JACKFRUIT PROCESSING UNIT

1. INTRODUCTION

Jackfruit (*Artocarpus heterophyllus*) is the biggest tree-borne fruit, known for its versatility, dietary benefits, and developing ubiquity as a feasible nourishment source. Native to South and Southeast Asia, jackfruit is progressively recognized globally as a versatile ingredient and a feasible alternative to meat. The fruit is characterized by its large size, sweet aroma when ripe, and unique texture that makes it versatile for different culinary applications.

Jackfruit flourishes in tropical and subtropical climates, making it well-suited for cultivation in many regions of India. Each jackfruit tree can produce up to 200 fruits yearly, with each fruit weighing between 10-25 kg, offering substantial yield for commercial processing. The fruit contains three main edible components: the bulbs or flesh (ripe or unripe), seeds, and rags (the fibrous portion between bulbs).

Rich in nutrients including fiber, potassium, vitamin C, and various B vitamins, jackfruit offers significant health benefits such as improved digestion, enhanced immune function, and better cardiovascular health. The unripe fruit's meat-like texture when cooked has led to its growing popularity as a plant-based meat substitute, particularly in Western markets where demand and popularity for vegan and vegetarian alternatives is rising.

2. PRODUCT AND ITS APPLICATION

The proposed processing unit will focus on producing a range of jackfruit-based products through advanced dehydration and processing techniques.

As per the Market Overview, the Applications of Jackfruit Products are:

1. **Primary Processed Products**
    - **Jackfruit Meat Alternative**: Processed unripe jackfruit packaged in brine or vacuum-sealed for use as a meat substitute in various dishes.
    - **Dehydrated Jackfruit**: Slices or chunks can be packaged as a healthy, ready-to-eat snack for health-conscious consumers.
    - **Jackfruit Flour**: Made from dried and ground jackfruit, useful for baking and cooking applications.
    - **Frozen Jackfruit Segments**: Convenient for direct consumption or cooking.
    - **Canned Ripe Jackfruit**: In syrup for desserts and sweet applications.
2. **Beverage Industry**
    - **Jackfruit Pulp**: Used for juices, smoothies, and other beverages.
    - **Jackfruit Concentrate**: For flavoring drinks and food products.
    - **Jackfruit Wine**: Fermented product with potential for premium positioning.
3. **Bakery and Confectionery**
    - Jackfruit can be used in cakes, muffins, cookies, and other baked products.
    - Jackfruit-based candies, preserves, and jams offer unique flavor profiles.
    - Fruit fillings for pastries and bread mixes.
4. **Seed-Based Products**

    - **Jackfruit Seed Flour**: High in protein and fiber, suitable for various food applications.
    - **Roasted Jackfruit Seeds**: Packaged as snacks.
    - **Seed Oil**: Extracted for culinary and cosmetic applications.
5. **Waste-Derived Products**
    - **Natural Fiber**: From rind and core for packaging materials.
    - **Biofertilizer**: Composted jackfruit waste for agricultural use.
    - **Bioactive Compounds**: Extracted for pharmaceutical and cosmetic industries.
    - **Animal Feed**: Processed rind and fiber as nutritious livestock feed.

3. DESIRED QUALIFICATIONS FOR PROMOTER

A promoter should ideally possess the following qualifications to succeed in the jackfruit processing enterprise:

1. Educational background in food technology, agriculture, horticulture, or related fields.
2. Practical experience in food processing, particularly in fruit preservation techniques.
3. Knowledge of waste management practices and circular economy principles.
4. Understanding of food safety regulations and quality control procedures.
5. Business management skills including marketing, finance, and operations.
6. Familiarity with export requirements if targeting international markets.
7. Networking capabilities to establish supply chains with local farmers.
8. Commitment to sustainable and environmentally friendly practices.
9. Awareness of current food industry trends, particularly plant-based alternatives.
10. Adaptability to incorporate technological innovations in food processing.

