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Development, Sensory Analysis and Nutritional Evaluation of "Nutritious *Polika"* for Protein Energy Malnutrition (PEM)

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Abstract

Nutritious *Polika*, a traditional dietary formulation enriched with a combination of cereals and pulses, addresses the nutritional need of the population suffering from Protein Energy Malnutrition (PEM). This paper presents a comprehensive investigation into the development, sensory evaluation and nutritional analysis of *Polika*. The product was developed systematically, leveraging guidelines as mentioned in the ancient classical text of *Ayurveda, Ksemakutuhalam*. The research methodology involves the preparation of the product, with variations in ingredients and processing techniques. Thereafter, sensory analysis by a panel of 15 semi-trained panelists was conducted using a 5-point hedonic scale to determine the overall acceptability of the product. A proximate analysis was conducted to determine the nutritional composition of the product including energy, proteins, fats, iron, carbohydrates and fibre content, thereby providing a comprehensive dietary profile of Nutritious *Polika*. The findings of this study provided a understanding of Nutritious *Polika*, integrating traditional *Ayurvedic* dietary practices with contemporary nutritional science. The research outcomes offer valuable insights for food technologists, nutritionists, and public health professionals, encouraging further exploration and application of this culturally significant food in addressing nutritional deficiencies, particularly in managing Protein Energy Malnutrition (PEM).

1. Introduction

Nutrition refers to the process of utilizing food for growth, development, metabolism and repair of body tissues [(1)]. A nutritious/wholesome diet is beneficial for an individual's bodily channels, constitution, and strength. Nutrition impacts the development process at all stages of life-cycle, from conception to death.

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Protein Energy Malnutrition (PEM) is a prevalent nutritional deficiency, particularly affecting children and socioeconomically disadvantaged populations. Protein Energy Malnutrition (PEM) refers to an imbalance between the supply and demand for essential nutrients required by the body [(2)]. This condition arises from an inadequate intake of protein and calories, leading to severe health issues such as stunted growth, muscle wasting, weakened immunity, and increased susceptibility to infections. Globally it is estimated that 26 million children under five years of age are severely malnourished [(3)]. Addressing PEM requires a multifaceted approach, including dietary interventions that are both nutrient-dense and culturally acceptable.

Ayurveda, the ancient science of life, offers a wealth of knowledge on dietetics and nutrition. The concept of *Ahara* (diet) in *Ayurveda* is considered as the best of all medicines and one of the pillars for sustenance of life. *Ayurveda* focuses on many therapeutic dietary formulations which can be used as an effective strategy for preventing and treating disease conditions. The *Ayurvedic* approach to diet emphasizes the use of natural, wholesome ingredients to maintain health and balance the body's elements. It can be observed that, the traditional dietary formulations derived from natural foods, can play a significant role in alleviating symptoms and offering relief from various ailments.

Selecting an *Ayurvedic* scripture renowned for its high protein and energy content, while being widely accepted by consumers, can significantly aid in combating Protein Energy Malnutrition (PEM) and promoting overall health and well-being. Traditional *Ayurvedic* texts like *Ksemakutuhalam*, authored by *Kshema* Sharma in the 16th century, is structured into 12 chapters, each called an *Utsava*. A thorough study of *Ksemakutuhalam* provides detailed guidance on food preparation methods that enhance both the nutritional value and therapeutic benefits of various recipes [(4)]. These time-tested culinary practices can be adapted to modern nutritional needs, offering innovative solutions to contemporary health challenges.

Nutritious *Polika* is a traditional recipe derived from *Kshemakutuhalam*, specifically designed to address malnutrition [(4)]. It combines a variety of cereals and pulses such as wheat, *moong dal*, *masoor dal*, and *urad dal* along with beneficial spices to create a balanced and nourishing food. These ingredients are known for their high protein, iron, and fiber content, making *Polika* an ideal dietary intervention for individuals suffering from PEM. By integrating traditional *Ayurvedic* principles with modern nutritional analysis, this study aims

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to develop and evaluate Nutritious *Polika* as a functional food product that can contribute to improving nutritional status in vulnerable populations.

