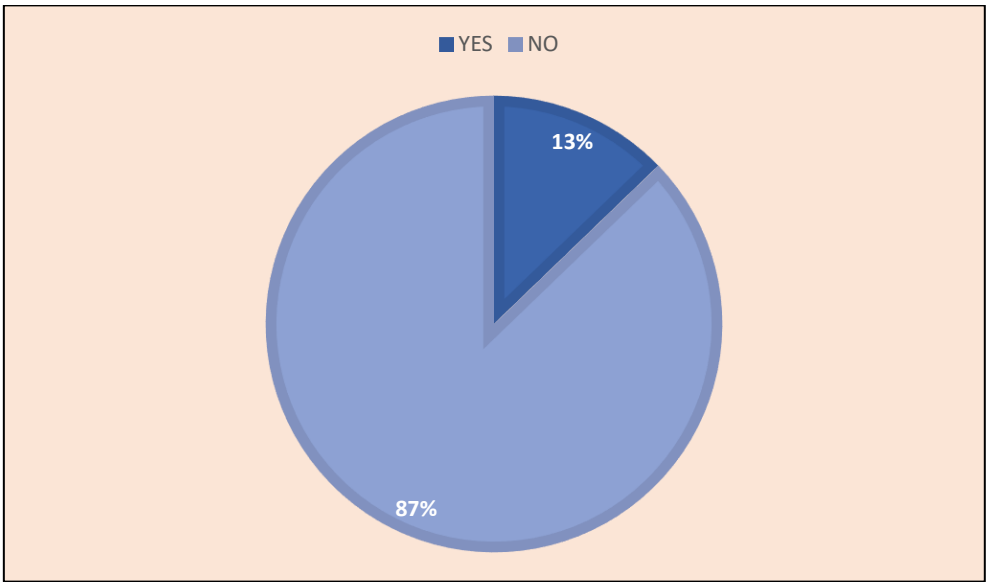

Figure 4.44 Consumption of BPF Incorporated Food

Actual consumption was low, confirming that BPF is a relatively new ingredient in mainstream diets. This affirms the innovative value of its incorporation in traditional recipes.

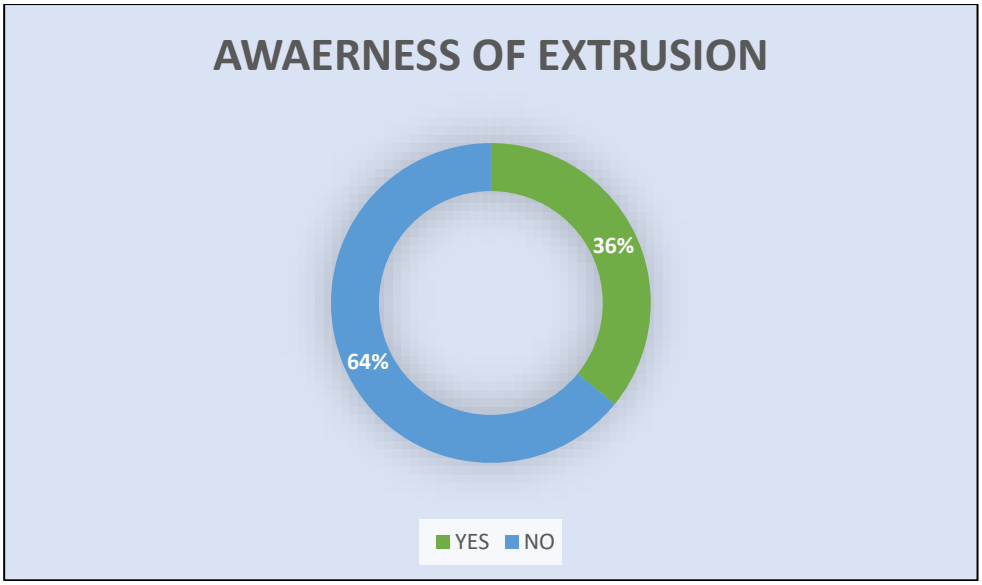

Figure 4.45 Aware of Extrusion Processing

Moderate awareness was noted regarding extrusion technology, showing that while respondents might not understand the technicalities, they are open to exploring products made through advanced processing methods.

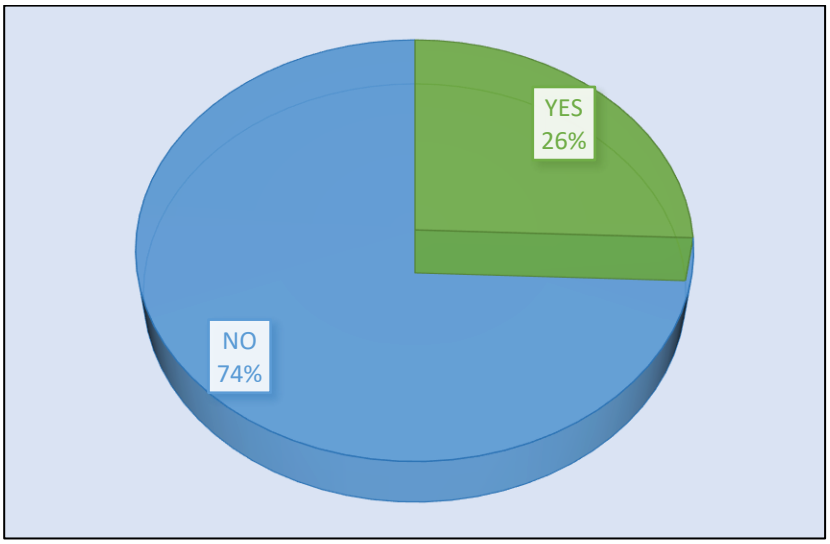

Figure 4.46 Aware of Any Extruded Food Product

Awareness of common extruded products (such as ready-to-eat cereals and snacks) existed, but the connection to health and nutrition may still need emphasis.

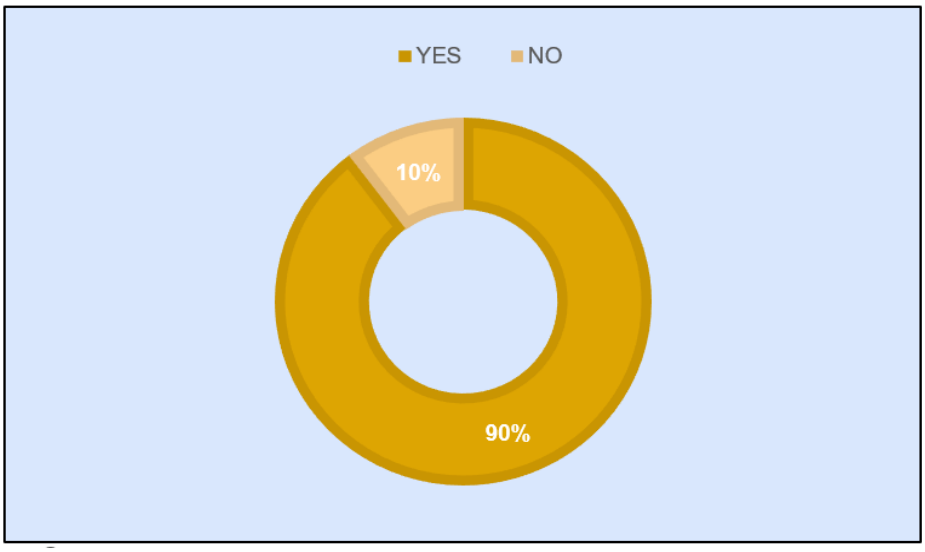

Figure 4.47 Awareness of Whey Protein Concentrates

Many respondents were aware of WPC, possibly due to its growing popularity in fitness and health markets. This supports the feasibility of its inclusion in functional formulations.