4. BUSINESS OUTLOOK AND TRENDS

The jackfruit processing industry presents promising opportunities due to several favorable market trends:

- **Rising Demand for Plant-Based Proteins**: The global plant-based meat market is projected to grow at a CAGR of over 15% through 2030, with jackfruit being a key ingredient due to its meat-like texture.
- **Health and Wellness Focus**: Consumer shift towards nutritious, minimally processed foods aligns with jackfruit's nutritional profile.
- **Sustainability Concerns**: Jackfruit's high yield per tree (up to 3 tons annually) makes it an environmentally efficient crop compared to animal protein sources.
- **Clean Label Movement**: The natural, clean-label appeal of properly processed jackfruit products meets growing consumer demand for transparent ingredient lists.
- **Circular Economy Integration**: The industry trend toward zero-waste operations enhances profitability through complete utilization of raw materials.
- **Export Potential**: Growing international demand, particularly in North America and Europe, where jackfruit is still considered novel.
- **Technological Advancements**: Improvements in processing and preservation techniques allow for better quality and longer shelf life.
- **Government Support**: Various initiatives supporting food processing industries, particularly those adding value to agricultural products.

- **E-commerce Growth**: The rise of online retail channels creates new distribution opportunities for shelf-stable jackfruit products.

5. MARKET POTENTIAL AND MARKETING ISSUES

The market potential for processed jackfruit products is substantial, driven by several factors:

Market Potential:

- **Domestic Market**: Growing urban middle-class consumers seeking healthy, convenient food options.
- **International Markets**: Expanding demand in Western countries for plant-based meat alternatives, with jackfruit gaining recognition.
- **Food Service Industry**: Restaurants, catering services, and institutional kitchens looking for innovative ingredients.
- **Retail Chains**: Increasing shelf space dedicated to plant-based and exotic fruit products.
- **E-commerce Platforms**: Direct-to-consumer sales opportunities through online marketplaces.

Marketing Issues to Consider:

- **Seasonality of Jackfruit**: While jackfruit has a relatively long season, ensuring year-round supply requires careful planning and inventory management.
- **Quality Control**: Maintaining consistent flavor, texture, and appearance across batches.
- **Cold Chain Infrastructure**: Ensuring proper transportation and storage, particularly for frozen products.
- **Consumer Education**: Many consumers are unfamiliar with jackfruit, necessitating educational marketing efforts.
- **Pricing Strategy**: Balancing affordability with premium positioning for value-added products.
- **Competition**: Differentiating from other plant-based alternatives and tropical fruit products.
- **Regulatory Compliance**: Meeting food safety standards and labeling requirements across markets.

Marketing Strategy:

Traditional sun-drying methods limit production capacity and quality consistency. Therefore, mechanically processed jackfruit products have become more commercially viable. Target markets include:

- Health food stores and specialty retailers
- Restaurant and foodservice industry
- Food manufacturing companies using jackfruit as an ingredient
- Export markets, particularly in regions where jackfruit is not locally grown
- E-commerce platforms for direct consumer reach
- Pharmaceutical and nutraceutical companies (for bioactive compounds)

Branding should emphasize the sustainable, nutritious, and versatile nature of jackfruit products, with packaging highlighting zero-waste processing methods.

6. RAW MATERIALS REQUIRED

The primary raw material is fresh jackfruit, with the following specifications and requirements:

- **Fresh Jackfruit**: The main processing unit will require approximately 30-40 tons per month during peak season.
- **Varieties**: Selection of appropriate varieties based on end product (e.g., firmer varieties for meat alternative, sweeter varieties for dessert products).
- **Quality Parameters**: Fruits should be free from pests, diseases, and damage.
- **Packaging Materials**:
    - Food-grade plastic bags for inner packaging
    - Vacuum-sealed bags for extended shelf life
    - Cardboard boxes for bulk packaging
    - Glass jars for premium preserved products
    - Biodegradable packaging made from jackfruit waste (for certain product lines)
- **Preservatives** (if used): Natural preservatives preferred to align with clean-label trends.
- **Processing Aids**: Food-grade sanitizers for washing, anti-browning agents.
- **Water**: Clean, potable water for washing and processing.

7. JACKFRUIT PROCESSING METHODS

The processing methods for jackfruit products include:

A. Selection and Preparation

- **Selection**: Careful selection of fruits based on ripeness, size, and quality.
- **Cleaning**: Thorough washing to remove dirt, pesticides, and surface contaminants.
- **Peeling and Core Removal**: Separating the edible portions from the rind and core.
- **Segregation**: Dividing into ripe bulbs, unripe flesh, seeds, and waste materials for different processing streams.

