Extraction of natural fibers from some plant species found in Akola region

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***Abstract*-Plants are the source of plant fibers. These plant-based fibers are used to create fabrics. Natural fibers are sustainable materials which are easily available in nature and have advantages like low-cost, lightweight, renewability, biodegradability, and high specific properties. Such fibers are derived from various parts of plants including leaves, stems (best fibers), fruits and seeds. Synthetic fibers are man-made fibers. The majority of them are petrochemicals because they are created using materials derived from petroleum. These fibers, which are used to create fabrics, can come from either natural or synthetic sources. Synthetic fibers do not absorb water or sweat melt and burn easily. On catching fire, it shrinks forming beads which stick to the skin. These fibers are non-biodegradable. Synthetic fibers are far less sustainable, consuming 342 million barrels of oil and releasing 8,000,000 tons of plastic into the ocean every year in the form of microplastics. It can take up to 200 years for synthetic fibers to biodegrade into the earth. They are an allergen to some. So, the increase in awareness of the damage caused by synthetic materials on the environment has led to the development of eco-friendly materials. In this study the natural fibers are extracted from those plants which are easily available and it has the potential to capture a good market share in the future.**

***Key words*-Natural fibers, extraction, plant parts use.**

INTRODUCTION:

Fiber crops are grown in fields that are used to make ropes, papers, cloth, etc. Plant fibers are also called natural fibers as they are obtained naturally and directly from the different sources of plants and their products. Among the plant species, the fiber yielding plants which are commonly usedby man holds the second position after the food plants in their economic importance. The ancient man started his nomadic life by using the plant material directly for covering and protecting his body, thatched leaves for shelters and huts; mats for household and other day-to-day activities. Gradually fast mobility and advancement in the lifestyle led him to search for lighter, more durable and sophisticated-looking materials for routine use. There began an era of developmentof different types of textiles, papers, basketries, woven cloths, mats, hats, ropes, and cordage material for various uses. The gradual depletion of forest resources of plant based material resulted in the loss of important diversity. The plant fibers havespecific qualities such as thermal insulation, resistance to water, and other desirabletraits to increase the constant supply of raw materials to plant fiber-based industriesa need was felt to explore and identify alternative materials. By identifying new fiber yielding species as well as novel uses of fiber through research and development, there would be decrees in pressure on a handful number of species used for fiber, besides supporting small scale industry and reinforcing fiber for waste fiber recycling the present enumeration is an effort taken in this direction (Gillah et al, 1998; Velasquez, 2001).

Survey of fiber yielding plants of Akola region has been left almost untouched. Akola is a district in Vidharbha region in the state of Maharashtra in central India.It is located at latitude 20-7 North longitude 77.07 the East. It is at an altitude of 925 ft (282m) above sea level. It has tropical savanna climate. Annual temperature ranges from high of 48^0 C (118 f) to a low of $10\ ^0$C (50 f).Natural fibersare good for the environment, comfortable to were, renewable, biodegradable, carbon neutral and can be used without depleting or damaging the environment. Whilst all land plants contain fibres they are usually too short or too weak to be used for anything other than paper-making, but there are well over 100 species suitable for growing in temperate climates that produce long and relatively strong fibres. They are of great insulators, good for sensitive skin trendy & fit in with the organicmovement. Synthetic fiber catch fire easily& dangerous to wear. They are by-products of petroleum, non biodegradable, creating long –term pollution. They can't easily recycle, hard to decompose & accumulate landfills more. Synthetic fibres can cause various bronchopulmonary diseases, such as asthma, extrinsic allergic alveolitis, chronic bronchitis with bronchiectasis, spontaneous pneumothorax, and chronic pneumonia. So, there is an urgent need to protect our environment by focusing on natural fibers.

MATERIAL AND METHOD:

Extensive survey of fiber yielding plants in Akola region was carried outfrom January to March 2022 and these plants were collected from different localities. More than 10 plants were collected in sterile polythene bags. Collectionwas made in different season. These plants were brought in laboratory and were identify by using Flora of Marathwada by Dr.V. N. Naik. Various plant parts suchas roots, leaves, fruits, seeds etc. were used for extraction of fibers. Plants such as*Gossypium hirsutum* (seed hairs), *Dracaena trifasciata (*leaves), *Dypsis lutescens* (leaves stalk), *Livistona chinensis* (leaves stalks), *Ceiba pentandra* (seed hairs), *Cocos nucifera (*mesocarp), *Agave Americana* (leaf), *Phoenix dactylifera* (stem) , *Livistona chinensis (*leaf), *Bambusa vulgaris*(stem), *Abelmoschus esculentus*(fruit), *Annona squamosa* (stem), *Ficus racemosa* (stem) , *Beaucarnea recurvate* (leaf), *Annona reticulata L.*(Stem) taken for extraction of plant fibers. Morphology of these plants was studied.

