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A Analysis on Impact of Natural Solvents on Tensile Power of Muga Silk Made By Antheraea Assamensis

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Abstract – As a natural protein, silk has an enormous request as textile product. On the other hand, contrasted with Bombyx mori silk, generally reputed to be mulberry silk, the other non-mulberry silks have a few inconveniences like coarseness, low hanging, wash and wear qualities and so on which could be changed utilizing chemical medication. In this study, impacts of some exceedingly polar, non-polar and bipolar solvents on fibre of muga silk have been concentrated on regarding tensile strength. Methanol and Phenol treated fiber demonstrated higher tensile strength than DMSO, Formaldehyde, Toluene, DMF, Benzene, Ethanol and THF treated fibres separately. Chemical degradation occurs under the movement of a few chemicals, different executors and recognizable hinging on the way of the bond burst.

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INTRODUCTION

Muga silk is a chief natural silk prepared by Antheraea assamensis in N.e. area of India. Silk is a protein, a sinewy biopolymer. Silk comprises of two structurally special polypeptide proteins, fibroin and sericin. These proteins may be relied upon to show serious between chain auxiliary holding through the >co and -NH assembly yet the conceivable outcomes are respectably confined by the side chains comprising of amino harsh corrosive buildups which happen much of the time.

The silkworm secretes ceaseless fiber of center protein fibroin processed by its two salivary organs, which are joined together by an alternate sticky protein sericin. The fiber solidifies and turns into the natural silk. Fibroin substance in the case is 70-80% while sericin is 20-30% and likewise holds optional parts, for example, waxy matter (0.4-0.8%), starches (1.2-1.6%), colors (0.2%) and inorganic matter (0.7%). Because of some exceptional mechanical and stylish lands like extraordinary shine, strength, phenomenal delicate quality, simple taking care of and so forth silk is regarded as the Queen of fiber. Notwithstanding, silk uniquely the non-mulberry silk, fails to offer some critical lands like wrinkle recuperation, water staining, photograph yellowing, wash and wear and so forth which might be enhanced by chemical adjustment strategies.

Noteworthy works have been carried out on Bombyx mori fibre with different chemical medicines. Despite the fact that A. assamensis is quite near B. mori in evolutionary terms, variety is obvious in amino harsh corrosive creation; consequently the structural design contrasts in an incredible degree. Tensile lands are the paramount structural variants of silk. The quality parameters of the degummed silk fibers and yarns might be measured with the variety of the tensile lands incorporating strain, stretch, tenacity, Young's modulus and so forth. Strength and extension tests are utilized broadly for surveying fiber's degradation in textile substances.

Muga fibre controls most noteworthy tenacity around all natural fibres. The higher tenacity of muga grants an extensive variety of its use in different purposes in textile and as non-weave material. Muga fibre shows irregular tensile conduct because of their spiraling impact of its fibrils (Devi et. al., 2011) and buildup of sericin is a component that gives this conduct. Maybe it upgrades the coarseness of muga fabric and it gives less solace of wearing contrasted with silk of Bombyx mori. To confer these lands, conversion of collapsed setup into augmented state is fundamental and it is conceivable with legitimate chemical medicine.

Sporadic studies have been led on physical lands like tensile strength, and so forth on muga, eri and mulberry silk fibres of NE India, for scholastic hobbies. Rajkhowa (1998) has reported mechanical lands like anxiety strain conduct, recuperation under constant and intermittent cyclic tests on muga fiber. Owing to the conceivable outcomes of complex employments of this valuable silk in textile and in other industry; it was acknowledged of investment to study the tensile lands under medication of some normal solvents.

METHODOLOGY

New cocoons of Antheraea assamensis. Helfer were gathered and bubbled in 0.3% Sodium Carbonate solution for 15 minutes at 900c to uproot the sericin. At that point the cocoons are washed altogether with distilled water and the fibres were reeled out. The silk fibre samples have been dealt with independently in Dimethyl sulfoxide (DMSO), Dimethyl formamide (DMF), Benzene, Toluene, Methanol, Ethanol, Formaldehyde, Tetrahydrofurane (THF) and Phenol in conelike cups under room temperature. These are kept for 7 days and afterward dried. These dried samples have been utilized for analysis. An example without chemical medicine has been tried as control.