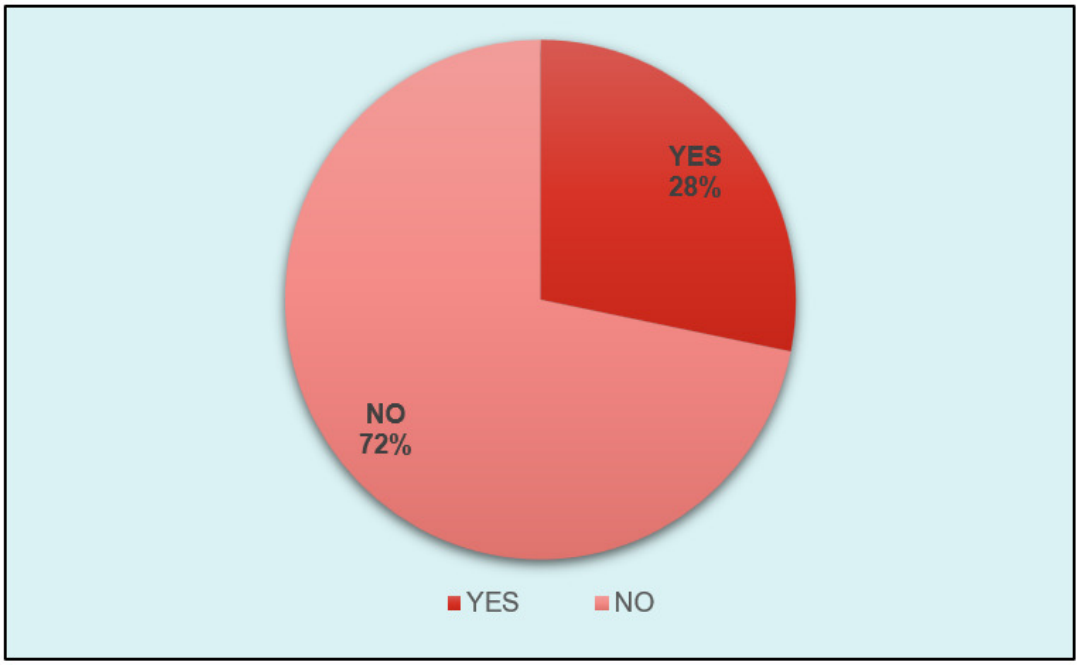

Figure 4.48 Consumption of Whey Protein Concentrates

Fewer respondents had actually consumed WPC, suggesting a gap between awareness and regular dietary use. This opens up potential for introducing WPC-fortified traditional foods in daily consumption.

4.3 Development of Recipe Booklet

The booklet of the BPMME Flour incorporated traditional Indian recipes subjected to sensory evaluation and scored highest was developed for propagating the use of BPMME flour in the daily diet of the population. (Appendix VII).

The booklet contains the following information:

- Introduction of traditional indian recipes, functional foods
- Information of functional foods
- Advantages of the ingredients used in bpmee flour
- Ingredients of the recipe
- Method of preparation of the recipes
- Nutrient composition of the recipes.

4.3.1 Introduction to Functional Foods

Functional foods provide health benefits beyond basic nutrition and are essential in preventing chronic diseases and supporting overall wellness. Blue Pea Flower (Clitoria ternatea), known for its rich antioxidant and anti-inflammatory properties, has been incorporated into BPMMPE (Blue Pea Millet Milk Protein Extrudate) flour. The vibrant color and potential health benefits of the flower offer both visual appeal and nutritional enrichment. This booklet presents traditional Indian recipes that integrate 5% BPF-enriched BPMMPE flour, making them modern functional foods with cultural relevance.

4.3.2 Methodology for Recipe Development

Recipes were developed using 5% Blue Pea Flower-enriched BPMMPE flour, incorporated at a fixed level of 15% into each traditional formulation. Recipe selection was based on sensory evaluation scores using a 9-point hedonic scale. Standardization ensured consistency in taste, texture and appearance across multiple trials. Ingredients were measured using household and standard metric units and cooking procedures were carefully recorded to allow easy replication. Nutritional values were computed using Indian Food Composition Tables (Longvah et al., 2017).

SUMMARY AND CONCLUSION

CHAPTER 5

SUMMARY AND CONCLUSION

This chapter presents a comprehensive summary of the findings derived from the current study titled *"Development of Traditional Recipes Using Blue Pea Flower Powder-Incorporated Extruded Millet and Milk Protein-Based Products and Their Sensory Acceptability."* The primary aim of this research was to assess the sensory acceptability of traditional Indian recipes enriched with an innovative extruded product formulated using blue pea flower powder, kodo millet, finger millet and milk protein.

The inclusion of functional ingredients such as blue pea flower, known for its antioxidant properties, along with nutrient-dense millets and milk protein, aligns with the broader objective of enhancing the nutritional profile of familiar culinary preparations. Through a structured experimental design, selected traditional recipes were modified by incorporating the extruded formulation and evaluated using sensory parameters to determine Semi-trained panelists acceptability.

This phase of the project is critical as it distills the core outcomes of the research, translating experimental findings into meaningful insights. The data collected and analyzed in this chapter serves as the foundation for drawing scientific conclusions regarding the palatability, visual appeal, taste, texture and overall acceptance of the developed recipes. The interpretation of these results is essential for determining the feasibility of integrating such nutrient-enriched extruded products into everyday diets, thereby contributing to the promotion of dietary diversity and functional food innovations.

The results are categorized into three main phases according to the study's objectives.

Phase I: Standardization and development of blue pea flower powder, millets and milk protein extrudates flour incorporated recipes.

Phase II: Sensory Evaluation of the blue pea flower powder, millets and milk protein extrudates flour incorporated recipes.

Phase III: Development of a blue pea flower powder, millets and milk protein extrudates flour incorporated recipes booklet.

Phase I: Standardization and development of blue pea flower powder, millets and milk protein extrudates flour incorporated recipes.

5.1.1 Selection of Recipes:

- Eighteen traditional Indian recipes representing various regions and culinary categories (breakfast, snacks, soups/beverages and desserts) were identified.
- These included recipes like Dosa, Idli, Thepla, Appam, Modak and Kutki Soup.

5.1.2 Categorization:

- Recipes were grouped based on type and cooking method like fermentation, steaming, pan-roasting, deep/shallow frying, etc. to ensure a comprehensive representation of Indian cuisine.

5.1.3 Standardization Process:

- Recipes were reconstructed under lab conditions to ensure consistency in taste, appearance, cooking time and yield.
- All recipes were analyzed for nutritional composition using the Indian Food Composition Tables (IFCT, 2017).

5.1.4 Proximate Analysis of Raw Ingredients:

- Blue Pea Flower powder showed the highest protein (20.52 g), energy (398.72 kcal) and ash content (6.07%), making it a promising functional ingredient.
- Finger millet and kodo millet offered good carbohydrate and fiber content.

