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# Physico-Chemical and Sensory Analysis of Moringa-Infused Chikki

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**AIM:** To develop a nutritious and affordable snack by incorporating Moringa (oleifera) leaf powder into traditional almonds Chikki, enhancing its nutritional value while maintaining its sensory appeal and cultural relevance.

## I. OBJECTIVES

To formulate a modified version of almonds Chikki enriched with moringa leaf powder. the nutritional composition of Moringa Chikki in comparison with regular almonds Chikki, focusing on key nutrients like protein, iron, calcium, and vitamins. To evaluate the sensory qualities (taste, texture, colour, and aroma) and overall acceptability of Moringa Chikki through consumer testing or sensory panels. To determine the optimum ratio of moringa leaf powder that can be added without compromising the taste and texture of the Chikki. To assess the shelf life and storage stability of Moringa Chikki under different conditions. To explore the potential of Moringa Chikki as a low-cost, functional food product for addressing nutritional deficiencies, particularly in vulnerable populations such as children and pregnant women. To promote the use of locally available moringa leaves and traditional food processing techniques to support rural entrepreneurship and sustainable food development.

## II. MATERIALS AND METHODOLOGY

This chapter contains all the materials and methodology followed to prepare and test the product. The test methods for testing raw materials and products are also discussed. New product development work was carried out at the Department of Food Technology, Ballarpur Institute of Technology, bamni, Ballarpur. Table 4: Material Required for New Product Development Material Required Collection Of Raw Material Moringa powder Super market Jaggery Super market almonds Home Oats Super market Butter Dairy shop water Mineral water (home) Grinder Processing Lab Weighing Machine Processing Lab Measuring cylinder Processing Lab Pan Processing Lab LDPE Stationary Shop 23 3.1 Packaging Material: Packaging of the product Packaging is the science, art and technology of enclosing or protecting products for distribution, storage, sale, and use. The packaging material for the product was selected according to the Food Safety and Standard (Packaging) Regulation, 2018 (schedule IV – List of suggestive packaging material. The packaging of the final product was done in PET/MET PET/LDPE, three layered packaging material. PET (polyethylene terephthalate) is the chemical name for polyester. It is clear, strong, light weight plastic that is widely used for packaging foods. It is durable, heat resistant film with very good oxygen barrier property. MET is nothing but PET film laminated with metal foil. It increases film's oxygen-water barrier and blocks out UV rays. LDPE (low density polyethylene) is a thermoplastic made from monomer ethylene which is a soft, flexible and lightweight. It has high clarity, heat-seal ability, high elongation and softness. Low-density polyethylene (LDPE) is a thermoplastic made from the monomer ethylene. It was the first grade of polyethylene, produced in 1933 by Dr John C. Swallow and M.W Perrin who were working for Imperial Chemical Industries (ICI) using a high -pressure process via free radical polymerization. Its manufacture employs the same method today. The EPA estimates 5.7% of LDPE (resin identification code 4) is recycled in the United States. Despite competition from more modern polymers, LDPE continues to be an important plastic grade. In 2013 the worldwide LDPE market reached a volume of about US\$33 billion. LDPE has SPI resin ID code 4. Low Density Polyethylene is made through a process known as free radical polymerization. This process requires heat (420-570 degrees K) and a lot of pressure (1000-3000 atm), so it is commonly conducted in an autoclave or tubular reactor in large batches. The first step is to gather the raw materials

from petroleum by breaking down the petroleum-based hydrocarbons into smaller molecules and then separating the ethylene gas from the resulting mixture. This ethylene gas is then pumped into the reactor, where it bakes alongside an initiator like oxygen or organic peroxide to initiate polymerization. A slurry of polyethylene forms and gets extruded into granules, with any unreacted gas left in the reactor being used for the next batch. The image below shows the molecular structure of polyethylene and ethylene. Natural LDPE is very flexible and translucent in appearance. It's a soft, flexible, lightweight plastic material, noted for its low temperature flexibility, toughness, and corrosion resistance. This allows the consumer to have a greater experience in seeing the contents and product level as well as holding and squeezing the packaging. (Team Xometry April 29, 2022) LDPE is the most inexpensive material for plastic films. It is flexible, soft, transparent, glossy, and features high resistances to moisture, tearing, and chemicals. It is most commonly found in plastic 24 bags but is also widely used for squeezable food bottles, bread and frozen food packaging, and flexible lids Mark Oulton. Methodology Ingredient Selection: Source high-quality moringa powder along with complementary ingredients. such as jaggery , almonds , oats ,butter, water, to achieve optimal taste and texture. 3.2.2. Formulation Development: Experiment with different ratios and formulations to achieve an ideal balance between taste, texture, and nutrition. Conduct sensory evaluations to gather consumer preferences Parameter Purpose Common Method Moisture Content Determines water content Oven drying method (AOAC 925.10) Ash Content Indicates total mineral content Muffle furnace method (AOAC 923.03) Crude Protein Measures nitrogen  $\times 6.25$  Kjeldahl method (AOAC 979.09) Crude Fat Measures total lipids Soxhlet extraction (AOAC 920.39) Crude Fiber Measures indigestible carbohydrates Wende method (AOAC 962.09) Carbohydrate (by difference)  $100 - (\text{Moisture} + \text{Ash} + \text{Protein} + \text{Fat} + \text{Fiber})$  Calculated Energy Value Estimated caloric value  $(\text{Protein} \times 4) + (\text{Fat} \times 9) + (\text{Carbohydrate} \times 4)$  Example

