The Ramie (*Boehmeria nivea*) is a flowering plant in the nettle family *Urticaceae*.

https://www.treenwaysilks.com/images/about/blendramie220w.png

http://upload.wikimedia.org/wikipedia/commons/0/0c/Boehmeria_nivea_1.jpg

“Ramie (*Boehmeria nivea*) fibers are considered the longest, strongest and silkiest of plant fibers and an excellent natural textile material. Ramie is one of the oldest fiber crops, having been used for at least six thousand years, and is principally used for fabric production. It is a bast fiber, and the part used is the bark (phloem) of the vegetative stalks.

It exhibits even greater strength when wet. Ramie fiber is known especially for its ability to hold shape, reduce wrinkling, and introduce a silky lustre to the fabric appearance.

**Physical and chemical properties of ramie fibers:**

<table>
<thead>
<tr>
<th>Cellulose (wt%)</th>
<th>Lignin (wt %)</th>
<th>Hemicellulose (wt%)</th>
<th>Pectin (wt%)</th>
<th>Wax (wt%)</th>
<th>Microfibrillar angle (°)</th>
<th>Moisture content (wt%)</th>
<th>Density (g/cm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>68.6-76.2</td>
<td>0.6-0.7</td>
<td>13.1-16.7</td>
<td>1.9</td>
<td>0.3</td>
<td>7.5</td>
<td>8.0</td>
<td>1.50</td>
</tr>
</tbody>
</table>

**Mechanical properties of untreated ramie fibers:**

<table>
<thead>
<tr>
<th>Fiber diameter (mm)</th>
<th>Fracture load (N)</th>
<th>Tensile strength (MPa)</th>
<th>Fracture strain (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.034</td>
<td>0.467</td>
<td>560</td>
<td>0.025</td>
</tr>
</tbody>
</table>

The extraction of the fiber occurs in three stages. First the cortex or bark is removed; this can be done by hand or by machine. This process is called de-cortication. Second the cortex is scraped to remove most of the outer bark, the parenchyma in the bast layer and some of the gums and pectins. Finally the residual cortex material is washed, dried, and de-gummed to extract the spinnable fibre.

Decorticated ramie fibers contain 20±35% gum consisting mainly of pectin and hemicellulose. This gum should be removed as fully as possible to fulfil the textile requirement (1.5±2.5% residual gum).

Ramie fiber is very durable, is pure white in colour and has a silky lustre. It is reported to have a tensile strength eight times greater than cotton and seven times than silk. According to other reports
tensile strength of cotton, flax, hemp and ramie are similar. These discrepancies can be partly attributed to the effects of source of supply, methods of processing, test conditions, temperature and humidity, on fibre strength.

Advantages of ramie as a fabric:

- Resistant to bacteria, mildew and insect attack.
- Extremely absorbent.
- Dyes fairly easy.
- Increases in strength when wet.
- Withstands high water temperatures during laundering.
- Smooth lustrous appearance improves with washing.
- Keeps its shape and does not shrink.
- Can be bleached.

Disadvantages of Ramie

- Low in elasticity.
- Lacks resiliency.
- Low abrasion resistance.
- Wrinkles easily.
- Stiff and brittle.
- Need to degum the fibres prior to processing.

Ramie Used as a Blend
Ramie is most often blended with other fibers for its unique strength, absorbency, luster and dye-affinity. When blended with high-quality cotton it offers increased lustre, strength and color. When mixed with wool, ramie adds lightness and minimizes shrinkage. When blended with rayon, it offsets the low wet strength.

Uses of Ramie
Ramie is used in fabrics resembling linen, such as apparel fabrics for shirts and shorts, tablecloths, napkins and handkerchiefs. It is often found as a blend with cotton in knit sweaters. Ramie is also used in fishnets, canvas, upholstery fabrics, straw hats and fire hose.

Care of Ramie
Ramie-blend fabrics can be laundered or dry-cleaned depending on the dyes, finishes and garment design. The care label will state the preferred method. The dry-cleaning method helps preserve the beauty of woven ramie items and gives best colour and shape retention and a wrinkle free appearance. With caution, white ramie fabrics may be bleached with chlorine-type bleaches. Ramie fabrics withstand ironing temperatures up to 400 to 450 degrees F or the cotton setting on an iron.

While storing ramie or ramie blends, lay them flat. Ramie fibres are brittle and tend to break. Avoid folding the garment or pressing sharp creases in woven fabrics.”