5.1.5 Development of BPMMPE:

- BPMMPE flour was developed using finger millet (ragi), kodo millet (kodri), whey protein concentrate (WPC-80) and blue pea flower (BPF) powder.
- Three variants of BPMMPE were created: 0% BPF, 5% BPF and 10% BPF.
- Each traditional recipe was prepared by incorporating 15% BPMMPE flour (by weight), substituting part of the main flour/base ingredient.

5.1.6 Visual and Nutritional Assessment:

- Nutritional tables and photographs were presented for each recipe to show variation in macro- and micronutrients.
- Recipes like Idli, Dhokla, Appam and Thepla showed enhanced protein, calcium and iron content with BPMMPE incorporation.

The proximate analysis of the raw ingredients highlighted the nutritional richness of each component used in the formulation. Blue pea flower powder demonstrated the highest protein content (20.52 g), energy value (398.72 kcal) and ash content (6.07%), underscoring its potential as a valuable functional ingredient. In addition, both finger millet and kodo millet contributed significantly to the carbohydrate and dietary fiber content, making them suitable base ingredients for developing nutrient-dense extruded products.

Phase II: Sensory Evaluation of the blue pea flower powder, millets and milk protein extrudates flour incorporated recipes.

5.2.1 Objective:

- To evaluate the acceptability of BPMMPE-based recipes using a sensory panel of 30–35 semi-trained participants from the Department of Foods and Nutrition.

5.2.2 Method:

- The recipes were prepared in three variants (0%, 5% and 10% BPF).
- Sensory acceptability was rated on a 9-point Hedonic Scale.

5.2.3 Panel Demographics and Awareness:

- Majority were aware of millets but less familiar with Blue Pea Flower and its health benefits.
- Awareness of extrusion processing and WPC was moderate to high.

5.2.4 Key Findings:

- Recipes with 5% BPF consistently received the highest sensory scores.

- Top-scoring dishes included Idli (8.3), Dosa (8.09), Mathri (8.2), Phirni (8.06) and Thepla (8.0).
- Acceptability tended to decrease at the 10% BPF level, likely due to intensified color or flavor **deviations.**

5.2.5 Semi-trained panelists Perception:

- Recipes with 5% BPF were described as visually appealing, well-textured and acceptable in taste.
- Panelists expressed willingness to incorporate such recipes into regular meals.

5.2.6 Visual Documentation:

- Graphs and figures illustrated trends across different recipes and BPF inclusion levels.
- Blue hue intensity increased with higher BPF, enhancing curiosity but sometimes affecting taste acceptability.

The 5% blue pea flower (BPF)-enriched Blue Pea-Millet-Milk Protein Extrudate (BPMMPE) emerged as the most optimal formulation, effectively balancing nutritional enhancement with sensory appeal. The incorporation of this functional extrudate into traditional recipes preserved their characteristic flavor profiles, with only subtle enhancements introduced by the added ingredients. Sensory evaluation results confirmed that the fortified recipes were well accepted by Semi-trained panelists, demonstrating that traditional foods can be enriched without compromising taste. Furthermore, Semi-trained panelists feedback indicated a positive response toward the inclusion of functional extrudates in familiar dishes, supporting the potential of such innovations to promote dietary diversity and improved nutrition.

Phase III: Development of a blue pea flower powder, millets and milk protein extrudates flour incorporated recipes booklet.

5.3.1 **Objective:** To promote the practical use of BPMMPE flour through easy-to-use, culturally relevant recipes.

5.3.2 Recipe Selection Criteria:

- Based on highest sensory acceptability (mainly 5% BPF variant).
- Recipes covered multiple meal types: breakfast, snacks, beverages, desserts.

5.3.3 Booklet Structure:

- Introduction to traditional Indian recipes and functional foods.
- Details on BPMMPE flour: its ingredients, nutritional benefits and preparation method.
- Step-by-step instructions for each recipe.
- Nutrient composition per serving using IFCT data.

5.3.4 Educational Component:

- Described the role of functional ingredients in preventing chronic diseases.
- Highlighted the health benefits of millets, BPF and whey protein.
- Promoted use of locally sourced, sustainable ingredients.

5.3.5 Target Audience:

- General population, especially health-conscious individuals, vegetarians and people with lifestyle disorders.

5.3.6 Usability:

- All recipes used simple, accessible ingredients and household cooking methods.
- Standardized measurements ensured ease of replication.

The recipe booklet developed as part of this study serves as an effective nutrition education tool aimed at promoting the inclusion of functional foods in everyday diets. By encouraging the use of underutilized yet nutrient-rich ingredients such as blue pea flower and kodo millet, the booklet not only supports healthier

eating habits but also fosters greater appreciation for traditional food systems. The integration of evidence-based functional food science into culturally meaningful recipes bridges the gap between health and heritage, making nutritious eating both accessible and culturally relevant. This resource holds practical value for use in public health initiatives, dietary counseling, school meal planning and culinary education, thereby extending its impact across diverse population groups and settings.

- The three-phase research approach systematically addressed the development, evaluation and dissemination of nutritionally enhanced traditional recipes.
- Phase I demonstrated that BPMMPE flour could be successfully incorporated into a wide array of Indian dishes without affecting preparation feasibility.
- Phase II confirmed that the 5% BPF variant yielded the best sensory outcomes, offering a blend of nutritional enrichment and Semi-trained panelists satisfaction.
- Phase III culminated in a practical output—a recipe booklet—that effectively translates research findings into user-friendly knowledge.
- Overall, the study supports the integration of novel functional ingredients into ethnic foods as a viable strategy for improving nutritional quality and Semi-trained panelists acceptance.
- The research outcomes align with the broader goals of sustainable diets, food innovation and the promotion of traditional food systems in a modern context.
- Future research can focus on clinical trials to assess health impacts, shelf-life studies for commercialization and community-based interventions for scale-up.

CHAPTER 6

RECOMMENDATIONS

- Promote BPMMPE Flour in Functional Food Development: The composite flour developed using ragi, kodri, WPC-80 and BPF can be recommended for developing functional traditional recipes across institutions, food services and community settings.
- Integrate BPMMPE in Institutional Diets: BPMMPE flour should be trialed in hostels, hospitals and mid-day meal programs, particularly in recipes like Idli, Dosa, Thepla and Phirni, which demonstrated high acceptability.
- Disseminate the Recipe Booklet Widely: The recipe booklet developed during this study should be distributed through dietitians, Anganwadi workers and culinary educators for promoting functional foods at the grassroots level.
- Promote Millets and Blue Pea Flower in Local Diets: Government and NGOs should advocate for the use of finger millet, kodo millet and BPF in household cooking for their nutrient richness and role in sustainable food systems.
- Develop Commercial Products Based on Acceptable Recipes: Sensory-validated recipes (especially with 5% BPF) have potential for commercialization as ready-to-cook products or health mixes targeting urban and health-conscious consumers.
- Use BPMMPE for Dietary Diversification: BPMMPE flour can be used to diversify Indian diets, especially among populations with limited protein intake or cereal-based monotonous diets.
- Encourage Multistakeholder Involvement: Collaboration between academic institutions, food industries and health departments is recommended to scale up production, awareness and use of BPMMPE-based functional foods.

