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Fibre

Plants yielding fibres have been second only to food plants in their usefulness to humans and their influence on the furthering of civilization. Primitive humans in their attempts to obtain the three most important necessities for life: food, shelter & clothing, focused on plants. Even though animal products were available, some form of clothing was needed that was lighter and cooler than skins. It was easier to obtain from plants such items as bowstrings, nets, snares, etc. Also plant products were available from the leaves, stems and roots of many plants to construct shelter.

Very early on plant fibres have had a more extensive use than silk, wool and other animal fibres. Gradually as humans' needs multiplied, the use of vegetable fibres increased greatly until presently they continue to be of great importance even after the onset of plastics. It is impossible to estimate the number of species of fibre plants. However, plant fibres of commercial importance are relatively few, the greater number being native species used locally by primitive peoples in all parts of the world. Their durability often exceeds those of synthetic manufacture, one example being sisal & Manila hemps.

Structure and occurrence -

Fibres are elongated, slender, thick walled sclerenchymatous cells with pointed ends. They possess very narrow lumen and highly thickened lignified secondary walls bearing simple pits. Fibres vary in length, chemical composition and place of origin. The cell wall of the fibre usually consists of cellulose, hemicellulose, and some percent of lignin.

They may develop singly or in groups and are abundantly found in stem, leaves, roots, fruits, and seeds of several plants.

Classification of fibres-

On the basis of their origin fibres are classified into the followings-

Bast fibre- These fibres are produced in group outside the xylem, in the cortex, pericycle or phloem. They are also termed as cortical fibres, pericyclic fibres or phloem fibres.

Leaf fibres- Leaf fibres are associated with vascular bundle strands in leaf stalks and leaf blades.

Wood fibres- They occur in the secondary wood. These fibres are found in the wood of angiosperms and gymnosperms.

Surface fibres- They develop as hair like outgrowth on the surface of many seeds and in the walls of the fruits.

Classification based on common use-

Plastic materials are often used instead of natural products because they cost less and sometimes tend to be more durable. However, natural plant products continue to have some superior attributes and are used when materials are readily available. There are six principal groups of fibres distinguished according to the way in which they are used.

Textile Fibres- are the most important in that they are used for fabrics, netting etc. To make fabrics and netting flexible fibres are twisted together into thread or yarn and then either spun, knitted, woven or in some other way utilized. Fabrics include cloth for wearing apparel, domestic use, etc. Fabric fibres are all of some commercial value.

Brush Fibres- are stiff tough fibres including small stems and twigs that are utilized for making brooms and brushes.

Rough Weaving & Plaiting Fibres- Plaits are fibrous, flat and flexible strands that are interlaced to make straw hats, baskets, chair seats, matting etc.

Filling Fibres- are used for stuffing mattresses, cushions and in upholstery; as stiffening in plaster and as packing material.

Natural Fabrics- are usually obtained from the bast of the tree that are extracted in layers or sheets and pounded into rough substitutes for lace or cloth.

Paper making fibres- several textile fibres, wood fibres and grasses are used in the paper making.

Fibres of economic importance occur in many different plant families, especially those from the tropics. Some of the more important families are the Palmaceae, Gramineae, Liliaceae, Musaceae, Malvaceae, Moraceae, Tiliaceae, Bombacaceae, and Luguminosae.

Textile Fibres

These fibres must be long and possess a high tensile strength and cohesiveness with pliability. They must have a fine, uniform, lustrous staple and must be durable and abundantly available. Only a small number of the different kinds of fibres possess these traits and are thus of commercial importance. The principal textile fibres are grouped into three classes: surface fibres, soft fibres and hard fibres, with the last two often referred to as long fibres.

Surface or short fibres include the so-called cottons. The soft fibres are the bast fibres that are found mainly in the pericycle or secondary phloem of dicotyledon stems. Bast fibres are capable of subdivision into very fine flexible strands and are used for the best grades of cordage (cords and strings) and fabrics. Included are hemp (*Cannabis sativa*), jute (*Corchorus capsular*), flax (*Linum usitatissimum*) and ramie (*Boehmeria nivea*).is

Hard or mixed fibres are structural elements found mainly in the leaves of many tropical monocots, although they may be found in fruits and stems. They are used for the more coarse textiles. Sisal (*Agave sisalana*), abaca (*Musa textilis*), agaves, coconut and pineapple are examples of plants with hard fibres

Surface Fibres

Cotton

Cotton is one of the greatest of all industrial crops. it is the principal fibre plant as well as one of the oldest and most economical. It was known since ancient times and well before written records.

Cotton Characteristics

Several species of the genus Gossypium provide what we call cotton. The fine fibrous hairs that occur on the seeds constitute the raw material. These hairs are flattened, twisted and tubular. Their length and other qualities vary with the different varieties.

Varieties differ in fibre character as well as other morphological features. Cultivated cottons of commercial importance are usually referred to one or another of four species: Gossypium barbadense and G. hirsutum in the Western Hemisphere and G. arboreum and G. herbaceum in the Eastern Hemisphere.

