PROPOSAL
FOR

AGRO PROCESSING BUSINESS

Proposed by

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INDEX

1. Executive Summary

Bangladesh abounds with a large variety of tropical and sub-tropical fruits. Major fruits, such as mango, banana, jackfruit, pineapple, papaya, litchi, guava, and jujube are produced on 79 percent of the harvested area. This cultivation is favoured by the range of latitudes and altitudes of the country. The Bengali people have long taken pride in the fertility of their soil. Now, based on the domestic agricultural output, it is evident that their faith is not misplaced. According to recent figures, total fruit production accounts for more than 34 million metric tons. Today, Bangladesh requires intensive collaboration among researchers, extension organizations, private fruit gardens, and nurseries to achieve higher levels of yield.

1.1 Fruit Production

Fruit cultivation has been a traditional part of the agricultural practices in Bangladesh. The industry is adequately established to provide value-added products, food security, and income for its stakeholders. The demand and cultivation of fruits capable of being processed are facing a steady rise. This trend could soon provide substitutions for imports.

In Bangladesh most fruit production is seasonal and occurs during the month of Jaistha according to the Bengali calendar, also referred to as “Modhu Mash” (honey month). This period falls between May to June. About 54 percent of total fruits produced in the country are harvested and marketed in the months of Baishakh, Jaistha, Ashar, and Srabon, that is, from April to August. The rest of the 46 percent is harvested during the other 8 months. Among the most important fruits harvested during Modhu Mash are mango, jackfruit, litchi, and pineapple. Papaya and banana are produced throughout the year. Further research in this sector is crucial to ensure that harvests of all categories of fruits can be sustained throughout the year.

1.2 Fruit Processing and Fruit Pulping

Over the last decade, the fruit processing industry has been boosted by factors such as increased demand for convenient meals, health awareness, and branding. However, more than 35% of the fruits and vegetables are wasted due to a lack of processing and storage facilities.

The Most Commonly Processed Fruit –

- Mango
- Pineapple
- Banana
- Alovera
- Jackfruit

2. Mango- The Most Commonly Processed Fruit

A major contributor to the local fruit pulping, canning, and juice industry of Bangladesh is

mango – the most commonly processed fruit in Bangladesh. In fact, the country is ranked 9th in the global production of mangoes. In particular, mango pulping is profitable due to its longer shelf life and affordability.

2.1 Impediments to Productivity

Shortage of cutting-edge technology, modern facilities, and sustainable infrastructure are major obstacles to growth in this industry. Another key stumbling block for this industry is a dearth of research collaboration. Bangladesh Agricultural Research Institute (BARI) has so far developed 40 improved varieties, known as the High Yielding Varieties (HYVs). But most of these HYVs are rarely seen in the fields. The practical uses of these improved varieties are very scarce among farmers. Thus, a significant yield gap exists between the research station and the farmers' fields. This variance ranges from two to five hundred percent.

2.2 Preservation and Processing

The deficiency of proper preservation and processing mechanisms rot about 30 to 40 percent of the total fruits annually. For that reason, imposition of restrictions is necessary on fruit import during peak harvesting seasons in our country, along with the establishment of private sector fruit processing plants. Besides fruits preservation and fruits processing, fruit marketing is also a major drawback for this industry. Farmers do not get a fair price. In fact, in most cases, they even fail to receive 50 percent of the price the consumers pay for the fruits. In reality, the intermediaries end up consuming the farmers' share of the revenue. Every step, from picking the fruit to delivering the final product should be carried on with more efficiency and diligence.

2.3 Impact on the Economy

A potentially rewarding market exists for fruit processors in Bangladesh. The overall impact is likely to alleviate food insecurity and escalate employment in the economy. This is particularly true for a large segment of the rural population. Recent trends show that the rise in fruit production has been sluggish, even with the cultivation of some foreign fruits on local soil. To raise these low levels of agricultural production, the government and the private sector both need to coordinate and use the country's skilled

labor force and rich natural resources to make the fruit processing industry establish a stronger foothold in the global market.

Bangladesh Food Industry

Industry	Gross Value Addition in billion BDT	Indirect Tax in billion BDT	Corporate Tax in billion BDT
Food manufacture	545.6	11.152	5.343
Beverage manufacture	47.57	11.9	0.305

Sources: BBS, Survey of Manufacturing Industries (2019)

The growth of the food processing industry has seen a boom in recent times. This growth was inevitable as almost all big corporate houses invested in this particular segment. It happened mainly because of the rapid urbanisation coupled with the rising disposable income of the people.
But the growth of the industry is yet to reach its optimum level, although some food processing brands have even gone beyond borders and are very popular in the international markets.
The industry could yield much better results by seizing the advantage of the country's rapid urbanisation that changed the lifestyle creating growing demand for such types of foods. But a number of challenges have hindered its onward march. They lack raw materials, sophisticated machinery and manpower, especially nutritionists. The tax environment is also not friendly for further growth of the industry. The industry bears a heavy burden of indirect tax.

At present, there are 486 agro-processing manufacturers in the country. Of them, 241 are exporters and 235 cater to the need in the domestic market. The main export items are frozen fish, shrimp and other frozen food products, tea, spices, fruits including dry fruits, and some other processed agricultural products. The major export destinations include the European Union (EU), the US, the Middle East and the Gulf. The last economic census in 2011 revealed that the food processing industry was employing 19 per cent of the industrial manufacturing workforce in Bangladesh, equivalent to 8.0 per cent of the total manufacturing labour force. The food industry employed 2.45 per cent of the country's total labour force and its share in the gross domestic product (GDP) was 2.01 per cent in 2010.

However, industry insiders said they were mostly using local agricultural products, but they were not getting adequate supplies. They needed to import such raw materials in a bid to continue their production. The agriculture system was still at a subsistence level where the farmers were producing foods for their own consumption. It needed to be upgraded and commercialised for the sake of more value addition. However, some big agro brands went for contract farming to ensure an uninterrupted supply of raw materials.

The dominant players in the market consist of a few dozen. Most of them are small and medium-sized, which produce same products by using old machinery. The big brands, however, are using modern machinery, mainly imported from Germany. The research and development also remain a far cry in the local food processing industry. There are very few brands that have appointed nutritionists and other food experts.

Industry insiders said the country was lagging far behind in modernisation as the small and medium enterprises (SMEs) were using old machinery. The government was supporting the sector by giving some tax benefits. Entrepreneurs said that the sector should be patronised more considering its role in food security. There is the issue of agricultural by-products. For example, there is cashew nut farming in the

CHT. The farmers use only the nut portion. They do not use cashew nut peels. It can be used for producing more products. Farmers need to be trained on the use of appropriate technology and funding for this purpose. The domestic market is huge. Inauguration of the Padma bridge has widened the scope further. There is every reason to promote foreign investments, particularly, in agriculture, food-processing and packaging, to cope with the demand in a competitive environment. There is an ample opportunity of job creation.

Bangladesh exports more than 700 items including 63 basic agro-processed products, to more than 140 countries. Most of them are cereal grains, frozen fish, processed meat, tea, vegetables, tobacco, cut flower, fruits, spices, dry food and other processed agricultural products. According to the Bangladesh Investment Development Authority (BIDA), the domestic market size of packaged food was worth about Tk 5.2 billion in 2018. It is forecast to reach Tk 7.3 billion in 2023. In the packaged food market, edible oils, dairy products and snacks dominate the sales in terms of value. These products are expected to see a growth in sales steadily by around 6.0 per cent per annum till 2023, according to the BIDA. In the fiscal year (FY) 2018-19, the agro sector fetched export earnings worth $ 1.41 billion.

Foreign investors either solely or in partnership with local firms should be offered financial support including tax incentives for setting up industrial units for food processing and packaging. It should happen alongside technology transfer. The RJSC (Registrar of Joint Stock Companies and Firms) now registers one-person company as it has amended the Companies Act. There are many one-person big names in the food processing industry in the world.

2.4 Green mango products

Mango is one of the few fruit which is utilized in all stages of its maturity from unripe stage to ripe stage. The green mango (young immature unripe stage) should be freshly picked from the tree. Raw mango is the star fruit of spring. Its tangy flavour compliments the weather beautifully. Raw mango are sour and green in colour its smells like pungent. Several other products are made from green mango fruit.

2.4.1 Mango pickle

Mango pickle is a spicy and tangy condiment. Mango pickle are classified as salt pickle or oil pickle or sweet pickle based on the type of preservation used. Raw mango cut into pieces, remove the stone than dried in the sun for a couple of days. Added some flavour, salt, mustard oil, and stew powder.

2.4.2 Mango powder

Aamchur also referred to as mango powder, is a fruity spice powder made from dried unripe green mango and is used as citrusy. Mango powder is ground from tart, unripe mangos which are sliced and sun-dried before grinding. It is not an actual “spice” but it can be used as citrusy in food as lemon juice etc. it is used in many dishes, like curries, chutney.

2.4.3 Mango chutney

A piquant relish or sauce of Indian origin, typically combining sweet and sour ingredients, and also vinegar with sugar and spices prepared from sliced or grated mangoes.

2.5 Ripe mango products

Ripe mango are luscious and sweetened, with a yellow- orange or red skin. They are ready to eat when it feels soft and give a gentle squeeze.

2.5.1 Mango pulp

Mango pulp is prepared from selected varieties of fresh mango fruit. Fully matured mangoes are harvested, quickly transported to the fruit processing plant. The refined pulp is also packed in cans, hermetically sealed and restored frozen pulp is pasteurized and deep frozen in plant freezers. No preservation is used in the caned mango pulp. However, when the pulp is filled in polyethylene jars for beverage and jam preparation, potassium met bisulphite used as preservative.

2.5.2 Mango beverages

In mango beverages there are three important beverages prepared on a commercial scale- mango juice, nectar as well as squash. Mango juice is prepared by adding equal quantity of water and adjusting the total soluble solid and acid. Mango nectar contain 20% pulp with sugar and acidity. These beverages are packed in cans. Mango squash contain 25% juice, 45% TSS and 1.2 to 1.5% acidity and is preserved with preservative in a glass bottle.

2.5.3 Mango jam

To prepare mango jam, pulp from dehydrated mango slices was heated with an equal quantity of sugar to 65-68oB and citric acid was added at the end to get 0.6-0.7% acidity in the final product score for colour and flavour sugar and acid tolerant microorganisms causing spoilage in mango jam.

2.6 Mango By-Product Utilization

After consumption or industrial processing of the fruits, considerable amounts of mango seeds and pulp are discarded as waste. Therefore, the utilization of mango by-products especially mango seed, peel may be an economical way to reduce the problem of waste disposal from mango production. The utilization technologies for different categories of mango by-products are- mango ready to eat breakfast cereal, mango dried chutney.

Mango kernel is a good source of starch and fat. Mango seed kernels have a low content of protein but they contain the most of the essential amino acids. Mango kernel is a good source of starch and fat. A preliminary study showed that the seed represents from 20% to 60% of the whole fruit weight, depending on the mango variety and the kernel inside the seed, which represents from 45% to 75% of the whole seed. Mango peel, generally termed as “total waste” is the second most important waste generated in the processing factories. During processing of mango, peel a major by- product, contributes about 15-20% of the fruit. Peel has been found to be a good source of phyto-chemicals, such as polyphenols, carotenoids, vitamin E, dietary fibre and vitamin C and it also exhibited good antioxidant properties.

2.7 Distribution Channels:

The channels may vary between large, medium and small farmers. Large farmers sell their harvest to wholesalers, while medium farmers sell their fruits to local markets or sell surplus fruits to neighbours or to village vendors and local retailers.

When the fruits are intended for export, the exporters or their commission agents visit production areas, examine the fruits and buy only those that meet the exporter's specifications. Fruits of the same maturity level are loaded and banana leaves are placed in between them to protect them from damage by direct sunlight. All around the truck, coconut leaves are placed to protect the fruits from sunburn. When fully loaded, coconut leaves are used to cover all around the truck and saw dust and ice sheets are placed to keep the fruits cool so that they will still be fresh at their point of destination. The big trucks are used to transfer the fruits to big cities where major markets are located. Once the truck reaches the destination, fruits are transferred to small trucks and ferried to their final destination. Following is list of the channels

Channel 1. To Central Market by:

a) Wholesalers through contract sale
b) Commission agents
c) Wholesalers who buy directly from orchards/ local markets.

Channel 2.

Farmers/Contractorswith big orchards send their produce directly to the central market (about 5%)

Channel 3.

Farmers/ Contractors bring their fruit to local wholesale markets where many vendors and even some consumers come to trade.

Channel 4.

Directly to exporter without passing through any middleman. Exporters assign their agents or collectors to procure fruit of a specific grade.

Channel 5.

Directly to processing unit with prior agreement on size, quality, and price.

3. Pineapple:

Pineapple, also known as Ananas which is a delicious tropical fruit full of nutritional benefits. According to different study pineapple is a healthy fruit with different types of vitamins and minerals. More than 130% daily requirement of vitamin for human beings come from a single pineapple. Pineapple reduces the threats of cough and cold, prevent cancer, improve vision, bone health, oral health, improve blood circulation and regulate blood pressure.

The honey queen variety of pineapple cultivated in the Madhupur Garo area has seen a better yield this year compared to the previous season. The mature, sweet and tasty fruit has already started to hit the market and is fetching better prices, making growers happy.

