AAU/DR/26/BU/944/2025-26

Technical Bulletin

on

Processing Technology for Instant Nutri-Food Mix for Elderly

Darsana Saikia, Rejaul Hoque Bepary, Kaushik Hazarika, Abhijit Borah, Soumitra Goswami, Premila L Bordoloi, Ananta Saikia

ICAR-AICRP on Post-Harvest Engineering and Technology Centre
Department of Agricultural Engineering
Directorate of Research (Agri)
Assam Agricultural University, Jorhat-785013

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Citation

Saikia, D., Bepary, R.H., Hazarika, K., Borah, A., Goswami, S., Bordoloi, P., Saikia, A. (2026) Technical bulletin on Processing Technology for instant Nutri-food mix for elderly, ICAR-AICRP on PHET centre, Department of Agricultural Engineering, Directorate of Research (Agri), Assam Agricultural University Jorhat, AAU/DR/26/BU/944/2025-26

Published by

Directorate of Research (Agri)
Assam Agricultural University, Jorhat-13
Email:dr_agri@aau.ac.in

Authors Affiliation

- Rejaul Hoque Bepary, Kaushik Hazarika, and Abhijit Borah, AICRP on PHET, Department of Agricultural Engineering, Directorate of Research (Agri), AAU, Jorhat-13.
- Darsana Saikia, Soumitra Goswami, Ananta Saikia, Food Science & Technology Programme, Department of Horticulture, College of Agriculture, AAU, Jorhat-13.
- Premila L Bordoloi, Department of Food and Nutrition, College of Community Science, AAU, Jorhat-13.

Preface

“India is witnessing a rapid demographic transition marked by a steady increase in its elderly population. With advancing age come unique physiological, nutritional, and social challenges that demand focused scientific and technological interventions. Nutrition plays a central role in healthy ageing, yet older adults often face difficulties such as reduced appetite, impaired digestion, chewing and swallowing problems, chronic health conditions, and limited access to balanced meals. These challenges are more pronounced in rural and semi-urban regions, where affordability, convenience, and cultural acceptability strongly influence food choices. Against this backdrop, the development of elderly-friendly, nutrient-dense, and easy-to-prepare foods has emerged as an urgent public health priority.

The present work was undertaken with the objective of developing a rice-based instant ready-to-eat food product specifically tailored to the nutritional requirements of the elderly population in Northeast India, with particular emphasis on Assam. The study integrates traditional food knowledge with modern food engineering and optimization tools. Locally available cereals, legumes, nuts, spices, and vegetables were judiciously selected and scientifically optimized using Linear Programming to achieve nutritional adequacy at minimal cost. This approach ensures that the final product is not only nutritionally balanced but also economically viable and scalable for wider adoption.

Special attention was given to product texture, sensory acceptability, rehydration behavior, shelf-life stability, and ease of preparation, recognizing the practical needs of elderly consumers. The work also explores packaging, storage, and quality parameters to ensure safety and consumer confidence. Beyond product development, the study highlights the potential for technology transfer, entrepreneurship, and commercialization through MSMEs, self-help groups, and start-ups.

This document is intended to serve as a comprehensive reference for researchers, food technologists, policymakers, and entrepreneurs interested in geriatric nutrition, functional foods, and sustainable food system innovations. It is hoped that the outcomes of this work will contribute meaningfully to improving nutritional security and quality of life among older adults.”

Authors

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1. TITLE OF THE TECHNOLOGY

Processing Technology for Instant Nutri-Food Mix for Elderly

2. BACKGROUND AND RATIONALE

Population ageing is one of the most significant demographic trends of the 21st century. Globally, the number of people aged 60 years and above is projected to reach about 2.1 billion by 20250, almost double the figures recorded in 2020. India is expected to witness an even sharper transition, with the elderly population projected to constitute more than 20 percent of the total population by mid-century. Recognizing these shifts, the Government of India defines individuals above 60 years as senior citizens and acknowledges that they have unique physiological, nutritional, and social requirement and demands targeted interventions