EXTRACTION OF PLANT FIBERS:

Hand scraping: In this fiber extraction method a knife or ceramic plate are used, by putting the parts of plant on a plate and scratch repeatedly by using the knife orceramic plate until the fiber is seen. After that scratch that plant part gently or slowly in order to prevent the fibers from damage. Finally, the extracted fiber willbe washed by water and dried in sunlight. Hand scraping of the plant part must be done in the first three days after harvesting. If left any longer, the plant part will become dry and the fibers will be difficult to extract. The gathered plant parts weresorted to remove any damaged, diseases or broken part of plants. Hand scraping method is the easiest and the shortest way of mechanically extraction of fiber,

RESULT AND DISCUSSION:

List of the plants used for extraction of fibers-

Sr. No.	Name of plants	Family	Part used forextraction of fiber
1	*Gossypium arboreum L.*	Malvaceae	Seed hairs
2	*Dracaena trifasciata(Prain) Mabb*	Asparagaceae	Hard (Leaves)
3	*Dypsis lutescens(H.Wendl.) Beentje & J.Dransf.*	Arecaceae	Hard(Leaves sheath)
4	*Livistona chinensis(Jacq.) R.Br. ex Mart.*	Arecaceae	Leaves rachis & Stem
5	*Ceiba pentandra (L.) Gaertn*	Malvaceae	Seed hairs
6	*Cocos nucifera L.*	Arecaceae	Fruit
7	*Agave americana L.*	Asparagaceae	Hard (Leaves)
8	*Phoenix dactylifera L*	Arecaceae	Leaves rachis
9	*Bambusa vulgaris Schrad. ex J.C.Wendl*	Poaceae	Bast (Stem)
1o	*Abelmoschus esculentus(L.) Moench*	Malvaceae	Fruit
11	*Annona squamosa L.*	Annonaceae	Bast (Stem)
12	*Ficus racemosa L.*	Moraceae	Bast (Stem)
13	*Beaucarnea recurvata Lem*	Asparagaceae	Hard (Leaves)
14	*Annona reticulata L.*	Annonaceae	Bast (Stem)

DISCUSSION:

Fibers derived from bio-based sources such as vegetables and animal originate termed as natural fibers. Some fibers (e.g., viscose rayon and cellulose acetate) are produced with chemical procedures from pulped wood or other sources (cotton, bamboo). Natural fibers being cost effective and abundantly available yield which have high potential in various industrial and commercial applications such as in the interior applications of the passenger cars, panels for partition and false ceiling, partition boards, roof tiles, coir fibers in packaging, furniture applications, as insulating materials in low energy houses, geo-textiles for soil protection and erosion control, enhancing barrier properties, composites etc. Due to research and developmental work in modification and treatment methods of natural fibers, utilization of natural fibers has observed a significant growth in various applications. The study addresses the potential applications of natural fibers in various commercial sectors for the development of environment-friendly products with an aim to replace synthetic fibers or inorganic fillers with cost-effective and efficient products.

In *Gossypium arboreum & Ceiba pentandra* fibers are obtain from seeds. In *Dracaena trifasciata, Dypsis lutescens, Livistona chinensis, Agave americana, Phoenix dactylifera, Livistona chinensis, Beaucarnea recurvata, fibres* are extracted from leaf while in *Cocos nucifera & Abelmoschus esculentus* it is extracted from fruit. In*Bambusa vulgaris, Annona squamosa, Annona reticulata & Ficus racemose* it is extracted from stem part.

Plant fibers are sclerenchyma elongated cells which occurs in different parts of plant, mainly in the stem and leaves. These are elongated cells with tapering ends and thick, usually heavilylignified cell walls.

Fibers are also associated with the xylem and phloem tissue of monocotyledonous and dicotyledonous plants stems and leaves. Sepration of fibers takes place by retting process, which involves bacteriaand fungi treatment. The cellulose, hemicellulose and lignin content in plant fibers vary depending on the plant species, origin quality and conditioner.

Natural fibers are an effective way of improving the quality of part regardingthe environment, economic and technical feasibility. However, to accomplish this goal there are certain issues that need to be tackled.

CONCLUSION:

Natural fibers are fully sustainable, renewable, and biodegradable. They have several advantages in comparison with man-made synthetic fibers and are widely used in the apparel sector and interior design. Unfortunately, they are flammable and not resistant to biodegradation. For this reason, their use is very often limited. Therefore, competitive products based on renewable resources needto be developed to have high quality, show excellent technical performance, and harm the environment less than current products based on petrochemical materials.Natural fibers are best option.