Joldungi pineapples are smaller in size but sweeter and tastier than other varieties. Tangail's Madhupur municipality is the key growing region for the fruit in Bangladesh. The latest data on pineapple production from the Bangladesh Bureau of Statistics is not readily available, but it is estimated that the country produced 208,000 tons of the fruit in 2020-21 and they were grown on around 35,000 acres of land. Pineapple farmers based in the Madhupur Garh region of Tangail district are ecstatic about the increasing demand for the fruit that has allowed them to secure better prices compared to previous years. The Madhupur Garh region is known for producing a majority of the pineapples cultivated across Bangladesh each year. The pineapples grown in the region, which includes the Giant Q, Honey Queen and Aswshina varieties, are famous for their sweet, juicy flesh that bears a distinct aromatic flavour.

According to the Department of Agricultural Extension (DAE) in Madhupur upazila, pineapples were cultivated on around 6,500 hectares of land in the region.

Similarly, more than 3,000 hectares of land in the adjacent Ghatail upazila and Fulbaria upazila in Mymensingh were used to grow the fruit. On an average, around two lakh tonnes of pineapple is produced in the country each year. About 85 per cent of the pineapples grown in the region are the Giant Q variety, locally known as Calendar. Of the rest, 5 per cent are the Honey Queen variety, locally called Joldungi, and 10 per cent are the Ashwina variety.

The Giant Q variety, which rules the markets between July and August, are being sold at Tk 40 to Tk 60 depending on size this year, up from Tk 20 to Tk 30 in previous years. Other than local traders, wholesalers from all over the country, including Dhaka, Gazipur, Manikganj and various northern districts, come to the markets in Madhupur to purchase pineapples during the picking season. Although the main season for pineapples is between May and September, these locally produced pineapples can now be found year-round. Local Farmers have introduced a market in the area for chemical-free pineapples as the authorities monitor local production practices to ensure that fruits with excessive amounts of hormones cannot enter the market.

A large amount of locally grown pineapples are left to rot each year due to a lack of preservation facilities. Local farmers incur losses as a result when their unsold pineapples turn ripe on the fields during the rains in July and August.

The pineapple juice market in Bangladesh was equal to 46.10 million USD (calculated in retail prices) in 2015. Until 2025, the juice market in Bangladesh is forecast to reach 103.27 million USD (in retail prices), thus increasing at a CAGR of 10.22% per annum for the period 2020-2025. This is an increase, compared to the growth of about 5.77% per year, registered in 2015-2019. The average consumption per capita in value terms reached 0.29 USD per capita (in retail prices) in 2015. In the next five years, it grew at a CAGR of 4.31% per annum. In the medium term (by 2025), the indicator is forecast to speed up its growth and increase at a CAGR of 7.88% per annum. Today, people are drinking less, but better quality juices and are willing to pay more for the health benefits they associate with them. Therefore, the category of juices and especially those with 100% fruit content has gained popularity among consumers across the world. Despite this, there is a concern among the health-conscious consumers regarding the high sugar content of the 100% pineapple juice, which has been an impediment for the development of the market in the last few years. However, people are also becoming more educated, thus understanding the difference between added sugar and natural sugar, which makes them more positive as an overall. In Europe, the pineapple flavor ranks among the top 5 flavors in many countries, including Spain, France, the UK, Malta, the Netherlands, Germany, and Cyprus. Although pineapple remains one of the most

popular flavors in many countries, younger consumers are increasingly opting for more interesting and exotic flavors including celery, cucumber, beetroot, and more. At the same time, demand for organic pineapple juice has been also growing. However, due to the fact that organic pineapple production is difficult, leading global producers have focused on sustainable production, and not organic. Another emerging trend on the global juice market as a whole is the proliferation of cold pressed juices. They became so popular, owing to the specific way of processing, which is known to better preserve both the flavor of fruit juices and their micronutrients, including vitamins and minerals. Furthermore, consumers are increasingly interested in homogeneous juices as most Europeans prefer to drink juice that was made from a specific variety of a fruit.

it is ranked third in terms total production and area farmed, both of which are increasing continually. It is grown in all regions, but especially in the Chittagong Hill Tracts, where many marginalised tribal people became involved in pineapple farming and trade, contributing to both rural livelihoods and national gross domestic product (GDP). Here, the 'Giant Kew' variety, known locally as Bandarban, has proved well adapted to local environmental conditions and to local and export preferences, being larger, juicier and sweeter than those grown in other areas of the country.

Pineapples are now cultivating worldwide. Based on time series analysis, it is the fourth most important fruit in Bangladesh in terms of its cultivating (Hossain and Abdullah, 2015). Pineapple is becoming the main industrial product of many countries and international demand for pineapple is increasing. It is widely cultivated because of its delicious and fragrant fruit in tropical and sub-tropical regions of the world. Bangladesh has a great probability of pineapple cultivation. According to the Bangladesh Bureau of Statistics (BBS) report most of the pineapple cultivates in Dhaka, Chittagong Hill Tract, Tangail, and Sylhet area. Dhaka division is the highest cultivable land in Bangladesh. May-July is the harvesting time of pineapple. After fulfilling the local demand there has found a surplus quantity of pineapple. Most of the time the cultivators either have to sell the surplus quantity at a low price or have to destroy the fruits. Every year a large amount of pineapple get damage because of proper preservation. Farmers are losing hope and they are shifting their farming. In Bangladesh, ripen pineapple consumed by the people. But internationally there have a demand of canned pineapple. By preserving the pineapple in a can with syrup it can be preserved for a year. Besides the cultivating season consumer can get the pineapple all the time. There are many countries who are exporting the pineapple using the can and syrup and there have demand of this processed pineapple almost all the important international market. Philippine and Thailand is the main exporter of canned pineapple. Every year Philippine is producing a large amount of canned pineapple from its pineapple cultivation. European Union and American market is the main importer of canned pineapple. With the surplus quantity of pineapple production Bangladesh also can enter those markets.

Global awareness is increasing about pollution free environment. Developed countries are now thinking about eco-friendly industrialization. Based on this the demand of environment friendly Fibre is increasing day by day. Man-made Fibre is light in weight but they contain different chemicals. Different type of natural Fibre is introducing. Among them pineapple leaf Fibre is famous for its different properties. This unused part of pineapple should have concern because of its highly commercial value. It is more useful than any other natural Fibre. Pineapple Fibre composite can be used in making different types of products. It is also used with other Fibre to increase the sustainability of cloth. This natural Fibre can be used as the alternative of existing textile Fibre. From the interview of Horticulture department official it is known that from every pineapple only 52% can consume as fresh fruit and jam or juice production, remaining 48% of pineapple peel and leaves are forming wastes. By using these wastes quality full luxury Fibre can be produced. Pineapple Fibre is famous for its lightness, softness and highly lustring quality. It is strong, soft, breathable, versatile, light, flexible textile that can be easily printed, stitched and cut. The Fibre is used in making footwear and different fashion accessories. It also can be used in interiors, car and aeronautics industries. Philippine, Thailand, Indonesia, China, India are the main pineapple cultivator in South East Asia. All these countries have good potential in making

pineapple leaf Fibre and different type of pineapple product. Bangladesh is also producing a good amount of pineapple in every year. It has a huge opportunity in pineapple leaf Fibre production. Using the huge amount of pineapple wastes it also can enter in the natural Fibre market. After harvesting and consuming the waste of pineapple is polluting the environment. So we can use those wastes effectively by implementing technology. No extra land, fertilizer and pesticide is not needed to make this products.

4. Banana

Bananas are one of the most popular and widely consumed fruits in Bangladesh. The country is blessed with a tropical climate, which makes it an ideal place for the cultivation of bananas. Bananas are a staple food in many parts of the country, and they are used in a variety of dishes, including desserts, smoothies, and curries. In this article, we will explore the significance of bananas in Bangladesh and the different types of bananas grown in the country.

4.1 History and Importance of Bananas in Bangladesh

Bananas have been grown in Bangladesh for thousands of years, and they have played a significant role in the country's culture and economy. Bananas are an important crop for many farmers in Bangladesh, and they provide a source of income for millions of people. Bananas are also an important source of nutrition for the people of Bangladesh. They are rich in potassium, fiber, and vitamins, making them a healthy and nutritious food choice. Bananas are also easy to digest, making them an ideal food for people of all ages. Bananas are also used in many traditional medicines in Bangladesh. They are believed to have a number of health benefits, including the ability to reduce blood pressure, lower cholesterol levels, and improve digestion.

4.2 Types of Bananas in Bangladesh

There are many different types of bananas grown in Bangladesh, each with its own unique flavor and texture. Some of the most popular varieties of bananas grown in Bangladesh include:

Sagor

Sagor (AAA genome[1]) is the most popular dessert banana in Bangladesh. It is also known as Amrit Sagor or Amritsagar. The plant is medium-sized and cannot withstand strong wind. The ripe banana develops a bright yellow colour. The average bunch has 5-7 hands and 12-13 fingers in each hand.

Raamsagor is the most famous Sagor for its large size, test and flavour.

Sabri

Sabri (AAB genome[1]) is also known as Malbhog, Onupam and Martaman. It is a popular dessert cultivar, widely grown in the north and western areas of Bangladesh . This tall plant has a yellowish green pseudostem with brownish blotches. The margins of the petiole and leaf sheath are reddish. The average bunch weight is about 10 kg. A bunch contains 85-120 fingers. Fruits are medium-sized. The peel is thin and the pulp is ivory-yellow in colour. Its texture is firm and taste sweet. However, hard lumps sometimes form in the pulp and the ripe fruits drop easily[1] .

This cultivar is highly susceptible to Fusarium wilt[1] .

Kobri

Kobri (AB genome[1]) is also known as Kabri, Bangla, Shail, Thutae and Manua. The fruits of this hardy plant are very sweet but sometimes contain seeds. The peel is light yellow in colour[1] .

Chini Champa

Chini Champa or Champa (AAB genome[1]) is one of the hardiest and tallest cultivar grown in the country. Its cultivation is especially widespread in the Chittagong and Chittagong Hill districts. It can be grown under rain-fed condition or with minial irrigation. Its fruits are small and have a thin peel. The pulp is creamy in colour and its taste is sub-acid. The fruits turn golden yellow when ripe and keep well. The bunch contains 150-250 fingers and weighs about 16 kg[1] .

The plant is resistant to Fusarium wilt and fairly resistant to Bunchy top[1] .

Mehersagar

Mehersagar (AAA genome[1]) is a medium-dwarf cultivar. Its fruits are large and have a greenish to dull yellow colour when ripe. The flesh is very soft and sweet. The keeping quality of fruits is poor and the market price is less. The average bunch weight is about 15 kg. It is susceptible to leaf spot diseases[1] .

Agniswar

The cultivar is favored for its pink color, good scent and sweetness.

Gerasundari

Kanthali Kola

This variety is common in the country's southern districts and popular for its flavour which is reminiscent of jackfruit, hence Kanthali, a derivation of Kanthal, the Bengali name for jackfruit. It is used as a home remedy for treating disentry.

BARI Kola-1

BARI-1 is a high yielding banana cultivar (AAA genome[1]) introduced to farmers by the Bangladesh Agriculture Research Institute (BARI)[2] . The cultivar yields 150–200 bananas per stalk, has a good in flavour and is resistant to Bunchy top and black leaf streak[3] .

Atia Kola

Atia Kola contains soft seeds. It is generally consumed by young people. It provides relief against constipation and intestinal disorders. The boiled and mashed inflorescence and pseudostem of the young plant are also consumend.



Bichi Kola

Bichi Kola also has soft seeds. It is found throughout the country, near roadsides and footpaths.

Kacha Kola

Kacha Kola, also know as Anaji Kola, is the most commonly found plantain in the country. The fruit is rich in iron and the inflorescence has a good anti-diabetic effect.

4.2 Banana Cultivation in Bangladesh

Bananas are grown in many parts of Bangladesh, but they are most commonly cultivated in the southern and south-eastern parts of the country. The cultivation of bananas in Bangladesh is a major source of income for many farmers, and it is an important part of the country's economy. Bananas are usually grown in small farms or in backyard gardens, and they are harvested throughout the year. The cultivation of bananas in Bangladesh is usually done using traditional methods, and it involves a lot of manual labor.

The process of banana cultivation in Bangladesh usually begins with the planting of banana saplings. These saplings are planted in rows in the field, and they are watered regularly. Once the bananas are fully grown, they are harvested by cutting down the entire plant. The harvested bananas are then sorted and packed into crates for transport to the market. Bananas are usually transported to the market on trucks, and they are sold to wholesalers who distribute them to retailers and consumers.

4.3 Banana Industry in Bangladesh

The banana industry in Bangladesh is a significant contributor to the country's economy. The industry employs millions of people, including farmers, laborers, and traders. Bananas are also a major export crop for Bangladesh, and they are exported to many countries around the world.

The banana industry in Bangladesh is largely dominated by small-scale farmers, who grow bananas on small farms or in backyard gardens. These farmers face many challenges, including limited access to markets, low productivity, and limited access to credit. Asia-Pacific is the main centre of banana production. Basically, India occupies a large part of the world art market. Banana market is growing day by day; as a result banana production is increasing.

According to the World Food and Agriculture Organization, the total production of bananas around the world was 69 million tons in 2000, and it has increased to 116 million tons by 2020, with a value of 31 billion US dollars. Only 15% of this production is sold in the international market. In terms of nutrition, what is the demand - the price of bananas is more or less in the market of all countries. And keeping this demand in mind, India, China, Brazil and South Africa are pushing the international banana market. For example, in the tropical island of the Philippines, bananas are not only a favourite fruit of the local population, but also an important export product.
Bananas connect its farmers with China, the country's largest export market. The results are supporting the efforts of livelihoods and farmers in the country to alleviate poverty and prosper under China-Philippines cooperation.