When directing the test for tensile strength, muga fibres treated with these 10 diverse chemical solvents were acclimatized in standard conditions of mugginess (65±2% RH) and temperature (27±20c) for 24 hours. At that point all these fibres were tried for tenacity, percentage lengthening at break, Young's modulus and durability on an Universal Testing Machine (UTM) (Model: 3343), from Instron Corporation, UK interfaced with a PC. A measure length of 5 cm and cross-head speed of 20 mm/min was picked for leading the tests. All the samples were mounted on the cross heads with a demand of 0.02 g/den. 20 tests were performed on every fibre specimen and the mean worth was taken.

RESULT AND DISCUSSION

Information on tensile lands of control and chemically treated muga fibre have been displayed in the Table 1. Each one quality is the normal of 20 reproductions.

TREATMENT	Tenacity (g/den)	Strain (%)	Young's modulus (g/den)	Toughness (g/den)
Control	4.61 ^{b} ±0.32	33.11 ^{ab} ±1.51	70.04 ^{ab} ±9.32	0.9084 ^{bc} ±0.1091
Methanol	6.13 ^{a} ±0.51	34.43 ^{a} ±1.98	86.02 ^{a} ±16.71	1.2099 ^{a} ±0.2713
Ethanol	3.78 ^{b} ±0.53	33.20 ^{ab} ±2.59	77.47 ^{ab} ±14.11	0.8902 ^{bc} ±0.1545
Benzene	3.86 ^{b} ±0.42	28.43 ^{c} ±4.75	81.29 ^{a} ±15.80	0.6911 ^{d} ±0.2136
Toluene	4.14 ^{b} ±0.51	31.48 ^{abc} ±2.89	85.69 ^{a} ±11.93	0.8093 ^{cd} ±0.1800
DMF	3.91 ^{b} ±0.38	33.07 ^{ab} ±1.90	78.78 ^{ab} ±4.17	0.7933 ^{bc} ±0.0654
DMSO	4.55 ^{b} ±0.48	33.94 ^{ab} ±1.22	82.51 ^{a} ±10.03	1.0140 ^{b} ±0.0663
THF	3.67 ^{b} ±0.68	29.74 ^{c} ±1.46	85.60 ^{a} ±12.87	0.6745 ^{d} ±0.0786
Phenol	4.99 ^{b} ±0.58	34.10 ^{ab} ±4.17	85.95 ^{a} ±13.34	1.0187 ^{b} ±0.0343
Formaldehyde	4.22 ^{b} ±0.60	30.68 ^{bc} ±0.95	66.08 ^{b} ±5.24	0.7622 ^{bc} ±0.0508

Table 1. Tensile properties of *A. assamensis* silk samples treated with different organic solvents.

From Table 1 it is seen that the treatment of distinctive natural solvents viz. Methanol, Ethanol, Benzene, Toluene, Dimethylformamide (DMF), Dimethyl sulfoxide (DMSO), Tetrahydrofuran (THF), Phenol and Formaldehyde have differing impacts on the tensile lands of degummed muga silk fibres obtained from cocoons. Of these solvents, treatment with methanol altogether expands the tensile lands of the fibres particularly the tenacity and sturdiness. The tenacity qualities demonstrate that methanol and phenol treatment builds the tenacity of muga silk in spite of the fact that phenol treatment is not essentially higher than the untreated silk. Then again, there is likewise seen unimportant misfortune of tenacity of the silk fibres upon treatment with whatever is left of the solvents.

The strain percent of the silk samples is found to expand after treatments with phenol, methanol, ethanol and DMSO in spite of the fact that the augmentations are inconsequential. Toluene, DMF, formaldehyde, benzene and THF treatments are found to decline the strain percent of the fibre yet just the last two treatments have huge impacts.

