

PLANT FIBRES

GALGOTIAS
UNIVERSITY

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CLASSIFICATION

- **Vegetable origin** – cotton, jute, hemp
- **Animal origin** – wool, silk
- **Mineral origin** – asbestos, glass wool
- **Synthetic origin** – nylon, terylene
- **Regenerated from cellulose** – rayon
- **Regenerated from protein** – milk protein, groundnut



COTTON / RAW COTTON / Synonym: Purified cotton.

BIOLOGICAL SOURCE: trichomes of seeds of cultivated species of *gossypium herbaceum* belonging to the Family: *Malvaceae*

Collection: The capsule of cotton consists of large number of seeds covered with trichomes, the trichomes are separated.

Long trichomes are used in preparation of fabric & short ones are used in preparation of surgical dressings.

This non absorbent cotton when treated with dilute soda solution for 10 to 15 hours at a higher pressure gets free of fats.

The resulting absorbent cotton is dried, sterilized with gamma radiation

Description: White, soft to touch.

- **Raw cotton discarded by the textile industry as combers waste consists of about 90% cellulose, 3% fat, wax and 7% moisture.**
- **This cotton is subjected to combing process so as to separate short fibres are spun and woven as cloth.**
- **The combers waste consisting mainly of short fibres is boiled with dilute caustic soda and soda ash solution for 10-15 hours at a pressure of 1-3 atmospheres.**
- **This treatment will remove fatty cuticle of the trichomes making the wall absorbent. Bleaching is done by treatment with sodium hypochlorite solution and dilute hydrochloric acid. It is washed with water and dried.**
- **This cotton is then carded into flat sheets. The carding machine forms thin continuous films of cotton wool.**
- **Several such thin films are placed one above the other and packed into packages, which are finally sterilized.**

- **Ginning – removes long hairs (better quality)**
- **Linters – removes remaining short hairs**
- **Raw cotton has a waxy (fatty) cuticle covering the trichome**
- **Making it fairly non-absorbent**
- **Removed by soaking (or pressure heating) loosened cotton in alkali (NaOH, KOH)**
- **To get absorbent cotton (trichome wall is absorbent)**
- **Then washed, bleached and mechanically loosened 'scutched'**

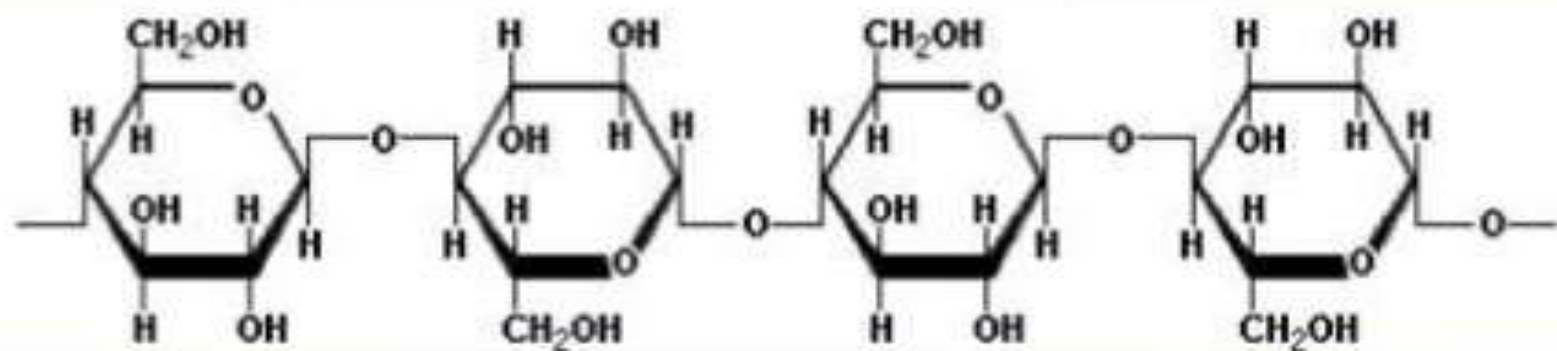
By-Products of Cotton

The raw cotton passes through several cleaning processes before it is baled. As a result, the grower obtains valuable by-products that amount approximately to one-sixth of the entire income derived from the cotton plant.