Ageing is accompanied by progressive physiological changes such as reduced metabolic efficiency, diminished appetite, impaired digestion, and an increased risk of chronic diseases including diabetes, cardiovascular disorders, osteoporosis, and sarcopenia. These changes often result in inadequate dietary intake and poor nutritional status among older adults. Nutritional care for the elderly therefore requires foods that are nutrient-dense, easy to digest, and sensorially acceptable. Adequate protein intake is essential to preserve muscle mass, while sufficient dietary fibre supports gut health and prevents constipation. Micronutrients such as calcium, iron, vitamin C, vitamin D, and antioxidants play a crucial role in maintaining bone health, immune function, and overall well-being. Additionally, age-related dental problems, reduced salivary flow, and swallowing difficulties necessitate foods with softer textures that can be consumed safely and comfortably.

In North-East India, particularly Assam, elderly nutrition presents both challenges and opportunities. The region is characterized by rich agricultural biodiversity and strong food traditions rooted in rice-based diets. Rice is the staple food for most communities and is typically consumed with legumes, vegetables, and traditional preparations that are rich in micronutrients and bioactive compounds. Assam also possesses a diverse range of rice varieties, including the widely cultivated Ranjit variety, known for its soft, cooked texture, easy digestibility, and neutral flavour. These characteristics make rice an ideal base for developing elderly-friendly foods. Indigenous cereals and pulses further enhance dietary quality by providing plant-based protein, dietary fibre, and essential minerals.

Although these advantages, traditional rice-based diets alone are often nutritionally imbalanced and may not adequately meet the specific dietary requirements of older adults. Many elderly individuals also face economic constraints, limited cooking capacity, and reduced access to diverse foods. In this context, instant and ready-to-eat (RTE) wholesome foods offer a practical solution. Such products combine convenience with nutrition, require minimal preparation, and can be designed to retain cultural acceptability while meeting nutritional needs.

Developing nutritionally balanced and cost-effective food formulations, however, is a

complex task, particularly when multiple nutrients, ingredient costs, and acceptability constraints must be considered simultaneously. Linear programming provides a powerful scientific tool to address this challenge. It enables the optimization of food formulations by identifying the most economical combinations of locally available ingredients that meet Recommended Dietary Allowances (RDA) while respecting practical constraints such as portion size, ingredient availability, and sensory acceptability. Linear programming has been successfully applied in human nutrition to design diets for vulnerable populations, including the elderly, demonstrating its suitability for developing realistic and scalable food solutions.

Against this backdrop, the present work was undertaken to develop a rice-based instant ready-to-eat food product specifically designed for the elderly population, using locally available ingredients and a linear programming approach. By combining Assam's rich agricultural diversity with scientific optimization techniques, this research aims to create an affordable, nutritionally adequate, culturally acceptable, and convenient food product that can support healthy ageing. The technology has strong potential for translation into commercial production, offering a practical dietary intervention to improve nutritional security and quality of life among elderly individuals in Assam and similar regions across India.

3. DESCRIPTION OF TECHNOLOGY

The present technology focuses on the development of a rice-based instant Ready-to-Eat (RTE) food product specifically designed to meet the nutritional, physiological, and sensory needs of elderly individuals. The product was formulated using a Linear Programming (LP) optimization model, a scientific tool that enables the selection of optimal ingredient combinations by minimizing formulation cost while maximizing nutritional adequacy, in line with the Recommended Dietary Allowances (RDA) for older adults.

Locally available and commonly consumed food ingredients were first identified through a systematic market survey conducted in the Jorhat district of Assam. Nutritional composition data for these ingredients were obtained from the ICMR Food Composition Table, while prevailing market prices were used to estimate formulation costs. The LP model was executed using MS Excel Solver, incorporating binary decision variables to represent ingredient inclusion or exclusion. Fixed proportion and group-specific constraints ensured that each formulation contained at least one representative ingredient from key food categories such as cereals, pulses, oilseeds, nuts, green leafy vegetables, and flavouring agents. Each optimized formulation was standardized to a total weight of 100 g.

