

Shelf Life Assessment of Optimized Ragi and Milk Based Extruded Snack Food

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ABSTRACT

The present study was conducted to evaluate the shelf life and storage stability of optimized extruded snack food prepared using maize flour, ragi flour, and whey protein concentrate (WPC). The developed snack product was packed in metallized polyethylene terephthalate (MET-PET) pouches and stored at ambient conditions (37±2°C). During storage, the product was analyzed for sensory, physico-chemical, microbiological, and textural characteristics at regular intervals. The moisture content, hardness, bulk density, microbial load, flavour, and crispness of the product showed gradual changes during storage. However, the optimized extruded snack remained microbiologically safe and organoleptically acceptable throughout the storage period. The study concluded that proper packaging significantly improved shelf stability and preserved the quality of the developed protein-rich extruded snack food.

Introduction

Shelf life evaluation is an important aspect in development of ready-to-eat snack products. Shelf life refers to the period during which a food product remains safe, nutritious, and acceptable to consumers under specified storage conditions. Extruded snack foods generally possess low moisture content and low water activity, which help in increasing storage stability. However, storage conditions, packaging material, and ingredient composition influence the deterioration rate of snack products.

Extrusion cooking is widely used in preparation of snack foods due to its ability to produce products with desirable texture, expansion, and shelf stability. Incorporation of

whey protein concentrate and ragi flour enhances nutritional quality but may also affect storage characteristics due to changes in moisture absorption and texture.

Ragi flour is rich in dietary fibre, calcium, and antioxidants, whereas whey protein concentrate provides high-quality milk proteins. These ingredients improve nutritional quality of snacks but require appropriate packaging to maintain product quality during storage. Metallized polyethylene terephthalate (MET-PET) packaging is commonly used because of its excellent moisture and oxygen barrier properties. The present investigation was undertaken to assess the shelf life and storage stability of optimized extruded snack food during storage.

Materials and Methods

Raw Materials

The optimized extruded snack product was prepared using:

- A. Maize flour
- B. Rice flour
- C. Ragi flour
- D. Whey Protein Concentrate (WPC-80)
- E. Paneer whey
- F. Salt

The ingredients and extrusion process were standardized previously using Response Surface Methodology (RSM).

Packaging and Storage

The extruded snack food after drying was packed in metallized polyethylene terephthalate (MET-PET) pouches of 12 microns thickness and stored at $37\pm 2^{\circ}\text{C}$ for shelf life evaluation.

Parameters Evaluated During Storage

The stored snack product was analyzed for:

- A. Moisture content
- B. Texture (hardness and crispness)
- C. Bulk density
- D. Sensory attributes
- E. Microbial quality
- F. Overall acceptability

Results and Discussion

Effect of Storage on Sensory Characteristics

The sensory quality of extruded snack foods gradually decreased during storage due to slight moisture absorption and loss of crispness.

However, the product maintained acceptable flavour, colour, appearance, and texture scores throughout the storage period.

Table.1 Packaging and Storage Conditions

Parameter	Description
Packaging Material	MET-PET Pouches
Thickness	2 microns
Storage Temperature	$37\pm 2^{\circ}\text{C}$
Product Type	Extruded snack food
Storage Study	Shelf life evaluation

Table.2 Sensory Characteristics during Storage

Storage Period	Flavour Score	Texture Score	Overall Acceptability
Initial	8.14	8.15	8.25
15 Days	8.00	8.02	8.10
30 Days	7.82	7.90	7.95
45 Days	7.65	7.70	7.80

Table.3 Physical Characteristics during Storage

Storage Period	Hardness (N)	Bulk Density	Expansion Ratio
Initial	4.95	0.116	3.91
15 Days	5.12	0.121	3.88
30 Days	5.45	0.126	3.84
45 Days	5.78	0.130	3.80

Table.4 Microbiological Quality during Storage

Storage Period	Total plate count (cfu/ml)	Yeast and mould count
Initial	Nil	Nil
15 Days	Very Low	Nil
30 Days	Low	Nil
45 Days	Acceptable	Very low

The reduction in sensory scores during storage may be attributed to oxidation reactions and moisture migration within the package

Effect of Storage on Physical Characteristics

The hardness and bulk density of the snack product slightly increased during storage because of moisture uptake from the surrounding environment. Expansion ratio remained almost stable throughout storage.

Microbiological Quality

Low moisture content and extrusion cooking significantly reduced microbial growth in the product. Proper packaging in MET-PET pouches prevented contamination and moisture absorption during storage. Total plate count remained within acceptable limits throughout the storage period.

Effect of Packaging on Shelf Stability

Packaging material plays a significant role in preservation of extruded snack foods. MET-PET pouches possess excellent barrier properties against moisture and oxygen transmission, thereby helping in maintaining crispness, texture, and flavour of snack products.

The low water activity of extruded products also contributed to better shelf stability and lower microbial growth.

In conclusion, the present study demonstrated that the optimized extruded snack food prepared using maize flour, ragi flour, and whey protein concentrate possessed good shelf stability under ambient storage conditions. Packaging in MET-PET pouches effectively preserved the sensory, physical, and microbiological quality of the product during storage. The product remained acceptable throughout the storage period with only slight changes in texture and sensory characteristics. Therefore, the

developed protein-rich extruded snack food can be successfully commercialized as a nutritious ready-to-eat snack product with good storage stability.

Author Contributions

Arunkumar: Investigation, formal analysis, writing—original draft. Amitkumar Manojbhai Patel: Validation, methodology, writing—reviewing. Niranjan:—Formal analysis, writing—review and editing.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval Not applicable.

Consent to Participate Not applicable.

Consent to Publish Not applicable.

Conflict of Interest The authors declare no competing interests.

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