In *Ayurvedic* texts, malnutrition, particularly in the context of Protein Energy Malnutrition (PEM), can be understood through the imbalances in the body's essential elements and energies. PEM manifests with symptoms such as weakness, emaciation, fatigue, and sometimes anemia, all of which indicate a depletion or imbalance of the *Prana* (body's vital energies) and *Dhatus* (structural components). According to Ayurveda, the root cause of malnutrition can be traced to disturbances in the *Agni* (digestive fire), which is responsible for proper digestion, absorption, and assimilation of nutrients. When *Agni* is weak, the body struggles to absorb and transform food into the essential nutrients needed for growth and maintenance. Additionally, imbalances in the *Doshas* (three regulatory energies) and *Dhatus* (seven fundamental body tissues) can lead to the depletion of *Ojas* (essence of all seven *dhatu*), leaving the individual vulnerable to fatigue, lethargy, and other symptoms of PEM. *Ayurvedic* texts describe such conditions as a derangement of the body's internal balance, where the normal functioning of bodily systems is compromised. Factors like improper *Ahara* (diet), inadequate *Nidra* (sleep), lack of *Vyayama* (exercise), and *Satva* (poor mental health) all contribute to the onset of malnutrition. The treatment of PEM in *Ayurveda* emphasizes the restoration of *Agni*, the balancing of *Doshas*, and the nourishment of the *Dhatus* through a carefully prescribed diet, lifestyle changes, and *Rasayana* (rejuvenative therapies) to restore strength, vitality, and proper nourishment.

2. Aim

The aim of the study was to develop and analyze ancient *Ayurvedic* scripture based Nutritious *Polika* (Cereals and pulses *Polika*) for its Organoleptic, Nutritional and Microbial qualities with special aim in the application for Protein Energy Malnutrition (PEM).

3. Objectives

The objectives of this study were-

- To identify the recipes with strengthening and nourishing properties from traditional classical *Ayurved* text *Ksemkutuhalam,* focusing on their potential to address Protein Energy Malnutrition (PEM).

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- To standardize the preparation of the selected Nutritious *Polika* recipe, and evaluate its nutritional, along with assessing its sensory qualities for better acceptability.
- To explore the practical application of Nutritious *Polika* in managing PEM, including its *Ayurvedic* benefits, storage stability, and providing dietary recommendations based on its therapeutic potential.
- To study the concept of malnutrition according to *Ayurvedic* principles and Modern nutrition science.

4. Materials & Methods

4.1 Methodology

As per the aim and objectives of the study, the methodology was designed as follows:

4.1.1 Preparation of Nutritious *Polika*

In classical *Ayurvedic* texts, the methods of food preparation and their therapeutic benefits are traditionally conveyed through *shloka* (verses). These poetic descriptions, while rich in knowledge, require interpretation to identify specific ingredients and processes. To bridge the gap between ancient wisdom and contemporary culinary practices, it is essential to analyze these verses, decode their components, and refine the preparation techniques to align with modern standards. This paper aims to standardize the preparation of Nutritious *Polika*, providing a clear, step-by-step method, and offering a detailed nutritional analysis to ensure its efficacy and health benefits in today's context.

To prepare Nutritious *Polika*, the traditional recipe described in the *Kshemakutuhalam* was carefully documented. According to the ancient text, *Mandak* is made by grinding husked wheat and roasting it in *ghee*. When large pieces of roasted wheat grain are used, the product is termed "*Polika*." It is traditionally characterized by its *vatnashaka* (*Vata*-pacifying), *pittanashaka* (*Pitta*-pacifying), *kaphkara* (*Kapha*-reducing), *snigdha* (unctuous), *madhura* (sweet), *guru* (heavy), and *asthisandhankara* (bone-strengthening) properties [(4)]. However, to tailor this recipe specifically for addressing Protein Energy Malnutrition (PEM) as per modern science, certain modifications were made. Along with wheat, additional nutrient-rich flours such as *moong dal* flour, *urad dal* flour, and *masoor dal* flour were incorporated. Spices and herbs like *kasturi methi* (dry fenugreek leaves), *jeera* (cumin seeds), *ajwain* (carom seeds) and *til* (sesame seeds) were added not only to enhance the flavor but

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also for their digestive and health-promoting benefits. All ingredients were freshly procured from local stores, ensuring high quality and adherence to the sensory and nutritional standards required for this therapeutic preparation.

- **Initial recipe preparation-**

To prepare Nutritious *Polika*, the required ingredients were carefully selected and procured from local vendors. The preparation began by mixing wheat flour, *moong dal* flour, *urad dal* flour, and *masoor dal* flour in a large bowl. To this mixture, sesame seeds, carom seeds, cumin seeds, dry fenugreek leaves, and rock salt were added to enhance both the taste and nutritional properties. Subsequently, a generous amount of hot *ghee* was added, and all ingredients were thoroughly mixed to achieve a crumbly texture. Water was then added gradually, kneading the mixture into soft and pliable dough. Once the dough was ready, it was divided into portions and rolled out to form thin flatbreads, commonly known as *poli* or *laccha poli*. These flatbreads were roasted on a hot griddle, during which additional *ghee* was spread on both sides to ensure even cooking and a rich, flavorful finish. The roasted *Polika* was then ready to be served, providing a nutritious and wholesome option suitable for addressing Protein Energy Malnutrition (PEM).