Following optimization, selected formulations were prepared using standardized processing methods and evaluated for rehydration behaviour, physicochemical properties, nutritional composition, and sensory acceptability. The Particular emphasis was placed on texture and rehydration characteristics to ensure ease of consumption for elderly users. The most acceptable formulation was further developed as an instant RTE product and assessed for shelf-life stability under ambient storage conditions.

3.1.Key features of the technology include:

- Use of locally available, low-cost ingredients
- Scientifically optimized formulation using linear programming
- Balanced macro- and micronutrient profile
- Soft texture and high sensory acceptability suitable for elderly consumers
- Quick rehydration and minimal preparation time
- Potential for scale-up and commercialization

4. RAW MATERIALS AND MACHINERIES REQUIREMENTS

4.1.Ingredients

The technology utilizes locally available, low-cost agricultural and spice ingredients, selected for their nutritional value, functional properties, sensory appeal, and suitability for elderly consumers. All materials used are food-grade and conform to standard safety and quality requirements.

Table 1: List of ingredients required for products

Ingredients	Quantity	Quality attributes
Rice	36g	Staple cereal serves as the primary carbohydrate source and base ingredient; selected for soft texture and easy digestibility.
Rajma	26g	Major plant protein source contributing essential amino acids, dietary fibre, and minerals.
Ground nut	7.9g	Source of healthy fats, protein, and energy density.
Pistachio Nut	3.96g	Provides unsaturated fats, micronutrients, and flavour enhancement.
Red Chili	2.97g	Provides unsaturated fats, micronutrients, and flavour enhancement.
Poppy seed	2.97g	Acts as a flavouring and texturizing agent; contributes minerals and healthy fats.
Cumin seed	3.96g	Enhances flavour and aids digestion.
Coriander seed	3.96g	Enhances flavour and aids digestion.
Mace	1.0g	Spice used for characteristic aroma and flavour.
Curry leaves	2.0g	Source of antioxidants and micronutrients; improves flavour profile.
Goose berry	2.97g	Rich source of vitamin C and antioxidants; used in powdered form.
Turmeric	1g	Rich source of curcumin and antioxidants; used in powdered form.
Beetroot	1g	Used as natural colourant and micronutrient source.
Salt	2g	Used as taste enhancer
Mustard oil	3g	Used as natural fat and micronutrient source.

4.2. Packaging Materials

Packaging plays a critical role in maintaining the quality, safety, and shelf-life of the rice-based instant RTE food developed for elderly consumers. The packaging system is designed to ensure ease of handling, protection from moisture and oxygen, and user convenience during reconstitution.

Table 2: Packaging materials required for the products

Type packaging	Packaging materials	Functions
Primary Packaging	Food-grade polyethylene (PE) pouches	• Used for packing the instant rice-based food mix • Provides basic protection against moisture ingress and external contamination • Suitable for short-term ambient storage • Heat-sealable and economical, making it suitable for small-scale and MSME production
	Pack size: 5g pouch 50g pouch	 For packaging of masala mix For packaging of rice-rajma-nuts mix
Secondary Packaging	Rigid plastic cups/containers with lids	• Used for demonstration, storage, and consumer convenience • Enables easy reconstitution by directly adding hot water • Lightweight, reusable, and elderly-friendly
	Outer cartons	• Corrugated paperboard boxes for bulk transport and storage • Protect individual pouches from mechanical damage during handling

4.3. Processing machinery requirements

The machinery and equipment required to produce instant Nutri-food mix for elderly are basic processing machines and packaging units suitable for small-scale operations. Cleaning and sorting equipment such as sieves and graders are used to remove impurities from raw materials. Soaking tanks and steam or pressure cookers are required for controlled cooking of rice and rajma. Drying is carried out using a tray or hot air dryer to achieve safe moisture levels. Grinders or pulverizers are used for spice preparation, while mixers ensure uniform blending. Packaging equipment includes pouch sealing machines, rigid container filling units, labeling machines, and shrink-wrapping machines. Quality control tools such as weighing balances and moisture meters help maintain product consistency and quality.