But this time green bananas are being exported to Malaysia through Chittagong Sea port. About 4,500 kg of raw bananas will be shipped through the port on Friday. The exporting company has obtained the certificate from the plant pest control centre for the export of this shipment on Thursday. Green bananas are being exported to Malaysia through Chittagong seaport. About 4,500 kg of unripe bananas will be shipped through the port on Friday (March 31). The exporting company has obtained the certificate from the plant pest control centre for the export of this shipment on Thursday.

Ripe bananas have been exported through Chittagong port before, but this is the first time that raw bananas have been exported. Syed Munirul Haque, pest control pathologist of Chittagong seaport's plant pest control centre, confirmed this. This raw banana is being exported by Sattar International of

Chittagong. Exporter's representative Touhidul Islam said that these raw bananas were collected from Shibganj in Bogra. The export value of the shipment is about five thousand dollars.

According to Export Promotion Bureau (EPB) data, the last ripe banana export from Bangladesh was in 2016-17 fiscal year. The export value was 6 thousand 280 dollars. Earlier in 2012, about 20 thousand kg of ripe sea bananas were exported to Poland. In all, bananas worth $14,914 were exported in 2012-13. Banana production is increasing in Bangladesh. According to the Bangladesh Bureau of Statistics (BBS), 826,000 tonnes of ripe bananas were produced in the fiscal year 2021-22. Five years ago in the fiscal year 2016-17, the production was eight lakh seven thousand tonnes.

The value of bananas in the world market is not low. According to market research firms, bananas were exported to the tune of $1,350 million in 2021. Ecuador, Philippines, Costa Rica and Colombia are the top exporting countries. And the United States, Germany, Russia, China and Belgium are the top importing countries. After successful exports of several fruits and vegetables - including guava, watermelon, and tomato - via sea route, the first shipment of green bananas is now heading for Malaysia from the Chattogram Port, adding to the list of agricultural exports by sea.

4.4 Banana Products

Bananas are considered the second most important fruit in the world. They are also considered a domestic market fruit, so to speak, since most countries produce them. Kenya herself is a top 10 producer of bananas according to stats by the Food and Agriculture Organization (FAO). Like all fruits, bananas have plenty of “derivatives.” Fruits can be used in flavoring for instance, and there’s no limits to how far anyone can go with that.

Flour Flour can be produced from bananas to different degrees of fineness. The product is like wheat flour but cheaper to produce, due to availability of the fruit. Typically, it's produced from green banana pulp. The pulp is dried then ground to produce flour. The funny thing is that the entire process can be done by hand – that wouldn't make sense for business purposes practically speaking.	
Pastries Banana flour is a product by itself. It can also make other products there is a market for. Don't you just love capitalism? It works. The flour can make bread, cakes, pancakes, cookies and all other pastries people have come up with. If you can work it into a dough, banana flour fits.	
Crisps Eggs and kachumbari are ok. But crisps will always be the top snack food. They can be made from bananas. The fruit is sliced and fried into crisps just as potatoes are.	
Jam, Puree, Chutney, etc. Let's not get caught up in semantics. The products in the title, and others similar, are essentially the same thing. They are all made from crushed fruit. Because ripe bananas are used for them, it's important to use an anti-browning agent like citric acid (lemon, for example). The paste can then be flavored as you see fit – or your customers. Whatever.	

Alcohol One day the Government will stop fighting traditional alcohol. Did you know banana beer is considered an East African (Great Lakes) heritage? Another banana alcoholic drinks exists in the form of wine. The process to produce either is relatively similar, save for fermenting. They are both derived from ripe banana paste. The paste is strained to produce juice, which is diluted and heated with water plus flavoring (sugar). Sorghum for beer and wine yeast for wine is added to produce the desired product on fermenting. Sterilization and packaging help avoid a Government raid.	
Fertilizer Fertilizer can be made from banana peels. Yeah, we used to live a pretty sustainable life before our ancestors got colonized. The peels are put away in water to come up with a solution nutritious to plants. The liquid fertilizer is produced with the peels filtered out. Banana fertilizer has all the nutrients we associate with bananas like potassium.	
Fibre Saving the best for last? No, we're like marriage (haha, okay we support marriages). Banana fibre is a raw material for the textile and paper making businesses. It is derived from the pseudostem. A specialized machines is used to thread it into fibre.	

5. Aloe Vera:

Medicinal plants serve as important therapeutic agents as well as valuable raw materials for manufacturing numerous traditional and modern medicines.

Aloe vera is a top ranked medicinal plant in Bangladesh. The objective of this study is to investigate the costs, returns and profitability of Aloe vera medicinal plant. The data were collected from the selected farmers of Bogura and Natore districts in Bangladesh during 2018. The total sample size is 123. The study applies the profitability analysis, break-even points and margin of safety percentage techniques. Surveyed farms are found at ranged from 0.01 to 0.41 hectares. Average cost of production per hectare is found at Tk. 876468.80, of which Tk. 647156.40 for operational cost and Tk. 229312.40 for fixed costs accounting for 73.84% and 26.16% of the total cost, respectively. The average yield of Aloe vera is stood at 41487.62 kg per hectare which is sold to two different markets: contract markets and local market. The mean price is estimated at Tk. 32.42 per kg in study area. The gross margin and net margin per hectare are found to be Tk. 698068.02 and Tk. 468755.61, respectively. The breakeven analysis showed that in the case of yield and price, the margin of safety percentage of Aloe vera is -53.48. It is also found at 42.01, 67.15 and 34.85 for variable cost, fixed cost and total cost of Aloe vera production. Therefore, the study noted that the Aloe vera medicinal plant production is profitable in the study area. Farmers have a great opportunity to allocate more land to Aloe vera production, which will make them more profit. Break-even analysis of Aloe vera production resists a large drop of yield and price before incurring a loss, which gives the farmers a comfortable margin of safety and a risk bearing ability. Export policy 2015 has identified the pharmaceutical sector as the highest priority sector. As a part of that, medicinal plants have been recognized as a sector having enormous potentials for export (BFTI, 2016). World health organization (WHO) forecasted that it is likely to hit the US$ 5.0 trillion market by 2050, as the global market of herbal medicine is growing at a fast pace (BFTI, 2016). Inventory of medicinal plant lists 21,000 species of medicinal plant in the world (WHO, 2003). Among those only about 700 plants are used in Bangladesh. Bangladesh is endowed with a rich diversity of plant species. In Bangladesh Aloe vera is a top ranked medicinal plant based on cultivating area. Its' local name is Ghritokumari .

Aloe vera medicinal plant producers encounter two outstanding sources of risk. First, they encounter yield risk because the medicinal plant is exposed both to weather conditions and to pests and diseases. The second source of risk stems from the market and relies on medicinal plant quantities that are distributed through each available market channel. The risks also make risky the farm revenue. Farm revenues from Aloe vera medicinal plant production are inherently volatile, subject to debilitating diseases, lack of quality varieties, and the vagaries of harsh weather. In addition, it represents long-term investments and higher initial cost of crop establishment. As a result, most of the time, medicinal plant farmers take switching decision to next alternative crops. Thus, planned or commercial production of

medicinal plant is virtually non-existent or in some cases at a very preliminary stage in Bangladesh, though commercial production of medicinal plant started in the early 1990s in Natore district. The farmers have cultivated MPs for periods varying from 2 to 20 years (Rashid et al., 2010).

In general, farmers are predicting about production costs and return with some confidence and then allocate land to new crops only if the economic returns from these crops are at least equal to returns from the most profitable conventional alternatives. We found that the farmers are motivated to cultivate medicinal plants because of its profitability. Profitability is a critical factor to adopt a new crop like medicnal plant, which also affected by different risks . Sharmin (2006) also found the sugarcane cultivation as more profitable than Aloe vera. Despite of lower yields of Aloe vera, the highest gross returns are observed under coconut based multistoried agroforestry systems compared to sole cropping. the Aloe vera as a viable way of earning a livelihood of the farmers in Nator district. They also identified one key challenge in managing the production of Aloe vera and other medicinal plant is to integrate the needs of farmers with available knowledge and technological support. On the choice of Aloe vera medicinal plant production, farmers need a clear picture about costs, returns and profitability of current production practices. Taking into consideration the present hindrance settings, the present study has been undertaken to find out the costs, returns and profitability of Aloe vera production in the study locations.

6. Jackfruit-Our National fruit

The jackfruit is native to parts of South and Southeast Asia and is believed to have originated in the rainforests of Western Ghats of India and is cultivated throughout the lowlands in South and Southeast Asia. Major jackfruit producing countries are Bangladesh, India, Myanmar, Nepal, Thailand, Vietnam, China, Philippines, Indonesia, Malaysia and Sri Lanka. Jackfruit is also found in East Africa as well as throughout Brazil and Caribbean nations such as Jamaica. Jackfruit is the national fruit of Bangladesh and is one of the three auspicious fruits of Tamil Nadu in India along with Mango and Banana.

The Jackfruit is a multi-purpose species providing food, timber, fuel, fodder, and medicinal and industrial products. The primary economic product of Jackfruit is the fruit which is used both when mature and unripe. Every part of the fruit and tree has health and economic value. Jackfruit seeds (nuts) can be roasted like chestnuts, or boiled. The fruit pulp is sweet and tasty and used as dessert or preserved in syrup. The fruits and seeds are also processed in a variety of ways for food and other products. Jackfruit value added products include chips, papads, pickles, icecream, jelly, sweets, beverages like squash, nectar, wine and preserved flakes etc. Additionally, Jackfruit leaves, bark, inflorescence, seeds and latex are used in traditional medicines. The wood of the tree is also used for various purposes. It is a nutritious fruit that is rich in carbohydrates, proteins, potassium, calcium, iron, and vitamin A, B, and C. Due to high levels of carbohydrates; jackfruit supplements other staple foods in times of scarcity in some regions. The flesh of the jackfruit is starchy and fibrous, and is a source of dietary fibre.

Despite the richness, massive market potential, and unlimited number of benefits that Jackfruit provides, it's still an unorganized market, thus leaving many opportunities to foray & expand across India and worldwide with its untapped and innovative products that have a huge market scope and scalability. Jackfruit remains an underutilized fruit species and deserves to be given the needed thrust for research and development. This report attempts to highlight the importance, benefits, potential, and marketability of select jackfruit products across the country and outside of it. It is also our humble attempt to educate, promote and influence masses, academia and relevant Government and Non-Government bodies/ lobbies to help spread the goodness of yellow, with the sole aim of creating and promoting a "Yellow Revolution" in all earnestness.

With a view to arrive at appropriate strategy for development of Jackfruit farmers and processing for value-addition, a study was commissioned by the National Institute of Agricultural Marketing, Jaipur

6.1 Various Processed Products from Jackfruit

Jackfruit fruit pulp is sweet and tasty and used as a dessert or preserved in syrup. The ripened pulp of fruitlets is used to flavour products such as ice cream and beverages and the fresh pulp is used to prepare jams, chutneys, jellies, or candies. Dried pulp is made into chips 7.

The jackfruit seeds contained in the ripe fruits are also cooked, boiled, or roasted for direct consumption. The importance of the fruit, seed, and rind is known very little to the growers and consumers. Hence, the University of Agricultural Sciences has taken up an important research and development project in their Post-Harvest Engineering and Technology Centre to develop value-added products from Jackfruits to utilize the surplus fruits available during the season as well as improve the livelihood of the farmers by enabling them to produce value-added products to improve their income as well as provide the surplus fruits to the fruit processing industries in their region which can produce these value-added products in large scale.