B. Meat Alternative Production (Unripe Jackfruit)

- **Cutting and Sizing**: Cutting unripe jackfruit into appropriate sizes.
- **Blanching**: Brief heat treatment to preserve color and texture.
- **Flavoring**: Addition of brine or spices as needed.
- **Packaging**: In cans, pouches, or vacuum-sealed containers.

C. Dehydration Process

- **Slicing**: Cutting jackfruit into uniform slices for even drying.
- **Pre-treatment**: Optional treatment with anti-browning agents.
- **Dehydration Methods**:
    - Hot Air Drying: Using temperature-controlled chambers (50-70°C).
    - Freeze Drying: For premium quality preservation.
    - Solar Drying: When applicable for energy efficiency.

- **Cooling**: Allowing products to reach room temperature.
- **Packaging**: In moisture-proof, airtight containers.

D. Seed Processing

- **Separation and Cleaning**: Removing and cleaning seeds.
- **Drying**: Reducing moisture content for flour production or roasting.
- **Grinding**: For flour production.
- **Roasting**: For snack production.
- **Packaging**: In appropriate containers based on end product.

E. Waste Stream Processing

- **Separation**: Categorizing waste by type (rind, core, damaged parts).
- **Composting**: Converting organic waste to biofertilizer.
- **Bioactive Extraction**: Isolating valuable compounds from rind and other parts.
- **Fiber Extraction**: For packaging material production.
- **Biogas Production**: Anaerobic digestion of suitable waste portions.

Processing Flow Chart: (A visual flow chart would be included here in the actual document)

8. MANPOWER REQUIREMENT

Sr. No.	Particulars	No.	No. of months in the year	Wages/Salaries per month (Rs. In Lakhs)	Annual Expense (Rs. In Lakhs)
1	Self-employed (Owner)	1	-	-	-
2	Food Technologist	1	12	0.40	4.80
3	Skilled Labor (Processing)	3	12	0.15	5.40
4	Semi-skilled Labor	5	12	0.08	4.80
5	General Labor (Packaging)	4	12	0.06	2.88
6	Quality Control Technician	1	12	0.20	2.40
7	Sales and Marketing Staff	2	12	0.15	3.60
Total		17			**23.88**

9. IMPLEMENTATION SCHEDULE

Sr. No.	Activity	Time Required (in months)
1	Enterprise/MSME Registration & Approval	1
2	Financial/Loan from Bankers or Financial Institutions	2
3	Land acquisition/Building construction	6
4	Power connection and utility setup	1
5	Machinery procurement & installation	2
6	Trial run and process optimization	1
7	Recruitment of Staff & Labor	1
8	Supplier and distribution network establishment	2
9	Actual commercial production	1
10	**Total (some activities shall run concurrently)**	**12**

11. COST OF PROJECT

Sr. No.	Particulars	Annual Expenses (Rs. In lakhs)
1	Land	25.00
2	Building Construction	35.00
3	Plant & Machinery	45.00
4	Waste Management Equipment	15.00
5	Laboratory Equipment	8.00
6	Furniture & Fixtures	5.00
7	Pre-operative & Preliminary Expenses	3.00
8	Working Capital	65.00
	Total Project Cost	**201.00**

12. MEANS OF FINANCE

Sr. No.	Particulars	Amount (Rs. In lakhs)
1	Promoter’s contribution (40%)	80.40
2	Bank Finance (60%)	120.60
	Total	**201.00**

12. LIST OF MACHINERY & EQUIPMENT

A. PROCESSING MACHINERY

Sr. No.	Particulars	Unit	Price per Unit (Rs. in lakhs)	Total Amount (Rs. in lakhs)
1	Fruit Washing and Cleaning System	1	3.00	3.00
2	Fruit Cutting and Slicing Machines	2	2.50	5.00
3	Blanching Unit	1	3.00	3.00
4	Industrial Dehydrator (48 trays)	2	7.00	14.00
5	Freeze Dryer	1	15.00	15.00
6	Grinding and Milling Equipment	2	2.00	4.00
7	Vacuum Packaging Machine	2	1.50	3.00
8	Cold Storage Facility	1	8.00	8.00
9	Weighing Scales and Quality Testing Equipment	-	-	5.00
	Total			**60.00**