Table 3: List of machineries required for the product processing

Unit operation	Machines	Function
Raw Material Handling and Cleaning	Raw material inspection table	For manual sorting and removal of foreign matter from rice, rajma, groundnut, pistachio, spices, curry leaves, and gooseberry.
	Grain and pulse cleaner (vibratory or sieve-based)	Used for cleaning rice grains and rajma prior to soaking to remove dust, stones, and broken grains.
	Nut and spice cleaner	For cleaning ground nuts, pistachios, cumin, coriander, and poppy seeds.
Soaking and draining	Stainless steel soaking tanks / container	Used for soaking rice and rajma separately at ambient temperature. It must be food-grade and corrosion-resistant.
	Draining baskets or perforated trays	
Thermal Processing	Steam cooker / steam kettle	Used for steam cooking of rice at ~100°C. Ensures uniform gelatinization and partial cooking.
	Pressure cooker / pressure steam cooker	Used for pressure cooking of soaked rajma to soften the grains efficiently.
Freezing and drying	Deep freezer (–20°C)	Used for freezing cooked rice to create a porous structure, enhancing rehydration characteristics.
	Hot air dryer (tray dryer)	A critical unit operation used for: • Drying cooked rice and rajma • Drying roasted nuts • Drying blanched gooseberry slices Operating range: 55–65°C with controlled airflow.
Nut Processing	Roasting unit (electric or gas-fired roaster)	Used for roasting groundnut and pistachio to develop flavor and reduce moisture.
	Cooling trays or cooling conveyor	For bringing roasted and dried materials to room temperature before mixing.
Gooseberry and Spice Processing	Washing and slicing unit / manual slicer	Used for cleaning and slicing fresh gooseberry.
	Blanching unit (hot water blancher)	Used for blanching gooseberry at ~85°C to inactivate enzymes and retain color.
	Pulverizer / spice grinder	Used for grinding dried gooseberry, beetroot, turmeric, chili, coriander, and other spices into fine powder.
Seasoning Preparation	Cooking pan / jacketed kettle	Used for heating mustard oil and preparing the spice mixture.
Mixing and Blending	Mixing and Blending	Used for homogeneous mixing of dried rice–rajma base with roasted nuts and prepared spice

		mix.
Packaging	Weighing balance (precision scale)	For accurate portioning (e.g., 5 g packs).
	Heat sealing machine	Used for sealing polyethylene pouches.
Supporting Utilities	• Stainless steel trays and utensils • Thermometers and moisture meter • Hygienic storage racks	

5. PREPARATION PROCESS OF INSTANT NUTRI-FOOD MIX

The preparation of the rice-based instant food involves separate processing of cereal–pulse-nuts as base and gooseberry-spice mix as seasoning, followed packaging to obtain a shelf-stable instant product.

5.1. Preparation of rice-rajma-nut base

Rice grains and rajma are first subjected to manual and mechanical cleaning to remove dust, stones, and other extraneous materials. The cleaned rice and rajma are soaked separately in potable water at ambient temperature for 20 min and 10hrs, respectively to facilitate hydration and uniform cooking. After soaking, excess water is drained off using perforated baskets. The soaked rice is steam cooked at 100°C for 15 minutes, ensuring partial gelatinization of starch, which improves texture and rehydration properties. Simultaneously, soaked rajma is pressure cooked until adequately softened (6-7 whistle). Following cooking, the rice and rajma is subjected to freezing at –20°C for 2 hours. This freezing step creates micro-porosity in the cooked rice matrix, which enhances rapid water absorption during reconstitution. Both cooked rice and rajma are then dried in a hot air dryer at controlled temperature until a safe moisture level is achieved. The dried materials are cooled to room temperature to prevent moisture condensation and quality deterioration.