Cotton Linters: Short hair like fibers used in making Regenerated fibers

Hulls: Outside portion of seed, rich in nitrogen, used as fertilizer

Inner Seeds: Seed inside the hull gives cottonseed oil, used in cooking and making soap.



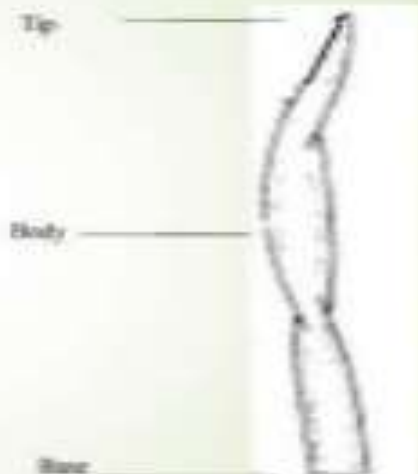
CELLULOSE CHAIN

Structure of Cotton Fiber

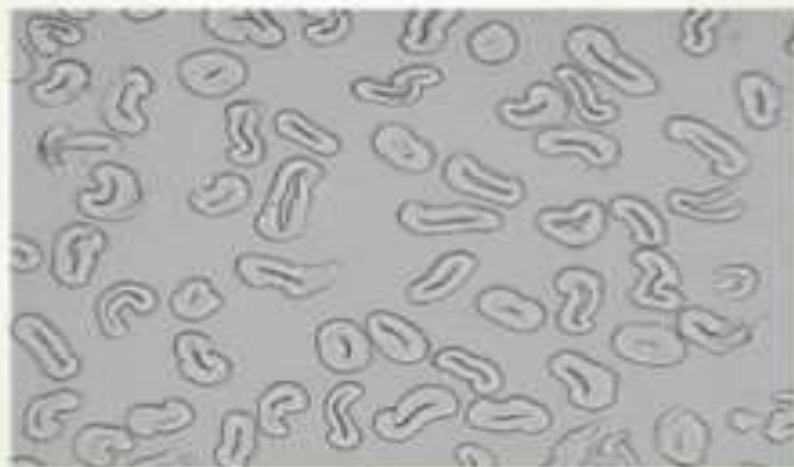


Longitudinal Structure of Cotton Fiber

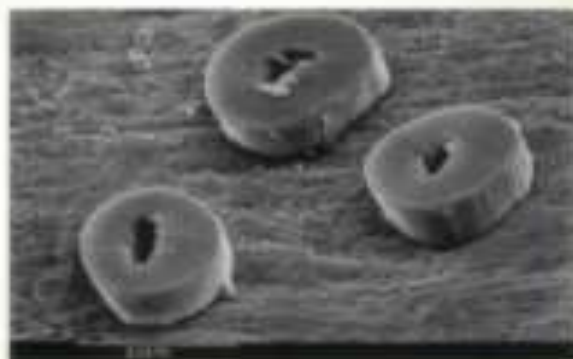
1. Base/Root
2. Body
3. Tip



Structure of Cotton Fiber



Cross-sections of fibers showing fully developed primary walls, mature fibers (SEM)



Chemical Tests

ABSORBENT COTTON

- Fibre when treated with N/50 iodine solution & 80% H₂SO₄ gives a blue stain
- Fibre when treated with cuoxam reagent, swells & dissolves
- Fibre gives a blue stain with chlorzinc iodide

NON ABSORBENT COTTON

Fibre when treated with cuoxam reagent, swells & dissolves with ballooning

Fibre gives a violet stain with chlorzinc iodide

Uses:

Fabrics, surgical dressings

Pharmaceutical filter medium

JUTE FIBRE

Jute fibres are very long (1 to 4 metres), silky, lustrous and golden brown in colour. In contrast to most textile fibres which consist mainly of cellulose, jute fibres are part cellulose, part lignin.