Jackfruit Seed Powder

Jackfruit Chips

Jackfruit Pickle

Canned Fruit

Squash

Fruit Bar

Cut Fruit

Jam

Frozen Jackfruits

Fresh Jackfruit Pod

Fresh Jackfruit Pod

Frozen Jackfruits Pod

Jackfruit Papadums
from Bangalore, India

Jackfruit chips

Jackfruits

Jackfruit Flesh

Jackfruit Jam

Jackfruit Pickle

Jackfruit Slice

Dehydrated Jackfruit

Vacuum Dried Jackfruit

Fresh Jackfruit

Dehydrated Jackfruit

Jackfruit Chip

Freeze Dried Jackfruit

Dried Jackfruit

Vacuum Dried Chips

Chips

There are nine different value-added products from different parts of the Jackfruit that can be processed as mentioned below:

S. N	Value-added products	Description
1.	Canned Jackfruit	Apart from the domestic market, canned jackfruits have good export potential also. As raw fruit is a highly perishable item, we can preserve it in sugar syrup for a long duration of time. We need to use the crisp bulbs of the ripe Jackfruit for canning purposes. Also, we will need raw materials like Sugar, Citric Acid and packing materials like Tin Can, etc.
2.	Fruit Bar	Generally, fruit bars are healthy snack items that provide a delicious taste also. It is also popular as fruit toffee. So, fruit bars have a wide market throughout the country. we can prepare the fruit bar from jackfruits also. Commercial manufacturing is a highly profitable business. As the raw materials, we will need starch, sugar, colour, preservatives, skimmed milk powder, hydrogenated fat, flavour, glucose, etc.
3.	Ice Cream	Ice creams in different fruit flavour are getting huge popularity these days. Currently, people of all age groups consume ice creams throughout the year. Hence, it is not a seasonal business. And we can prepare ice cream with jack pulp.
4.	Jackfruit Chips	Raw jackfruit is the basic raw material for fried jack chips. First, cut the raw jackfruits into large pieces. Then, remove the bulbs and seeds by hand. Then cut the raw bulbs into suitable lengthwise pieces. Finally, fry these pieces in coconut oil or refined vegetable oil. Also, we may add salt to the frying pieces to enhance their taste and preservation
5.	Jackfruit Nectar	"Nectar" typically refers to beverages produced by dilution of fruit pastes or juices with or without the

		addition of sweeteners. It is a healthy food item even for children and seniors. in nectar processing, you will need to remove the bulbs from ripe jackfruit. And pass them through a pulping/fruit mill. Then mix with about 10% hot water and pass through a pulper having a fine sieve of 1 mm hole. Now we can use this pulp for preparing nectar.
6.	Jackfruit Squash	In our country, fruit squash is a popular product in preparing homemade cold drinks like sharbat. we can find a wide number of established brands like Kissan, Druke, Ruhafza, etc. we can prepare jackfruit squash from the juice and pulp. The manufacturing process is simple. We will need to provide good quality moisture and leak-proof packaging.
7.	Jack Seed Flour	The manufacturing of jackfruit seed flour is easy. Also, the technology is readily available for entrepreneurs. Due to its high carbohydrate content and other nutrients, they can be added to baked products for value addition without affecting the functional and sensory properties of the final product.
8.	Jam	For jam preparation, we will need to use fully ripe jackfruits. we can prepare it by boiling fruit pulp with sugar, pectin, and acid. we need to invest a small startup capital for starting a small-scale unit. Jam is an intermediate moisture food and high sugar content increases its caloric value. Due to the sweet taste, people of all age groups consume jam frequently.
9.	Pickles	we will need to use unripe jackfruits for preparing pickles. Apply oil to a knife and peel the jackfruit. Peel the skin. Cut the peeled fruits into 12-18 mm thick slices. Prepare a 5% common salt solution by mixing salt with water, 50 g salt/l. Place the slices in a container and cover with the brine solution. Drain the slices after 24 hours. Finally, grind and mix with spice and vinegar and cook it to make taste.

Jackfruit is a highly fibrous fruit. Also, can be kept as ripe fruit fresh for a long duration of time. Therefore, you need to take considerable care in the time of procuring fresh jackfruits for preparing any type of value-added food products.

6.1.1 Uses of Jackfruit

Jackfruit has many uses. Mature Jackfruit can be prepared as a vegetable by boiling or cooking. Ripe jackfruit is a very popular fruit. Both young Jackfruits, as well as Jackfruit seeds, are prepared as a vegetable, while Jackfruit seeds are also cooked to produce delicious traditional dishes. Its many uses have been summarized below:

1. a) As a nutritious food - mature Jackfruit, young jackfruit and the jackfruit seeds provide high nutritional value.
2. b) Fruit - can be consumed as a ripe fruit
3. c) Value-added processed food - dehydrated jackfruit, canned/bottled jackfruit, chips and
4. d) Other snacks based on jackfruit.
5. e) Timber - Jackfruit tree provides an excellent medium hardwood timber that shows termite resistance. This timber is widely used for making furniture, doors, boats, windows and musical instruments.
6. f) Firewood - branches are used as firewood
7. g) Ecological and environmental use - provides perennial cover, reducing the impact of raindrops and provides shade and serves as a windbreak.
8. h) Medicinal value - various parts of the tree and the fruit are used in traditional medicine in many South-East Asian countries.
9. i) Cultural value - chips of heartwood when boiled yield yellow dye, used to color the robes of Buddhist monks. People of Hindu communities use leaves to decorate temples and other places of worship.

Jackfruit wood is widely used in the manufacture of furniture, doors and windows, in roof construction, and fish sauce barrels. The wood of the tree is used for the

Value-added products:
Following is a pictorial depiction of value-added products that can be produced from

Jackfruit:

VALUE-ADDED PRODUCTS	
Dried jackfruit flakes	
Preserved jackfruit bulbs	
Dehydrated jackfruit bulbs	

Ready-to-serve jackfruit beverages Jackfruit Squash Jackfruit Nectar Jackfruit Wine	 
Jackfruit Vinegar	

Canned jackfruit products	
Candied jackfruit	 
Jackfruit bar & ice cream	
Jackfruit Pickles	 
Jackfruit Chips	 
Jackfruit Papad	 

Jackfruit Sweets	 
Jackfruit Jelly	 

Jackfruit Seed Flour	 
Roasted Nuts	 

Jackfruit has significant nutritional value as indicated in Annexure II A brief of the aforementioned products follows:

6.1.2 Dried Jackfruit Flakes:

Dehydrated Jackfruit flakes with a shelf life of one year were standardized by KAU (1999). A farmer family in Sirsi village in India regularly uses unripe dehydrated flakes and flour to prepare pancake for breakfast. Dehydrated Jackfruit flakes have used a vegetable by Vista Company in Sri Lanka. The Jackfruit flour produced by Hardikars Food Processing, Pune (India) can be used as a raw material for several products. The flour prepared from dehydrated Jackfruit flakes was found to be suitable for preparing chapattis, pazhampori and bhaji by replacing 25% wheat flour, maida or Bengal gram flour, respectively with Jackfruit flour.

Dried Jackfruit flakes are prepared by slicing the jackfruit bulbs using jackfruit bulb slicer and subsequently dried in a combo drier. Mechanically sliced Jackfruits can be dried using an efficient blancher-cum- drier.

Blanching is one of the pre-treatment that is used to arrest the enzymatic activities before drying. Mechanical blanchers are usually available for blanching operations. Separate blanching and drying procedure is a time consuming and tedious process. It will also lead to an increased production cost. Efficient drying with minimal time and operation cost is the main attraction of the newly developed blancher cum drier. The capacity of the blancher cum dryer unit is 18- 28 kg/ batch. Efficient drying and quality dried product can be produced by this combo machine. Approximate cost of the machine is Rs. 2 Lacs. This machine is highly useful to micro and small- scale Jackfruit processing units for producing safely dried Jackfruit flakes with minimum cost.

6.1.3 Preserved Jackfruit Bulbs:

Fresh Jackfruit bulbs are a consumer-preferred commodity and relished well by all sections of population. Ready-to- eat fresh Jackfruit bulbs along with seeds were preserved under vacuum (760 mm lbs pressure) by treating with 1.5% KMS and 0.5% sodium benzoate. Preserved bulbs depicted negligible changes in the chemical constituents and were organoleptically stable for period of 15 days under refrigeration.

6.1.4 Dehydrated Jackfruit Bulbs:

The recommended approach to produce dehydrated bulbs involves steeping of Jackfruit bulbs in 0.1% potassium meta bisulphite solution for 30 min to improve the quality of the dried products. Good quality dehydrated products were obtained (drying ratio 3:1) when sulfuured at the rate of 16 lbs sulfur /ton fruit/1000 cft space.

6.1.5 Ready-to-serve Jackfruit beverages:

The ready-to-serve beverages can be prepared from fruits very easily with a composition of 10% of juice, 10% of TSS and 0.3% acidity (Chopra and Chauhan, 2001). Singh et al. (2001) have formulated ready-to-serve beverages from jackfruit pulp with 10% pulp content, 12% TSS and 0.3% acidity.

Jackfruit squash:

As early as 1956, a refreshing beverage with pleasant taste and aroma was developed from the bulbs of ripe Jackfruit. This was found to have a shelf life of 60 weeks when stored at room temperature (24-30°C). Studies indicate that Jackfruit squash could be stored for one year at room temperature without any change in quality except for a slight reduction in vitamin C content.

Jackfruit Nectar:

Fruit nectar is a concentrated form of fruit pulp having honey-like consistency. Nectar is the pulp of the fruit blended with sugars and citric acid to obtain a product of 15-20°Brix with mild acid taste. CFTRI (1977) standardized nectar from jackfruit pulp. Jackfruit nectar was standardized successfully from the two popular varieties of Jackfruit available in Kerala individually and by blending with other fruit pulp Blending with other fruit pulps resulted in improvement in flavor and taste in the nectars.

Jackfruit Wine:

There is considerable scope for fruit-based fermented beverages in India, especially wine and vinegar. Two fermented products, which can be prepared from jackfruit pulp, are wine and vinegar. Jackfruit in general contains high amount of easily fermentable sugars, which makes it suitable medium for the growth of wine yeasts.

Jackfruit can be a very important source for commercial wine production. pH, temperature and inoculum concentration play an important role during the fermentation of jackfruit wine. It has also been seen that fermentation is faster in Jackfruit, which corroborates to earlier findings by Andre et al. Jackfruit wine possesses good antioxidant activity, owing to its gradual increase in phenolic content as the fermentation progresses.

Jackfruit Vinegar:

Vinegar is another fermented product which can be formulated from Jackfruit. It is observed that Jackfruit vinegar recovered from the ripe fruits yielded 7% alcohol and 6% acetic acid upon fermentation.

Canned Jackfruit Products:

It is well known that canning is widely practiced to extend the period of availability of fruits. Jackfruit bulbs both raw and ripe could be successfully canned for subsequent use in vegetable curries and also for table purpose. The Standardized approach involves canning raw Jackfruit bulbs in brine solution containing 0.5-0.75% citric acid. Canned Jackfruit when stored at room temperature (24-30°C) was found to retain normal color and characteristic taste and aroma. However, the product, when stored at 37°C for 19 weeks depicted deteriorative changes.

In India, canned Jackfruit is a nascent industry and there is no commercialization of the fruit for canning yet. However, some big brands in the West offer some canned jackfruit products in the market. The technology and know-how can be built in India and the product can be marketed with the right impetus

6.2 Dehydrated Jackfruit Slice:

Recently, at IIHR, Bangalore (India), a process has been developed for making osmotically dehydrated Jackfruit slices. Osmo-air dried fruits are the dehydrated fruit products based on the novel approach towards dehydration. Suitable fruits are selected at optimum stage of ripeness (hard ripe stage) made into slices and dipped in sugar syrup containing citric acid, preservatives and with and without maltodextrin. After immersion time, slices are drained and dried in cabinet dryer till the moisture content reaches to around 15%. Dried slices are packed in plastic punnets and can be stored at room temperature for one year. The quality of osmotically dehydrated product is near to the fresh fruit in terms of color, flavor and texture. It can be consumed as a snack. Such a product can be used in ready-to-eat type of foods, ice-creams, fruit salad, kheer, cakes, bakery products, etc. About 11-12 Kg ripe fruits are required to make one kg of Osmo-air dried slices and shelf life of product is one year under ambient conditions. However, the technology or the process has not yet been made commercial and there is no known branded product in the market today.

6.3 Jackfruit bar and Ice-cream:

Ready-to-eat fruit bars are well-relished products and are being commercially prepared and marketed in our country. Jackfruit ice-cream and Jackfruit mixed mango ice-cream are also becoming popular in India. It is observed that Jackfruit bars stored in modified polypropylene packets (MPP) recorded higher percent of nutrient retention and minimum microbial to have distinct taste and flavor. Blending Papaya pulp with Jackfruit pulp imparted better appearance, color and textural qualities, while blending with mango pulp resulted in better flavor, taste and overall acceptability.

Jackfruit Pickles:

The Central Food Technology Research Institute (CFTRI) had undertaken studies in 1977 on the preservation of jackfruit and reported that tender jackfruit could be preserved in the form of pickles. The important pickle preservations include sweet oil pickle, spiced vinegar pickle, and plain vinegar pickles.

Jackfruit Chips:

Jackfruit chips are prepared using raw bulbs. The oil used for frying influence the shelf- life of Jackfruit chips. Shelf stability of Jackfruit chips could be increased by adding antioxidants like butylated hydroxytoluene and sorbic acid. Gokul brand of vacuum fried chips from Kundapur (India) are very popular. The housewives in Sirsi area Karnataka (India) prepare three different types of jackfruit chips.

Jackfruit Papad

Jackfruit bulbs which are neither fully mature nor completely raw, could be used for preparing jackfruit papads. It is observed that jackfruit papads wrapped in a paper had a shelf-life of 4-6 months at room temperature (24-30°C)..Mayura brand of jackfruit papad produced by Kadamba Marketing Cooperative, Sirsi, Karnataka and PonsaAppolopapad in Karnataka are very popular in India.

Jackfruit Sweets

Various sweet delicacies such as Jackfruit halwa (variety), pudding, jackfruit toffee, Jackfruit barfi, elayappam, adda, Muffin and payasam, etc. could also be prepared from Jackfruit bulbs.

Jackfruit Jelly

Jackfruit rind contains fair amount of sugar and pectin could be used for pectin extraction. Siddappa and Bhatia (1956) standardized a method for preparing jelly and suggested an extract-sugar ratio of 1:1 with 0.6 and 0.8 acids preparing a good quality jelly.

Jackfruit Seed Flour:

Jackfruit seeds may be converted into flour after inactivating the anti-nutritional factors by drying. The flour prepared from Jackfruit seeds can be used for making chapattis by blending with wheat flour (25:75). Further, Jackfruit flour produced may be used as thickening and binding agent in food systems. Jackfruit seed flour is a good source of protein and exhibits low water and fat absorption capacity hence, the flour could be incorporated in the preparation of deep fried products. Jackfruit seed flour can be used for preparing cereal/pulse based fried preparations like vada, Pazhampori, Bajji and Puri by replacing 50% of flour of cereals/pulses.