Moreover, the groundnut and pistachio are cleaned thoroughly to remove impurities. The cleaned nuts are roasted at high temperature (approximately 150–160°C for 10 minutes) to develop characteristic flavour, reduce moisture content, and improve shelf stability. After roasting, the nuts are dried further using a hot air dryer, if required, and then coarse grind and cooled to room temperature. The rice, rajma and nut are mixed and packed in food-grade polyethylene pouches (50 g per pouch).

5.2. Preparation of masala mix for seasoning

Fresh gooseberry (3 g) is cleaned, washed, and sliced uniformly. The slices are blanched at 85°C to inactivate enzymes and preserve color and bioactive components. Blanched gooseberry slices are then hot air dried at 65°C for 4 hours. The dried slices are ground using a grinder or

pulverizer to obtain a fine gooseberry powder.

For the preparation gooseberry-spice mix, the mustard oil is heated in a cooking pan or jacketed kettle. The mace, curry leaves, and whole cumin seeds are added to the hot oil and cooked on a low flame with continuous stirring to release their aroma. After that poppy seeds are added and mixed thoroughly. Followed by the gooseberry powder, beetroot powder, salt, red chilli powder, and coriander powder are added to the seasoning mixture. The entire mixture is cooked for approximately 5 minutes with continuous stirring to ensure uniform mixing and flavor development. The cooked seasoning is then cooled to room temperature. The cooled spice-seasoning mix is blended uniformly using a mixer to obtain a homogenous mix. The final product is packed in food-grade polyethylene pouches (5 g per pouch).

5.3. Rice-Based Instant Food Product

The rice–rajma–nut base pouch and the masala seasoning pouch are packed together in a food-grade rigid container along with a disposable spoon. The container is then properly labeled and shrink-wrapped. Finally, the packed units are placed in outer cartons for safe handling, storage, transportation, and marketing.

Figures 1: Photograph of rice-based instant food for elderly

Figures 2: Process flowchart for rice-based instant food for elderly

6. PRODUCT QUALITY SPECIFICATIONS

6.1.Nutritional Quality

The nutritional composition of the selected rice-based instant food (100 g) was determined as: moisture 8.84±0.7g/m^3, carbohydrate 539.13±0.92g, protein 15.13±0.09g, dietary fiber 7.96±0.75g, ash 2.67±0.16g, fat 8.92±0.12g, vitamin C 42.23±1.56mg, calcium 189.57±2.54mg, magnesium 114.02±8.00mg, and iron 17.27±2.00mg. A 100 g serving of this product contributed significantly to the Recommended Dietary Allowance (RDA) for the elderly, fulfilling 22.18% of energy, 35.16% of protein, 64.97% of vitamin C, 24.88% of dietary fiber, 23.70% of calcium, 90.89% of iron, and 30.82% of magnesium.

Table 4: Nutritional quality of rice-based instant food for elderly

Nutrient	Experimental Value (100g)	% RDA Fulfilled per 100g serving
Energy (kcal)	377.00 ± 40.00	22.18
Crude Protein (g)	15.12 ± 0.54	35.16
Total Carbohydrate (%)	539.13 ± 0.92	-
Crude Fat (%)	8.92 ± 0.12	
Dietary Fiber (g)	7.96 ± 0.75	24.88
Total ash (%)	2.67 ± 0.16	-
Crude fiber (%)	5.31 ± 0.48	-
Calcium (mg/100g)	189.57 ± 2.54	23.7
Magnesium (mg/100g)	114.02 ± 8.00	30.82
Iron (mg/100g)	17.27 ± 2.00	90.89
Potassium (mg/100g)	206.11 ± 0.01	-
Vitamin C	42.23 ± 1.56	64.97
RDA: Recommended daily allowance,		

6.2. Sensory Quality

The average OAA for the rice-based instant food was the highest (8.48±0.51) as compared the market available *Masala khichdi kadhi's (*7.04±0.45.). This indicates the product has high acceptance by above-60 years old individuals.

6.3. Shelf-life and Storage

The storage quality parameters such as sensory attributes, moisture, water activity, colour, Browning index, rehydration time, free fatty acid, peroxide value remained stable during six months storage period.

