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The blending of *Hibiscus Cannabinus* (Kenaf) with *Bohemeria nivea* (Ramie) and evaluation of its physical properties

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Abstract
The growing importance of fiber blends in apparels are due to many reasons such as it will be cost effective by blending them with other fibers that produce fabrics with a better combination of performance characteristics in the product. The aim of the blends are reduce economic and enhanced the durability, physical properties, colour and appearance. To produce fabrics with a better combination of performance characteristics in the product and to obtain beter hand on fabric appearance and colour dyed effect Hence the present work has been undertaken with an aim to blend the Hibiscus Cannabinus with Ramie for value added products. Different blending ratios were followed such as Kenaf: Ramie 75:25, 50:50 and 25:75 to produce different blended yarns as well as fabrics. Ramie yarn showed highest tenacity (20.87g/tex) while lowest tenacity was observed in controlled Kenaf (13.09g/tex). In case of blended yarn, maximum tenacity was seen in (25:75) kenaf: ramie (16.18g/tex).Plain weave structure fabrics was prepared from the controlled and blended yarns.

Keywords: Blending, kenaf, ramie, tenacity and elongation

Introduction
The natural fibers are renewable resource, thus providing a better solution of sustainable supply, like it has low cost, low density, least processing expenditure, no health hazards, and better mechanical and physical properties (Satyanarayana *et al.,* 1990 and Yan *et al*., 2014) [1]. The most important property of natural fibre is biodegradability and non-carcinogenic which brings it back into fashion, with an advantage of being cost-effective. Kenaf has been cultivated in India since prehistoric times. Kenaf, derived its name from a Persian word for flax or hemp, and its botanical name is *Hibiscus cannabinus.* It is an annual plant of the *malvaceae* family. The importance of the crop is mostly with regard to paper pulp production, the kenaf fiber is characterized as a multipurpose crop because it has a number of further industrial applications (Alexopoulou and Monti 2013) [2]. kenaf fibers in the manufacture of pulp, paper, and paperboard products, and as synthetic fiber substitutes. Thus, production of kenaf as an industrial raw material will necessarily be localized in the same region as processing facilities (LeMahieu, P. J., E. S. Oplinger, and D. H. Putnam. 2003) [3]. Actually, kenaf is a feasible source of cellulose which is economically viable and ecologically friendly. The idea of making fabrics from kenaf has been practiced since the early 1990s. Kenaf fibers have a long staple, meaning very fine and strong fiber which can be spun. Kenaf textiles are also naturally very absorbent, and even fire-retardant, making it especially ideal for outerwear or shoes. Bast fibers are simple to process. Blended with cotton, kenaf fibers can be made into yarn and woven into fabrics. These textiles are aesthetically pleasing, lightweight, and have a soft feel.
This makes them suitable for quality textiles. Ramie fibre comes under bast fibre category, which can be classified as underutilized fibres. The high potential of ramie fibre is not fully exploited due to various techno-economic reasons. It is one of the strongest natural fibres having rich cellulose content. Apart from textile uses, ramie fibre can be utilised for the production of various diversified products (Seiko Jose, S. Rajna and P. Ghosh, 2017) [4]. Ramie which is a natural cellulosic fiber abundantly found in northeastern region can easily be

blended with Kenaf fiber to make clothing and other value added products. So the purpose of the study is to enables the technician to combine fibers so that the good qualities are emphasized and poor qualities are minimized by blending both the fibers that produce fabrics with a better combination of performance.

Methodology
For this study the blending of kenaf (*Hibiscus Cannabinus*) and ramie fiber were done at carding stage at the ratio and 75:25 (kenaf: Ramie) 50:50 (kenaf: ramie) and 25:75 (kenaf: ramie). Along with the blending proportions controlled kenaf and controlled ramie fibers were also used to preparing the yarns.

Scanning Electron Microscopy (SEM) analysis
The surface morphology of raw, degummed and bleached fibers were examined using emission scanning electron microscope (SEM) (marke-Carl Zeiss. Modal-Sigma) with 500x magnification.

