Chemical Characterization of Khimp Fibre (Leptadenia pyrotechnica)

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The characteristics of Khimp fibre (Leptadenia pyrotechnica) are studied with a view to exploring wider uses for it. The high \(\alpha\)-cellulose and low lignin contents of the fibre with favourable length/breadth ratio of the ultimate cell make it suitable for use in blending with cotton or polyester fibres to produce blended textile yarns and in pulp and paper industries.

Introduction

In India, many vegetable fibres, having good potentiality, are not being properly exploited. If these fibres are put to proper use, the rural economy of the country could be improved significantly. One of these is the wildly grown fibre crop (Leptadenia pyrotechnica), belonging to the family 'Asclepiadaceae' and is popularly known as 'Khimp' in Rajasthan, 'Khip' in Gujarat, and 'Kip' in Punjab.

Khimp plant is a natural desert shrub and grows abundantly in the Thar Desert of Rajasthan throughout the year of which about 44,000 sq miles are in India and the rest about 30,000 sq miles in Pakistan. The khimp plant is profusely branched with a height of 1.8 m. The flowers are small and yellow in colour. The pods are cylindrical, green in colour when immature, and turn grey when mature. Average life period of a single plant is 15 to 20 years.

Presently, the khimp plant is being used in rope making, animal fodder and thatching purposes. Due to its good sand binding property, it is also being used for soil conservation in the desert region. The fibre is extracted from the green stem of khimp plant by crushing and subsequent retting. As it is a perennial plant, the green stem is available throughout the year, specially in large quantity in rainy seasons. After 2 years of growing, 2.5 to 3 kg (approx), green stems can be obtained from a single plant which increases up to 10 to 12 kg (approx) per week as the plant grows older. The fibre yield from the green stem is approximately 8 to 10 per cent.

The khimp fibre is more or less similar to cotton linters and it can be used to serve as a raw material for textile and pulp and paper industries. In order to explore the possibility of putting the fibre to wider use, the chemical constituents have been determined. The results obtained are reported.

Materials and Methods

Khimp plant was collected from Ganganagar (District Bikaner), Rajasthan, India. The fibre was obtained from the green stem of the khimp plant by crushing, followed by retting and combing.

The chemical constituents, e.g., pentosan, lignin alcohol-benzene extract and ash, were estimated according to TAPPI Standard Method. The \(\alpha\)-cellulose content was determined according to the modified method of Sarkar et al. The degree of polymerization of the \(\alpha\)-cellulose was estimated from the relative viscosity of \(\alpha\)-cellulose in cupriethylene diamine, using the equation of Battista. Acetyl value was determined by Clerk method. The pectin content was estimated by extraction with 0.5 per cent ammonium oxalate solution. Uronic acid was determined by spectrophotometry at 535 nm, using UV-VIS Spectrophotometer (Model No. U-3410, Hitachi).

The polysaccharides of the fibre were hydrolysed, according to the method of Jeffery, et al. Sugars in the hydrolysate were identified by paper chromatography.
using Whatman filter paper No.1 and butyl acetate: pyridine: ethanol: water (8:2:2:1) as solvents and were detected using aniline oxalate solution.

The sugars in the hydrolysate were converted to their alditol acetate and estimated by GLC, using a Hewlett Packard 5830A model gas chromatograph equipped with FID and stainless steel column (15 X 0.05 cm), containing 3 per cent ECNSS-M on Supelcoport (80-100 mesh) at 190°C, using nitrogen as carrier gas.

The ultimate cell length and its diameter were estimated by the method suggested by the Textiles Institute, Manchester. The length/breadth ratio was also calculated. The gravimetric fineness of the fibre was determined by the method of Bandyopadhyay et al. The filament tensile was estimated with INSTRON Tensile Tester at a test length of 1 cm and the cross-head speed of 1 cm/min.

**Results and Discussion**

Khimp fibre is a ligno-cellulosic bast fibre obtained from the stem of khimp plant, but unlike other long vegetable fibres viz., jute, mesta, and sunnhemp, has a very short filament length. The chemical characteristics of the fibre are given in Table 1 and the physical and mechanical properties are summarised in Table 2. The fibre has high α-cellulose content and low lignin and pentosan contents comparable to the compositions of sunnhemp and flax. The alcohol-benzene extract and ash contents are high in comparison to those of jute, mesta, and sunnhemp. The loss in alkali boil is comparable to wood. The degree of polymerization of α-cellulose is comparable to other ligno-cellulosic fibres. Analysis of the neutral sugars of the fibre showed the presence of glucose (93.95 per cent), xylose (1.60 per cent), arabinose (4.09 per cent) and rhamnose (0.36 per cent).

From the physical characteristics, it is observed that the ultimate fibre length is fairly high and the length/breadth ratio is around 5:20. The strength of khimp fibre is comparable to that of other ligno-cellulosic bast fibres e.g., jute, ramie and flax, but the breaking stress is comparable to that of sunnhemp, ramie, and flax. When compared to unicellular cellulosic fibre, like, cotton, it is observed that the strength was more or less same as that of cotton but the breaking stress is found to be much lower than that of cotton which is 6.5 to 7.5 per cent.

Considering these properties, the fibre appears to have good potential as raw material in pulp, paper, and other
cellulosic industries. The fibres are quite strong, as indicated by their tenacity values, but the fibre in its original form cannot be spun due to its short filament length. It could be used in combination with cotton and polyester to produce blended yarn for making diversified value added products.

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