Table 1: Experimental Trials- Quantity of ingredients

Ingredients	**T_1**	**T_2**
Wheat flour (g)	50	50
Moong dal flour (g)	20	30
Masoor dal flour (g)	20	10
Urad dal flour (g)	20	10
Rock salt (g)	2.5	3
Cow's *ghee* (ml)	5	15
Sesame seeds (g)	5	5
Dry fenugreek leaves (g)	-	5

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Carom seeds (g)	5	5
Cumin seeds (g)	5	5

- **Sensory Analysis-** Two trials of the product (T_1 and T_2) consisting of different proportions of ingredients were conducted. Both trials were subjected to sensory analysis by 15 semi trained panelists using 5-point hedonic scale. T_2 trial product was found to be excellent in terms of overall acceptability; hence the proportion of ingredients of T_2 trial was finalized.

Figure 1: Sensory Analysis Scorecard

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SENSORY ANALYSIS SCORECARD

Trial No:

Name of the Product:

Date:

Name of the Panelist:

Directions:-

Please taste the sample/ product provided to you and rate according to the key points given below. Do mention any comments if you feel so. Your suggestions are important.

1	2	3	4	5
Poor	Fair	Good	Very Good	Excellent

Sample	Appearance	Colour	Flavour	Taste	Texture	Shape	Overall Acceptability

Comment:-

Signature of the Panelist

- **Final recipe preparation-**

The final recipe was prepared by using following quantity of ingredients:

Table 2: Final product quantity of ingredients

Ingredients	**Weight**
Wheat flour (g)	50

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Moong dal flour (g)	30
Masoor dal flour (g)	10
Urad dal flour (g)	10
Rock salt (g)	3
Cow's *ghee* (ml)	15
Sesame seeds (g)	5
Dry fenugreek leaves (g)	5
Carom seeds (g)	5
Cumin seeds (g)	5

- **Nutritional Analysis-** The final product was subjected to laboratory analysis. Physicochemical and nutritional analysis methods were done by using the standard methods in government accredited laboratory as follows:

Various methods used for proximate nutritional analysis

Table 3: Test method used for nutritional analysis

Test Done	Test Method
Total Energy	FHHL/SOP/CHEM/F/17(f) Issue No. 2 Issue Date -01 June 2022
Protein	IS 7219 (Modified method by FOSS Kjeltec): 1973
Iron	FHHL/SOP/CHEM/F/17(f) Issue No. 2 Issue Date -01 June 2022
Carbohydrate	FHHL/SOP/CHEM/F/17(f) Issue No. 2 Issue Date -01 June 2022
Fat	IS 6287 Cl. No. 10: 1985
Crude Fiber	IS 10226 (Part 1): 1982

Method used for microbial analysis

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Total Plate Count- IS 5402:2012

4.2 Materials

- **Property of each ingredient as per Ayurveda**

4.2.1. Wheat Flour (*Triticum aestivum*)

Wheat flour is *madhura* (sweet) in taste and *sheeta* (cold) in potency. It is characterized by *guru* (heavy) and *snigdha* (unctuous) qualities. Wheat flour is known to pacify *Vata* and *Pitta dosha* while increasing *Kapha dosha*, and blood production. It is nourishing (*bruhana*), strength-promoting (*balya*), and supports tissue repair (*sandhankruta*) and reproductive health (*shukrakara*). Additionally, wheat flour is beneficial for enhancing skin health (*vrnya*) and promoting vitality (*jeevana*) [(5)], making it an important dietary staple for overall nourishment and strength.

Nutritive Values (Per 100g):

Energy- 321kcal

Carbohydrate- 64.1g

Protein-10.94g

Total Fat- 1.5g

Iron- 4.1mg

Fiber- 11.36g

Vitamin B1- 0.42mg

Vitamin B3-2.37mg

Vitamin B9- 29.22µg [(6)]

4.2.2 *Moong dal* flour (Green gram flour/ *Vigna radiate*)

Moong dal flour is *madhura* (sweet) and *kashaya* (astringent) in taste, with a *sheeta* (cold) potency and *katu* (pungent) post-digestive effect. It is characterized by *ruksha* (dry), *grahi* (absorbent), *laghu* (light), and *vishad* (clear) qualities. *Moong dal* flour helps to pacify *Kapha* and *Pitta doshas*. It is known to be *balya* (strength-promoting) and *pushtiprad* (nourishing), making it beneficial for enhancing strength and tissue nutrition. Additionally, it supports skin health by promoting a radiant complexion (*vrnya*) [(7)].