The products were found highly acceptable in sensory evaluation test. Further, seed flour can be used to produce biscuit. Jackfruit 365 a new Kerala based company is focused on selling Jackfruit flour and is popularising this product through recipes for a number of food items which are normally prepared with other ingredients.

Roasted Nuts

The roasted jackfruits seeds are reported to resemble chestnuts in nutritive value and flavor and are palatable. However, the shelf life of fried seeds is low, as these cannot be stored for more than a few days at room temperature of 24-30°C.

In addition to the above, raw jackfruit and seed flour of jackfruit are used in making a large number of recipes, namely, biryani, curry, tartetatin, idli, dumplings, unniappam, dosa, etc. Ready-to-cook tender jackfruit is also very popular in urban areas of Sri Lanka and is easily available. The Saras Company in Kerala, India has also developed a new product from tender Jackfruit which is being marketed as a ready-to-cook product.

6.3 Specialty Products for Niche Markets

It is interesting to note that Jackfruit products extend beyond what we normally come across in OTC stores, e Commerce sites or suppliers.

In the current fast food era, consumers are preferring healthy functional foods. Increased workload, imitation of foreign culture and health awareness made them more addicted to ready to cook and eat foods. Nowadays pastas and noodles are considered to be the prime food in urban areas. Maida is the major ingredient of these pastas and noodles. Continuous consumption of these products will lead to problems in digestive systems. To avoid such health issues, gluten free pastas could be prepared from Jackfruit seed, raw matured jackfruit etc. These are considered to be the least exploited and are of high medicinal valued (low glycaemic index) foods. Production of pastas by these ingredients will help in fortification and meets the large consumer demands. Pasta machine is the major machinery used for the large scale production purpose. Apart from pasta machine blancher, slicer, cabinet drier, hammer mills, and blenders are necessary for feed preparation.

6.4 Jackfruit: Export opportunities for Bangladesh's economy

There is a reason why jackfruit is Bangladesh's national fruit. It grows in abundance across the country, particularly in the highland areas. Madhupur and Bhawal are among the top areas where jackfruit production is high. Once considered a backyard fruit, jackfruit now has the potential to become an export item - offering new economic opportunities and providing a sustainable food source for the population. In this article, we will explore how jackfruit can become a game-changer.

6.5 Jackfruit Market

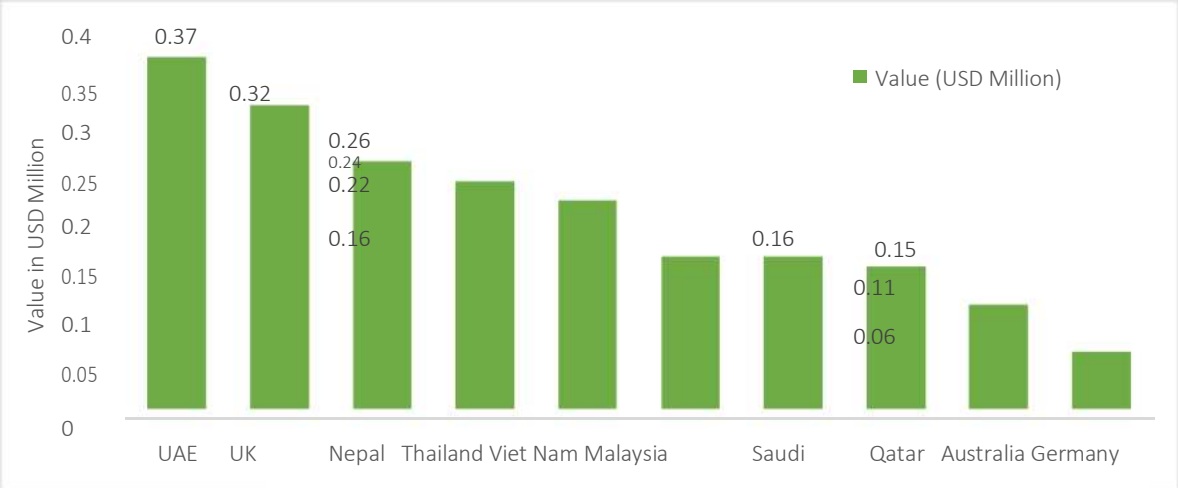
The major populace in the jackfruit-producing areas normally consume ripe fruits and seeds locally, with some quantity of fruits finding their way to the markets. However, due to the bulk and weight of the fruit and its perishability, long distance markets are unreachable and most of the fruit is left to rot in the orchards. However, in the last 5-6 years, jackfruit has been getting paramount importance from the urban consumers and abroad markets in value-added and processed forms. As per a market study on Jackfruit, it has been estimated that approx. 25% of the production is channelled into the manufacturing of value-added products.

The rising concerns for climate change fuelling the vegan culture across the globe has led to an increase in demand for jackfruit worldwide causing a rise in exports from the country to west Asian countries, Germany, and Great Britain. India, the leading producer of Jackfruit, exported the superfood to over 75 countries worth USD 2.3 million in the year 2020-2021 (April to November) with the total volume of export around 2,300MT in the same period. In May 2021, approximately 1.2 tonnes of jackfruit sourced from Krishi Sanyoga Agro Producer Company of Tripura was exported to London 19.

The entire jackfruit tree is loaded with various use cases. Apart from being used as fruit when ripe and as a vegetable when consumed in an unripe state, the leaves of the jackfruit are used as cattle feed. The wood from the tree is termite-proof and is superior to teak for furniture, construction, musical instruments, etc. Consumers in countries including the UK, the US, and Germany perceive the cooked, unripe Jackfruit has a texture like pulled pork or chicken, making it a popular vegan option in these countries. Brands such as The Jackfruit Company and Upton's Naturals have shown how versatile an ingredient the fruit can be, consistently launching new products such as curry, pasta, and noodle meal kits all based around the meaty fruit.

6.6 Marketing Potential of Jackfruit

The top 5 trading partners of India are United Arab Emirates (0.37 USD Million), United Kingdom (0.32 USD Million), Nepal (0.26 USD Million), Thailand (0.24 USD Million), Viet Nam (0.22 USD Million) . The total export value of Jackfruit in these countries is 1.41 USD million. These top 5 countries account for over 61.3% of the total Jackfruit export from country



Country	Value (USD Million)	Share (%)
United Arab Emirates	0.37	16.09
United Kingdom	0.32	13.91
Nepal	0.26	11.3
Thailand	0.24	10.43
Viet Nam	0.22	9.57
Malaysia	0.16	6.96
Saudi Arabia	0.16	6.96
Qatar	0.15	6.52
Australia	0.11	4.78
Germany	0.06	2.61
Total	2.05	89.13

Among the top countries, United Arab Emirates market share of the total Jackfruit export shipments from India is 16.09%. Followed by United Kingdom with the Jackfruit shipment value being 0.32 USD Million. The top 10 countries in total shared the share of 89.13% of the Jackfruit export value from country. The following table gives insights on a monthly report of November 2020 on Jackfruit export from India to the top 8 trading partners.

Country Wise Trends for Jackfruit export (USD Million)

S.no.	Country Name	Qty in Kgs	Value (USD Million)
1	United Arab Emirates	22010	0.04
2	Kuwait	8370	0.02
3	Qatar	12180	0.02
4	Singapore	7660	0.02
5	Australia	1970	0.01
6	Bahrain	4560	0.01
7	Oman	3820	0.01
8	Saudi Arabia	6170	0.01
Total		66740	0.14

In the month of November 2020, India majorly exported Jackfruit to United Arab Emirates (0.04), Kuwait (0.02), Qatar (0.02), Singapore (0.02), Australia (0.01). The total export volume and export value of these top 5 importing countries is 52190 and 0.11 USD million, which is the 78.57% of the overall export volume in the month of November 2020.

However, the export data of value-added products of jackfruits are not available hence we have provided the above data which are according to the connect to India export data.

Strengths

- Favourable agro-climatic conditions for cultivation of Jackfruit
- Production of approximately 2,10,000MT of Jackfruit in the year 2019-2020 in the state
- Production of Jackfruit happens in all the 27 districts of Chhattisgarh
- Proximity of the state to Amritsar-Kolkata Industrial Corridor and East coast Industrial Corridor
- With approximately 45% of the state covered with forest cover and presence of multiple rivers, the state has natural resources in abundance to support the industry
- Growing health related awareness and acceptability of Jackfruit by the consumers
- Growing environment related awareness and comparatively similar taste of Jackfruit as of pork

Weakness

- Inadequate facilities for post-harvest handling of Jackfruit
- The pulping of Jackfruit is still done manually
- Considerable quantities of raw material is wasted at the source itself
- Upgradation of technology for processing of raw material
- The bulkiness of the fruit and high transportation costs may lead to disinterest of an entreprenuer in Jackfruit
- High perishability of Jackfruit and lack of storage facilities may lead to low capacity utilisation of the plant

Opportunities

- Scope for improving industrial infrastructure to attract more investments
- Incentives provided by the government to promote processing of Jackfruit
- The huge availability of processing quality produce is the big opportunity for the state
- The increasing awareness of Indian Consumer health orientation, and export orientation of the produce has given further impetus to the consumption of ayurvedic products in the food plate

Threats

- Less support in terms of research & development of the product may cause the private entities to invest in other high value products
- Possibility of ecological imbalance because of illicit felling of trees

6.7 INDUSTRY LOOKOUT AND TRENDS

Fresh-cut produce is sold in open-air markets and food stands in many Asian countries and is increasingly being sold in supermarkets. Fresh-cut fruits, in particular, have gained popularity in urban centres of the region. Often these products are displayed without the benefits of refrigeration so their shelf-life is frequently not extended beyond the day of display. The market for fresh-cut products in Japan and Republic of Korea has shown a steady growth trend since the late 1980s and 1990s respectively (Kim 2007).

While the food service industry for school meals and restaurants is the main user of fresh-cut products in these countries, demand for them has grown in retail markets. Fresh-cut vegetables for cooking constitute the largest part of the fresh-cut produce industry in both countries. Fresh-cut salads are another major category as consumers perceive them to be healthy. Fresh-cut fruits continue to show a rapid growth trend in these countries. However, with increasing demand for fresh-cuts at the retail level, the fresh-cut industry in Japan and Republic of Korea is facing challenges to extend shelf-life and enhance food safety.

6.8 MARKET POTENTIAL AND MARKETING ISSUES, IF ANY:

Sri Lanka is the world leader in jackfruit cultivation with 40% of their produce being converted into ready-to-eat food items. More than 5,000 people are engaged in jackfruit trade and there are 14 institutions that train farmers and traders on jackfruit in Sri Lanka. While jackfruits in Karnataka are sold at Rs 7 - 10 per kg, it fetches about $20 - 30 in Mexico. Though, jackfruit is available in plenty in the state, it has been neglected by farmers and traders. Around 300 million numbers of jack fruit is produced in Tamil Nadu and Kerala every year. At an average weight of 5 kilograms a piece, the total quantity is estimated at 1.5 million tons. Much of the product is wasted. The project aims to utilize the

resources mainly raw and ripe fruit and convert them into a more acceptable product. The products that are being considered for processing and as a result of value addition are: Jack fruit jam from ripe fruit, Jack chips from tender raw fruit, Enrobed jack from the dried ripe fruit. The major market outlets are the “A” and “B” class stores. The product also finds placement in self-service counters and departmental stores. Bakeries can also sell the product.

6.9 RAW MATERIAL REQUIREMENTS:

Raw material requirement for Jack Fruit Jam are Jack fruit, Sugar, Pectin, flavors, preservatives, etc. For Jack Fruit Chips, Raw Jack Fruit, Oil, Salt and spices, etc. For Enrobed tidbits, Ripe Jack Fruit, Jaggery, Sugar, Cardamom green, Packaging material requirement are Primary packing material – 200 ml cups with foil and lid, Cartons and straps, the plant will be in operation for one shift a day. The product mix would be as follows: 200 kilograms of jam from one tonne of the ripe fruit. 200 kilograms of chips from 800 kilograms of the raw fruit. 100 kilograms of enrobed jack tidbits from 250 kilograms of the ripe fruit. The time period required for achieving full capacity utilization is one year. Sales revenue with an ex-factory selling price at Rs. 60.00 per kilogram of jams, and Rs. 70.00 per kilogram each for tidbits and chips, the total sales revenue would be Rs. 99.00 lakhs per annum.

6.10 MANUFACTURING PROCESS:

Jack fruit is a highly fibrous fruit. It has a thick wasted skin enclosing seeded fruit pods to which also adhere lots of fibrous tissue. Peeling and cleaning of the fruit to make it fit for processing is a difficult laborious process. Careful investigation reveals that the recovery of juice from the fruit that could be used for processing into jams is a maximum extent of 10% of the weight of the fruit. Thus a fruit weighing 5 kilograms yields about 500 grams of the juice that can be converted into jams. The second aspect is the strong flavor of the fruit that makes it unpalatable. The flavor has to be removed to a large extent by exhaustion during the process. After extraction of the juice and pulp in the pulper, the extracted mass is taken to the kettle where it is cooked under the influence of jacketed steam. Sugar is then added in desired quantities and the mass further cooked with constant stirring till a thick fluid mass is formed with a reading of 65 to 70 degrees brix on the brix meter. After cooking, the required quantities of citric acid, pectin, flavors (cardamom) and colors are added and the mass stirred thoroughly. The mass after homogenous mixing is emptied into steel containers from where they are poured into cups of 200 grams capacity. On cooling, the jam sets. The cup is sealed after placing a foil paper at its top. The cup is covered with a lid, and placed in cartons, strapped prior to dispatch. For production of chips, tender raw fruit is taken. After removing the fibrous matter, the slices are dried in the tray drier. After drying, they are fried in the thermostat frier, shaken to remove excess oil and dusted with salt and spices before being packed in the packing machine. For production of enrobed jack tidbits, the ripe fruit is cut into small squares of uniform size. They are then dipped into a vessel containing sugar or jaggery solution with the former highly concentrated at 70 to 75 degrees brix. The tidbits are dried in the tray drier and packed in the packing machine. Jams are packed in 200 gram polyethylene cups. Jack chips are packed in 50 grams, 100 grams and multiples thereof in polypropylene or laminated polyester- poly pouches. Enrobed jack is packed in laminated polyester-poly pouches.