There is no noteworthy variety of Young's modulus of the silk fibres after treatment with these solvents. Aside from formaldehyde, all different solvents have expanded the Young's modulus of the silk fibres after treatment.

Sturdiness of the muga silk example have been found to expand after treatment with methanol, DMSO and phenol yet just methanol is found to give huge build in strength after treatment. Then again, after THF and benzene treatments, the silk loses its sturdiness altogether.

The breaking loads of the chemically treated muga silk fibres are demonstrated in Figure 1. It is seen that the methanol, phenol, DMSO and THF treated silks picked up noteworthy breaking load after treatment.

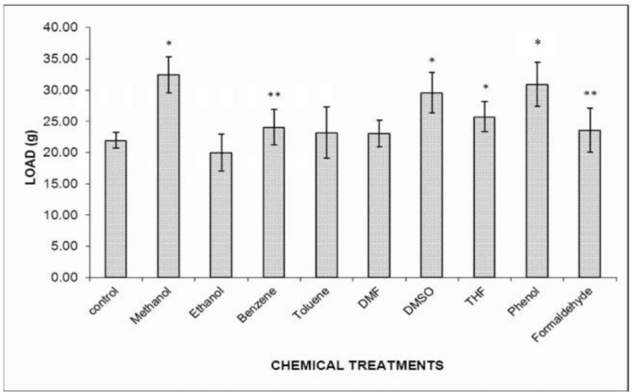

Figure 1. Breaking load of muga fibre after different chemical treatments. * represents significant at 5% level. ** represents significant at 1% level. Figures without * or ** are non-significant.

Chemical treatment can cause alterations of the silk fundamental polypeptide chains and side chains of amino acids, which thusly impact the fiber's chemical, physical and mechanical lands. The progressions of tenacity may be because of the variety of moisture substance and the change of level of crystallinity in the wake of treating with the chemicals. In a fluid medium and chemical treatment, the intermolecular hydrogen bonds might break and thusly expedite a certain drop in tenacity or Young's modulus. Substantial decrease in tensile lands has a tendency to show that fabrics/garments can't be home laundered or machine-washed without harm or mutilation. The more stretching of silk fibres after the chemical treatments may be because of progressions of orientation of fiber atom in the polypeptide chain. After chemical treatment, the confinement brought on by the remaining gum (sericin) has been uprooted and the particles have been revised in a systematic way, subsequently the cross linkage between the atoms of the fiber are additionally conceivable. In the event that sericin is available, the tensile conduct of silk is all in all changed in wet condition. Surprising changes watched in breaking load after chemical treatment demonstrates that the treatment offer ascent to close pressing of fibre particle with an expansion in the intermolecular strengths. Consequently the decline of breaking burden may be because of the relaxing of diverse holding compels inside the fibre.

Fine silk fibres have higher tensile strength and Young's modulus. It is apparent that Antheraea silk holds more buildups with longer side chains in amino acids composition15. The perpetual atomic chain in non-crystalline area in fiber structure slip simpler in Antheraea assamensis silk when extended and consequently they show variety in extension after different chemical treatments. As far as tenacity and durability, the methanol treated samples shows essentially higher qualities.

The tensile strength of THF treated muga fabric is quite low. Henceforth it is a poor hopeful for attire. Formaldehyde corrupts the atomic weight and hydrogen holding representing a certain drop in tenacity. Huge decrease in textile lands has a tendency to show that fabric/garments can't be home laundered or machine-washed without harm or mutilation, which has been watched in other silks16. Higher tensile property of methanol and phenol treated fibre demonstrate the prospect of employments in the textile businesses.

CONCLUSIONS

It is seen that the muga silk fibres could be chemically altered and it change the tensile lands. Methanol and phenol treated fiber indicated higher tensile strength than the untreated example and also DMSO, formaldehyde, toluene, DMF, benzene, ethanol and THF treated fibres individually. Chemical degradations happened under the movement of a few chemicals and different executors, which are recognizable relying on the way of the bond crack in the protein structure of the silk fibre. The silks with higher tensile strength might be utilized within textile and other identified requisitions.

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