EXTRACTION OF PINEAPPLE FIBRES FOR MAKING COMMERCIAL PRODUCTS

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ABSTRACT

Pineapple (Ananas comosus) is an significant fruit of India. The information provided by Indian Horticulture Database suggest that Pineapple is cultivated in an area of 85.4 thousand ha and total production is 1,353.1 thousand tons in India, up to year 2006 and also that it is the 6th largest country in the production. In this paper, modern scenario for commercial products, obtained by extract of its fibre is being discussed. It is abundantly grown in almost entire North East region. Assam, Manipur, Tripura and Meghalaya are the main contributing states in the production of Pineapple. Assam has 14.6 ha area and 241 thousand tons production up to year 2006. The North East region has remarkable advantages of fertile and organically rich soils, ample rainfall, water resources and great climatic diversity supporting diverse cropping possibilities. Pineapple leaf contains only 2.5-3.5% fibre, covered by a hydrophobic waxy layer. Extraction of thousands of tons of pineapple leaf fibre can be done after the harvesting of the fruit. The fibre extraction alone from the leaves is not economically viable, so the utilization of the residual sludge, remained after the process can be done in vermicomposting and other applications. The commercial products manufactured by using the PALF are of great importance in textile industry. The South Indian Textile Research Association (SITRA) has also commissioned a PALF extraction plant in Tripura. This review paper aims to indicate the developing trends in extraction methods and economic optimization of the products in the market obtained by the PALF in Assam, India. The North East region has vast potential of producing better crop quality and fulfilling the needs of the people in this field as the scope for emerging market is there.

Key Words: Harvesting, PALF, Vermicomposting, Ample rainfall, Optimization

INTRODUCTION

North-east region of India has a vast potential to produce pineapple crop on a large scale. The extraction of pineapple leaf fibre for commercial purposes is creating a market for entrepreneurs and peasant farmers. Numerous other opportunities are being investigated including various other fibres which can be extracted from the pineapple. Pineapple, as a crop is not an unknown fruitful area to this tropical region. Valuable dietary fibre is the new sector to extract and it can be utilized for market opportunities. The fibre from the fruit is a healthy additive for an appreciable range of food. The other area which can be seen is the fruit’s microcrystalline cellulose for use in the pharmaceutical industries. Learning from the innovative projects which make use of leaves, stems and roots of the pineapple plant there are fibre fortunes apart from the solid base of it in plantations in Assam and north-east region. The major pineapple growing countries in the world are Brazil, Thailand, Philippines, Costa Rica, China and India. Assam has the maximum area for the cultivation of pineapple crop in India with medium productivity scale. This area can be used for more production of this crop resulting in more fibre opportunities. The region produces more than 40% of the total Pineapple of the country and almost 90-95% of the produce is organic. Increase in the living standards of the people as well as in consumption lead to the development of fibres and fabrics focusing on the green environment.
Natural fibre has been an important textile material in human civilization. The fabrics of pineapple leaf fibre are easy to print and dye, sweat-absorbent and breathable, hard and not wrinkling, and it has good antibacterial and deodorization performances. In present scenario, India with other countries is carrying out more systematic research and development of the pineapple leaf fibre extraction, try spinning and weaving and making clothes. In today’s world with the energy crisis and environmental increasing degradation the need for natural fibre and eco-textile is making way. PALF has a good potential as reinforcement in thermoplastic composite. Pineapple Leaf Fibre (PALF) serving as reinforcement fibre in most of the plastic matrix has shown its significant role as it is cheap, exhibiting superior properties when compared to other natural fibre as well as encouraging agriculture-based economy. Assam has a rich source of nature’s support with the cheap labour cost for the extraction purposes. The medium scale production of PALF can be increased with the proper resource utilization. Fig. 1 shows the respective microstructure of the PALF.

**Fig. 1:** Optical micrograph of crosssection of PALF

**AIMS AND OBJECTIVES**

To analyze the modern trends in the extraction of PALF with economic variations in Assam, India according to the area of the production available for pineapple crop yield and scope for the market potential.

**DISCUSSION**

**Characterization of PALF**

It has been found that PALF consists of following chemical entities - Holocellulose - 87.56%, Alpha-cellulose–78.11%, Hemicellulose– 9.45%, Lignin – 4.78%. This composition gives the thermoplastic composite for construction application. Apart from this dietary fibre is also of great importance for commercial purposes.

**Extraction methods for PALF**

Pineapple leaf fibre in nowadays are waste products of pineapple cultivation. A special purpose machine having metal knife scraper roller and serrated roller used to scrap out the waxy layer and at the same time with retting process the pineapple leaf fibre being extracted.

**Chemical constituents**

Various pineapple fibre constituents viz. \(\alpha\)-cellulose, pentosans, lignin, fat and wax, ash content, nitrogenous matter, pectin ,degree of polymerization and crystallinity of \(\alpha\)-cellulose determined with standard methods.