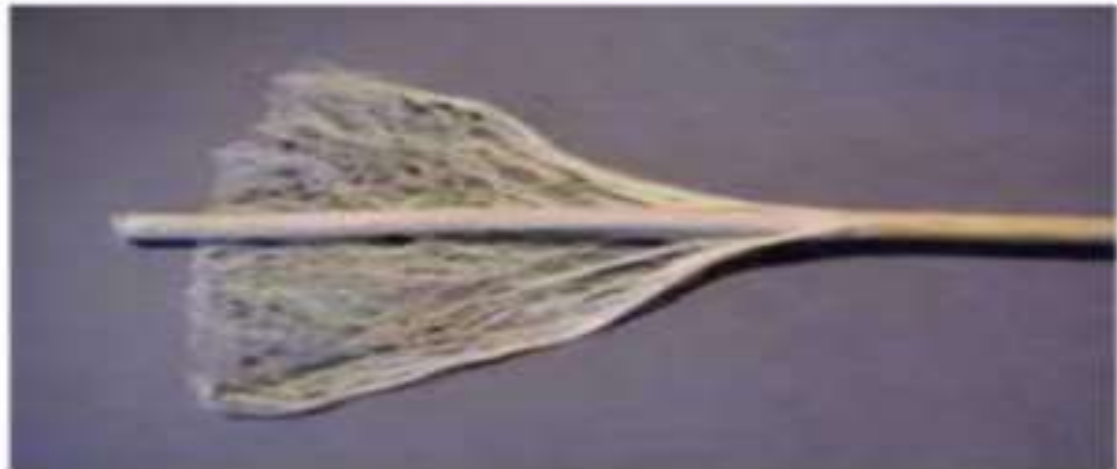
- Cellulose is a major component of plant fibres while lignin is a major component of wood fibre;
- jute is therefore partly a textile fibre and partly wood. Jute fibre has strength, low cost, durability and versatility.

BIOLOGICAL SOURCE: obtained from phloem fibres of *corchorus capsularis* belonging to the Family: tiliaceae

Description:

Brown, rough to touch

- Fibres separated ---- hesian and sacking
- Remaining short fibres 'tow' – jute in pharmacy



- Jute is a rainy season crop, sown from March to May according to rainfall and type of land.
- Jute requires a warm and humid climate with temperature between 24 °C to 37 °C.
- The soil of good depth, containing salts from annual floods, is best for jute. The stalk diameter of plant is ¾ inches.



Stages of Production & Processing



CULTIVATION PROCESS

Sowing of jute starts with the showers in March or April and continues till early June. Phosphorus, Potash & Nitrogen fertilizers are used for this crop.

HARVESTING PROCESS

Jute is harvested any time between 120 days to 150 days when the flowers have been shed, early harvesting gives good healthy fibers. .

The harvested plants are left in the field for 3 days for the leaves to shed (means leaves got dried up).

RETTING PROCESS

Retting is a process in which fibers get loosened due to decomposition of hard cell walls by the action of bacteria. The bundles are steeped in water at least 60cm to 90cm depth.

STRIPPING PROCESS (FIBER EXTRACTION)

Stripping is the process of removing the fibers from the stalk after the completion of retting. Fibers are removed from the stalk by any one of the following methods:

1. Single plants are taken and their fibers are taken off.
2. Taken off a handful of stalks, breaking it in a to and fro motion in water.

WASHING PROCESS

Extracted fibers are washed in clean water. The dark color of fibers can be removed by dipping them in tamarind water for 15 to 20 minutes and again washed in clean water

DRYING PROCESS

The fibers are hung on bamboo railings for sun drying for 2-3 days. After drying, the fibers are ready to be sold in the market.



BAILING & PACKING PROCESS

The bailing of jute fiber is done according to grading system



Identification of jute fiber

Feeling test: Stiff and a harsh hand to human skin, feels bad against skin.