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Nutritive Values (Per 100g):

Energy- 326kcal

Carbohydrate- 52.6g

Protein-23.8g

Total Fat- 1.3g

Iron- 3.9mg

Fiber- 9.3g [6]

4.2.3 *Masoor dal* flour (Red lentil/ *Lens culinaris*)

Masoor dal flour is *madhura* (sweet) and *kashaya* (astringent) in taste, with a *sheeta* (cold) potency and a *madhura* (sweet) post-digestive effect. It possesses *snigdha* (unctuous), *guru* (heavy), and *sara* (flowing) qualities. *Masoor dal* flour is effective in pacifying *Pitta* and *Kapha doshas* while mildly increasing *Vata*. It is *balya* (strength-promoting), providing nourishment and strength to the body. Additionally, it promotes skin health and radiance (*vrnya*) [8].

Nutritive Values (Per 100g):

Energy- 323kcal

Carbohydrate- 52.6g

Protein-24.3g

Total Fat- 0.7g

Iron- 7.06mg

Fiber- 10.4g [6]

4.2.4 *Urad dal* flour (Black gram flour / *Vigna mungo*)

Urad dal flour is *madhura* (sweet) in taste, with an *ushna* (heating) potency and an *amla* (sour) post-digestive effect. It is characterized by *snigdha* (unctuous), *guru* (heavy), and *sara* (flowing) qualities. *Urad dal* flour tends to increase *Pitta* and *Kapha doshas* while effectively pacifying *Vata*. It is known for its nourishing (*bruhana*) properties, promoting muscle health (*manskara*), and enhancing lactation (*stnyavardhaka*). Additionally, it provides nourishment

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(*tarpana*), acts as a mild laxative (*sarak*), and is strength-promoting (*balya*), making it highly beneficial for overall strength, nourishment, and vitality [9].

Nutritive Values (Per 100g):

Energy- 324kcal

Carbohydrate- 51g

Protein-23.06g

Total Fat- 1.69g

Iron- 4.67mg

Fiber- 10.43g [6]

4.2.5 *Goghruta* (Cows *ghee*)

Cow's *ghee* is *madhura* (sweet) in taste, with a *sheeta* (cooling) potency and a *madhura* (sweet) post-digestive effect. It exhibits *snigdha* (unctuous), *guru* (heavy), *alpabhishyandi* (slightly obstructive), and *mrudu* (soft) qualities. Cow's *ghee* tends to increase *Kapha dosha* while balancing *Vata* and *Pitta* in moderation. It is highly nourishing (*bruhan*), enhances vitality (*vrushya*), and supports fat metabolism (*medovardhak*). Additionally, cow's *ghee* offers several other benefits, including improving complexion (*varnya*), enhancing digestion (*deepana*), and promoting strength and overall vitality (*balvardhak*) [10].

Nutritive Values (Per 100g):

Total Fat- 99.5%

Vitamin A- 28.21 ± 0.142 IU/g

Vitamin D- 11.42 ± 0.425 IU/g

Vitamin E- 31.55 ± 1.109 IU/g [11]

4.2.6 Sesame seeds/ *til* (*Sesamum indicum L.*)

Sesame seeds are *madhura* (sweet) and *tikta* (bitter) in taste, with an *ushna* (hot) potency and a *katu* (pungent) post-digestive effect. They exhibit *snigdha* (unctuous), *guru* (heavy), and slightly *alpbhishyandi* (obstructive) qualities. Sesame seeds help balance *Vata dosha* while reducing *Kapha* and *Pitta*. They are nourishing (*bruhana*), promote strength (*balya*), and support lactation (*stanyavardhak*). Additional benefits include improving complexion (*varnya*), enhancing digestion (*agnivardhak*), and promoting overall vitality (*vrushya*) [12].

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Nutritive Values (Per 100g):

Energy- 520kcal

Carbohydrate- 10.8g

Protein-21.7g

Total Fat- 43.05g

Iron- 15.04mg

Calcium- 1283mg

Fiber- 16.99g [6]

4.2.7 *Ajwain(Carom seeds/ Trachyspermum ammi L.)*

It is *katu* (pungent) and *tikta* (bitter) in taste, with an *ushna* (hot) potency. It possesses *laghu* (light) and *tikshna* (sharp) qualities. *Ajwain* helps balance *Vata* and *Kapha doshas* while increasing *Pitta*. It is known for its digestive (*deepana*) and appetite-enhancing (*ruchya*) properties, and is beneficial for heart health (*hrudya*) [13].