**Physical properties**

Tenacity, fineness, flexural rigidity, torsional rigidity are determined by standard procedures for comparative purpose.

**Scraping of pineapple leaf**

The new machine used for scraping the pineapple leaf has the following modifications, such as the machine has three rollers, (i) feed roller (ii) leaf scratching roller and (iii) serrated roller. The leaves are fed through feed roller and then scratched by other roller to remove the waxy layer followed by serrated roller creating space for retting microbes. Fig. 2 shows the scraping machine operation.
Retting

The scratched leaves are being tied and immersed in a retting tank. Urea or di-ammonium phosphate added for quick retting. At the end of retting leaves are taken out and washed mechanically by pond water.

Using ceramic plate

By implying ceramic plate over the pineapple leaf with pressure and fast movement of it, will give the fibre beneath the leaf. The way how to do the extract the fibre from long leaf done by easy approach.

Pre and post harvesting metabolism

As a part of the grading standard, not only pineapple fruit but also crown quality is an vital characteristic of economic concern. As such, leaf damage, occurring as brown spots on the crown leaves, is causing appreciable economical losses. During daytime CO$_2$ will be released and processed via Rubisco behind closed stomata. The pineapple crown is being a continuation of the vegetative stem, and the spirally arranged leaflets have similar morphology. The photosynthetic activity of crown leaves remained unexplored.

Table 1 shows the experimental results. Pineapple fibre is white, creamy and lustrous as silk fibre and is more coarse as cotton and the fibre can easily retain dyes. India is the 6th largest producer of pineapples in the world. The major pineapple producing states in India are West Bengal, Assam, Karnataka, Bihar, Tripura and Kerala. In India, the manual process employed for extracting fibre is very hectic.

Also, there is a great need for marketing activities to promote pineapple fabric. Pineapple plants are enormously grown in tropical America, in Far-East Asian countries and in Africa. In Philippines and Taiwan, the pineapple plant is largely used as a resource of fibre. In India, also the pineapple plant is used as a well known source of fibre. Pre and post harvesting is the crucial part of the PALF extraction. As the time spent the crop should be used within the desired time period.

Commercial use after harvesting

Pineapple fibre is used for making cloth and also at times combined with silk or polyester to manufacture textile fabrics. Pineapple fibre is also used for table linens, bags, mats and other clothing items. It makes different uses across the various parts of the world. The huge potential for pineapple fabric makes it for diverse uses and eco-friendly properties. Weaving, sewing and other activities lead to the commercial products manufacturing. The scope of a huge market in Assam and outside of north-east region of India is there. The natural fibres with different crops like jute, coir, ramie, flax, hemp etc. in comparison to PALF already established themselves in the market worldwide. (Fig.3)
Table 1 : Experimental results and actions

<table>
<thead>
<tr>
<th>Sampling points in production chain</th>
<th>Time of sampling (Days)</th>
<th>Climatic conditions</th>
<th>Type of measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field</td>
<td>Before harvest</td>
<td></td>
<td>Stomata opening index</td>
</tr>
<tr>
<td>Harvest</td>
<td>0</td>
<td></td>
<td>Total titratable acids</td>
</tr>
<tr>
<td>Transport</td>
<td>21</td>
<td>Dark + 8°C</td>
<td>Total titratable acids</td>
</tr>
<tr>
<td>Storage</td>
<td>28</td>
<td>Dark + 10°C</td>
<td>Total titratable acids</td>
</tr>
</tbody>
</table>

Bio-Ethanol extraction from pineapple peelings
There is a global oil crisis, as the demand for petroleum increases each year while our supplies are rapidly being depleted. Bioethanol, a principle biofuel, is a natural alternative to gasoline. Peel samples, coming from Ananas comosus, will undergo a series of physical and chemical analyses to determine the glucose content, which will be utilized to yield bioethanol. The SSF process will be manipulated in terms of fermentation time and buffer level used to determine the best variables for biofuel production. The world is currently undergoing an oil crisis. Due to our continuous annual oil consumption, our reserves are quickly being depleted with scientists predicting that at our current rate of consumption, in just 40 years, our entire fossil fuel supply will run completely out. However, oil consumption rates are increasing rather than decreasing, thereby using up even more of this finite resource. Moreover, while oil has a number of uses in the global community, burning it increases the trace gas concentration in the atmosphere and causes significant environmental problems such as global warming.
Waste peelings were collected from pineapple. These were then ground into pulp using a blender, placed in a sterile container and stored for the subsequent sugar concentration analysis. The container was then labeled for identification in preparation for the Total Sugar Determination. Fifty grams (50g) of the pulp was subjected to automatic chemical analysis of its total sugar content. The test determined that the glucose content of the pineapple peelings was suitable for saccharification and fermentation. Having determined the glucose content of the peelings to be used for SSF, 120g of peelings were cut into smaller particles and ground into pulp for fifteen minutes using a blender to make the samples more susceptible to enzyme attack.\(^\text{10}\)

**Rural way marketing system in Assam**

The economy of Assam has been affected consequently for the past few years due to inadequacy of financial sources, insurgency problems and natural calamities like flood. At the current prices the Net State Domestic Product (NSDP) recorded a growth rate of 9.9 percent in 1998-99 as against the growth rate of 10.3 percent recorded in previous year.\(^\text{11,12}\) In respect of per capita income the growth rate was registered only 0.4 percent as against the growth rate of 2.2 percent during 1997-98. The economy of the state is basically agricultural based and the growth in this sector has been disappointing over the years.

