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Utilization of pineapple waste as textile application: A Review

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ABSTRACT

Pineapple is one of the most important tropical fruit grown in the north – eastern part of India. India is the fifth largest producer of pineapple with annual output of about 1.2 millions. Among different types of natural fibers, Pineapple Leaf Fiber (PALF) shows outstanding fiber properties which are rich in cellulose, cost effective, eco-friendly having good fiber strength. Pineapple fiber is white, creamy and lustrous as silk fibre and is more coarse as cotton and the fiber can easily retain dyes. 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.

Key Words : Pineapple, Textile application, Fibre, Silk

INTRODUCTION

Man has always been innovative. When talking of textile fibres, man has made natural fibres many plants. One of such inventions is Piña, a textile fibre obtained from pineapple leaves for making fabric. 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 (http://www.ecdc.co.za/news*http:/ / article/1630/Eastern Cape pioneering_new fibre_processing possibilities*). Pineapple (*Ananas comosus*) belongs to the family of Bromeliaceae; is a tropical fruit with edible multiple fruit consisting of coalesced berries. It is common name for the member of Bromeliaceae, a family of chiefly epiphytic herbs and small shrubs. Some varieties of Ananas yields a very hard fibre from spiny leaves known as Gravata in South America used in the manufacturing of clothes. The fruit whose spiny skin is yellowish brown when ripe is sweet and juicy; it is topped by distinctive rosette of green leaves. It is grown throughout in the warmer regions. Pineapple is one of the important commercial fruit crops of India (Saloni *et al*., 2017).

Global production of pineapples amounted to 25.8 million metric tonnes in 2016. In that year, Costa Rica was the biggest producer of pineapples; producing approximately 2,930 thousand metric

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tons. (FAO Stat). Pina fabric made from fibres extracted from pineapple leaves has occupied a pride of place in Philippines.

The leaves of Pineapple were considered as agro-waste in the past due to lack of knowledge about the potentiality of Pineapple Leaf Fibre (PALF). But in the era of modern science it is thought as a good source of eco-friendly fibres. Although it was not well known and most useable fibre, now researchers are trying to introduce Pineapple Leaf Fibre as a golden fibre like jute from the commercial point of view. 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 (Kannojiya *et al.*, 2013).

Commercially pineapple fruits are very important and leaves are considered as waste materials of fruit which is being used for producing natural fibres. The chemical composition of PALF constitute holocellulose (70–82%), lignin (5–12%), and ash (1.1%) (Pavithran, 1987). Pineapple (PALF) has tremendous mechanical properties and can be applied in making of reinforced polymer composites low density polyethylene (LDPE) composites, and biodegradable plastic composites (Mishra, 2001).

Table 1 : Difference between Pina and other natural fiber (physical and chemical properties)

Physical properties	Pineapple leaf fiber	Jute	Cotton
Length(mm)	3-9	0.8-6.0	15-60
Breadth(10-3mm)	4-8	5-25	15-20
L/B ratio	450	110	1300
Gravimetric Fineness (tex)	1.54	1.25-5.0	0.10-0.30
Tenacity (g/tex)	50	35-50	20-45
Extension at break(%)	2-6	1.0-2.5	6.5-7.5
Chemical properties			
Alpha- Cellulose	70	60.5	92.89
Lignin	4.5	13.3	0.54

Extraction process of PALF:

The available, traditional methods of fibre extraction involve the processes *viz*., retting, decortication, combing etc., which takes 5-7 days. During decortications, it is difficult to extract the fibres as they are sticky due to the presence of pith thus necessasiating the use of chemicals which is not ecosafe. Pineapple fibres are extracted from pineapple leaves by manual means hand as well as by decorticator. The common method in the practice is a combination of water retting and scraping. The fibres are thoroughly washed and dried. The total yield of the fibre is 2.5 to 3.3 % of the weight of green leaves. Pineapple leaves steeped in water for 18 days yield good spinnable fibres (Doraiswamy and Chellamani, 1993)

Scrapping of pineapple leaf :

Scrapping machine is used for the scrapping the pineapple leaf fibre. 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 (Kannojiya *et al.*, 2013). Fig.1(a) shows the scrapping machine operation.