Nutritive Values (Per 100g):

Energy- 357kcal

Carbohydrate- 24.5g

Protein-15.9g

Total Fat- 21.1g

Iron- 13.6mg

Fiber- 20.6g [6]

4.2.8 *Jeera* (Cumin seeds/ *Cuminum cyminum*)

Jeera is *katu* (pungent) in taste, with an *ushna* (hot) potency. It possesses *ruchya* (promotes taste), *deepana* and *pachana* (stimulates digestive fire) qualities. *Jeera* helps to alleviate *kapha*. It is *laghu* (light to digest) in nature, *sugandhi* (fragrant), and helps to treat vomiting and diarrhea. *Jeera* also helps to cure colicky pain, abdominal disorders and worm infestations [14].

Nutritive Values (Per 100g):

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Energy- 305kcal

Carbohydrate- 22.6g

Protein-13.9g

Total Fat- 16.6g

Iron- 20.5mg

Fiber- 30.3g [6]

4.2.8 *Saindhav lavana* (Rock salt)

Rock salt (*Saindhav lavana*) is *lavana* (salty) in taste, with a *sheeta* (cooling) potency. It exhibits *laghu* (light) qualities. Rock salt helps balance the *Pitta dosha*. It is known for its digestive (*deepana*) and carminative (*pachana*) properties, aiding in overall digestion and appetite stimulation [15].

Nutritive Values (%):

Na- 39.00

K- 0.12

Cl- 60.27 [16]

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- **Stepwise execution of the research**

Comprehensive literature review from ancient classical texts of Ayurved *(Ksemakutuhalam)*, to find a nutrient dense and suitable recipe for Protein Energy Malnutrition (PEM)

↓

Identifying and short listing *Polika* recipe for its easy acceptability and nutritious property

↓

Modifying the recipe using additional nutrient rich ingredients such as moong dal, urad dal, and masoor dal along with spices and herbs like *kasturi methi* (dry fenugreek leaves), *jeera* (cumin seeds), *ajwain* (carom seeds) and *til* (sesame seeds) to address PEM

↓

Procurement of authentic raw materials required for Nutritious *Polika* preparation from the local vendors of Pune.

↓

Standardization of therapeutic product *(*Nutritious *Polika)* as per the standard protocol mentioned in the (*Ksemakutuhalam*) with slight modifications as per practical application.

↓

Sensory evaluation of the trial products on 5 point Hedonic Scale with the help of 15 semi trained panelists and finalization of final product ingredient proportion.

↓

Conduction of sensory, nutritional and microbial analysis of the product.

5. Result and Discussion

5.1 Processing characteristics of Nutritious *Polika*:

The ingredients utilized in the formulation of Nutritious *Polika* are nutritionally optimized to provide enhanced functional properties. Results indicate that *Polika* prepared with the most acceptable treatment composition (T_2) consisting of 45% wheat flour, 25%

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moong dal flour, 10% urad dal flour, and 10% masoor dal flour, along with 10% other ingredients like ghee, Kasturi methi, sesame seeds, cumin seeds, and *ajwain*; demonstrated superior results in terms of quality. The processing methodology for the Nutritious *Polika*, based on the most favorable treatment (T2), is mentioned in table 4.

Table 4: Processing Characteristics of Nutritious *Polika*

Sr.No.	Characteristics	Values
1.	Composition	45% wheat flour, 25% moong dal flour, 10% urad dal flour, 10% masoor dal flour and 10% other ingredients like ghee, Kasturi methi, sesame seeds, cumin seeds, *ajwain* etc.
2.	Quantity of mixture used for trial	100-150g
3.	No. of Polika	3-4
4.	Time required for cooking	10-15 minutes
5.	Cardamom powder	Yellowish Pink

5.2 Analysis of Nutritious *Polika*:

5.2.1 Sensory analysis of Nutritious *Polika*: Two trials of the product (T_1 & T_2) were evaluated for sensory characteristics (appearance, color, flavor, texture, taste, shape and overall acceptability). It was carried out by 15 semi trained panelists on 5-point hedonic scale. Among the two trials, T_2 sample exhibited excellent for its all sensory characteristics and further underwent nutritional and microbial analysis in a government authorized laboratory.