Sea-Island Cotton- It has fine, strong and light cream-colored fibres that are regular in the number and uniformity of the twists and they have a silky appearance.

Egyptian Cotton- Its length, strength, and firmness make this cotton suitable for thread, undergarments, hosiery, and fine dress goods.

Gossypium arboreum is the perennial tree cotton of Africa, India and Arabia. It was most likely the first to be used commercially, but production is now confined to India. The staples are coarse and very short (0.3 in to 34 in. long), but they are strong.

Gossypium herbaceum is the principal cotton of Asia. It was grown in Indian in ancient times. Its chief use is for fabrics, carpets and blankets and is often blended with wool.

Soft or Bast fibres-

Flax

Once the most valuable and useful of fibres, flax gradually became less important as synthetics and cotton assumed more prominent roles. Flax is more durable than cotton and can yield a very fine fabric. The plant has been under cultivation for so long that its point of origin is unknown.

Flax is in the genus Linum that contains several wild species of no economic importance as well as *Linum usitatissimum*, the source of the commercial fibre. The fibres are formed in the pericycle and are made up of very tough, stringy strands from 1-3 ft. long that are aggregates of many long pointed cells with very thick cellulose walls. Flax grows best in soil that is rich in organic matter and moisture and in temperate regions, but it may be grown elsewhere. Preparation of the fibres is a more expensive procedure than for cotton. The crop is harvested and the stems are broken. The fibres may then be rotted out by submerging the stems in water. During this process called *retting,* bacterial activity dissolves the calcium pectate of the middle lamella, which holds the cells together, and frees the fibres. After retting, the straw is dried and cleaned. The fibres get completely separated from the other tissues of the stem by an operation known as *scutching*. Finally the shorter fibres that constitute the tow (Broken fibres) are separated from the longer fibres by the process called hackling. The long fibres are the only ones suited for spinning.

The fibres of flax have great tensile strength, staple length, durability and fineness. They are used in the manufacture of linen cloth and thread, canvas, strong twine, carpets, cigarette paper, writing paper and insulating materials. Fibres from the stalks of flax grown for seed are too harsh and brittle for spinning but may be used for other purposes.

Flax is grown for its seed in areas with low rainfall. The seed is used in medicine and as a source of linseed oil.

Hard Structural Fibres

Coir

This is a term applied to the short, coarse and rough fibres that make up a large part of the husk of coconut fruits, *Cocos nucifera*. It is the only prominent fibre that is obtained from fruits. Unripe coconuts are soaked in salt water for several months to loosen the fibres. They are then beaten to separate the fibres that are then washed and dried. The product has varied uses. Coconut fibres are superior to all others for this purpose because they are very light and elastic and resistant to water. Coir has also been used for brush bristles, doormats, sacks, floor coverings, some textiles, upholstery, and stuffing. Sri Lanka has been the centre for commercial production.

Rough Weaving & Plaiting Fibres

There are relatively few materials that are manufactured for plaited or coarsely woven articles. The raw materials include the rushes, stems of reeds, willows, bamboo, grasses, rattan and leaves and roots. They are used entirely or split. They are woven or twisted together in a simple manner and made into sandals, mats, hats, matting, screens, chair seats, baskets, etc.

Filling Fibres

Many plant fibres have been used to stuff pillows, cushions, furniture, mattresses, etc. They are also used as stiffening for plaster, and for the protection of delicate objects during shipment. Synthetic materials frequently take

the place of these long used products, but in some ways they retain some superiority. Surface fibres are commonly used for stuffing because their staples are too short to be spun and thus are not valued in the textile industry. Bast fibres are too costly, and hard fibres are frequently too stiff and coarse. The silk cottons are the most important source for stuffing.

Kapok

This is the most popular silk cotton and most valuable of all the stuffing substances. Ceiba pentandra. Originally confined to the American tropics, it is now found worldwide. It is very fluffy, light and elastic and is thus an ideal stuffing material for mattresses and pillows.

Kapok Substitutes

There are a number of other plants with seed hairs or floss that can be used as a substitute for kapok. The Red Silk Cotton Tree or Simal, Salmalia malabarica, supplies reddish floss known as Indian Kapok that has been important as a stuffing in India for centuries.

Natural Fabric

Some trees have basts with tough interlacing fibres that can be extracted from the bark in layers or sheets and can then be pounded into rough substitutes for cloth. Tapa Cloth is one of these as it once constituted the main clothing in Polynesia and parts of Eastern Asia. The material is obtained from the bark of the paper mulberry, Broussonetia papyrifera. Strips of bark are peeled from the trunk and the outer coating is scraped away. After soaking in water and cleaning these strips are placed on a hardwood log and pounded with a mallet. Overlapping the edges and beating them together unite the individual strips. The finished product varies according to thickness from muslin like material to one of leather. Tapa cloth is frequently dyed.