1. The business feasibility report includes a business plan of jackfruit processing to produce and market a number of products such as canned jackfruit, jackfruit jam, jackfruit nectar, jackfruit pickle jackfruit chips of 100 MT capacity a year at a cost of 2.70 million Taka with a net profit Tk. 0.646 million a year. It will process about 500 MT of jackfruit in a year.

It seems that if one-third of total production of jackfruit (1, 352, 000 MT) is brought under industrial processing there are potential of establishing about 900 small jackfruit processing industries in the country creating opportunity of 9000 permanent full time employment and many new wage earners in the process of production, procurement, transportation, processing and marketing of the products.

In order to exploit the potential the key activities are to prepare business plans, access machinery, arrange human and financial resources, establish a system of identifying suitable trees and supervised procurement, adopt quality and safety requirements, set management and financial control systems, identify and promote markets of both home and aboard.

Based on those studies the Consultant put forwarded the following key recommendations:

- Jackfruit processing is a potential new venture in Bangladesh. Experimental efforts are noticed at individual and group levels through NGOs as in Rajbari by Practical Action and by Idilpur Pineapple Cultivators and Mouchas Unnayan Samity in Modhupur as well as at enterprise level through own initiatives as by PRAN and Rajshahi Mango Products Ltd. The consultant recommends organizing micro enterprises as CLUSTER with common production and marketing facilities.

- The consultant recommends providing technical assistance to all enterprises operating as CLUSTER as well as individual enterprises that have plans to invest.
- Grant winning clusters and enterprises should have linkage for credit support through Bangladesh Banks or any other MFI for investment and operational funds
- By-product processing should be integral part of any jackfruits investment project to avoid environmental hazards and make cattle feed, bio fuel, etc which will make the main products cheaper.
- Training of consultants and entrepreneurs will surely improve their skills in preparing applications. Flexibility in evaluating the application of Lot 1(a) is important for jackfruit processing.

6.11 Major Findings

Jackfruit product subsector is at subsistence level. Fruits are grown all over the country primarily for family consumption. Abundant production of quality jackfruits is intensified in certain districts of Bangladesh such as Dhaka, Gazipur, Tangail, Khagrachari, Rangamati, Mymensingh, Moulvibazar, Narsingdi, Dinajpur and Rangpur.

Traditional value chain system operates all over the country to transport the surplus production to cities and towns for consumption of fresh fruits.

Production potential of jackfruit is very high. It can be increased 3 to 5 times more as compared to present level of production if commercial plantations, small or large, are established and management practices are improved. Jackfruits processing thus provides greatest opportunity of investment for increasing employment and income

There are efforts of processing jackfruits at individual, group, and institutional levels e.g. some individual and groups, involved in processing other fruits, have been trying to process jackfruits. Two enterprises such as PRAN and Rajshahi Mango Product Ltd. tried to process jackfruits and market processed products at enterprise level.

- These efforts did not become commercialized and were rather unsuccessful because there was no serious efforts to overcome the problems of accessing technologies, organizing production and procurement, improving quality, scaling up production and promoting sales.
- BCSIR has developed some products and patented but recipes are available to entrepreneurs on payment of royalty. BARI has developed some products and recipes are available through MOU without any payment.
- There is no cluster in jackfruit processing. Experimental initiatives can be organized either as cluster of MSMEs or as individual enterprise. Entrepreneurs of both types aspire to get technical support for rapid industrialization of jackfruits.
- Customers are not accustomed to consume jackfruit processed products as it is not available in the market. Some reported that jackfruit chips are highly tasty which they enjoyed in Thailand. A great deal of market promotion will be required to create domestic market.
- Bangladesh can also focus on export market if companies can meet quality and safety compliance requirements.
- To realize the processing potentials awareness creation among producers, entrepreneurs and professionals is very important. They also need technical support to begin with. Initial success will stimulate business community to invest.

- Action plans were suggested to create JACKFRUIT PROMOTION COUNCIL (JPC) to create awareness for investment and provide technical assistance to entrepreneurs as well as to increase capacity of BIOs
- Clusters require support to develop common processing facilities to produce quality products. Jackfruit producers can also participate on production sharing basis for community sales and for household food security
- BIOs should have strong advocacy for variety development, rapid propagation of desired verities, supporting capacity development and market promotion. The institutional framework of JPC with logistical facilities of mass communication can play these roles
- Clusters and individuals both require financing of their enterprises through MFI and banks for investment and working capital.
- There will be huge by-products particularly skins and non-edible parts of jackfruits. Unless by-products are processed as cattle feed or bio-fuels as integral part of the industry it will create serious problems of disposal and will create environmental hazards. By-products can be converted as excellent cattle feed and bio-fuel.
- The BIOs should also establish quality standard, system of certification and enforcement among its members (both clusters and individual enterprises) to establish customer confidence on their products.

6.12. Competitors Analysis

It is generally assumed that the production of jackfruit will expand mostly due to an expanding market for processed products. It is estimated that the demand for fresh fruits will expand in countries such as Japan, Malaysia, and the United Kingdom in addition to Singapore and Hong Kong and some Middle Eastern countries.

Bangladesh exports about 54.00 MT jackfruit to the United Kingdom at a price of £1.23/kg. In the United Kingdom a fresh fruit is sold at £2.45 per kg and a medium size fruit may cost £16-£20. Canned tender raw jackfruit and seeds can be sold in international markets, mostly for ethnic consumers. One cane containing 250 g of bulbs in brine is sold in the United Kingdom retail market for £1.39. In Bangladesh there is no government support for exporters from the Export Promotion Bureau. Malaysian Government has recently signed a contract with Bangladesh to supply jackfruit which will be processed in Malaysia for re-export.

The main exporters of jackfruit in Asia are Thailand, China and Malaysia, and among them, Thai products are considered to be the market standard, followed in quality by Malaysia and China. Malaysia exports to Singapore (almost 85%) and Hong Kong, where grading for uniformity in shape is not required as strictly as in the United Kingdom. In Thailand, the jackfruit has a long season, April to October, and it is exported to the USA year round. Colombia, India, Malaysia, Uganda, Jamaica, Thailand, Sri Lanka. Bangladesh and Kenya export jackfruit to the United Kingdom market. Among these, Colombia, India, Malaysia and Uganda supply throughout the year. Thailand exports throughout the year except for July-September and Sri Lanka exports during all calendar months except December and January. The UK retailer Sainsbury is increasing its range of fruits as customers are prepared to try an increasing variety and jackfruit has now reached 15 of its stores. The jackfruit is the most expensive fruit on sale in Britain costing about £25.00 per fruit. The jackfruit has regional and international markets because it is available as a fresh fruit as well as a processed product. Malaysia exported more than 4633 tones of fresh fruits

to Singapore and Hong Kong in 1995 (Azad, 2000) and earned about US$ 740,000. Jackfruit is popular in Hong Kong and the fruits are supplied from Thailand, Malaysia and particularly from other parts of China. The Philippines has also exported jackfruit to the value of US$ 324,000.The jackfruit is available in the wholesale markets of Australia, supplied from Queensland and the Northern Territory. The fruits are sold in the Sydney market, most frequently ranging from A$ 3-4 /kg. In addition to Sydney, jackfruit is traded in Melbourne and Brisbane. The fruits are consumed by ethnic groups such as Pacific Island communities and Southeast Asian communities resident in Australia. Whereas the large, heavy and perishable fruits will have limited fresh export capacity from producing countries. There is a clear niche for canned and other processed products as exports. Bangladesh should focus due attention on those products.

