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Blending of silk floss with cotton and its properties

Blending refers to the sequence of processes required to convert two or more kinds of staple fibres into a single yarn composed of a mixture of the component fibres. Silk floss is not always the most preferred among consumers, therefore manufacturer are going for blending. (*http://texmin.nic.in*). Technology of blending of silk floss and other fibres that result in improving the qualities of constituent fibres and cost effectiveness of the yarn/fabric has a great potential for adoption and development. There is also a need to develop diversified products and innovative blending process that will make use of silk floss in the production of good quality apparel (Papnai and Goel, 2005). Silk floss is blended with other fibres to utilize the respective advantages of the other fibres. These advantages may be either unattainable, undesirable side effects or be too costly if only one type of fibre is used. Commercial point of view, blends are formed to reduce the total costs of production, improve the performance properties and create market demand. As the silk floss is a short staple fibre, and may not have spinnability characters. Thus, the present study is planned on blending of silk floss to assess the physical properties of silk floss and cotton blended yarns.

The outer layer of the cocoon is usually covered by a thin, loose layer of floss which hides the cocoon's beauty. This layer is called as silk floss (5.6 microns fineness with uneven length) it is removed by using cocoon deflosser procured from nearby villages of Dharwad. BT /banni cotton lint (29mm length, 3.8 microns fineness and 23g/tex strength) was procured from Sree jayalakshmi auto spin limited, Chitradurga, for blending. Silk floss is having impurities such as leaf, soil, dead worms and feacal matters of the silk worm. Hence, proper cleaning is necessary for silk floss. The silk floss was opened by hand and cleaned. Blending of silk floss and cotton with varied proportion *viz.,* 70/30 and 0/100, cotton/silk floss respectively was done by simple stack method (Verma *et al.,* 2013). The fibre were stacked based on the weight and proportion. Because of uneven cut length of silk floss was not suitable for commercial blending and opening with cotton. Hence, the beating was done by hand from gadhi makers. Opening was done on simple willow opener machine. Blended fibre mass was subjected to spinning. Hand Spinning Machine *i.e.,* foot operated medleri charaka spun into single yarn by local spinners at Uppinabetageri, Dharwad District.

Further, blended spun yarns were tested to determine the physical properties of the yarn. The properties of silk floss and cotton/silk floss blended yarns were assessed in the present study which includes yarn count, yarn twist and yarn strength and elongation and yarn evenness.

The term yarn count is a numerical expression which determines the fineness of yarn and referred as yarn number or linear density. In indirect system the yarn fineness is inversely proportional to the yarn count *i.e.,* higher the yarn count finer the yarn. Various counting system using different unit of mass and length are used like direct, indirect and tex system.

Indirect system was used to determine the yarn count*, i.e.,* the No of 840 yards yarn weighing in One pound. The count for pure and blended silk floss and cotton yarns were calculated as per the following formula. This test was repeated for 10 samples of each pure and blended yarn and average was calculated.

$$Ne = \frac{\text{Yarn length (Yards) x 1 (lb)}}{\text{Yarn weight (lb) x 840 yards}}$$

Yarn count of silk floss and cotton/silk floss blended yarn, spun on hand spinning medleri charkha. Mean yarn count of cotton/silk floss (70/30) blended yarn was significantly higher than the 100 per cent silk floss yarn due to hand spinning and was not in identical synchronization (Papnai and Goel, 2005) and also improper blending of cotton and silk floss. Cotton/ silk floss (70/30) blended yarn was coarser than the other yarn because higher the yarn count coarser the yarn. There is 5 per cent level significant difference between two yarn samples.

Twist is the measurement of the spiral turns given to a yarn in order to hold the constituent fibres or thread together. The twist is necessary to give a yarn coherence and strength. Twist in yarn was determined by following BIS method IS:83 using the MAG Electronic twist tester.

Table 1 revealed the yarn twist of silk floss and cotton/silk floss blended yarn, spun on hand spinning system. The cotton/silk floss (70/30) blended yarn showed highest yarn twist (11 tpi) compared to 100 per cent silk floss yarn due to finer yarn count i.e., higher the count finer the yarn and higher the twist. Papnai and Goel (2005) revealed that variation in yarn twist is due to the pulling of yarn between the thumb and finger through spindle of charkha during spinning process which was not in identical synchronization. There is 5 per cent level significant difference between two yarn samples.

Table 2 narrates the yarn tenacity of silk floss and cotton/ silk floss blended yarn. The maximum load or force supported by specimen in a tensile test carried out to rapture is the breaking load or the tensile strength of a yarn. The breaking strength of a yarn determined under certain specific condition is usually taken as an index of yarn quality and is expressed in grams or pounds. Instrument used for tenacity and elongation Unistretch 250. The specimens were tested as directed in IS- 12673, 1989.