B. WASTE MANAGEMENT EQUIPMENT

Sr. No.	Particulars	Unit	Price per Unit (Rs. in lakhs)	Total Amount (Rs. in lakhs)
1	Biogas Digester System	1	7.00	7.00
2	Composting Equipment	1	3.00	3.00
3	Compound Extraction Unit	1	5.00	5.00
	Total			**15.00**

Potential Equipment Suppliers:

1. **Food Processing Equipment India Ltd.** Mumbai, Maharashtra, India
2. **Bajaj Process Equipment** Delhi, India
3. **SSP Pvt Ltd.** Faridabad, Haryana, India
4. **Atlas Technologies** Bengaluru, Karnataka, India
5. **Bio-Tech Equipment Systems** Coimbatore, Tamil Nadu, India

Besides these, online platforms such as India Mart, Trade Mart, and Alibaba can be explored for equipment sourcing.

13. SALES REALIZATION

Sr. No.	Product	Sales Percentage	Annual Sales (Rs. In lakhs)
1	Jackfruit Meat Alternative	30%	108.00
2	Dehydrated Jackfruit Products	25%	90.00
3	Jackfruit Flour	15%	54.00
4	Seed-Based Products	10%	36.00
5	Waste-Derived Products	20%	72.00
	Total	**100%**	**360.00**

14. PROFITABILITY CALCULATION

Sr. No.	Particulars	Annual Expenses (Rs. In lakhs)
A.	Sales realization	360.00
B.	Cost of production	
i)	Raw materials	80.00
ii)	Utilities (electricity, water, fuel)	18.00
iii)	Manpower Cost (Salaries/wages)	23.88
iv)	Administrative expenses	12.00
v)	Packaging Cost	24.00
vi)	Material Loss Cost	5.00
vii)	Selling & distribution expenses	18.00
viii)	Repairs & maintenance	8.00
ix)	Interest	14.47
x)	Misc. expenses	6.00
	Total (B)	209.35
	Gross profit/loss (A – B)	150.65
	Less: Depreciation	12.00
C.	PBIT	138.65
D.	Income-tax	34.66
E.	Net profit/loss	103.99
F.	Loan Repayment (Annual)	24.12
G.	Retained surplus (E-F)	79.87

15. BREAK-EVEN ANALYSIS

Fixed cost	**Amount (Rs. in lakhs)**
Depreciation	12.00
Interest	14.47
Permanent Workforce	15.00
Administrative Expenses (Fixed portion)	8.00
Total Fixed cost	**49.47**
Variable cost	
Raw materials	80.00
Utilities	18.00
Variable Workforce	8.88
Packaging Cost	24.00
Selling & distribution expenses	18.00
Total Variable cost	**148.88**
Contribution margin	**58.6%**
Break-Even Point (Rs. in lakhs)	**84.42**
Break-Even Point (% of capacity)	**23.45%**

16. WASTE MANAGEMENT AND VALUE ADDITION

Waste Streams Identification

- **Rind/Peel**: Comprises 50-60% of total fruit weight
- **Core**: Approximately 5-10% of fruit weight
- **Fiber/Rag**: The fibrous material between bulbs (5-8%)
- **Damaged or Unmarketable Parts**: Varies based on fruit quality

Value Addition from Waste

1. Biofertilizer Production

- **Process**: On-site composting facility using modern methods
- **Equipment**: Composting bins, shredders, temperature monitors
- **Products**:
    - Premium organic fertilizer
    - Vermicompost from rind waste
    - Liquid bio-stimulants
- **Market Potential**: Local farmers, nurseries, organic farming operations
- **Revenue Potential**: Rs. 15-20 lakhs annually

2. Bioactive Compound Extraction

- **Process**: Extraction of valuable compounds from rinds and unused parts

- **Equipment**: Extraction units, filtration systems, drying equipment
- **Products**:
  - Pectin (used in food industry as gelling agent)
  - Natural yellow dye for food colorant
  - Antioxidants and phenolic compounds
- **Applications**: Food additives, natural coloring, nutraceuticals
- **Revenue Potential**: Rs. 25-30 lakhs annually