DEGUMMING OF RAMIE

Chemical treatment of ramie:

As per literature, the chemical treatment involved in degumming of ramie fibres is as follows:

- The untreated ramie fibres are treated in 1% HCl for 30 minutes at room temperature.
- The fibres are washed thoroughly and dried
- The dried acid treated ramie are treated with 1.5% NaOH at 100°C for 60 minutes Followed by 6.0 % NaOH at 100°C for 30 minutes.
“After alkali treatment, semicrystalline and amorphous portions in the fibers, such as hemicellulose, lignin and other alkali-soluble fraction, were preferentially removed. It cleans fibre surface removing impurities, waxy substances and natural oils. It also produces a rough surface topography, facilitating mechanical interlocking which leads to an improvement in fibre-matrix adhesion.

**Fiber Surface Treatment**

**Alkaline Treatment**

Untreated and chemically treated ramie fibers were used for reinforcing the composites. Generally, the first step was that ramie fibers were soaked in the distilled water for 6 h to remove the water-soluble material and then dried for 24 h. The second step was the alkali treatment. Fibers were treated with 5 % NaOH (98 %, Extra pure, Samchun Chemicals) for approximately one hour, washed several times in distilled water and finally dried at 60°C for 24 h.

**Silane Treatment**

The fibers were pretreated with alkali and dipped in an alcohol-water mixture (90:10 w/w) containing 1 wt% triethoxy vinyl silane coupling agent (97 %, Aldrich). The pH of the solution was maintained between 3.5 and 4 by adding glacial acetic acid. The fibers were allowed to remain in the solution for 1 h and dried in the oven at 60 ºC for 24 h.

**Peroxide Treatment**

These fibers were further treated with peroxide after an alkali pretreatment. The alkaline-treated fibers were treated with 1 l of a 4% solution of dicumyl peroxide (98 %, Sigma Aldrich) in acetone for 30 min.”

**OBJECTIVE:**

**Our objective was to test our microbial strains for degumming of ramie fibres.**

**Procedure:**

The strain with ability of degumming of silk fibres was used alone as well as in combination with another with ability of producing lignin peroxidase in extracellular supernatant. The strains were cultured for 18-20 hrs and inoculated in media. Ramie fibres was dipped in it and incubated at room temperature for different time intervals as mentioned later. The fibres were scrubbed in tap water, soaked in newspaper and dried in oven at 37°C. The difference in weight pre and post degumming were measured. The dried fibres were loosened manually. Some of the fibre specimens were observed under the environmental scanning electron microscope. Pictures of experimental setup are attached below:
RESULTS:

<table>
<thead>
<tr>
<th>S No</th>
<th>TREATMENTS</th>
<th>UNTREATED (gms)</th>
<th>TREATED(gms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>STRAIN 1 (RAW)</td>
<td>48</td>
<td>7.4</td>
</tr>
<tr>
<td>2.</td>
<td>STRAIN 1+ STRAIN 2 (RAW)</td>
<td>49.3</td>
<td>8.39</td>
</tr>
<tr>
<td>3.</td>
<td>STRAIN 1 (PRESSED)</td>
<td>56.2</td>
<td>12.37</td>
</tr>
<tr>
<td>4.</td>
<td>STRAIN 1+ STRAIN 2 (PRESSED)</td>
<td>67.2</td>
<td>9.04</td>
</tr>
</tbody>
</table>

* However there has been an artifact in conducting the above experiment where the untreated were Moist (raw / pressed) fibres while the treated were all dried in the oven.

The texture of the treated fibres were relatively soft and smooth as compared to untreated samples (pictures provided below). The pictures for the treatment are provided below. The untreated samples are in column 1. Column 2 contains the treatment with strain 1 while column 3 contains treatment with strain 1 and 2 combined.
The fibers were also visualized under the environmental scanning electron microscope (Zeiss EBO-MA 10). The images show no significant difference as compared to chemically treated samples provided by IIT KGP.
The tensile strength was measured in the laboratory of Prof. B. Adhikari, Department of Material Sciences, IIT Kharagpur. The partial chemical treated samples were further treated microbially. It was seen that the degumming of the fibre was better with biological means as compared to chemical means (analysed through Atomic force microscopy and biochemical assessment). The microbial treatment yielded better and cheaper degumming of the fibre with better texture and shine.

REFERENCES:
http://en.wikipedia.org/wiki/Ramie
http://www.swicofil.com/products/007ramie.html
http://textilelearner.blogspot.in/2014/06/ramie-fiber-properties-of-ramie-fiber.html