Burning test: Not melt, burn easily, smell like paper burning, because paper is also a cellulosic material.

Microscopic identification: Polygonal shaped cross-section and many ultimate cell of longitudinal view identified jute fiber.

Solubility: Jute is dissolved by H_2SO_4 .

Staining: To study the morphology of fiber surface.

Chemical Test:

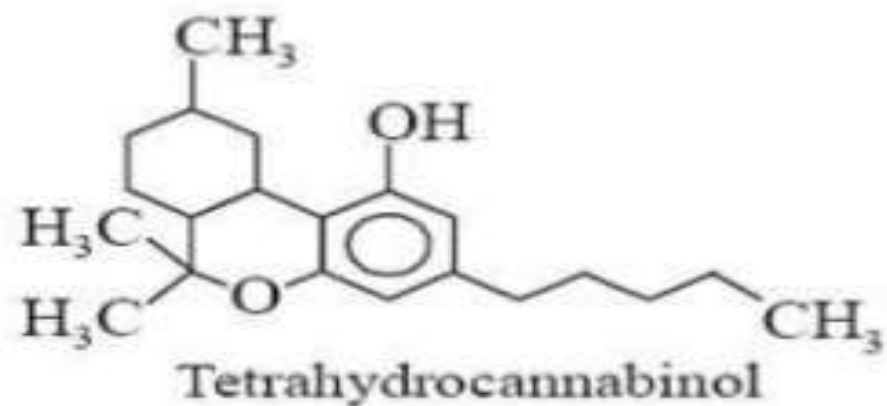
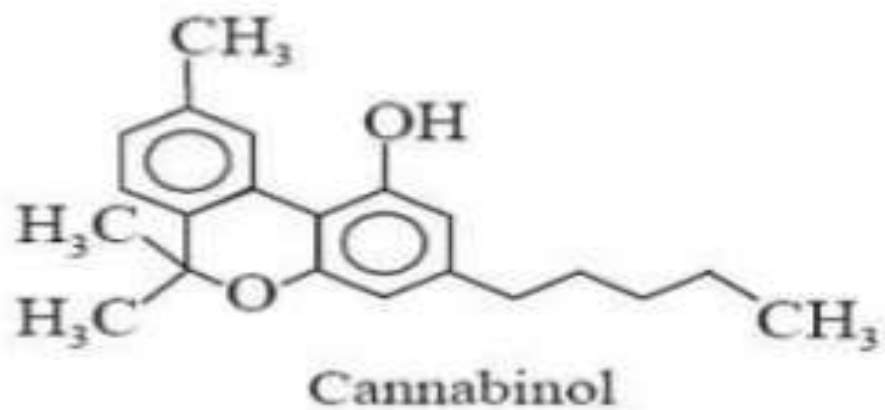
- Fibre when stained with phloroglucinol & HCl gives a deep red colour
- Fibre gives a yellow stain with chlorzinc iodide

USES

- **Jute is cheap and reasonably strong and is available in large quantities.**
- **Generally used in: Sacks & Packing Cloth Food Storage Backing cloth for carpets Curtains & Furnishing fabric**
- **Used in Geotextiles, technical textiles and textile composites**
- **Mixed with wool, used in cheap clothing**

HEMP

Cannabis Indica, Indian hemp, Ganja; Marihuana, Charas



- **Hemp, (*Cannabis sativa*), also called industrial hemp, plant of the family *Cannabaceae* cultivated for its fibre (bast fibre) or its edible seeds. Hemp contain tetrahydrocannabinol (THC), a compound that produces psychoactive effects in humans,**
- **Fibres are obtained by subjecting the stalks to a series of operations—including retting, drying, and crushing—and a shaking process that completes separation from the woody portion, releasing the long, fairly straight fibre, or line.**
- **The fibre strands, usually over 1.8 metres (5.8 feet) long, are made of individual cylindrical cells with an irregular surface.**
- **Hemp is usually yellowish, greenish, or a dark brown or gray and, because it is not easily bleached to sufficiently light shades, is rarely dyed. It is strong and durable and is used for rope, cable, and string—and for artificial sponges**

CHEMICAL CONSTITUENTS

1. Resin:

(i) Cannabidiol,

(ii) cannabiodolic acid (sedative and antibiotic),

(iii) cannabinalol,

(iv) cannabigerol,

(v) cannabichromene and

(vi) Most important constituents, tetra hydro cannabinalol (THC).