PROCESSING

Chart-01: Pre-processing of bulbs and pulps

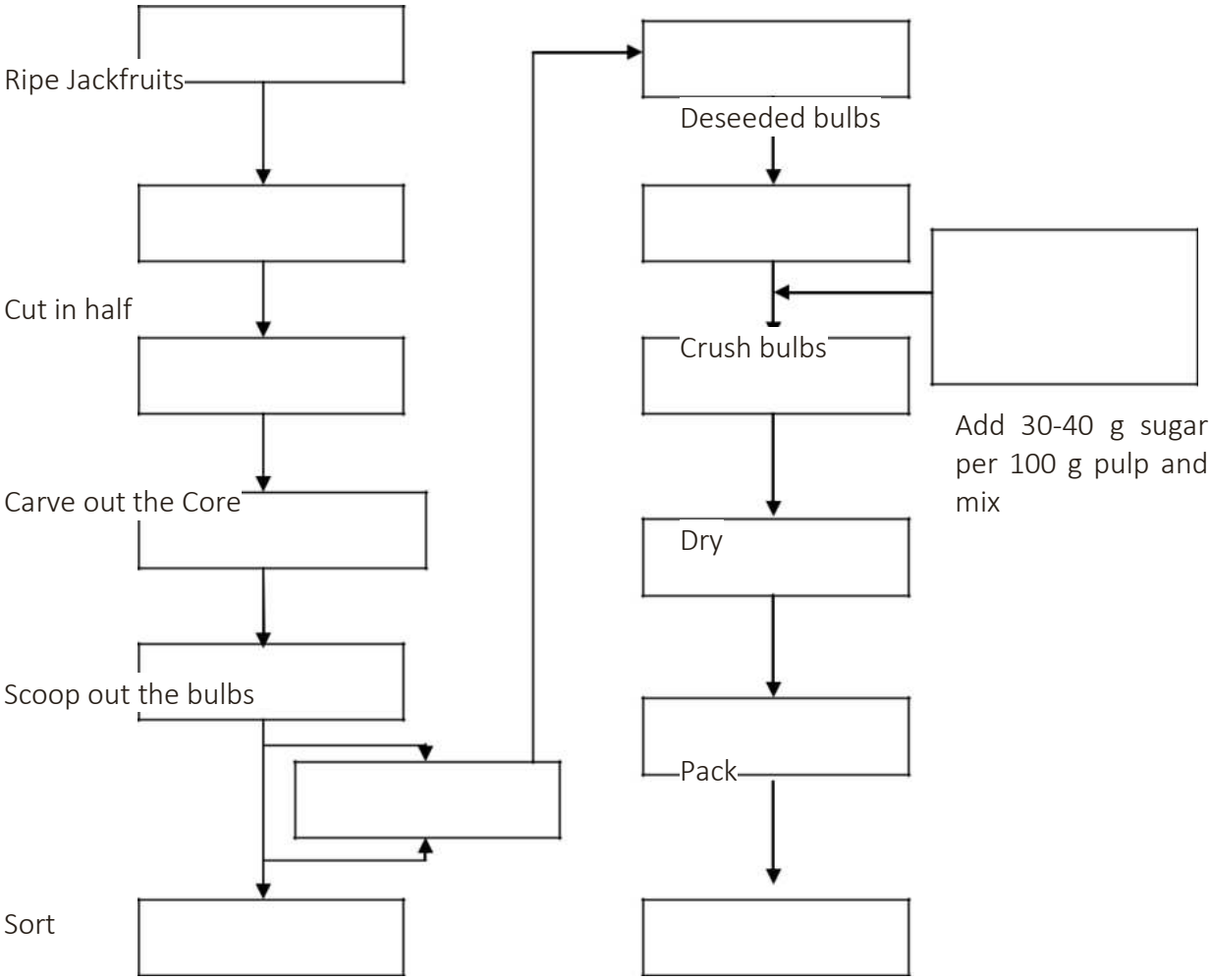


Chart 2: Process of preparing flakes and leathers

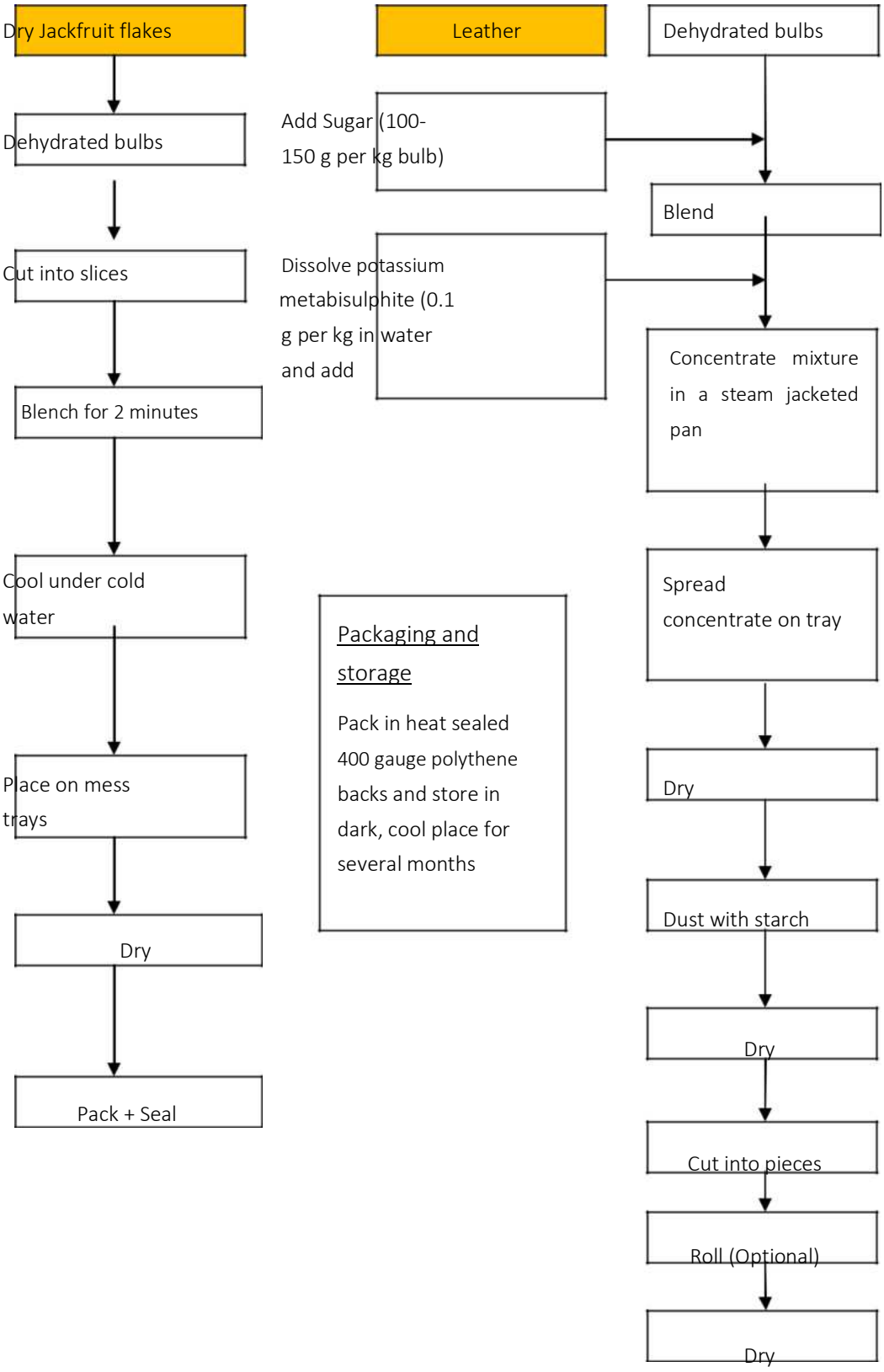
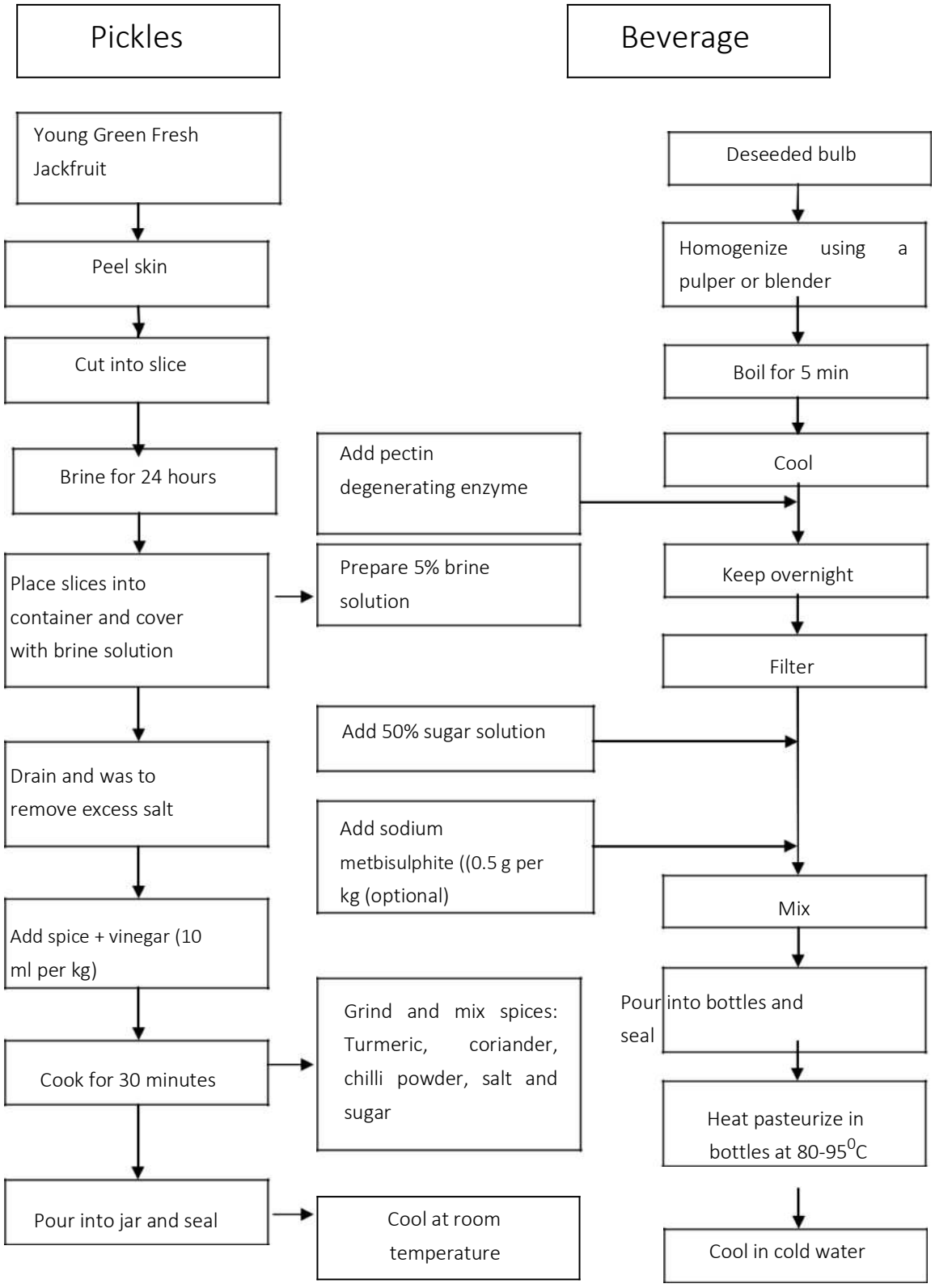


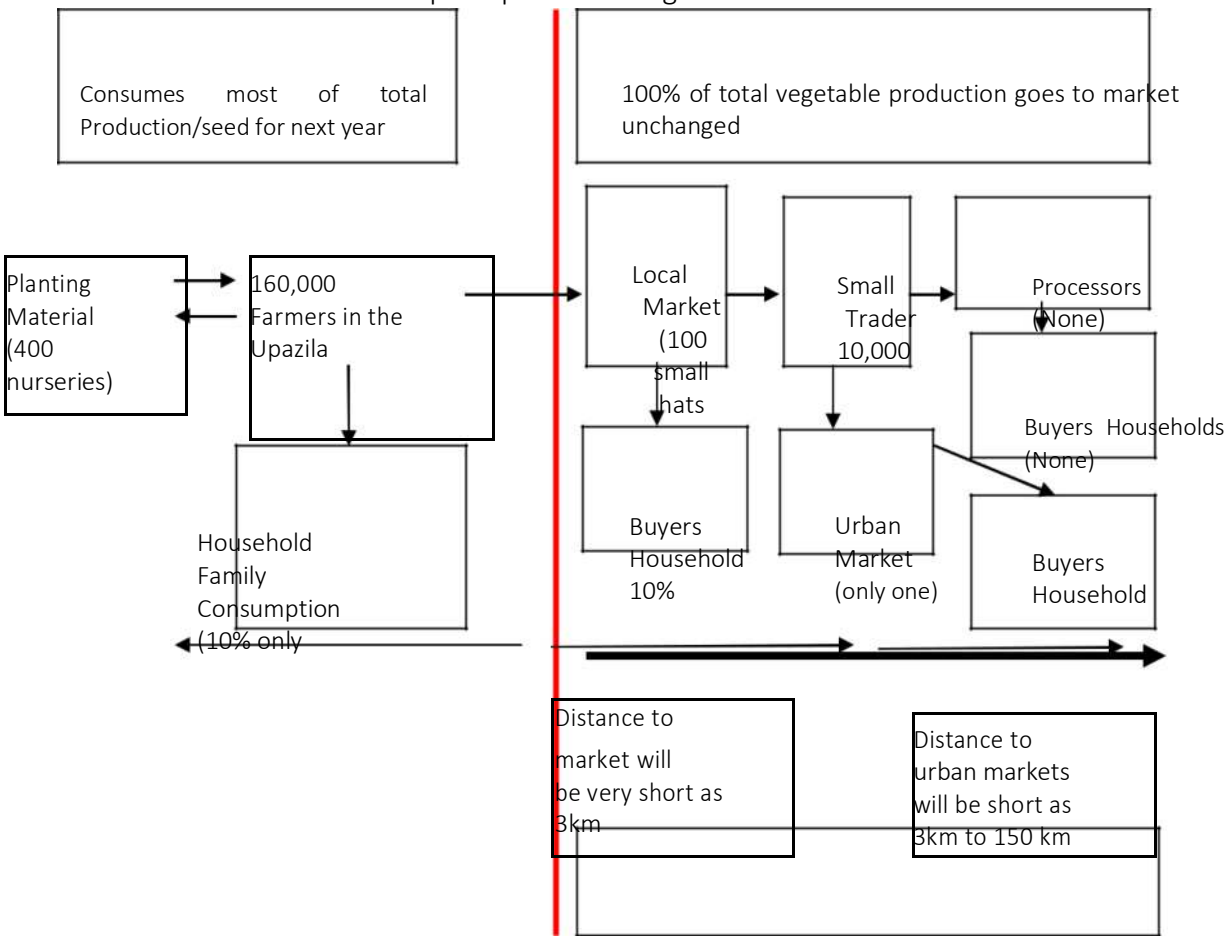
Chart 3: Process of preparing pickles and beverages



7.1 Availability of jackfruit in different countries

Countries	Main season(s) of availability
Australia	June-April
Bangladesh	June-August
Brazil	January-March, August-October
Colombia	January-December
India	April-July
Indonesia	August-January
Jamaica	January-July
Kenya	June-October
Malaysia	April-August, September-December
Philippines	March-August
Sri Lanka	February-November
Thailand	January-May, October-December
Uganda	January-December
USA (Florida)	May-August, September-October
Zanzibar	June-December

Value chain of Jackfruit in Madhupur Upazila of Tangail District



8. Jackfruit Production

Jackfruit is almost a natural product in Madhupur. About 160,000 farmers are involved in production. Generally, seeds or grafts from nurseries are planted scattered in the homestead or in adjacent areas. Small scale commercial gardens cover about 20%. There is no dearth of planting materials as there are about 400 nurseries in the upazila. The quality of grafts is reported to be good. Producers cannot recognize the varieties but accustomed with three types such as soft bulb, medium hard bulb and hard bulb. Similarly there are early, medium and late maturity types. There are wide variation of size, flavour and sweetness. There are very little knowledge of agronomy, disease and pest protection, maturity and post harvest handling and operation. As a result waste is very high. Harvesting season is May to August. The peak season is July. Farmers reported that when jackfruit is raised in an organized garden and intercropped production increased 3-5 times more as compared to homestead scattered trees whose yield is about 10 tons per hectare. Production, harvest and post harvest is not organized to meet the requirements of industries. There are varieties as reported by farmers which produce fruits year round which can be multiplied rapidly to feed the industry year round.

8.1 Production Costs

Jackfruit in Bangladesh is almost a natural crop. Nothing is done after planting except harvesting from the trees. There is no cost of production except the price of the graft which is about Tk. 20.00, in exceptional cases plants may require fencing which is about Tk. 10.00. When the plants are above man height nothing is for about 15-20 years or more, only plucking and selling.

8.2 Market Trends

Demand of fresh Jackfruit is increasing due to population increase and urbanization. In certain areas like Madhupur production is also increasing as the region is most suitable for Jackfruit cultivation. Demands of metropolitan cities are increasing faster. Traders' guess is that demand and supply are equally increasing approximately about 10% a year. During last ten years it has doubled. Industrialization will increase the demand further but there is scope to increase area three times and that of yield by 3-5 times if production is organized as commercial plantation with selected high producing industrially suitable varieties through rapid multiplication of selected tries through tissue culture technique.

8.3 Trading

Trading of jackfruits takes place at several levels. Farmers take their fruits in the neighbourhoods market or some small traders buy matured/ripen fruits from the household and sell in the neighbourhood market or to the Earthers (aggregators) who ship it to wholesale markets of metropolitan cities where whole sellers buy and
sell to retailers. The retailers sell in the road side or fruit shops in organized markets. It is transported to long distance on the top of bus, bulk in truck or pick up to market of short and long distance.

8.4 Processing and Value Addition

Virtually there are no value addition activities, except transporting to markets of high demand which fetch high prices. Even sorting, grading and packaging is not done. There is no industrial level processing initiative primarily due to lack of knowledge and access to technology. The traders and agro-processors have no idea about consumers' taste and preferences. There is no import of any processed products. Small scale home/cottage level processed products like pickle, jam, jelly and dehydrated product could not be marketed due small scale supply, poor quality, packing and preservation. In fact no serious efforts are noticed among the public, private and NGO sector.