(a) (b)

Fig. 1 : a) Mechanical extraction of PALF by decorticator machine, b) Manual extraction of PALF by ceramic

Retting of pineapple leaves :

The retting 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.

By using ceramic plate:

By implying the ceramic plate over the pineapple leaf with pressure and fast movement of it, will give the fibre benaeth the leaf. The way how to do the extract the fibre from long leaf done by easy approach (Kannojiya *et al.*, 2013). Fig.1(b) shows the manual operation.

Fibres are extracted by means of machine/manual (hand) processing. The extracted fibres will be in the form of long strands with slightly dull yellowish in colour. These fibres are then washed and dried followed by gentle combing in wet condition with the fine pins moving slowly to separate the ultimate coarser bundles and give fine fibres of considerable length (Doraiswamy and Chellamani, 1993).

Utilization of pineapple waste :

From each pineapple fruit, only 52 % is used for jam and juice production. Remaining 48 % consists of fruit peel and leaves forming the waste. These waste are rich in lignin and cellulose and thus from a very good raw material for allied fibres. Also, waste disposal is a major problem in these industries because of very high lignin and cellulose content of the waste leaves which is difficult to be degraded, thus resulting in pollution and affecting the environment (Fiber to fashion com http://www.fiber2fashion.com). The wastes from pineapple canneries have been used as the substrate for bromelain, organic acids ethanol, etc. since these are potential source of sugars, vitamins and growth factors (Larraurietal, 1997; Nigam, 1999a, b; Dacera *et al*., 2009).

Anti-dyeing agent :

Dyes used in textile industries have been a threat to environmental problem since these are visible in small quantities due to their brilliance when mixed and thrown with large volumes of waste water from different steps in the dyeing and finishing processes (Robinson *et al*., 2001; Babu *et al.*, 2008). Some works on utilizing pineapple waste to remove the dyes have been reported.

Pineapple stem is used as low-cost adsorbent to remove basic dye (methylene blue) from aqueous solution by adsorption (Hameed *et al*., 2009). In another report, pineapple leaf powder has been used as an unconventional bio-adsorbent of methylene blue from aqueous solution (Weng *et al*., 2009)

Fibre:

The pineapple leaves have been used to make coarse textiles and threads in some Southeast Asian countries (Tran, 2006). Alkaline pulping methods were found to be superior over semi-chemical mechanical pulping with yields below 40%. A yield of 2.1g fibre/100 g pineapple pulp waste has been reported (Sreenath *et al*., 1996). Furthermore, pineapple leaf fibres are investigated in making fibre-reinforced polymeric composites because of high cellulosic content, abundance and inexpensiveness (Devi *et al*., 1997; Luo and Netravalli, 1999; Arib *et al*., 2006). They investigated the tensile, flexural, and impact behavior of pineapple leaf fibre-reinforced polyster composites as a function of fibre loading, fibre length, and fibre surface modification. They found that the mechanical properties of the composites are superior to other cellulose-based natural fibre composites.

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 natural fibres with different crops like jute, coir, ramie, flax, hemp etc. in comparison to PALF already established themselves in the market worldwide.

Conclusion:

Pineapple is one of the most familiar tropical fruits widely cultivated around the world for its fruits. Pineapple leaves, the major part of the plant that is currently unused needs global attention for its commercial exploitation. The fibre has a natural gloss similar to silk, and is better in quality. This gloss protects the fibres and as a result, piña does not require any to treatment with toxic chemicals. It is easy to wash and care for; no dry cleaning required. Piña cloth is wear-resistant. It is an ideal eco-textile for clothing Pina fibre Long, fine, lustrous. The utilization of pineapple leaf fibre for making diversified products is a new source of materials which can be economic, ecofriendly, and recyclable. PALF is widely accepted in textile sector and already used in our daily life materials but we attribute that further study will enhance the application in various other exiting products.