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Table 5: Comparative analysis of the trials conducted

Name of Sample	Appearance	Color	Flavor	Taste	Texture	Shape	Overall Acceptability	Rank
T_1	3.9	4.2	3.7	4. 5	3.5	4.1	3.9	II
T_2	**4.6**	**4.5**	**4.3**	**4.5**	**4.4**	**4.6**	**4.7**	**I**

*Mean values of 15 judges using five point hedonic scale (5 Excellent – 1 Poor)

[Ranking: Rank I: >4, Rank II: 3-4, Rank III: <3]

[Key Points: Excellent: 1, Very Good: 2, Good: 3, Fair; 2, Poor: 1]

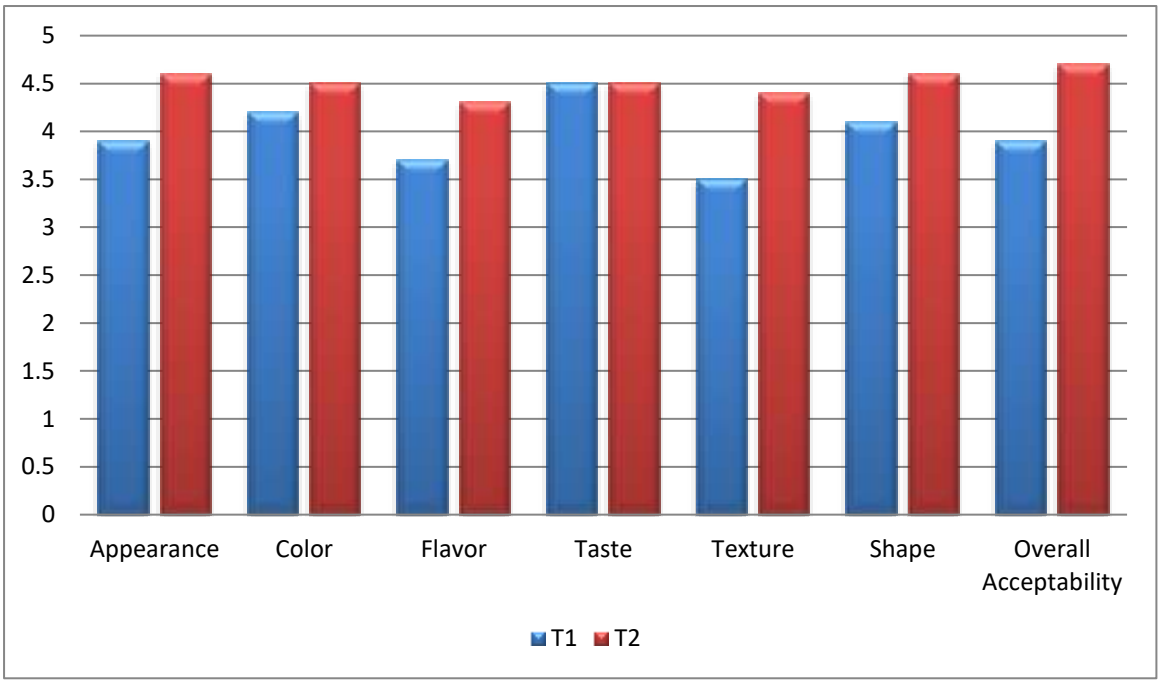

Figure 2: Mean score values of sensory analysis of the trial samples

5.2.2 Nutritional analysis of Nutritious *Polika:* The Nutritious *Polika* was subjected to a comprehensive nutritional analysis to evaluate its content of essential nutrients, including total energy, carbohydrates (available), protein, iron, fat, and crude fiber. These analyses were performed to determine the product's nutritional quality, ensure it meets dietary requirements, and assess its potential benefits for addressing Protein Energy Malnutrition (PEM). The analysis was conducted under controlled conditions, with samples stored at room temperature in sealed containers. The detailed results of this nutritional evaluation are presented in Table 6

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Table 6: Nutritional analysis of Nutritious *Polika*

Test done	Result	Unit	Test Method
Total Energy	372.87	Kcal/100g	FHHL/SOP/CHEM/F/17(f) Issue No. 02 Issue Date 01 June 2022
Carbohydrate (available)	64.76	g/100g	FHHL/SOP/CHEM/F/17(f) Issue No. 02 Issue Date 01 June 2022
Protein	22.99	g/100g	IS 7219 (Modified method by FOSS Kjeltec): 1973
Iron	39.60	mg/100g	FHHL/SOP/CHEM/F/17(f) Issue No. 02 Issue Date 01 June 2022
Total Fat	2.43	g/100g	IS 6287 Cl. No. 10:1985
Crude Fiber	1.43	g/100g	IS 10226 (Part 1): 1982

5.2.3. Microbial analysis of Nutritious *Polika*: The product underwent microbial analysis to ensure its safety and quality. The test conducted was the Total Plate Count (TPC), which measures the total number of viable bacteria in the product. This analysis helps in assessing the microbial load, ensuring the product is safe for consumption and has an extended shelf life.