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ANNEXURES

Institutional Ethics
Committee for Human
Research
(IECHR)

FACULTY OF FAMILY AND COMMUNITY SCIENCES
THE MAHARAJA SAYAJIRAO UNIVERSITY OF BARODA

Ethical Compliance Certificate 2024-2025

This is to certify Ms. Riddhi Vichare study titled; "Development of Traditional Recipes Using Blue Pea Flower Powder -Incorporated Extruded Millet and Milk Protein-Based Products and Their Sensory Acceptability." from Department of Foods and Nutrition has been approved by the Institutional Ethics Committee for Human Research (IECHR), Faculty of Family and Community Sciences, The Maharaja Sayajirao University of Baroda. The study has been allotted the ethical approval number IECHR/FCSc/M.Sc./10/2024/45.

Komal

Prof. Komal Chauhan
Member Secretary
IECHR

Prof. Mini Sheth
Chairperson
IECHR

Chair Person
IECHR
Faculty of Family & Community Sciences
The Maharaja Sayajirao University of Baroda

ANNEXURE II

DETAILS OF CO-ROTATING TWIN SCREW EXTRUDER

Extruder Machine

The extruder used for this experiment was laboratory Co-Rotating Twin-Screw Extruder (Basic Technology Pvt. Ltd (BTPL lab model) made, Model EB-10).

Components and Features of Extruder Machine

Component	Description
Material of Construction	Stainless steel for hygiene purposes
Drive System	Main drive: 7.5 HP variable speed motor (440 V, 3 phase, 50 Hz) with Siemens/ABB frequency drive. Torque limiter coupling on output shaft of worm-reduction gear.
Extruder Barrel	Two parallel co-rotating intermeshing screws, driven by drive assembly. Self-cleaning due to rotation in the same direction.
Feeder	Co-rotating feeder with Siemens Frequency Controller variable speed. Rated capacity controlled by knob on control panel. Calibration chart for feed rate.
Heating Arrangement	Three electric heaters at feeding, kneading, and die sections. Temperature sensors connected to temperature controller on control panel.
Extruder Die	Die plate fixed with a screwed nut. Opening size fixed at 3 mm.
Cutting Knife	Automatic cutting knife driven by variable speed AC motor controlled by frequency controller. Safety guard provided.
Panel Board	Stand-alone control panel displaying screw speed, barrel temperature, feed rate, feed temperature, and cutter rpm.

Water Circulation	Water jacket connected to extruder barrel for cooling. Circulation starts when heater temperature exceeds set limit.
Inching	Bypass switch provided for direct motor drive application for cleaning purposes. Dies must be removed before using inching device.
Emergency Stop	Emergency stop switch on control panel for immediate shutdown in case of foreign object entry into the barrel. Red color for visibility.

Operational Parameters for Crispies Production Using Twin Screw Extruder

Parameters	Specifications
Barrel Temperature	$110^{O}C$
Extruder screw speed	350 rpm
Feeder speed	12 rpm
Cutter speed	2629 rpm
Torque	10.68
Diameter of the die	3 mm

ANNEXURE III

SENSORY EVALUATION OF THE RECIPES

HEDONIC RATING SCALE

Name:

Product name:

Date:

Taste the food samples and rate the samples for their acceptability as per the 9-point scale given below.

Points	Degree of Preference	Sample A	Sample B	Sample C
9	Like extremely			
8	Like very much			
7	Like moderately			
6	Like slightly			
5	Neither like nor dislike			
4	Dislike slightly			
3	Dislike moderately			
2	Dislike very much			
1	Dislike extremely			

Comments and suggestions:

Signature:

ANNEXURE IV

CONSENT FORM FOR SENSORY EVALUATION

STUDY TITLE:

Development of Traditional Recipes Using Blue Pea Flower Powder - Incorporated Extruded Millet and Milk Protein-Based Product and Their Sensory Acceptability

INVESTIGATORS

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PURPOSE OF STUDY

The purpose of this study is to develop and evaluate traditional recipes by incorporating flour from a novel extrudate made from blue pea flower (*Clitoria ternatea*), kodo millet (*Paspalum scrobiculatum*), finger millet (*Eleusine coracana*) and whey protein concentrate (WPC). This study aims to evaluate the influence of extruded flour made from blue pea flowers, millets and milk protein on the sensory characteristics and overall acceptability of traditional Indian dishes, with a focus on promoting dietary diversity and improving the nutritional profile of commonly consumed recipes. The research seeks to explore the potential of integrating the extrudate flour into traditional foods while maintaining cultural authenticity and improving health outcomes.

PROTOCOL OF THE STUDY

If you decide to join this study you will be required to taste blue pea flowers, millets and milk protein extrudates' flour incorporated traditional recipes and carry out the sensory evaluation of the recipes, using the hedonic rating scale. 15 different traditional recipes will be incorporated with blue pea flower (*Clitoria ternatea*), kodo millet

(*Paspalum scrobiculatum*), finger millet (*Eleusine coracana*) and whey protein concentrate (WPC)., sensory evaluation of which will be carried out on different days.

COST

This study only requires your time and co-operation. All the costs incurred will be borne by the researcher and there is no financial compensation for your participation in this research.

POSSIBLE BENEFITS AND RISKS

The investigation into the inclusion of 'blue pea flowers, millets and milk protein extrudates' flour in traditional recipes with a purpose of renovating the sensory aspects. Kodo millet, a gluten-free, fibre, vitamin and mineral-filled grain, providing the advantage of weight management, digestion and the control of diabetes. Whey protein concentrate is the source of high-quality protein, necessary for the regeneration of muscles and beneficial for the overall nutritional value. Blue pea flower brings to the dishes the distinction of natural, antioxidant properties, that also bring cognitive and stress-relieving and other health benefits. The risk of participation in this study is minimal.

CONFIDENTIALITY

In the study your identity will be kept confidential. The results of the study, may be published for scientific purposes but will not reveal your name or include any identifiable references to you.

RIGHT TO WITHDRAW

Your decision to join the study is voluntary. You may quit at any time, for any reason, without notice. We hope you will take part for the entire study period because we need all the information to draw correct conclusions.

VOLUNTARY CONSENT

Your co-operation is important for the success of this study. Unless many volunteers like you participate in this study it will not be possible.

INVESTIGATOR'S STATEMENT

I have explained the research program, purpose of the study and possible benefits and risks of participating in the study. The participating was given an opportunity to discuss the procedures and to ask any additional questions.

_____

Signature of the Investigator

Date_____

PARTICIPANT'S STATEMENT

I certify that I have read, or had read out to me, and that I have understood the description of the study. By signing this form, I am attesting that I have read and understood the information given above.

I give my consent to be included as a subject in the study being carried out by Ms. Riddhi Vichare under the guidance of Ms. Kanchi Baria of The Maharaja Sayajirao University of Baroda to determine the acceptability of Extrudates flour incorporated recipes.

I understand that the study requires the participant to taste formal out incorporated recipes. I have had a chance to ask questions about the study. I understand that may ask further questions at any time I have been explained to my satisfaction the purpose of this study any time

PARTICIPANT’S NAME_____

SIGNATURE_____

DATE_____

ANNEXURE V

QUESTIONNAIRE- SEMI TRAINED PANEL- RECIPES

General information of the semi trained panellists required for the sensory evaluation.

1. Name: ……
2. Gender: ◯ Male ◯ Female ◯ Others
3. Occupation:
4. Date of Birth:
5. Age:
6. Phone Number:
7. Email address:

8. Interested in the qualitative work of sensory evaluation for the extrudates flour incorporated recipes.

   - Yes
   - No

9. Willing to spend the time in sensory evaluation of the developed recipes.

   - Yes
   - No

10. Having any past or current medical history?

    - Diabetes
    - Hypertension
    - Thyroid
    - Other…….