REFERENCES

Asim, M., Abdan, Khalina, Jawaid, M., Nasir, M., Dashtizadeh, Zahra, Ishak, M.R. and Hoque, M. Enamul (2015). A review on pineapple leaves fibre and its composites. *Internat. J. Polymer Sci., Pp.* 950567, 16 pages

Babu, B.R., Rastogi, N.K. and Raghavarao, K.S.M.S. (2008). Liquid–liquid extraction of bromelain and polyphenol oxidase using aqueous two-phase system. *Chemical Engg. & Processing,* **47** : 83–89.

Dacera, D.D.M., Babel, S. and Parkpian, P. (2009). Potential for land application of contaminated sewage sludge treated with fermentaed liquid from pineapple wastes. *J. Hazardous Materials,* **167**: 866-872.

Devi, L.U., Bhagawan, S.S. and Thomas, S. (1997). Mechanical properties of pineapple leaf fiber-reinforced polyester composites. *J. Appl. Polymer Sci.*, **64** : 1739-1748.

Dr.Yasodha Thirumal Fiber to fashion.com http://www.fibre2fashion.com/industry-article/5076/advantages-of-pineaple-fiber)

Hameed, B.H., Krishni, R.R. and Sata, S.A. (2009). A novel agricultural waste adsorbent for the removal of cationic dye from aqueous solutions. *J. Hazardous Materials*, **162** : 305-311.

India Doraiswamy and Chellamani, P. (1993). Pineapple- leaf Fibers, Textiles progress, Volume **24**(1).

Kannojiya, R., Gaurav, K., Ranjan, R., Tiyer, N.K. and Pandey, K.M. (2013). Extraction of pineapple fibres for making commercial products. *J. Environ. Res. & Development*, **7**(4) : 1385.

Larrauri, J.A., Ruperez, P. and Calixto, F.S. (1997). Pineapple shell as a source of dietary fiber with associated polyphenols. *J. Agric. & Food Chem.*, **45**: 4028-4031.

Mishra, S., Misra, M., Tripathy, S.S., Nayak, S.K. and Mohanty, A.K. (2001). Potentiality of pineapple leaf fibre as reinforcement in PALF-polyester composite: Surface modification and mechanical performance. *J. Reinforced Plastics & Composites*, **20** (4) : 321–334.

Nigam, J.N. (1999a). Continuous ethanol production from pineapple cannery waste. *J. Biotechnol.*, **72**: 197-202.

Nigam, J.N. (1999b). Continuous cultivation of the yeast Candida utilis at different dilution rates on pineapple cannery waste. *World J. Microbiol. & Biotechnol.*, **15** : 115-117.

Pavithran, P.S., Mukherjee, M., Brahmakumar, and Damodaran, A. D. (1987). Impact properties of natural fibre composites. *J. Materials Sci. Letters*, **6** (8) : 882–884.

Robinson, T., McMullan, G., Marchant, R. and Nigam, P. (2001). Remediation of dyes in textile effluent: a critical review on current treatment technologies with a proposed alternative. *Bioresource Technol.*, **77**: 247–255.

Saloni, S., Sindhu, Chauhan, K. and Tiwari, S. (2017). Pineapple production and processing in north eastern India. *J. Pharmacognosy & Phytochemistry*, 2017; SP1: 665-672

Sreenath, H.K., Sudarshanakrishna, K.R., Prasad, N.N. and Santhanam, K.(1996). Characteristics of some fiber incorporated cake preparations and their dietary fiber content. *Starch/Starke*, **48**: 72-76.

Tran, A.V. (2006). Chemical analysis and pulping study of pineapple crown leaves. *Industrial Crops & Products*, **24**: 66-74.

Wang, C.H., Lin, P.J. and Chang, J.S. (2006). Fermentative conversion of sucrose and pineapple waste into hydrogen gas in phosphate-buffered culture seeded with municipal sewage sludge. *Process Biochem.*, **41** : 1353-1358.

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