Table 7: Microbial analysis of Nutritious *Polika*

Test done	Result	Units	Test Method
Total Plate Count	5.1 x 10^2	cfu/gm	IS 5402:2012

5.3 Discussion

The development of Nutritious *Polika*, inspired by traditional Ayurvedic formulations, presents a significant opportunity to address Protein Energy Malnutrition (PEM) through a holistic approach that integrates both modern nutritional science and ancient dietary wisdom. PEM is a critical health issue that arises from insufficient intake of protein and calories, leading to severe consequences such as muscle wasting, stunted growth, and

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weakened immunity. According to Ayurveda, malnutrition can be traced to imbalances in the *Dosha* (body's essential elements), *Agni* (weakened digestive fire), and the depletion of *Dhatus* (vital body tissues). The Nutritious *Polika*, as developed in this study, is specifically designed to counter these challenges by providing a nutrient-dense, easy-to-digest food option that aligns with both modern dietary recommendations and Ayurvedic principles.

5.3.1. Nutritional and *Ayurvedic* Benefits of Ingredients in Nutritious *Polika*:

The formulation of Nutritious *Polika* leverages a combination of cereals and pulses such as wheat, *moong dal*, *urad dal*, and *masoor dal*, each selected for their high protein, iron, and fiber content. These ingredients are traditionally known for their *Balya* (strengthening) and *Bruhan* (nourishing) properties, which are crucial for combating PEM.

5.3.1.1 Wheat Flour

Wheat is a staple grain rich in carbohydrates, providing a quick and sustained source of energy. It also contains essential B vitamins and iron, which are critical for the production of red blood cells and overall metabolic functions. Ayurveda describes wheat flour as *Madhura rasa* (sweet in taste), *Sheeta virya* (cooling potency), and *Guru guna* (heavy quality), making it beneficial for building body mass and enhancing strength. For individuals suffering from PEM, wheat aids in the restoration of energy and muscle tissue, thus addressing the fatigue and weakness associated with malnutrition.

5.3.1. 2 *Moong Dal*:

Known for its high protein content, *moong dal* is easily digestible and considered to balance all *Pitta* and *Kapha doshas*. *Ayurveda* attributes *Madhura* (sweet) and *Kashaya* (astringent) tastes, as well as cooling properties to *moong dal*, making it ideal for those with compromised *Agni* (digestive fire). Its light and nourishing qualities promote tissue repair, enhance immunity, and contribute to the regeneration of muscles, which is particularly beneficial for individuals with PEM who require nutrient-dense, easy-to-digest foods to rebuild body tissues.

5.3.1. 3 *Urad Dal*:

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According to *Ayurveda*, urad dal has *Snigdha* (unctuous) and *Guru* (heavy) qualities with an *Ushna virya* (heating potency), which helps to pacify *Vata dosha* and support physical endurance. For PEM patients who experience muscle wasting and weakness, urad dal's *Bruhan* (nourishing) and *Balya* (strength-promoting) properties aid in rebuilding muscle mass and providing sustained energy. Rich in protein and essential amino acids, Urad dal supports muscle strength and bone health.

5.3.1. 4 *Masoor Dal*:

Masoor dal's kashaya (astringent) and *madhura* (sweet) properties, combined with its *sheeta virya* (cooling potency), make it beneficial for blood purification and enhancing overall vitality. *Ayurveda* highlights its *Balya* (strengthening) properties, which help in boosting physical strength, and its *Madhura vipak* (sweet post-digestive effect), making it gentle on the digestive system. This lentil is known for its rich iron content, which is essential in combating anemia; a common complication of PEM.

5.3.1. 5 Sesame Seeds, *Ajwain*, and Cumin Seeds:

These spices not only enhance the flavor of Nutritious *Polika* but also support digestion and nutrient absorption. Sesame seeds are a rich source of healthy fats, calcium, and antioxidants, promoting bone health and increasing the body's nutrient density. *Ajwain* and cumin seeds are known for their digestive and carminative properties, which stimulate *Agni* (digestive fire), thus improving the absorption of nutrients from the diet. For PEM patients, these spices aid in overcoming digestive sluggishness, which is often a barrier to effective nutrient uptake.

5.3.1. 6 Cow's *Ghee*:

Ghee is considered as a superfood in *Ayurveda* due to its nourishing, rejuvenating, and digestive-enhancing properties. It is *Madhura rasa* (sweet to taste), *Sheeta virya* (cold potency), and promotes *Snigdha* (unctuous) and *Guru* (heavy) qualities, which support tissue lubrication, enhance strength, and nourish *Dhatus* (the body tissues). The high caloric value of ghee helps in weight gain, and support overall health.