Evaluation of the physical properties of the yarns
The blended and controlled yarns were tested to observe the following parameters:

Determination of Twist
Twist is the measure of spiral turns given to a yarn in order to hold the constituent fibers or threads together. Yarn twist is expressed in terms of twist per inch (tpi).

Twist on the yarns was determined by following BIS method: I.S.: 83.

Determination of the count of the yarn (Ne)
The count of the yarn is a numerical expression which defines its fineness. Count is defined as a number indicating the mass per unit length or length per unit mass of yarn. Count is expressed in Ne.

Determination of Density of yarn (gm/cm^3)
The blended yarns were cut into very fine pieces with the help of a sharp scissors. Then samples were inserted separately in measuring cylinder up to a level of 10ml. After that, the yarns were taken out and weighted in electronic balance. The process was repeated for ten times for each yarn. The density was expressed in gm/ cubic centimeter.

Determination of tenacity (g/tex) and Elongation (%)
The tenacity was determined by following ASTM procedure (ASTM 2256T, 1964) [5] using Instron. Value of tenacity and elongation of the test specimen were read directly from a chart.

Wicking test
Test specimens were preconditioned at 25±2ºC and 65±2% relative humidity was suspended vertically with its lower end immersed in a reservoir of distilled water. The height reached (at a constant time of 2 minutes) by the water in the yarn above the water level in the reservoir of distilled water was measured and recorded. (Booth, 1967)[6].

