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JACKFRUIT: WASTE TO WEALTH

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ABSTRACT

Jackfruit a nutritionally rich tropical fruit, generates significant waste in the form of peel, seeds, and fibrous core. These by-products, often discarded, pose environmental challenges but offer considerable potential for value addition. Rich in fibre, starch, antioxidants, and bioactive compounds, jackfruit waste is suitable for diverse applications in food, pharmaceutical, cosmetic, animal feed, and biofuel sectors. Its conversion into biodegradable packaging, bioethanol, and functional foods can reduce ecological burdens while promoting economic growth. Proper utilization of jackfruit waste aligns with sustainable development goals, offering a promising pathway for environmental conservation and circular bioeconomy advancement.

KEYWORDS: Bio-based applications, Jackfruit waste utilization, Value-added products, Sustainable agriculture

INTRODUCTION

Jackfruit (*Artocarpus heterophyllus*), native to South and Southeast Asia, is among the largest tree-borne fruits and widely cultivated in tropical regions. It is renowned for its nutritional richness and culinary adaptability. Despite its economic and dietary importance, a substantial portion of the fruit—comprising its peel, seeds, and core—is often discarded, contributing to environmental degradation and resource inefficiency.

Global attention towards jackfruit is growing due to its potential in addressing food security, particularly as a plant-based meat substitute. The edible pulp is widely utilized in fresh and processed forms including chips, jams, and canned products. However, approximately 50–60% of the fruit's total weight remains underutilized. These non-edible components are rich in bioactive compounds and nutrients, making them suitable for diverse industrial applications.

The jackfruit peel, constituting a major portion of the waste, is rich in dietary fibre, antioxidants, and polyphenols, and shows promise in applications such as animal feed, biodegradable packaging, and natural dyes. Jackfruit seeds, with high starch and protein content, can be processed into flour and

functional food ingredients. The fibrous core and rind are also valuable for biofuel production. Additionally, bioactive compounds in jackfruit waste exhibit medicinal properties, presenting opportunities for pharmaceutical and nutraceutical development. Strategic utilization of these components can contribute significantly to sustainable development and circular economy models.

COMPOSITION AND NUTRITIONAL VALUE OF JACKFRUIT

Jackfruit waste primarily includes peel, seeds, and fibrous core, each with distinct nutritional profiles:

Peel: Rich in dietary fibre, antioxidants, and polyphenols; beneficial for gut health and suitable for bio-based product development.

Seeds: Contain substantial amounts of starch, protein, and essential minerals; viable for food, pharmaceutical, and industrial applications.

Core and Rind: Predominantly fibrous and phytochemical-rich, suitable for biochar, bioethanol, and functional food production.

Nutritional Composition (per 100g dry weight):

- Carbohydrates: 60–70%
- Protein: 6–8%
- Fat: 0.4–1%
- Starch: 35–40%
- Dietary Fibre: 3–5%
- Minerals: Potassium, Magnesium, Calcium

Other Key Nutritional Components:

- Moisture: 50–80% (dependent on ripeness)
- Crude Fibre: 10–20%
- Ash: 2–5%
- Vitamins: Vitamin A (β-carotene), B1, B2, B3, B6
- Minerals:
- Potassium: 300–400 mg
- Calcium: 20–37 mg
- Magnesium: 27 mg
- Phosphorus: 38 mg
- Iron: 0.5 mg

3. APPLICATIONS OF JACKFRUIT WASTE

3.1 Food Industry Applications

1. *Jackfruit Seed Flour*: Jackfruit seeds, which make up approximately 10–15% of the fruit's weight, are rich in carbohydrates, proteins, and dietary fibre. They can be processed into flour for use in baked goods, pasta, and other products, enhancing nutritional value while reducing reliance on wheat or maize-based flours.
2. *Snacks and Confectionery*: Boiled or roasted jackfruit seeds serve as high-protein, antioxidant-rich snacks. These seeds are also incorporated into confectionery items like chocolates and energy bars, providing a nutritious and sustainable alternative.
3. *Fermented Products:* The fermentable sugars in jackfruit peel and core allow their use in producing vinegar, probiotic beverages, and alcoholic drinks such as wine, offering innovative avenues in fermented food products.

3.2 Animal Feed

Due to their high fibre and protein content, jackfruit peel and seeds can be converted into livestock feed. Dried peel is suitable for inclusion in feed formulations for cattle, poultry, and goats, offering an economical and sustainable alternative to conventional feed ingredients.

3.3 Bioplastics and Packaging Materials

Jackfruit peel, rich in lignin and cellulose, is a valuable raw material for bioplastic production. Biopolymers extracted from jackfruit starch and fibre can replace petroleum-based plastics in sustainable packaging, contributing to waste reduction and environmental conservation.

3.4 Pharmaceutical and Cosmetic Applications

1. *Antioxidant and Antimicrobial Properties:* Jackfruit waste contains flavonoids, tannins, and phenolic compounds with significant antioxidant and antimicrobial activity. These bioactives have potential for use in pharmaceutical formulations targeting oxidative stress and infections.
2. *Skincare and Haircare*: Extracts from jackfruit waste are incorporated into personal care products due to their moisturizing, anti-aging, and protective properties. Their rich antioxidant profile makes them suitable for creams, lotions, and haircare formulations.

3.5 Biofuel and Biogas Production

High carbohydrate and lignocellulosic content make jackfruit waste ideal for bioenergy production. Anaerobic digestion of peels and seeds generates biogas for use in cooking and electricity. Similarly, bioethanol can be extracted, supporting renewable energy initiatives and reducing fossil fuel dependence.

3.6 Composting and Organic Fertilizer

Jackfruit residues are rich in organic matter and nutrients, making them ideal for composting. Compost derived from peels, seeds, and cores enhances soil fertility and microbial health, providing an eco-friendly alternative to chemical fertilizers.

3.7 Enzyme Production

Jackfruit waste serves as a cost-effective substrate for producing industrial enzymes like cellulase and amylase. These enzymes have applications in starch hydrolysis, textile processing, and industrial waste management, further expanding the value chain of jackfruit by-products.

CONCLUSION

Jackfruit waste presents a promising opportunity for sustainable resource utilization. Although often discarded, components such as seeds, peels, and fibrous core are rich in nutrients and bioactive compounds. These by-products can be effectively harnessed in food, pharmaceutical, cosmetic, energy, and agricultural sectors. Utilizing jackfruit waste not only mitigates environmental impact but also adds economic value through product diversification. Strategic integration of jackfruit by-products into industrial applications supports a circular economy, enhances sustainability, and contributes to waste-to-wealth transformation in tropical agriculture.

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