5.3.2. *Ayurvedic* Concept of Malnutrition and the Role of Nutritious *Polika*

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In *Ayurvedic* texts, malnutrition, particularly PEM, is understood through the lens of imbalances in the body's *doshas* and weakened *Agni*. Weakened digestive fire results in poor assimilation of nutrients, leading to depletion of the body's vital energies (*Prana*) and tissues (*Dhatus*). Nutritious *Polika* addresses these concerns by incorporating ingredients that are not only nutrient-rich but also help in balancing the *doshas* and strengthening the digestive fire. The combination of spices (*ajwain*, cumin) and nourishing legumes helps rekindle *Agni*, thereby improving nutrient absorption and utilization.

The recipe's specific qualities, such as its *Bruhana* (strengthening), *Balya* (strength-giving), and *Deepana* (digestive-enhancing) properties, align with the *Ayurvedic* treatment goals for PEM, which focus on restoring *Agni*, nourishing the tissues, and balancing the *doshas*. By doing so, Nutritious *Polika* helps combat the symptoms of PEM, such as weakness, fatigue, and muscle wasting, thereby promoting overall vitality.

5.3.3 Effect of Preparation Techniques on Nutritional Value

The preparation technique of Nutritious *Polika*, involving roasting and combining various flours with ghee, enhances both the taste and the nutritional profile of the product. Roasting the ingredients increases their digestibility, making the nutrients more bioavailable [(17)], which is crucial for individuals with weakened digestive systems. The use of ghee not only improves the taste but also aids in enhancing the overall nutritional value of the *Polika*.

The blending of cereals and pulses ensures a complete amino acid profile [(18)], addressing protein deficiencies common in PEM. The use of a traditional preparation method aligned with Ayurvedic principles ensures that the *Polika* is not only a source of nourishment but also promotes digestion and enhances the therapeutic benefits of the ingredients.

5.3.4 Potential of Nutritious *Polika* as a Dietary Intervention for PEM

The combination of high-quality protein, energy-dense ingredients, and digestive aids makes Nutritious *Polika* a suitable dietary intervention for individuals suffering from PEM. It provides a balanced intake of macronutrients and micronutrients, helping to restore body weight, muscle mass, and overall strength. The inclusion of iron-rich pulses helps alleviate anemia, while the presence of digestible carbohydrates and healthy fats supports rapid energy replenishment.

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By leveraging both modern nutritional insights and traditional Ayurvedic wisdom, Nutritious *Polika* offers a culturally acceptable, nutritionally rich food product that can be integrated into dietary plans aimed at combating malnutrition. It's easy-to-digest nature, combined with its therapeutic benefits, makes it an ideal choice for vulnerable populations, particularly children and socioeconomically disadvantaged groups who are most at risk of PEM.

6. Conclusion:

Nutritious *Polika*, developed through a blend of *Ayurvedic* knowledge and modern nutritional science, presents a promising solution to the challenges posed by Protein Energy Malnutrition (PEM). The recipe's nutrient-rich ingredients, combined with traditional preparation methods, ensure a high level of acceptability and therapeutic efficacy. Future research could focus on clinical trials to validate its effectiveness in improving health outcomes in malnourished populations, further establishing Nutritious *Polika* as a functional food for nutritional rehabilitation.

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8. Annexure

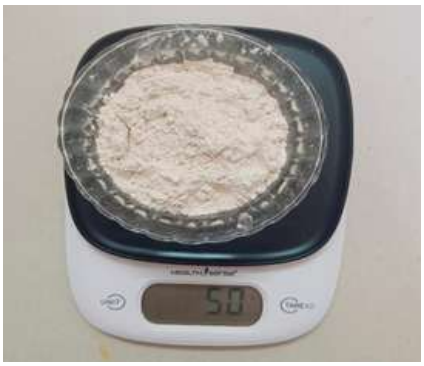

Figure 3: Measuring wheat flour

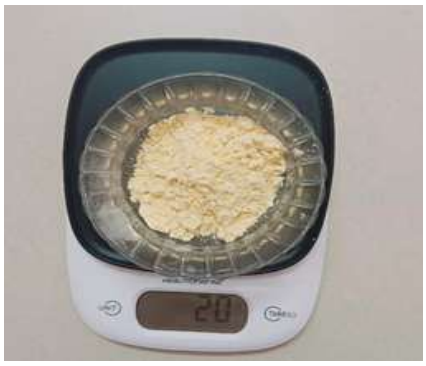

Figure 4: Measuring moong dal flour

Figure 5: Measuring masoor dal flour

Figure 6: Measuring urad dal flour

Figure 7: Measuring all spices and herbs

Figure 8: Measuring ghee

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Figure 9: Nutritious *Polika/ Laccha Poli*