11. Medications if any?

    ……..

12. History of cold/ cough in past three days?

    - Yes
    - No
    - Maybe

13. Allergies if any?

    …….

14. Undergone any type of surgeries in past one year?

    - Yes
    - No

15. Any addictions?

- Smoking
- Alcohol
- Tabacco
- None

Knowledge and Consumption of the Millets, Blue pea flower, Milk protein and Extruded products.

16. Which of the following millets you consume?
    - Sorghum-Jowar
    - Pearl millet-Bajra
    - Finger millet-Ragi
    - Foxtail millet-Kang
    - Banyard millet-Sama
    - Proso millet-Cheno
    - Kodo millet-Kodri
    - Little millet-Gajro
    - Amaranth-Rajgira
    - Buckwheat-Kuttu
17. Are you aware of its health benefits?
    - Yes
    - No
18. Have you heard about butterfly pea flower (Parijat)
    - Yes
    - No
19. If yes, are you aware of its health benefits.
    - Yes
    - No
20. Have you consumed any food product incorporated blue pea flower recipes before?
    - Yes
    - No
21. Do you know about extrusion?
    - Yes

- No

22. If yes, do you know any extruded products.

- Yes
- No

23. Do you know about the whey protein?

- Yes
- No

24. If yes, do you consume it?

- Yes
- No

----------Thank You----------

INDIAN TRADITIONAL

Blue Pea Flower Incorporated Recipes

THE MAHARAJA SAYAJIRAO UNIVERSITY OF BARODA

सत्यं शिवं सुन्दरम्

Estd. 1949,
Accredited Grade "A+" by NAAC

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Ms. Riddhi Vichare

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Vadodara, Gujarat, India.

For any queries related to Traditional Indian Blue Pea Flower Incorporated Recipes,

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Vadodara, Gujarat, India.

INDEX

Introduction:

Traditional Indian recipes are an integral part of the country's culinary heritage, offering a diverse range of flavors, textures and nutritional benefits. With the increasing emphasis on health and preventive nutrition, there is a growing interest in enriching these recipes with functional ingredients that offer added health benefits beyond basic nutrition (Kaur & Das, 2011). This booklet presents a collection of traditional Indian recipes formulated using BPMME flour, a unique combination of Blue Pea Flower Powder, Ragi (Finger Millet), Kodo Millet and Milk Protein Extrudates.

Functional foods, as defined by (Martirosyan and Singh 2015), are those that provide additional physiological benefits and can contribute to disease prevention. Millets such as Ragi and Kodo are excellent sources of dietary fiber, minerals and antioxidants and have been linked to improved metabolic health and reduced risk of chronic diseases (Devi et al., 2014). Blue pea flower, rich in anthocyanins, is known for its antioxidant, anti-inflammatory and cognitive-enhancing properties (Ghavami et al., 2020). Whey protein, a component of milk protein extrudates, is a high-quality protein that supports muscle development and overall well-being (Puglisi et al., 2008).

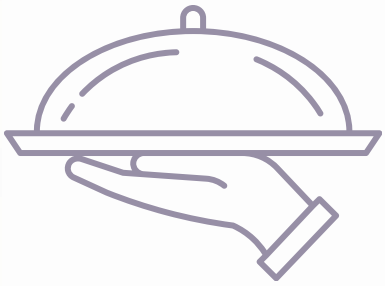
By combining millets, blue pea flower and whey protein concentrate through extrusion, a novel flour with superior nutritional and sensory characteristics can be developed. This extrudate flour offers numerous opportunities for fortifying traditional Indian recipes, making them nutritionally rich and culturally appealing and responding effectively to modern consumer preferences for convenient yet health-promoting foods.

This booklet aims to promote the use of BPMME flour as a functional ingredient by showcasing easy-to-prepare, traditional recipes that integrate these nutrient-dense components. It also provides useful information on the health benefits of each ingredient, making it a valuable resource for individuals and families looking to improve their dietary habits in a culturally relevant and sustainable way.

Advantages of Ingredients Used

- Blue pea flower powder (*Clitoria ternatea*) is a rich source of natural antioxidants, especially anthocyanins, which are responsible for its deep blue color. These antioxidants help reduce oxidative stress, enhance cognitive performance and support immune and skin health. The flower is also known for its anti-anxiety and neuroprotective effects and serves as a natural coloring agent in food products (Ghavami et al., 2020).
- Ragi, or finger millet, is a highly nutritious grain, notable for its high calcium content, dietary fiber and polyphenols. It has a low glycemic index, making it suitable for diabetic individuals. The high calcium levels help in maintaining bone health, while the fiber aids in digestion and promotes satiety. Ragi is also gluten-free, making it ideal for those with gluten sensitivities (Devi et al., 2014).
- Kodo millet is another millet variety recognized for its high dietary fiber and antioxidant content. It plays a significant role in regulating blood glucose levels, improving digestion and supporting cardiovascular health. Its richness in polyphenols contributes to chronic disease prevention and like other millets, it is naturally gluten-free (Saleh et al., 2013).

- **Whey protein concentrate, a form of milk protein, is a complete protein that contains all essential amino acids. It supports muscle growth, tissue repair and immune function. Whey protein is easily digestible and promotes satiety, making it beneficial for weight management and general nutrition, especially in active and elderly populations (Puglisi et al., 2008).**
- **Extrusion technology has emerged as a valuable processing method in modern food manufacturing. It involves forcing raw ingredients through an extruder under high temperature and pressure, transforming them into exp anded, crunchy, shelf-stable products. Extrusion enhances digestibility, palatability, nutritional quality and food safety. Furthermore, extruded foods are attractive to modern consumers seeking convenience, variety and enhanced nutrition in their diet (Guy, 2001; Baria et al., 2023).**



Breakfast Recipes

01

UPAMA

SERVING SIZE :
1 CUP

Ingredients:

5g BPMME flour, 25g Semolina, 15g Onion, ½ tsp oil, ¼ tsp Bengal gram dal, ¼ tsp black gram dal, groundnut, ½ tsp chopped green chilli, ⅛ tsp salt, 5nos of curry leaves, ½ tsp of chopped coriander, ½ tsp of lemon juice, ½ cup water.

NUTRITIVE VALUE	
Energy (kcal)	175
Protein (g)	5.08
Carbohydrates(g)	24.17
Fat (g)	6
Fiber (g)	13
Calcium (mg)	14
Iron (mg)	1
Potassium (mg)	87.9
Sodium (mg)	202

Method:

1. Roast 30g of semolina on low flame until it turns light golden. Keep stirring to avoid burning.
2. Heat a pan and add a little oil. Temper the oil, then add 15g of chopped onion and green chili.
3. Cook the onion mixture until it turns translucent.
4. Add water, salt, and bring it to a boil.
5. Slowly add the roasted semolina while stirring continuously to avoid lumps.
6. Cover the pan with a lid for 2 minutes, then continue cooking without the lid.
7. Add stir-fried groundnuts, Bengal gram, and black gram dal.
8. Turn off the flame, add lemon juice, and garnish with coriander leaves.

02

DHOKLA

SERVING SIZE :
5 PIECES

Ingredients:

7.5g BPMME flour, 38g Bengal gram dal, 4 g Black gram dal, ½ tsp oil, ½ curd, ⅛ tsp fenugreek seeds, 1 tsp green chilli, ginger and garlic paste, ¼ tsp of mustard seeds, 4 Curry leaves, 1 tbsp chopped coriander leaves.

