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Development of Plant based meat alternatives produced from Palmyra Sprout

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ABSTRACT: The increasing global demand for sustainable, nutritious, and ethical food alternatives has accelerated research into plant-based meat analogs. In this study, an innovative approach was undertaken to develop a plant-based meat alternative using Palmyra sprout (*Borassus flabellifer* L.), a nutrient-rich and underutilized plant resource found in tropical regions. Palmyra sprouts are recognized for their high protein, fiber, and antioxidant contents, making them a promising base ingredient for meat substitutes. The formulation process involved cleaning, blanching, grinding, mixing with natural binders, flavor enhancers, and shaping into meat-like textures through thermal processing. The developed product was subjected to a comprehensive set of analyses to evaluate its nutritional profile, microbiological safety, physicochemical characteristics, antioxidant potential, texture, and sensory acceptance. Nutritional analysis revealed that the Palmyra sprout-based meat analog contains 250 Kcal/100g of energy, 23 g of protein, 40 g of carbohydrates, 4 g of fat, and 6.3 g of fiber, along with significant mineral contents such as potassium (685 mg/100g), calcium (55 mg/100g), and iron (2.1 mg/100g). The product is also low in sodium (25 mg/100g) and provides vitamin C (5 mg/100g), making it a health-conscious choice for consumers. Texture Profile Analysis (TPA) indicated acceptable meat-like properties, while antioxidant assays (DPPH and total phenolic content) demonstrated significant bioactive potential. Sensory evaluation using a 9-point hedonic scale showed high consumer acceptability, particularly for appearance, flavor, and texture, with average scores above 8.0. Furthermore, shelf-life assessment under refrigeration (-18°C) confirmed product stability and safety for up to 21 days. This study successfully establishes Palmyra sprout as a novel, functional ingredient for developing plant-based meat alternatives, offering both nutritional benefits and environmental sustainability. The findings contribute to the growing body of knowledge on plant-based innovations and support the diversification of protein sources to meet future food security challenges. Future work may explore product scalability, packaging improvements, and fortification strategies to further enhance product appeal and shelf stability.

KEYWORDS: Palmyra Sprout, Plant-Based Meat, Meat Alternative, Nutritional Analysis, Sustainable Food Innovation.

I. INTRODUCTION

The increasing global concern over environmental sustainability, health consciousness, and animal welfare has led to a significant rise in the demand for plant-based meat alternatives. Traditional livestock farming contributes substantially to greenhouse gas emissions, water scarcity, and deforestation, thereby urging researchers and food innovators to explore alternative protein sources that are both nutritionally adequate and environmentally sustainable.

As a result, plant-based diets are gaining traction worldwide, with meat analogs emerging as a promising solution to mimic the texture, flavor, and nutritional profile of conventional meat without relying on animal-based ingredients. Palmyra sprout (*Borassus flabellifer* L.), locally known in many tropical countries, is an underexploited and nutritionally rich plant resource.

The transition toward meat alternatives has typically focused on soy, wheat gluten, and pea protein as the primary ingredients. However, reliance on a limited pool of crops poses agricultural sustainability and biodiversity risks. Exploring indigenous and underutilized crops such as Palmyra sprout offers a dual advantage: diversifying the plant-based protein sources and promoting local agriculture.

II. RELATED WORK

Recent years have seen a significant rise in the development of plant-based meat products due to increasing consumer concerns over health, sustainability, and animal welfare. focusing on replicating the texture, flavour, and nutritional content of animal meat using plant-derived ingredients such as soy, peas, and mung beans (Smetana et al., 2015).

III. METHODOLOGY

- 1. INGREDIENT SELECTION AND PREPARATION:**Palmyra Sprout Flour. Processing Palmyra sprouts into flour by washing, drying, and grinding.
Binding Agents: Using natural binders such as wheat gluten or starch to achieve cohesive texture
Flavour Enhancers: Incorporate spices, natural flavour extracts (mushroom or yeast extract), and oils to mimic meat flavour
- 2. FORMULATION OPTIMIZATION:**Blending Palmyra sprout flour with binding agents, plant oils, and spices in varying proportions (eg. 60:20:10:10) to create a meat-like consistency
Test different hydration levels to achieve a fibrous and juicy texture
- 3. PROCESSING :**Extrusion: Using a low-cost extrusion process to create the fibrous texture resembling meat
Shaping: Form the mixture into patties, sausages, or chunks suitable for cooking
Cooking Trials: Conducting frying, baking, and steaming tests to evaluate cooking stability. and sensory quality

IV. RESULT AND DISCUSSION

The synthesized films exhibit improved thermal stability, mechanical strength, and barrier properties compared to pure agarose films. SEM analysis reveals uniform dispersion of papain and silicates within the agarose matrix. PXRD analysis confirms the presence of crystalline phases in the films. Antimicrobial testing demonstrates the efficacy of the films against both gram-negative and gram-positive bacteria, indicating their potential for food packaging applications.

V. CONCLUSION AND FUTURE WORK

- This study highlights the potential of Palmyra sprouts in developing a plant-based meat alternative that meets the growing demand for sustainable, ethical, and nutrient-rich foods
- By leveraging the unique nutritional properties of Palmyra sprouts and optimizing texture and flavor, this project contributes to innovative food solutions for health-conscious consumers
- The product aligns with global trends in plant-based diets and offers an eco-friendly alternative to conventional meat, promoting sustainability and public health

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