Results and Discussion
SEM analysis

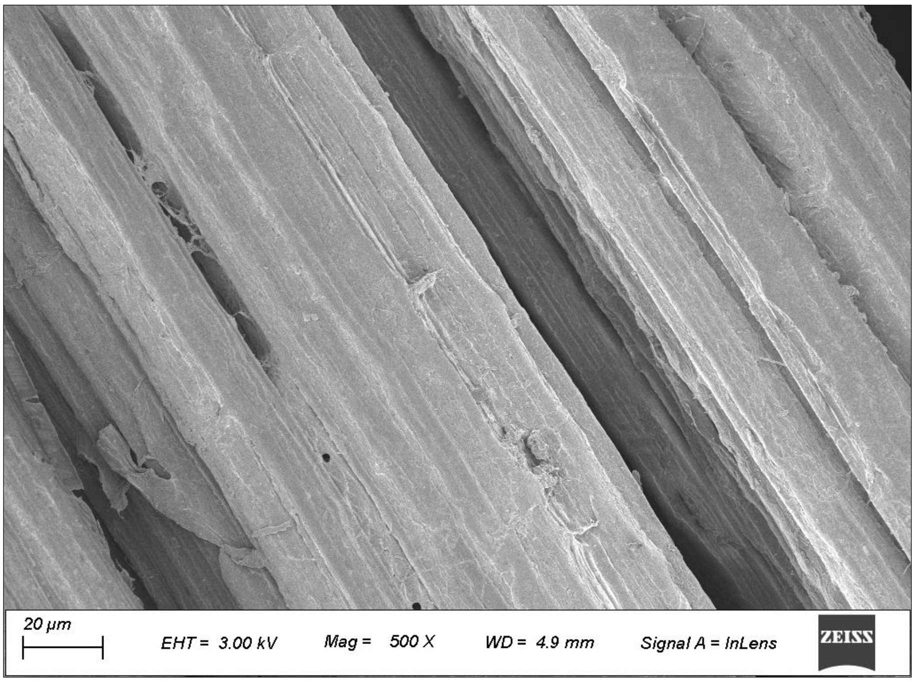

Fig 1a: Bleached Ramie fiber

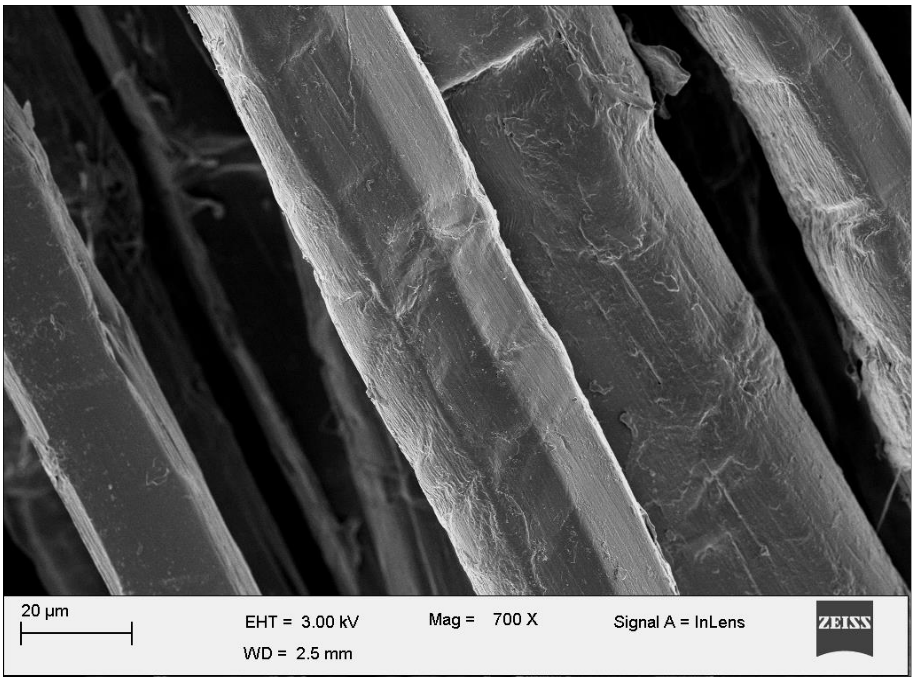

Fig 1b: Bleached Kenaf fiber

Scanning electron micrographs of fiber surface revealed that after bleaching treatment entire gum was removed from the fiber which enhanced the individualization of fiber entity (Fig 1a & 1b). This bleached fiber were utilized for blending of yarns.

Controlled and Blended yarns

Fig 2a. Controlled Kenaf yarn

Fig 2b. Controlled Ramie yarn

Fig 2c. Blended Kenaf:Ramie yarns 75:25, 50:50 & 25:75

Physical properties of controlled and blended yar

Twist, count and density of controlled and blended yarns

The physical properties of yarn such as twist, count and density were evaluated and presented in the Table 1.

It was apparent from the Table, that Z twist direction and single ply were maintained for all the yarns during the investigation. The same yarn count (40s) was used for all the samples. Among the controlled yarns, highest twist (tpi) was registered in controlled ramie yarns (6.38 tpi) and density (4.20 g/cm³) and lowest was observed in controlled kenaf yarns (6.22tpi) and density (4.04g/cm³). In terms of blended yarns, maximum twist per inch was seen in blend proportion (25:75) kenaf: ramie as (6.28tpi) and density (4.12g/cm³) was exhibited followed by (75:25) kenaf: ramie (6.26tpi) and density (4.08g/cm³) and (50:50) kenaf: ramie (6.18 tpi) and density (4.07g/cm³).

It was also noted that, controlled ramie exhibited highest density (4.20g/cm³) in the controlled yarn and among the blended yarn (25:75) kenaf: ramie exhibited highest density (4.12g/cm³) followed by (75:25) kenaf: ramie (4.08g/cm³) density and 50:50 kenaf: ramie and density (4.07g/cm³). The twist per inch depends on the density of fibers in yarn. Usually in finer yarn, fiber density is higher. The density is changing according to the number of twist in the yarn. Higher the twist more finer will be the yarn (Kumar and Mitra, 2005) [7].

Table 1: Twist, count and density of the controlled and blended yarns

Yarn	Twist (tpi)	Direction	Ply	Count	Density (g/cm³)
Controlled yarn					
Kenaf yarn	6.22	Z	Single	40s	4.04
Ramie yarn	6.38	Z	Single	40s	4.20
Blended Yarn					
Kenaf: Ramie 75:25	6.26	Z	Single	40s	4.08
Kenaf: Ramie 50:50	6.18	Z	Single	40s	4.07
Kenaf: Ramie 25:75	6.28	Z	Single	40s	4.12
SEd(±)	0.09				0.07
CD (0.05)	0.19				1.32

The results were mean of five observations

Tenacity (g/tex), Elongation (%) of controlled and blended yarns

The tenacity (g/tex), elongation (%) of yarns were analyzed both for controlled and blended yarns and presented in the Table.2.