Table 1. Yarn count (Ne) and Yarn twist (tpi/tpm) of silk floss and cotton/silk floss blended yarn

Yarn samples	Yarn count (Ne)	Yarn twist (tpi/tpm)
Silk floss (100%)	5.56	7.80
Cotton/ silk floss (70/30)	8.12	10.73
t-stat	-2.64*	-4.15*

*= Significant at 5 % level

Table 2. Yarn tenacity (kgf) and Elongation (%) of silk floss and cotton/ silk floss blended yarns

Yarn samples	Yarn tenacity (kgf)	Elongation (%)
Silk floss (100%)	0.25	9.94
Cotton/silk floss (70/30)	0.57	5.92
t-stat	-2.41	0.88

*= Significant at 5 % level

The maximum yarn tenacity was observed in cotton/silk floss (70/30) blended yarn (0.57kgf) subsequently pure silk floss yarn (0.25kgf). Elongation (%) of silk floss and cotton/silk floss blended yarn. Maximum elongation per cent was observed in 100 per cent silk floss yarn (9.94) followed by cotton/silk floss (70/30) (5.92). Among the yarns, cotton/silk floss (70/30) blended yarn showed significantly greater yarn strength may be due to the higher percentage of cotton fibres which attributed to the good alignment because of its long polymers within fibres and the countless, regular hydrogen bond formations between adjacent polymers (Gohl and Vilensky, 2005). Higher the yarn count and yarn twist better the strength of the yarn (Booth, 1968). Least yarn strength was observed in silk floss yarn due to uneven cut length of silk floss yarn and may be attributed to the pulling of yarn between the thumb and finger through spindle of charkha during spinning was not in indistinguishable harmonization this is in agreement with findings of Papnai and Goel (2005). There is no significant difference between two yarn samples.

Table 2 depicts elongation per cent of the silk floss and cotton/ silk floss blended yarns. The least elongation was found in cotton/ silk floss (70/30) blended yarn because of higher proportion of cotton in blended yarn and crystalline polymer system of cotton (Gohl and Vilensky, 2005) with high strength. Whereas the 100 % silk floss yarn showed highest elongation percentage and least yarn strength. This may be because of strength and elongation are inversely proportionate to each other. These findings confirms the results of Praveen and Vatsala, (1992). The yarn strength was increased with the decrease in elongation. Yarn strength was increased with the increasing proportion of cotton. Elongation was highest in pure silk floss may be due to beta-configuration in silk polymer system (Gohl and Vilensky, 2005) and more number of silk floss fibres were occupied in the yarn diameter. There is no significant difference between two yarn samples.

Table 3 depicts the yarn evenness of silk floss and cotton/ silk floss blended yarn. The term thick and thin places are refered as even and unevenness of the yarn diameter throughout its length. Yarns can be examined by wrapping them on to a matt black surface such as a piece of flat board. The wraps should be equally spaced to avoid optical illusions of irregularity and the blackboards examined under good lighting conditions. The test yarn is wound on a blackboard approximately 9 in. x 4 in. with the correct spacing and compared directly with the corresponding standard (Booth, 1968).

Table 3. Yarn evenness of silk floss and cotton/silk floss blended yarns

Yarn samples	Thick places/mtr	Thin places/mtr	Neps/ mtr	Total imperfection/ mtr
Silk floss (100%)	8	16	22	46
Cotton/Silk floss (70/30)	16	25	3	44

*= Significant at 5 % level

Maximum number of thick places were observed in cotton/ silk floss (70/30) (16 nos/mtr) followed by 100 % silk floss yarn (8 nos/mtr). Maximum number of thin places was observed in cotton/silk floss (70/30) blended yarn (25 nos/mtr) followed by 100 per cent silk floss yarn (16 nos/mtr). Highest neps were observed in cotton/silk floss (70/30) (3 nos/mtr) followed by 100 % silk floss yarn (2 nos/m). Total imperfection were observed in 100 per cent silk floss yarn (46 nos/mtr) compared to cotton/ silk floss (70/30) blended yarn (44 nos/mtr). The 100 per cent silk floss yarn showed highest yarn total imperfection because of silk floss possesses uneven cut length. Unevenness of yarns is associated with the variation in the weight per unit length. The evenness of silk floss and cotton/silk floss blended yarns was dependent upon skill of the spinner and presence of thick/ km and thin places/km in the yarn during hand spinning system where all the processes are manually controlled explained by Joshi and Goel (2015).

It was concluded that, the yarn count, twist and tenacity was observed highest in cotton/silk floss (70/30) blended yarn and elongation and yarn evenness was highest in 100 per cent silk floss yarn. Further, more cultivation of silk worm on commercial scale not only forms an income generating activity for sericulture industry, but also a source of livelihood for local spinners and weavers, thus positively supports the socio-economic status of the spinners, the neglected sector of the spinners community.

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