8.5 Global Competitors

Bangladesh is exporting about 55 tons of jackfruit to the United Kingdom at a price of £1.23/kg. In the United Kingdom a fresh fruit is sold at £2.45 per kg and a medium size fruit may cost £16-£20. Canned tender raw jackfruit and seeds can be sold in international markets, mostly for ethnic consumers. One can containing 250 g of bulbs in brine is sold in the United Kingdom retail market for £1.39. In Bangladesh there is no 138 government support for exporters from the Export Promotion Bureau, but the Malaysian Government has recently signed a contract with Bangladesh to supply jackfruit which will be processed in Malaysia for re-export. If Bangladesh enters into global market of jackfruit with fresh or processed products her competitors will be Malaysia, Thailand, India and Vietnam

8.6 Consumers

All Bangladeshis like to eat fresh jackfruits except few who do not like its strong odor and messiness. Supermarkets have started to separate bulbs of ripen fruits, arrange on a cellophane tray, cover by thin cellophane and put in the self. It is reported that affluent consumers also prefers to buy in such condition at a higher prices. Since there is no process products in the market consumer taste and preference cannot be evaluated.

8.7 Regulatory Framework

No regulatory problems are reported relating to production, trading and processing. It is a fruit which is grown and sold everywhere in the country with no regulation and legal constraints. However traders in recognized and regulated markers require licenses to conduct business any

8.8 Business Development Services

No business development such as extension, research, financing, and other advisory and regulatory services are available for jackfruit production, trading and value addition activities, no appropriate transportation system. It is simple a negligence to this nutritious and valuable crop while neighbouring countries have progressed quite far. Provision of these services is a must to industrialize the crop.

8.9 Constraints

Even in the traditional system constraints are many with severe consequences. Graft of desired varieties is not available; there is damage of trees due to disease and pest infestation, during harvest in monsoon no vehicle can ply in muddy road of production sites, needs to carry head load to nearby market, immature harvest, artificial ripening with chemicals, damage due to bulk transportation and no scientific knowledge of production, processing and storage is are available. All are done in traditional way.

8.10 Comparison of properties of tropical fruits

Fruits	Cal.	Prot. (g)	Ca (mg)	Fe (mg)	Vit. A (IU)	Thiam. (mg)	Vit. C (mg)
Orange	53	0.8	22	0.5	-	0.05	40
Banana	116	1.0	7	0.5	100	0.05	10
Mango	63	0.5	10	0.5	600	0.03	30
Pineapple	57	0.4	20	0.5	100	0.08	30
Papaya	39	0.6	20	0.5	1000	0.03	50
Ber	21	1.75	-	0.5-1	-	-	166
Ripe	98	2.0	37	1.1	540	0.09	10
Tender	50	2.0	53	0.4	30	0.12	12
Jackfruit	139	7.04	50	1.5	17	0.25	11
seeds							
Cal.- calorie, Prot.- protein, Ca - calcium, Fe - iron, Vit - vitamin, Thiam.-							
thiamine. Source: Azad (2000), Pareek							

9. MARKET STRATEGY

9.1 Demand and Supply

Jackfruit is sweet in taste and also contains Vitamin-A. Like any other fruit, it is perishable in nature. Jackfruit is grown in only certain parts of greater Dhaka division like Madhupur, Bhaluka, Tangail, Savar etc but its popularity is not limited to the growing regions only. It is heavy and bulky fruit and hence transportation is not very easy and is costly as well. Therefore, its down the stream products with longer shelf-life can be easily transported and shall also have value-addition. Products like canned pieces, nectar, jam, pickle and chips are recommended.

9.2 Marketing Strategy

These products have market round the year since it is very perishable and becomes available for a very short period of time and are popular through-out the country as well as in the ethnic communities abroad. Products shall have to be sold with the help of retailers at many locations like cities/towns, bus-stands, railway stations, school/college canteens, picnic spots and various exporters etc. There is a distinct possibility of marketing these products in the metropolitan cities, district head-quarters and other up-scale markets as well. Super markets show-cases widely across the country are very lucrative places of marketing such products in case of a bit large project of its type.

9.3 MANUFACTURING PROCESS

Jackfruit is heavy and bulky and actual recovery of bulbs or edible portion varies from 20% to 25%. After cutting the fruit in several pieces, the bulbs are removed manually. As the fruit contains highly sticky latex, small quantity of vegetable oil is applied on hands and then seeds are removed from bulbs. In case of canned jackfruit, these bulbs are canned with a small quantity of citric acid as the pH value of this fruit is very high. While making nectar, the bulbs are passed through pulping/fruit mill and around 10% hot water is mixed. Nectar is prepared from this pulp. In case of chips, raw or unripe jackfruits are used. After removing bulbs as stated earlier, suitable smaller sizes are cut and they are fried in edible oil. These fried pieces are salted and then packed. In case of pickle also unripe jackfruits are used. After removing bulbs and seeds, small pieces are made and they are mixed with oil, salt and spices before packing. Jam is prepared from the pulp of ripe fruits with additives.

10. PLANT AND MACHINERY

Technical Specifications for Plant & Machinery for Jackfruit Processing Unit

The following table has summarized the technical specifications of plant and machinery used in processing unit. Some of these machines shall have a common use for all four products which shall include processes of Washing, Blanching, Control panel for controlling the unit, RO plant etc. The details of technical specifications have been mentioned here.

Specification of Plant & Machinery		
Equipment Name	Description of Machine and Specification	Diagram
Feeding Hopper Cum Washer	• The parts of machine are made of stainless steel with simple design and sturdy construction. • The machine has hopper for feeding the raw material continuously, which gets washed by slow tumbling action. • Capacity – 1 MT/Hour • Power - 2.4 kW	
Working Table	• The working table is made of stainless steel with a simple design. • Length- 6 feet • Width- 2 feet • Height –3.5 feet • Required Nos. of Table- 8	
S/S Trays	The S/S Trays are made of stainless steel with a simple design. • Finish- Mirror Finish • Required Nos. of Trays- 50	
Plastic Crates	• Plastic Crates made of plastic. • Capacity - 20 to 25 Kgs • Shape -Rectangular • Size -540x360x290mm • Required Nos. - 200	

Large Cutting Knives	• Blade Material made of Carbon Steel • Colour- Black • Handle Material- Wood, Steel, Iron • Blade Edge- Plain • Required Nos. - 20	
Specification of Plant & Machinery		
Equipment Name	Description of Machine and Specification	Diagram
Blancher	• S.S. Drum & Body and other frames are made by MS. • Production Capacity -200KG/Hour • Motor-2 HP • Type- Continuous • Power- 2 kW Usage: The Blancher is a versatile machine which is designed for heating and cooking a variety of food products.	
Steam Jacketed Kettle of Stainless-Steel Construction	• Mounted on stainless steel legs. Jacket and pan made of 10/12 Standard Wire Gauge stainless steel. Complete with pressure gauge, safety valve, steam Trap. The kettles are double jacketed for maximum steam utilization and efficiency. • Kettles fixed type with Teflon scrapper fitted with geared motor completely made of stainless steel (legs, mounting etc.) • Capacity: 200 litres • Surface Finish- Mirror Finish Usage: Steam-jacketed kettles are often used to rapidly and uniformly heat food and agricultural products to processing temperatures .	

Equipment Name	Description of Machine and Specification	Diagram
Slicer	• The machine can slice jackfruit bulbs into uniform-sized slices. • Made of stainless steel • Capacity- 750kg/day • Space required- 50 Sq. Ft. • Required Nos. - 4	
Filling Tank	• Made of Stainless steel, SS-304 • Capacity – 500-1000 Litres. • Insulated for maintaining the inside temperature	
Semi-automatic can sealer machine	• Capacity: 35 Cans Per Minute • Power: 2.5 Hp • Machine Type: Semi-Automatic • Motor Speed -1440 rpm • Net Weight -850Kg • Voltage - 440V	
Pulper	• Consists of 2 Nos pulper mounted on the basic structure of M.S. 1st stage is fitted with a sieve. The product gets pulped in the 1st stage & then flows into the 2nd stage, which is fitted with a sieve (as per requirement). All contact parts made of stainless steel AISI-304. • Stages -2 • Automation Grade- Semi-Automatic • Voltage -440v • Electricity Phase-Three Phase • Capacity- 2.5/3 tonnes /hrs	

Specification of Plant & Machinery		
Equipment Name	Description of Machine and Specification	Diagram
	• Total load- 7.5 HP	
Pulveriser	• Material- Stainless steel • Power- 7.5 HP • Electricity Phase- 3 Phase Motor • Capacity –250 kg per hour. • Automatic Grade- Semi automatic Use: A pulveriser or grinder is a mechanical device for the grinding of many different types of materials.	
Solar Dryer	• Operating Temperature: 50-60^0 C • Feature: With electric heater as back up, controlled by digital Temperature controller with PT-100 sensor • Base Area- 12 x 30 feet • Capacity- 300 kg/ batch	
Or		
Mechanical Dryer	Mechanical Tray Dryer • Material- Mild Steel • Automation Grade- Automatic • Capacity- 24 tray dryer. • Heating Media - Electric	
Masala Coating Machine	• The Masala Coating Machine is made of a Stainless-steel body. • Capacity -100 kg / hrs • Operation Mode-Automatic	

Specification of Plant & Machinery		
Equipment Name	Description of Machine and Specification	Diagram
	• Electricity Connection-Three Phase • Motor Power -2 HP • Required Nos. - 1	
PS-RO PLANT	• RO Capacity- 2000LPH • Purification Type- RO • Features- Fully Automatic • Automation Grade- Automatic • Power Source -AC • Power- 10-12 kW	
Frozen storage	• Temperature: -18-25 Degree C • Phase- 3 Phase • Compressor Type- Air Cooled • Size of Storage- 1500 cubic feet • Capacity -20 tonnes • Temperature- 2^0C to 8^0C • Humidity- 85% - 90% • Power: 12-15 kW	
Boiler	• Power Source- Electric • Automation Grade- Automatic • Power Consumption: 5 kW 3 Phase • Capacity- 600 (kg/hr) • Weight-1200 kg	

Specification of Plant & Machinery		
Equipment Name	Description of Machine and Specification	Diagram
Plate chiller	• Capacity- 2 Ton • Power -440 V • Phase -3 Phase • Material- Stainless Steel • Frequency - 60 Hz Use: plate chillers are used for pulp packing to 5 -10 kg and it has specially used to preserve pulp without chemical mixing at cold storage.	
Automatic chips frying machine	• Material- Stainless Steel • Driven Type- Automatic • Capacity -300kg/h • Power Consumption - 3 HP • Machine Components - Fryer	
Jackfruit Seed Grinder	• This is used for fine grinding of jackfruit seeds into powder. • Weight- 50 kg • Voltage- 220V • Capacity- 100 Kg/Hr • Power-3.5 HP Motor	
FFS machine with nitrogen flush	• This is a Semi-Automatic pneumatically operated vacuumizing, sealing and enhance the product self-life. • Power Supply- 220 V AC, Single Phase, 50 Hz • Power Consumption- 1.8 kW • Filling range- 25 gm – 500 gm • Phase- 1 Phase	

Specification of Plant & Machinery		
Equipment Name	Description of Machine and Specification	Diagram
	• Packaging Speed- 35-40 Pouch/Min	
Homogenizer	• Pressure- 100-150 Bar • Voltage - 380 volt • Capacity- 100-1000 litres/hour • Phase-3 phase. • Automation Grade- Semi-Automatic • Power- 5 HP Use: Homogenizer is a special equipment of the liquid material thinningand high-pressure transportation.	
DG Set	• Electric Power- 50 kVA • Alternator- Brushless, Single Bearing, IP23, Class H Insulated, 50 Hz, Voltage Regulation +- 0.5%, 0.8PF Lag • Size- 2000 X 900 mm	
Effluent Treatment Plant	• Working Voltage Range -440 V 3 Phase • PH Level- 6 to 8 • Operating Temperature- 25 to 50 degrees Celsius • Operating Pressure- up to 3 bar • Feed Flow Rate- 0.5 to 2 m3/hr • Dimension -4ft* 3.2ft*4ft • Power- 1.5 to 2.5 KW	

Specification of Plant & Machinery		
Equipment Name	Description of Machine and Specification	Diagram
Transformer	• Capacity – 100 kVA • Input Voltage- 300-460 Volt • Cooling Type- Oil cooled. • Phase- 3 Phase • Frequency- 50-60 HZ • CarbonRollers-HighGrade Graphite Rollers	
Pallet jacks	• Fork Length- 1150 mm • Fork Width- 550 mm • Capacity- 2 ton	
Carton rapping machine	• Strap Width- 12 mm • Wight- 210 Kg • Material- Mild Steel • Speed- 25 Cycle/Min	
Bag Closer Machine	• Frequency- 50 Hz • Voltage- 220V. • Needle – Double • Capacity- 25-30 Bag/Min • Carton strapping and taping machine	
Manual bag closer machine	• Capacity: 5-8 bags per min. • Voltage - 220V • Stitch Type - Single Thread/Chain Stitch • Weight -6 Kg	

Specification of Plant & Machinery			
Equipment Name		Description of Machine and Specification	Diagram
Laboratory	List of equipment • Laminar Air Flow • Microscope • Oven • Incubator • Refractometer ($0 – 32^0$B, $28\text{-}62^0$B & $58\text{-}90^0$B) • Salinometer (0-100%) • Pressure tester • PH Meter • Weighing Balance (mg to g) • Other equipment (Petri dish, Burner, inoculating needle, Chemicals, Microorganisms growing media, test tube, beaker, flask etc)		

11. HUMAN RESOURCES of Management Team

Brief Profile of Management Team