Natural fibers and the products designed around these materials possess many distinctive advantages such as cost-effective, low coefficient of friction, ease of availability, exhibit good thermal and dimensional stability, environmentally friendly, etc. Many of them are plentiful and readily available. These fibers can be used as a model for developing a national priority bio-product based on textile innovation, which can be facilitated through government support. It will be also beneficial to farmers, in order to increase

their economy. So, there must be the establishment of an information system for natural fibers, as well as collaboration with a variety of systems such as research and development institutions, companies,and universities, which can take efforts to increase the use of natural fibers in a sustainable circular economy.

Photo Plate 1

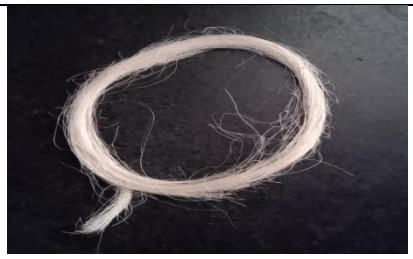
A) Gossypium hirsutum

B) Cotton fiber

C)Cocos nucifera

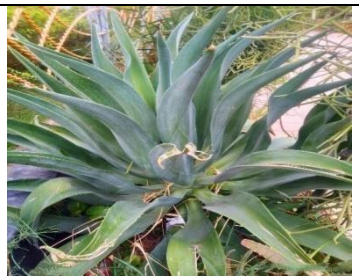
D) Coir fiber

E) *Dracaena trifasciata*

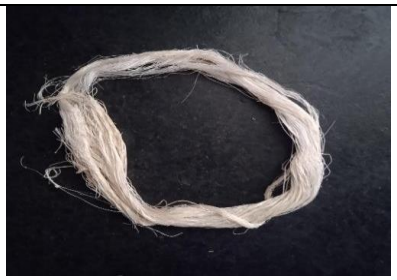


F) Leaf fiber

Photo Plate 2



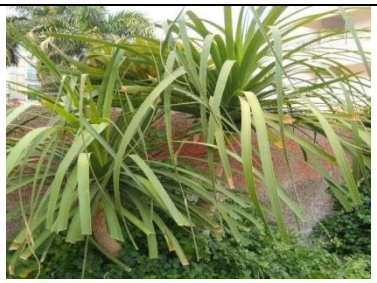
A) Agave americana



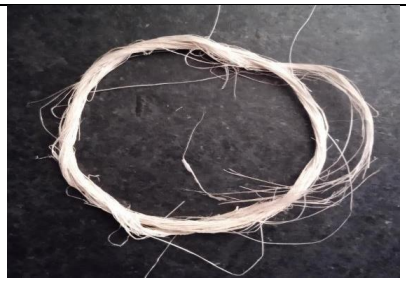
***B)* Leaf Fiber**

C***) Ceiba pentandra***

D) Seed hairs fiber



E)Beaucarnea recurvata



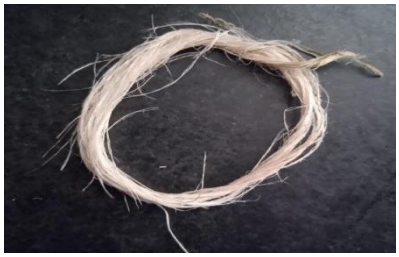
F) Leaf fiber

Photo plate 3

A) Dypsis lutescens

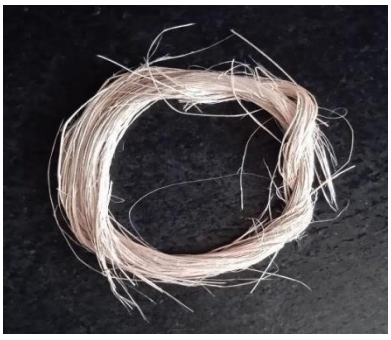
B) Leaf sheath fiber

C) Annona squamosa



D) Stem fiber

E) *Phoenix dactylifera*



F) Leaf rachis fiber

Photo plate 4

A) Bambusa vulgaris

B) Stem fiber

C) ***Ficus racemosa***

D) Stem fiber

E) Annona raticulata

F) Stem fiber

Photo plate 5

A) Abelmoschis esculentus

B) Fruit fiber

C) Livistona chinensis

D)Leaf sheath fiber E) Leaf rachis fiber

REFERENCES:

1. Abugoch James L.E. Quinoa (Chenopodium quinoa Willd.): Composition, Chemistry, Nutritional, and Functional Properties; Advances in Food and NutritionResearch; 58, 1–31.
2. Angela Sophia Sarabia, Juztine Ramos, Kiel Diquit Snake Plant (Sanserviera trafisciata) and Abaca (Musa textilis) Fiber as Compressive Enhancer for Course Aggregate of Concrete Hollow Blocks (2019)
3. Anonymous,Promising fibre-yielding plants of the Indian Himalayan region. G.B.Pant (2010)
4. Applequist, W. L., Cronn, R. and Wendel, J. F. (2001) Comparative development of fiber inwild and cultivated cotton. Evol. Development (2001) 3, 3–17.
5. Ashik, K.P.; Sharma, R.S. A Review on Mechanical Properties of Natural Fiber Reinforced. Hybrid Polymer Composites. J. Miner. Mater. Charact. Eng. (2015), 3,420–426
6. Ashish Hulle, Pradyumkumar Kadole, Pooja Katkar Agave Americana leaf fibers Fibers(2015) 3 (1), 64-75,
7. Begum, H. A., S. K. Saha, A. B. Siddique, and T. Stegmaier.. Investigation on thespinability of fine areca fiber. The

Journal of the Textile Institute (2019)110: 1241–45.
8. Benezet JC, Stanojlovic-Davidovic A, Bergeret A, Ferry L, Crespy A. Mechanicaland physical properties of expanded starch, reinforced by natural fibres. IndustrialCrops and Products. (2012);37(1):435-440
9. Binoj, J. S., R. E. Raj, V. S. Sreenivasan, and G. R. Thusnavis.. Morphological, physical, mechanical, chemical and thermal characterization of sustainable indian areca fruit husk fibers (areca catechu l.) as potential Alternate for hazardous synthetic fibers. Journal of Bionic Engineering(2016) 13 (1) 156–65.
10. BISFA. Terminology of man-made fibres, 2006 Edition. Brussels: BISFA; (2006)
11. Chandra, J., N. George, and S. K. Narayanankutty.. Isolation and characterization of cellulose nanofibrils from Areca nut husk fibre. Carbohydrate Polymers (2016)142: 158–66.
12. Chethan, M., P. S. N. Venkat, G. S. Gopala Krishna, R. Chennakesava, and P. Vijay. Dynamic vibrational analysis On areca sheath fibre reinforced bio composites by fast fourier analysis. Materials Today: Proceedings 5 (9) (.2018)19330–39.
13. Dagang Liu, Jianwei Song, Debbie P Anderson, Peter R Chang, Yan Hua Cellulose19 (2012)(5) 14491480,
14. Desai, R. H., L. Krishnamurthy, and T. N. Shridhar.. Effectiveness of areca (betel)fiber as a reinforcing material in Eco-friendly composites: A review. Indian Journal of Advances in Chemical Science (2016)
15. Deshmukh, P. S., P. G. Patil, P. U. Shahare, G. B. Bhanage, J. S. Dhekale, K. G. Dhande, and V. V. Aware.Effect of Mechanical and chemical treatments of areca nut (areca catechu l.) fruit husk on husk and its fibre. Waste Management 95(2019):458–65
16. Ferrero F, Periolatto M. Modification of surface energy and wetting of textile fibers.In: Wetting and Wettability. Chapter 6. London, UK: In Techopen;(2015):139-168
17. Himadri Das, Dipul Kalita Fibers and dye yielding plants of north East India(2016),77-99,
18. Idicula M, Boudenne A, Umadevi L, Ibos L, Candau Y, Thomas S. Thermophysicalproperties of natural fiber reinforced polyester composites. Composites Science andTechnology. (2006);66(15):2719-2725
19. Jan EGVDA. Environmental benefits of natural fiber production and use. In: Proceedings of the Symposium on Natural Fibers. (2008). Pp. 3-17
20. Jorg M. Industrial Applications of Natural fibers. A John Wiley and Sons Ltd. Publication; (2010). Pp. 509-522
21. KG Ramawat, MR Ahuja Fiber plants: an overview Fiber Plants, (2016)3-15,
22. Lobna A. Elseify ,Mohhomad midani Cellulosic fibers extracted from date palms (Phoenix Dactylifera L.) and their applications (2019)
23. P Kolte, A Daberao, A Miss Sharma Agave Americana: The natural leaf fibre Text.Rev(2012) 7, 1-5,
24. Ramesh M, Palanikumar K, Reddy KH. Plant fibre based bio-composites: Sustainable and renewable green materials. Renewable and Sustainable Energy Reviews. (2017); 79:558-584
25. Shinoj S, Visvanathan R, Panigrahi S, Kochubabu M. Oil palm fiber (OPF) and itscomposites: A review.Industrial Crops and Products. (2011); 33:7-22
26. V. S Naik Flora of Maharashtra
27. Yadav S. R & Sardesai M. M, 2002, Flora of Maharastra State Dicotyledones, VolI, Lakshminarasimhan P. & Prasanna P.