2. Volatile oil

3. Trigonelline

4. Choline.

CANNABIS PRODUCTS

FLAT GANGA:

Stems are cut about 15 cm above the ground and kept for few hours in sunlight. They are then cut into pieces of 30 cm length

ROUND GANGA:

It is prepared in Bengal, similar to flat Ganga but with greater care.

CHARAS:

Charas is the crude resin obtained by crushing the flowering tops in the hand and collecting it in the piece of cloth, placed below. Charas is purified by passing through cloth. Sometimes people with leather aprons walk through the plants, Charas sticks on the leather, it is scraped and collected.

BHANG:

It consists of leaves of male or female plants obtained from cultivated or wild plants.

CHEMICAL TESTS

1. Shake 0.1g of resin with 5 ml petroleum ether (60-80°C) and filter. To 1 ml of the filtrate, add

2 ml of 15% solution of HCl gas in ethanol, when a red colouration appears at the junction of the two layers. However, after shaking, the upper layer becomes colourless while the lower one attains a distinct orange pink colour, which finally vanishes upon addition of water.

2. Extract 1g of resin with methanol, filter and evaporate to complete dryness. Again extract the resulting residue with petroleum ether (60-80°C), filter directly into a separating funnel and extract the ethereal layer successively with 5% (w/v) Na_2CO_3 and 5% (w/w) H_2SO_4 . Wash the ethereal layer with distilled water, decolourise with powdered activated carbon, if necessary, and evaporate the filtrate. Add to the residue a few drops of N/10 alcoholic KOH solution, when a purple colouration is obtained.

- ***Cannabis sativa* seeds are chiefly used to make hempseed oil which can be used for cooking, lamps, lacquers, or paints.**
- **They can also be used as caged-bird feed, as they provide a wonderful source of nutrients for most animals.**
- **The flowers (and to a lesser extent the leaves, stems, and seeds) contain psychoactive chemical compounds known as cannabinoids that are consumed for recreational, medicinal, and spiritual purposes.**
- **When so used, preparations of flowers (called marijuana) and leaves and preparations derived from resinous extract (e.g., hashish) are consumed by smoking, vaporising, and oral ingestion.**
- **Historically, tinctures, teas, and ointments have also been common preparations. In traditional medicine of India in particular *C. sativa* has been used as hallucinogenic, hypnotic, sedative, analgesic, and anti-inflammatory agent**

USES

- 1. Sedative (calm down excitement).**
- 2. Analgesic (pain killer).**
- 3. Hypnotic (induce sleep).**
- 4. Psychotropic (exerting an effect upon the mind).**
- 5. Antibacterial agent.**

References:

1. Bruneton.J.,(1999). Pharmacognosy,Phytochemistry,Medicinal plants” 2nd Edition ; Lavoisier Publication France, Page. 123-136
2. C.S. Shah, J.S. Quadry., (1995) Text Book of Pharmacognosy 11th edition Page. 37-59
3. C.K. Kokate, A. P. Purohit, S.B. Gokhale., (2002) Pharmacognosy 13th edition, Nirali Prakashan, Page. 57-89
4. Evans, W. C. Trease and Evans Pharmacognosy, 16th ed.; Elsevier: New York, 2009, page no- 315-380
5. Varro E. Tyler, Lynn R. Brady & J..E.Robbers Pharmacognosy, 9th ed; U.S.A, 1988, page no- 235-267
6. Michael Karus: European Hemp Industry 2002 Cultivation, Processing and Product Lines. Journal of Industrial Hemp Volume 9 Issue 2 2004