Method:

1. Take Bengal gram dal and black gram dal in a 9:1 ratio.
2. Add ¼ tsp fenugreek seeds, clean, and wash them.
3. Soak in water for 4 hours. Grind to a smooth batter and add curd.
4. Ferment the batter in a warm place for 8-10 hours.
5. Dilute the batter with little water, add green chili-ginger paste, and salt.
6. Transfer the batter to a clean container and add a green chili on top.
7. Grease the Dhokla mold and pour the batter evenly.
8. Preheat the steamer and steam for 5-8 minutes.
9. Cut into diamond shapes and de-mold.
10. Heat oil, add tempering, and pour it over the Dhokla. Garnish with coriander leaves.

NUTRITIVE VALUE	
Energy (kcal)	194.1
Protein (g)	10.51
Carbohydrates(g)	26.44
Fat (g)	2.6
Fiber (g)	5
Calcium (mg)	34
Iron (mg)	2.7
Potassium (mg)	437
Sodium (mg)	211

03

APPAM

SERVING SIZE :
6 PIECES

Ingredients:

6.5g BPMME flour, 30 g Rice, 8 g black gram dal, 4g oil, 20g finely chopped onion, ½ tsp curd, ⅛ tsp fenugreek seeds, 1 green chilli, ⅛ tsp mustard seeds, ⅛ tsp cumin seeds, 2 no's curry leaves, 1 tsp of chopped cori ander leaves, pinch of salt.

NUTRITIVE VALUE	
Energy (kcal)	213
Protein (g)	5.8
Carbohydrates(g)	35.09
Fat (g)	4.9
Fiber (g)	2
Calcium (mg)	27
Iron (mg)	0.9
Potassium (mg)	197
Sodium (mg)	205

Method:

1. Take rice and black gram dal in a 2:1 ratio.
2. Add ¼ tsp fenugreek seeds, clean and wash them.
3. Soak in water for 4 hours. Grind to a smooth batter and add curd.
4. Ferment the batter in a warm place for 8-10 hours.
5. Dilute the batter with little water, add onion tempering, cori ander, salt and spices. Mix well.
6. Transfer the batter to a clean container and add a green chili on top.
7. Preheat the Appe pan and brush it with oil. Pour the batter into the pan.
8. Cover with a lid and cook until golden brown, then flip to the other side.
9. Cook until both sides are golden brown.

04

IDLI

SERVING SIZE :
3 PIECES

Ingredients:

9g BPMME flour, 40 g rice, 10 g Black gram dal. ¼ tsp oil, ½ tsp curd, ⅛ tsp fenugreek seeds, ⅛ tsp salt.

Method:

1. Take rice and black gram dal in a 2:1 ratio.
2. Add ¼ tsp fenugreek seeds, clean, and wash them.
3. Soak in water for 4 hours.
4. Grind to a smooth batter, add curd, and transfer the batter to a clean container.
5. Add a green chili on top to accelerate fermentation.
6. Ferment in a dark and warm place for 10-12 hours.
7. Dilute the batter with little water and add salt.
8. Grease the Idli pan with oil and pour the batter.
9. Steam for 5-8 minutes.

NUTRITIVE VALUE	
Energy (kcal)	225
Protein (g)	6.8
Carbohydrates(g)	44.1
Fat (g)	2
Fiber (g)	2
Calcium (mg)	12
Iron (mg)	0.8
Potassium (mg)	165
Sodium (mg)	204

05

DOSA

SERVING SIZE :
2 PIECES

Ingredients:

9g BPMME flour, 40g rice, 10 g Black gram dal. ¼ tsp oil, 1 tsp curd, ⅛ tsp fenugreek seeds, ⅛ tsp salt.

Method:

1. Take rice and black gram dal in a 2:1 ratio.
2. Add ¼ tsp fenugreek seeds, clean, and wash them.
3. Soak in water for 4 hours.
4. Grind to a smooth batter, add curd, and transfer to a clean container.
5. Add a green chili on top to accelerate fermentation.
6. Ferment in a dark and warm place for 10-12 hours.
7. Dilute the batter with little water and add salt.
8. Preheat the pan.
9. Spread the batter on the pan in a circular motion using the back of a ladle.
10. Cook for 2-4 minutes with little oil until golden brown.

NUTRITIVE VALUE	
Energy (kcal)	234
Protein (g)	6.8
Carbohydrates(g)	44.1
Fat (g)	3
Fiber (g)	2
Calcium (mg)	12
Iron (mg)	0.8
Potassium (mg)	165
Sodium (mg)	204

06

IDADA

SERVING SIZE :
6 PIECES

Ingredients:

8g BPMME flour, 38g Rice, 8.5g Black gram dal, ½ tsp oil, ½ tsp curd, ⅛ tsp fenugreek seeds, ½ tsp grated ginger, pinch Asafoetida, ¼ tsp mustard seeds, ¼ tsp sesame seeds, 4curry leaves, 1 tbsp finely chopped coriander.

Method:

1. Take rice and black gram dal in a 4:1 ratio.
2. Add ½ tsp fenugreek seeds, clean, and wash them.
3. Soak in water for 4 hours.
4. Grind to a smooth batter, add curd, and transfer to a clean container.
5. Add a green chili on top to accelerate fermentation.
6. Ferment in a dark and warm place for 8-10 hours.
7. Dilute the batter with little water, add green chili-ginger paste, and salt.
8. Grease the Idada mold and pour the batter evenly.
9. Sprinkle black pepper powder on top.
10. Preheat the steamer and steam for 5-8 minutes.
11. Cut into diamond shapes and demold.
12. Heat oil, add tempering, pour it over cooked Idada, and garnish with coriander leaves.

NUTRITIVE VALUE	
Energy (kcal)	222
Protein (g)	6.42
Carbohydrates(g)	40.87
Fat (g)	1.2
Fiber (g)	6
Calcium (mg)	25
Iron (mg)	4.9
Potassium (mg)	147
Sodium (mg)	203

07

BHAKRI

SERVING SIZE :
2 PIECES

Ingredients:

BPMME flour (6g), Whole wheat flour (34g), Ghee (5g), salt a pinch, water 2 tbsp

NUTRITIVE VALUE	
Energy (kcal)	176
Protein (g)	4.34
Carbohydrates(g)	26.4
Fat (g)	5.5
Fiber (g)	3
Calcium (mg)	11
Iron (mg)	1.4
Potassium (mg)	106
Sodium (mg)	81

Method:

1. Mix BPMME flour and whole wheat flour in a bowl.
2. Add a pinch of salt and mix well.
3. Gradually add water and knead into a firm dough.
4. Let the dough rest for 5-10 minutes.
5. Divide the dough into equal portions and roll into thick discs.
6. Preheat a tawa on medium heat.
7. Place the bhakri on the tawa and cook on one side for 30-40 seconds.
8. Flip and cook the other side while pressing gently with a cloth or spatula.
9. Once both sides are cooked, apply ghee evenly.
10. Serve hot with sabzi, dal, or yogurt.

08

THEPLA

SERVING SIZE :
2 PIECES

Ingredients:

6g BPMME flour, 30g Whole wheat flour, 3g Bengal gram flour,(4g) Fenugreek leaves, 11g curd, 1/4tsp Jaggery, ⅛ tsp salt, ⅛ tsp Turmeric powder, 1/4 tsp Green Chilli, ginger and garlic paste ⅛ tsp Sesame seeds, ⅛ tsp carom seeds, ⅛tsp coriander-cumin powder.