6.4.Cost

The total cost of rice-based instant food for elderly is Rs 60/- per 100g of packet

7. PREPARATION AND USAGE

To prepare the rice-based instant food product, tear open the rice–rajma–nut base pouch (50 g) and transfer the contents into the rigid container provided. Next, tear open the masala- mix pouch (5 g) and add it to the same container. Mix the contents thoroughly using the disposable spoon. Add 200 ml of boiling water, cover the container, and allow the mixture to stand for 2.5 minutes for proper reconstitution. Stir well and consume approximately 250 g of the prepared product while warm.

8. SAFETY AND QUALITY CONSIDERATIONS

Safety and quality are critical considerations in the production of the rice-based instant ready-to-eat (RTE) food product. Good Manufacturing Practices (GMP) must be strictly followed at all stages of processing to ensure product safety and consistency. All raw materials should be sourced from reliable suppliers and handled under hygienic conditions to prevent contamination. Processing, drying, and packaging operations must comply with FSSAI standards for RTE foods, including approved packaging materials and proper labeling. Hygienic packaging in moisture- and oxygen-resistant materials is mandatory to maintain product quality, extend shelf life, and ensure consumer safety, particularly for elderly users.

9. ADVANTAGES OF THE TECHNOLOGY

a) *Region-specific and culturally acceptable*: Developed using locally available rice-based ingredients suited to regional dietary habits.
b) *Cost-effective formulation*: Optimized through a Linear Programming (LP) model to minimize cost while meeting elderly RDA requirements.
c) *High nutritional density*: Provides balanced macro- and micronutrients, including protein, fiber, minerals, and vitamins.
d) *Easy preparation and consumption*: Quick rehydration, soft texture, and minimal cooking time make it suitable for elderly users.
e) *Scalable and entrepreneur-friendly*: Simple processing steps and low capital investment make it ideal for MSMEs and rural entrepreneurs.
f) *Addresses elderly malnutrition*: Specifically designed to meet age-related nutritional and physiological needs.

10. SCOPE FOR COMMERCIALIZATION

a) Health food and functional food sector targeting wellness-oriented consumers.
b) Geriatric nutrition market addressing age-specific dietary requirements.
c) Hospitals, nursing homes, old-age homes, and assisted living centers.

d) Government nutrition and social welfare schemes for senior citizens.
e) Public distribution and subsidized food programs for vulnerable elderly populations.

11. TECHNOLOGY TRANSFER DETAILS

a) **Mode of Transfer:**
The technology can be transferred through a License agreement, Memorandum of Understanding (MoU), or a non-exclusive technology transfer agreement, depending on the scale and requirement of the adopting agency.

b) **Target Users:**
Food entrepreneurs, Micro, Small and Medium Enterprises (MSMEs), Self-Help Groups (SHGs), start-ups, and rural enterprises interested in health and geriatric nutrition products.

c) **Support Offered:**
- Detailed formulation and ingredient specifications
- Complete process know-how including preparation, drying, and packaging
- Training, technical guidance, and initial handholding for successful adoption and commercialization

12. CONCLUSION

The developed processing technology for rice-based instant Nutri-Food Mix offers a practical, scientifically optimized, and culturally appropriate solution to address the nutritional challenges of the elderly population. By integrating locally available ingredients with a Linear Programming–based formulation approach, the product ensures nutritional adequacy, cost-effectiveness, and high sensory acceptability. The instant nature of the product, quick rehydration time, and soft texture make it particularly suitable for elderly consumers with limited cooking ability or chewing difficulties. Shelf-life studies indicate acceptable stability under ambient conditions, with scope for further improvement through advanced packaging and storage strategies. The simplicity of the processing steps and moderate machinery requirements make the technology suitable for adoption by MSMEs, SHGs, and start-ups. Overall, this technology has strong commercialization potential and can contribute significantly to improving dietary quality, nutritional security, and quality of life among elderly populations in Assam and similar regions.

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