3. Biogas Generation

- **Process**: Anaerobic digestion of organic waste
- **Equipment**: Biogas digester, gas collection system, purification unit
- **Outputs**:
  - Biogas for facility energy needs (20-30% of total requirement)
  - Digestate as additional fertilizer product
- **Benefits**: Energy cost reduction, carbon footprint reduction
- **Savings/Revenue**: Rs. 8-10 lakhs annually

4. Biodegradable Packaging Material

- **Process**: Processing of rind fiber for packaging applications
- **Equipment**: Fiber extraction unit, molding systems
- **Products**:
  - Biodegradable plates and containers
  - Paper alternatives
  - Protective packaging materials
- **Market Potential**: Eco-conscious consumers, food service industry
- **Revenue Potential**: Rs. 18-22 lakhs annually

5. Animal Feed Production

- **Process**: Processing jackfruit rind and fiber for livestock feed
- **Equipment**: Dryers, grinders, mixing and pelleting machines
- **Benefits**:
  - High fiber content beneficial for ruminants
  - Nutritionally enhanced through fermentation
- **Market**: Local dairy farms, poultry operations
- **Revenue Potential**: Rs. 10-12 lakhs annually

Environmental Benefits

- Zero waste operation model
- Reduced greenhouse gas emissions
- Water conservation through treatment and reuse
- Reduction in landfill contribution
- Lower carbon footprint of end products

Economic Impact of Waste Utilization

- Additional revenue streams (20% of total revenue)
- Reduced disposal costs
- Enhanced brand value through sustainability credentials
- Potential for carbon credits and environmental certifications
- Improved overall project viability and return on investment

17. STATUTORY/GOVERNMENT APPROVALS

For a jackfruit processing business, the following licenses and approvals are required:

1. **FSSAI License**: Essential for food processing operations.
2. **Pollution Control Board Clearance**: Particularly important due to waste management operations.
3. **GST Registration**: Required for all business transactions.
4. **Factory License**: From the state factory department.
5. **MSME Registration**: To avail government subsidies and support.
6. **BIS Certification**: For applicable products.
7. **Export License**: If targeting international markets.
8. **Local Municipal Permissions**: For operation within municipal limits.
9. **Water and Electricity Connection Approvals**
10. **Fire Safety Clearance**

18. TRAINING CENTERS AND COURSES

Entrepreneurs looking to enter jackfruit processing can pursue relevant courses at the following institutes:

1. **Central Food Technological Research Institute (CFTRI)**, Mysore
2. **National Institute of Food Technology Entrepreneurship and Management (NIFTEM)**, Haryana
3. **Indian Institute of Food Processing Technology (IIFPT)**, Thanjavur
4. **State Agricultural Universities** with food technology departments
5. **Central Institute of Agricultural Engineering (CIAE)**, Bhopal

Online resources include:

- **Swayam portal** (https://swayam.gov.in/) for courses on food processing, entrepreneurship, and business management
- **Food Safety and Standards Authority of India (FSSAI)** for food safety training
- **Entrepreneurship Development Institute of India (EDII)** for entrepreneurship development programs

19. CONCLUSION

The proposed jackfruit processing project presents a compelling business opportunity with significant economic, environmental, and social benefits. By implementing a comprehensive

waste management and value-addition strategy, the project transforms potential waste streams into valuable resources, enhancing overall profitability and sustainability.

Key highlights of the project include:

1. **Multiple Revenue Streams**: From primary products and waste-derived innovations.
2. **Strong Market Potential**: Growing demand for plant-based alternatives and sustainable food products.
3. **Circular Economy Model**: Zero-waste approach enhances brand value and operational efficiency.
4. **Attractive Financial Returns**: Projected ROI demonstrates commercial viability.
5. **Environmental Benefits**: Reduced carbon footprint and sustainable resource utilization.
6. **Social Impact**: Employment generation and support for local agriculture.

With proper implementation, this project can serve as a model for sustainable food processing that balances commercial success with environmental responsibility. The integrated waste management approach not only addresses a significant challenge in fruit processing but transforms it into a competitive advantage that positions the business for long-term success in an increasingly sustainability-conscious market.