**Land use**

The provisional estimates of the land utilization statistics of the state for the year 1997-98 reveal that there exists 39.44 lac hectare gross cropped area of which net sown area is about 27.51 lac hectare which accounts for 53.1 percent of the total geographical area. The area sown more than once was 12.43 lac hectares during 1998-99.\(^\text{11}\) There are better possibilities for the development of the land in Assam, India.

**Agriculture**

Agriculture occupied a very important position in the economy of Assam and forms the major occupation of the people of the state. According to 1991 census around 69 percent population of the state was dependent on farming activity. Government of Assam has assigned high level priority to the various programmes in this sector in view of its contribution to the state economy.

**Cropping pattern**

The major crops cultivated in Assam are food grains, pulses and oil seed. Among food grains, rice is cultivated in autumn and winter season which occupies large area under cultivation. Crops in season of rabi are largely dominated by the oilseed however a small area is also covered under rice during this season. Among pulses black gram occupy larger area in rabi than green gram. The red gram is cultivated in a very limited area due to medium scale productive area.

**Management intake**

Input distribution has been a challenging task for the functionaries at the district and village area due to infrastructure and logistic problem in the state. The distribution of fertilizer is channeled through apex bodies and private dealers under the control of the state agriculture department. Some important agricultural input like seed, pesticide, extension services, credit and the like are arranged through various state agencies. Assam Seed Corporation Ltd. is entrusted with the production and distribution of quality seeds except the private dealers. The Table 2 shows the performance of seed distribution by Assam Seeds Corporation Ltd during 1999-2000.\(^\text{11}\)

**Table 2 : Seed distribution by assam seeds corporation Ltd**

<table>
<thead>
<tr>
<th>S/N</th>
<th>Crop</th>
<th>1999-2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Paddy</td>
<td>11900</td>
</tr>
<tr>
<td>2.</td>
<td>Wheat</td>
<td>14730</td>
</tr>
<tr>
<td>3.</td>
<td>Pulse</td>
<td>3349</td>
</tr>
<tr>
<td>4.</td>
<td>Oil seeds</td>
<td>1984</td>
</tr>
<tr>
<td>5.</td>
<td>Jute</td>
<td>330</td>
</tr>
</tbody>
</table>

**CONCLUSION**

Pineapple leaf fibre has been modified by alkali, acetylation and graft copolymerisation. Grafting improved the thermal stability of pineapple leaf fibre modified fibres showed significant hydrophobicity, improved mechanical strength and chemical resistance. SITRA has fabricated the pineapple leaf fibre extraction plant at the behest of the Assam Rifles of Tripura under the Ministry of Civil Action programme, which has sponsored the fibre extraction plant project for the Tripura-based NGO called Mushroom
Growers Welfare Society. The society members would be using the plant to produce the pineapple fibre, which would be used for diverse commercial application including value-added handicraft and handloom products. The plant, capable of yielding 35 kg of leaf-fibre per 8-hour shift, can also produce yarns from other sources such as banana or sisal leaves. This fibre extraction unit consists of the deorticating machine, fibre cleaner, carding machine and a single ply machine besides a rope-making machine. The economy of the northeastern states is predominantly agriculture having 77 per cent of the working population engaged in cultivation and the role of agricultural marketing system has considerable importance in the overall economy of the region. It has been found that the in the selected states there are large number of unorganized rural markets and the private traders hold the core agribusiness activities in the region. It shows that a major share of marketable surplus finds its outlet in the poorly equipped markets held periodically in the villages. Most of the transactions in the rural markets involve small quantity of agricultural Produce to purchase the commodities of daily requirements. The private traders, middleman, petty retailers and moneylenders locally known as Mahajan dominate these markets. The farm produces in the state pass through a number of channels before reaching the consumer. The farmer gets only a small producer’s share in the consumer’s rupee. Middlemen at different stages of marketing process have emerged as a powerful channel for the procurement of food grains taking the advantage of the farmer’s poor economic condition and weak bargaining power. Thus, the farmer needs protection from such exploitation and also assistance in many respects, more so in a state like Assam where the agriculturists are subject to natural calamities and various other constraints. The village moneylenders advance loans to the cultivators at the time of need making it obligatory on the part of the farmer to deliver their produces after harvest at a price offered by the moneylender. The farmers lose market price significantly due to lack of proper sale arrangements in markets. In addition, farmers do not undertake proper clean -ing and grading of the produce before sales, which is also one of the reasons for low price.

REFERENCES