### III. RESULTS

Proximate Composition of Moringa Chikki (Values are approximate and can vary based on formulation — e.g., peanut vs. sesame chikki, % moringa powder used, etc.) Component Result (%) Remarks Moisture  $3.8 \pm 0.2$  Low moisture  $\rightarrow$  longer shelf life Ash  $2.9 \pm 0.1$  Rich in minerals (from moringa & jaggery) Crude Protein  $14.6 \pm 0.4$  High protein (from peanuts & moringa) Crude Fat  $22.5 \pm 0.3$  Healthy fats from nuts/seeds Crude Fiber  $5.2 \pm 0.2$  Dietary fibre from moringa Carbohydrates  $51.0 \pm 0.5$  Mostly from jaggery Energy (kcal/100g)  $\sim 515$  kcal Nutrient-dense snack

### IV. CONCLUSION

The development of Moringa Chikki represents a successful fusion of traditional Indian confectionery with modern nutritional innovation. By incorporating moringa leaves or powder—a well-known superfood—into the conventional chikki formulation, the product gains enhanced nutritional value, offering significant health benefits without compromising on taste or texture. Moringa is naturally rich in vitamins (A, C, and E), minerals (calcium, iron, potassium), antioxidants, and essential amino acids, making it a powerful functional ingredient. When blended with jaggery and peanuts (or other nuts and seeds), the result is a nutrient-dense snack that provides a balanced combination of protein, healthy fats, and micronutrients. This makes Moringa Chikki an ideal energy booster, especially for children, athletes, and health-conscious individuals. From a sensory standpoint, the product maintains the crunchy texture and sweet-nutty flavour typical of traditional chikki, with a mild earthy note from moringa that complements the jaggery's caramel undertones. With appropriate formulation and processing techniques, issues like bitterness or colour variation from moringa can be minimized. Economically, Moringa Chikki can serve as an affordable, shelf-stable, and accessible health snack, supporting both local moringa cultivators and small-scale food entrepreneurs. Environmentally, it promotes the use of sustainable, plant-based ingredients that contribute to local food security and nutrition. In conclusion, Moringa Chikki not only bridges the gap between traditional snacks and functional foods but also aligns with current trends in healthy eating, natural ingredients, and sustainable food production. With proper quality control, packaging, and marketing, it holds strong potential for both domestic and international markets, contributing positively to public health and rural economic development.

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#### Parameter

Purpose Common Method Moisture Content Determines water content Oven drying method (AOAC 925.10) Ash Content Indicates total mineral content Muffle furnace method (AOAC 923.03) Crude Protein Measures nitrogen  $\times$  6.25 Kjeldahl method (AOAC 979.09) Crude Fat Measures total lipids Soxhlet extraction (AOAC 920.39) Crude Fiber Measures indigestible carbohydrates Wende method (AOAC 962.09) Carbohydrate (by difference)  $100 - (\text{Moisture} +$

Ash + Protein + Fat + Fiber) Calculated Energy Value Estimated caloric value (Protein × 4) + (Fat × 9) + (Carbohydrate × 4)

**Component Result**

(%) Remarks Moisture 3.8 ± 0.2 Low moisture → longer shelf life Ash 2.9 ± 0.1 Rich in minerals (from moringa & jaggery) Crude Protein 14.6 ± 0.4 High protein (from peanuts & moringa) Crude Fat 22.5 ± 0.3 Healthy fats from nuts/seeds Crude Fiber 5.2 ± 0.2 Dietary fibre from moringa Carbohydrates 51.0 ± 0.5 Mostly from jaggery Energy (kcal/100g) ~515 kcal Nutrient-dense snack.

Parameter	Purpose	Common Method
Moisture Content	Determines water content	Oven drying method (AOAC 925.10)
Ash Content	Indicates total mineral content	Muffle furnace method (AOAC 923.03)
Crude Protein	Measures nitrogen × 6.25	Kjeldahl method (AOAC 979.09)
Crude Fat	Measures total lipids	Soxhlet extraction (AOAC 920.39)
Crude Fiber	Measures indigestible carbohydrates	Wende method (AOAC 962.09)
Carbohydrate (by difference)	100 – (Moisture + Ash + Protein + Fat + Fiber)	Calculated
Energy Value	Estimated caloric value	(Protein × 4) + (Fat × 9) + (Carbohydrate × 4)

**Example Results: Proximate Composition of Moringa Chikki**

(Values are approximate and can vary based on formulation — e.g., peanut vs. sesame chikki, % moringa powder used, etc.)

Component	Result (%)	Remarks
Moisture	3.8 ± 0.2	Low moisture → longer shelf life
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Crude Fiber	5.2 ± 0.2	Dietary fibre from moringa
Carbohydrates	51.0 ± 0.5	Mostly from jaggery
Energy (kcal/100g)	~515 kcal	Nutrient-dense snack

Component	% Composition
Moisture	3.8
Ash	3.1
Protein	14.6
Fat	22.5
Fiber	5.2
Carbohydrate (by difference)	50.8
Energy	515 kcal/100 g

A. Microbiological Quality

Parameter	Method	Frequency	Acceptable Limit
Total Plate Count	ISO 4833 / Plate Count Agar	Every 15-30 days	$\leq 10^4$ cfu/g
Yeast & Mould Count	PDA at 25 °C, 5 days	Every 15-30 days	$\leq 10^2$ cfu/g
Coliforms / E. coli	VRBA or EMB agar	Initially final &	Absent / <10 cfu/g
Pathogens (Salmonella, S. aureus)	Selective media	Initially final &	Absent in 25 g

Interpretation:

An increase beyond limits indicates microbial spoilage or hygiene failure.

B. Physicochemical Parameters

	Method	Indicator of
Moisture content	Oven drying (AOAC)	Shelf stability & texture
Water activity (a <sub>w</sub> )	Hygrometer	Microbial growth risk (<0.6 ideal)
pH	Digital pH meter	Chemical stability
Peroxide value / rancidity	Titration method	Fat oxidation (nuts & moringa)





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