Method:

1. Take whole wheat and Bengal gram flour (9:1).
2. Add fenugreek leaves, oil, curd, jaggery, spices, and salt.
3. Knead the dough for 10 minutes, adding little water.
4. Cover and rest for 20 minutes.
5. Divide into equal portions (20g each).
6. Roll into 6-inch circles with light flour dusting.
7. Preheat pan on medium-high heat.
8. Cook one side until light brown, then flip.
9. Apply little oil on both sides and cook until golden brown.

NUTRITIVE VALUE	
Energy (kcal)	209
Protein (g)	6.01
Carbohydrates(g)	28.5
Fat (g)	7.4
Fiber (g)	4
Calcium (mg)	85
Iron (mg)	2.2
Potassium (mg)	179
Sodium (mg)	210

09

PUDLA

SERVING SIZE :
2 PIECES

Ingredients:

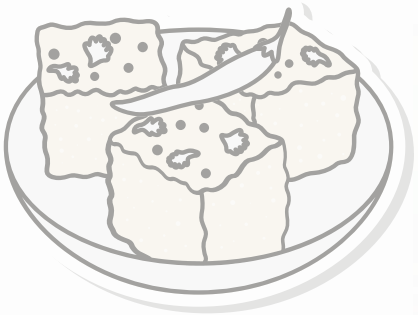
7.5g BPMME flour, (17g) whole wheat flour, 8.5g Bengal gram flour, 8.5g bajra flour, 8.5g rice flour, 50 g bottle gourd, 1/4tsp oil, ½ tsp curd, ½ tsp green chilli, ginger and garlic paste, ½ tsp sesame seeds, ¼ tsp carom seeds, ½ tsp coriander-cumin powder, 60ml water.

NUTRITIVE VALUE	
Energy (kcal)	225
Protein (g)	7.06
Carbohydrates(g)	33.84
Fat (g)	6.3
Fiber (g)	5
Calcium (mg)	62
Iron (mg)	2.4
Potassium (mg)	268
Sodium (mg)	205

Method:

1. Take whole wheat, Bengal gram, bajra, and rice flours (2:1:1:1 ratio).
2. Mix flours with grated bottle gourd (1:1 ratio).
3. Add 50g of grated bottle gourd, curd, salt, spices, and sugar.
4. Gradually add water and mix to get a smooth batter.
5. Cover and rest the batter for 15 minutes.
6. Preheat the pan on medium-high heat.
7. Brush a little oil on the pan and pour 90g of batter.
8. Spread the batter circularly using the back of a ladle.
9. Cover and cook one side, then flip.
10. Cook uncovered until golden brown.

Snack Recipes



01

MATHRI

SERVING SIZE :
2 PIECES

Ingredients:

4.5g BPMME flour, 20g Whole Wheat flour, 2g Bengal gram flour, 2g Semolina, 8ml oil, ⅛ tsp salt, ¼ tsp of onion seeds, ⅛ tsp of black pepper, 1 ½ tbsp water.

Method:

1. In a bowl, mix BPMME flour, whole wheat flour, Bengal gram flour, and semolina.
2. Add salt, onion seeds, and black pepper. Mix well.
3. Pour oil into the flour mixture and rub with fingers until it resembles coarse crumbs.
4. Gradually add water and knead into a stiff dough.
5. Cover and let the dough rest for 10-15 minutes.
6. Roll the dough into a sheet and cut into small pieces or desired shapes.
7. Heat oil in a pan for frying on low-medium heat.
8. Fry the mathris until golden brown and crispy.
9. Remove and drain on a paper towel.
10. Let them cool and store in an airtight container.

NUTRITIVE VALUE	
Energy (kcal)	170
Protein (g)	3.58
Carbohydrates(g)	19.61
Fat (g)	8.5
Fiber (g)	2
Calcium (mg)	8.2
Iron (mg)	1
Potassium (mg)	92.2
Sodium (mg)	202

02

METHI KHAKHRA

SERVING SIZE : 2 PIECES

Ingredients:

3g BMME Flour, 17g Whole wheat flour, 4g fenugreek leaves, ¼ tsp oil, ⅛ tsp carom seeds and ⅛ tsp sesame seeds, ⅛ tsp turmeric, ⅛ tsp of red chilli powder, pinch of salt, 1 ½ tbsp of water.

Method:

1. Mix whole wheat flour with dried fenugreek leaves.
2. Add spices, seeds, salt, and oil to the flour.
3. Gradually add water and knead into a dough.
4. Cover the dough with a muslin cloth and let it rest for 5 minutes.
5. Knead the dough again for 10 minutes.
6. Divide the dough into equal portions (10g each).
7. Roll each portion into a thin 5-inch circle.
8. Roast the khakhra on a low flame.
9. Keep flipping and pressing to ensure even cooking.
10. Cook until golden brown and crispy.

NUTRITIVE VALUE	
Energy (kcal)	77
Protein (g)	2.45
Carbohydrates(g)	12.3
Fat (g)	1.5
Fiber (g)	2
Calcium (mg)	23
Iron (mg)	1.1
Potassium (mg)	64.2
Sodium (mg)	82

03

VEG CUTLET

SERVING SIZE :
2 PIECES

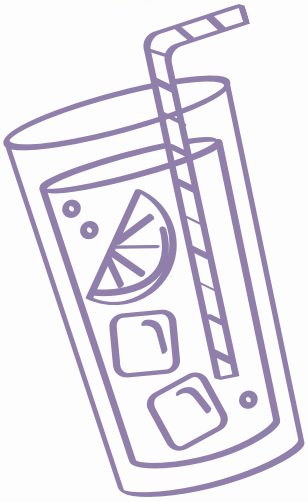
Ingredients:

5.5g BPMME flour, 17g Potato, 8.5g Green peas, 5g Carrot, 5g beetroot, 4 g Poha, 5 ml oil, ⅛ tsp of salt, ¼ tsp of finely chopped green chilli, 1 tbsp of chopped coriander leaves.

Method:

1. Boil and mash the potato, green peas, carrot, and beetroot.
2. Rinse poha in water and let it soften for a few minutes.
3. In a bowl, mix BPMME flour, mashed vegetables, softened poha, salt, chopped green chili, and coriander leaves.
4. Add oil and mix well to form a dough-like mixture.
5. Shape the mixture into small cutlets or patties.
6. Heat a pan with little oil and shallow fry the cutlets on medium flame.
7. Flip and cook until both sides are golden brown and crisp.
8. Serve hot with chutney or ketchup.

NUTRITIVE VALUE	
Energy (kcal)	98
Protein (g)	1.94
Carbohydrates(g)	11.3
Fat (g)	5
Fiber (g)	1
Calcium (mg)	6.7
Iron (mg)	0.5
Potassium (mg)	146
Sodium (mg)	228



Soups & Beverages

01

AMBIL

SERVING SIZE :
1 GLASS

Ingredients:

3g BPMME flour, 17g finger Millet flour, 150 ml buttermilk, ¼ tsp cumin powder, ⅛ tsp ginger, ⅛ tsp of green chilli, ⅛ tsp salt, ½ tsp of coriander, 50 ml water.