The elongation and strength are the primary properties of fiber and are useful for spinning quality, which ultimately enhances the cohesiveness of the fiber during spinning process.

It was evident from the Table 2 that among the controlled yarns, ramie showed highest tenacity (20.87g/tex) while lowest tenacity was observed in controlled Kenaf (13.09g/tex). The high tenacity of ramie yarn might be due to the high tensile strength of ramie in its fiber stage as fiber properties had significant effect on yarn strength (Doraiswami and Chellani, 1994) [8].

And in case of elongation highest elongation (%) was seen in controlled kenaf yarns (14.05%) followed by controlled ramie yarns (6.71%) because elongation is inversely proportional to tensile strength of the yarn, also ramie is high cellulosic fiber so prolonged treatment with strong alkali and strong acids causes loss in fiber properties and also decrease the elongation percentage as suggested by (Mazumdar, 1976) [9].

In case of blended yarn, maximum tenacity was seen in (25:75) kenaf: ramie (16.18g/tex) and minimum in elongation (11.44%) followed by (50:50) kenaf: ramie (13.13g/tex) and elongation (11.44%) was recorded and minimum was seen in (75:25) kenaf: ramie (10.09g/tex) and more elongation (13.06%) was observed. As strength of ramie is more than kenaf, so higher the percentage of ramie in blend proportion exhibited better strength compared to other blend proportions.

Table 2: Tenacity, Elongation of controlled and blended yarns

Yarn	Tenacity (g/tex)	Elongation (%)
Controlled yarns		
Kenaf yarn	13.09	14.05
Ramie yarn	20.87	13.95
Blended yarns		
Kenaf: Ramie 75:25	10.09	13.06
Kenaf: Ramie 50:50	13.13	10.34
Kenaf: ramie 25:75	16.18	11.44
SEd(±)	0.58	0.20
CD (0.05)	0.12	0.42

The result were mean of five observations

Wicking height of controlled and blended yarns

The wicking height of yarns were analyzed both for controlled and blended yarns and presented in the Table 3.

Ramie fibers have better absorbency than other cellulosic fibers, so wicking height is good in controlled ramie (2.25cm) followed by kenaf (2.00cm). The blended fabrics of 25:75 kenaf: ramie has highest wicking height (1.65cm) followed by 50:50 kenaf: ramie (1.62cm) and 75:25 kenaf: ramie (1.57cm) wicking height. Ramie fibers have good porosity that makes it better wicking behavior.

From the above findings it could be concluded that the differences in wicking height of the controlled and blended yarns might be due to the different processes involved in blending of yarns.

Table 3: Wicking height of controlled and blended yarns

Yarns	Wicking height(cm)
Controlled yarn	
Kenaf yarn	1.20
Ramie yarn	1.75
Blended yarn	
Kenaf: Ramie 75:25	1.57
Kenaf: Ramie 50:50	1.62
Kenaf: ramie 25:75	1.65
SEd(±)	0.45
CD (0.05)	0.20

Result were mean of five observations``1110020

Conclusion

From the present investigation it may be concluded that kenaf fibre can be easily blend with ramie fiber. Blended yarns have good potential for making different value-added products based on yarn properties. The tensile strength of blended kenaf/ramie 25:75 exhibited maximum due to the higher percentage of ramie in the blend since the strength of ramie is higher than kenaf. Moreover, it is also found that the wicking height of controlled ramie yarn registered more which interns effect on blend proportion of kenaf/ramie 25:75. Due to higher percentage of wicking height the absorbency of blended yarn is enhanced. Quality characteristics of yarn produced from blending of Kenaf and ramie can be utilised for the manufacture of different value added product with distinct characteristics. It also opens wide scope of diversifications into the manufacture of home textiles like interior fabrics and furnishings.

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