Method:

1. Roast the finger millet flour in ghee for 2 minutes on low heat.
2. Add water, salt, and spices. Cook for 5 minutes.
3. Turn off the flame and add buttermilk. Mix well.
4. Garnish with coriander leaves.

NUTRITIVE VALUE	
Energy (kcal)	105
Protein (g)	3.46
Carbohydrates(g)	15.46
Fat (g)	3.2
Fiber (g)	2
Calcium (mg)	151
Iron (mg)	0.91
Potassium (mg)	153
Sodium (mg)	100

02

KUTKI SOUP

SERVING SIZE :
1 BOWL

Ingredients:

3g BPMME flour, 12g little millet flour, 10g Onion, 8g Carrot, 8 g of peas, 8 g corn, ¼ tsp oil, ⅛ tsp salt, 1 tsp lemon juice, ⅛ tsp black pepper powder, ¼ cumin seeds, 200 ml water.

Method:

1. Dry roast 20g little millet, let it cool, and grind into coarse flour.
2. Take a pan, add oil for tempering, and sauté chopped onion, carrot, peas, and corn.
3. Cook for 5 minutes until the vegetables are 60% done, then add the millet flour.
4. Add water, salt, and cook for 5-10 minutes.
5. Turn off the flame, add lemon juice, and garnish with coriander leaves.

NUTRITIVE VALUE	
Energy (kcal)	97
Protein (g)	2.56
Carbohydrates(g)	14.86
Fat (g)	2.84
Fiber (g)	2
Calcium (mg)	17.16
Iron (mg)	0.34
Potassium (mg)	107
Sodium (mg)	207

03

SATTU DRINK

SERVING SIZE :
1 GLASS

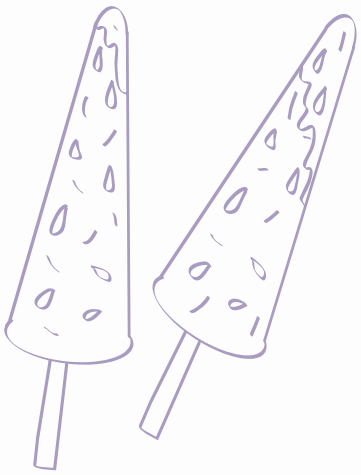
Ingredients:

2g BPMME flour, 8g Sattu, 5g dates powder, ¼ tsp Cumin powder, 2 tsp lemon juice, finely chopped mint leaves, 200 ml Water.

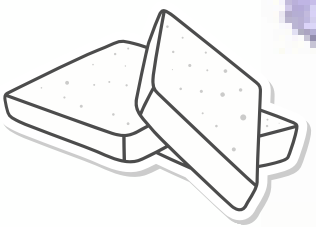
Method:

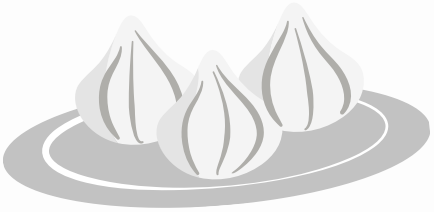
1. Dry roast 10g Bengal gram, let it cool, and grind into fine flour (Sattu).
2. Take water and add the Sattu along with cumin powder.
3. Add black salt, lemon juice, chopped green chili, ginger, and black pepper.
4. Mix everything well, refrigerate for 1 hour.
5. Serve cool, garnished with finely chopped mint leaves.

NUTRITIVE VALUE	
Energy (kcal)	47
Protein (g)	2.14
Carbohydrates(g)	8.67
Fat (g)	0.5
Fiber (g)	1.46
Calcium (mg)	7.5
Iron (mg)	0.8
Potassium (mg)	120
Sodium (mg)	82



Dessert Recipes





01 UKADICHE MODAK

SERVING SIZE :
1 PIECE

Ingredients:

3g BPMME flour, 17g Rice flour, 5g jaggery, 12g shredded coconut, ¼ tsp ghee, pinch of salt, pinch of cardamom powder, 3 tbsp water.

Method:

1. Take grated jaggery and shredded coconut (3:7 ratio).
2. Roast coconut for 2 minutes on medium flame, then add jaggery.
3. Cook until the jaggery melts and forms a thick stuffing. Keep aside.
4. In a pan, boil water with ghee and salt.
5. Add rice flour and stir until water is absorbed. Turn off the flame and cover.
6. Let it cool slightly, then knead into a smooth dough.
7. Make small balls from the dough and flatten into small discs.
8. Fill each disc with stuffing and shape into modaks.
9. Place a wet muslin cloth in a steamer and arrange the modaks on it.
10. Cover and steam for 5-8 minutes.
11. Serve warm!

NUTRITIVE VALUE	
Energy (kcal)	157
Protein (g)	2.37
Carbohydrates(g)	20.7
Fat (g)	7.21
Fiber (g)	1
Calcium (mg)	9.2
Iron (mg)	1.47
Potassium (mg)	74.4
Sodium (mg)	3.2

02 SHEERA

SERVING SIZE :
1 BOWL

Ingredients:

3g BPMME flour, 17g Semolina, 55 ml Milk, 5g sugar, 5 g ghee, pinch Cardamom powder, 3-4 pieces chopped Cashews and raisins.

Method:

1. Heat a pan and add 5g ghee.
2. Once the ghee melts, add 17g semolina (rava) and 3g BPMME flour.
3. Roast the mixture on low to medium flame until it turns golden and gives a nice aroma.
4. In a separate pot, warm 55 ml milk and dissolve 5g sugar in it.
5. Slowly add the milk-sugar mix to the roasted flour, stirring continuously to avoid lumps.
6. Cook until the mixture thickens and leaves the sides of the pan.
7. Add a pinch of cardamom powder and mix well.
8. Garnish with 3-4 chopped cashews and raisins.
9. Serve warm and enjoy!

NUTRITIVE VALUE	
Energy (kcal)	216
Protein (g)	4.89
Carbohydrates(g)	26.9
Fat (g)	9.8
Fiber (g)	1.53
Calcium (mg)	73.69
Iron (mg)	0.8
Potassium (mg)	147
Sodium (mg)	17

03

PHIRNI

SERVING SIZE :
1 BOWL

Ingredients:

2g BPMME flour, 8 g Rice flour, 150 ml Milk, 6g Sugar, ⅛ tsp cardamom, 2-3 strands Saffron, 2 - 3 pieces chopped Pistachios and almonds.

Method:

1. Take 10g rice, wash and soak it for 2 hours.
2. Dry the soaked rice and grind it coarsely.
3. In a pan, add 150 ml of milk and cook until it reduces to 70%.
4. Add the ground rice and cook, stirring continuously.
5. When rice is 90% cooked, add sugar and cardamom.
6. Stir until fully cooked and thick.
7. Turn off the flame and refrigerate for 2-3 hours.
8. Garnish with chopped almonds and pistachios.
9. Serve chilled!

NUTRITIVE VALUE	
Energy (kcal)	247
Protein (g)	7.5
Carbohydrates(g)	26.92
Fat (g)	12
Fiber (g)	1
Calcium (mg)	191
Iron (mg)	0.3
Potassium (mg)	216
Sodium (mg)	45

Abbreviations & Measures

- Tsp- teaspoon
- Tbsp- tablespoon
- Nos.- numbers
- g- gram
- mg- milligram
- cm- centimeter
- kcal- kilocalories
- 1 cup- standard cup

- 1 tsp- 5 g
- 1 tbsp- 15 g
- 1 standard cup- 200ml

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