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RESEARCH PAPER

Development of blended yarns from agro-waste material-corn husk

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Abstract : The present investigation has been undertaken to develop blended yarns using agro-waste plant materials since the potential of its usefulness is not fully exploited. Development of suitable textile textures may partially address to the eco-concerns. The study was focused on chemical extraction of corn fibres and properties of blended yarns. Corn husks were treated in 1% alkali solution (1:20 material to liquor ratio) at high temperature (85–90^{0}C) for 1 hour. Softening of fibres was done with silicone emulsion (0.5% by weight of fibres) at room temperature. Higher denier value for corn husk fibres (70.09) and low bundle strength (5.00 g/tex) were observed in contrast to hemp and viscose rayon. Length of corn husk fibres (145.71 mm) was lower than hemp fibres with moisture content 8.34%. The extracted corn husk fibres were hand spun in the blend of viscose rayon (70CH:30VR) and hemp (30CH:70HA). Higher tenacity (0.95g/tex) and lower breaking force (759.5g) of CH/HA yarn were found in comparison to CH/VR yarn. Also, higher yarn count 1.31 Ne was observed in case of CH/HA. Both the yarns were considered suitable for developing fabrics for home textiles and apparel.

Key Words : Corn husk fibres, Blends, Viscose rayon, Hemp

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INTRODUCTION

The agricultural waste materials create havoc through pollution when allowed to decay in public places or burnt. Corn (*Zea mays*) or maize is the second largest agricultural crop grown in the world, second only to sugarcane with 875 million tonnes produced in the world in 2012 (Reddy and Yang, 2005). In India, 9.30 million hectare area was under maize cultivation with 23.70 million tones production during 2014-15 (Ministry of Agriculture, Punjab, 2014-15). In past, various types of natural fibres have been the subject of intense research interest such as flax, sisal, jute, kenaf and hemp (Panthapulakkal and Sain, 2006; Jin-qui and Jian-chum, 2010; Debnath and Madhusoothanan, 2010; Nam and Netravali, 2006; Shubhra *et al.*, 2011; Yilmaz *et al.*, 2012 and Zaman *et al.*, 2010). Among the agricultural biomass, corn husks have been a subject to very limited research interest as a fibre source (Huda and Yang, 2008). Corn husks (ears, shucks) are fibrous structures that can be upto 20 cm in length and have been traditionally used for

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decoration, handicrafts and other applications. Corn husks are composed of cellulose (42%), lignin (13%), ash (4.2%) and other materials (41%). According to Norashikh and Ibrahim (2009), the constituents other than the lignocellulosic fibres can be removed by alkalization as in the case for bast fibres. Study of the agricultural biomass will not only support the rural community and farmers by adding value to their products but would also prevent the burning of these fields's leftover, which is a common practice by farmers and thereby save environmental pollution (Ashori and Nourbakhsh, 2009).

The ultimate aim of plant and agro-waste management is to make the best utilization through useful product development on one hand and control the pollution on the other. The present investigation is undertaken to address the issues of agro-waste utilization to the benefit of mankind. Due its availability in abundance and the potential of obtaining fibres, the present work was aimed at extracting corn husk fibres using chemical extraction method and studying the physical properties of blended yarns. Blending is the technique which enhances the quality of yarns and also adds the positive attributes of each of its components, minimizes negative characteristics and economizes the cost of the product. Blended fibres enhance the pliability and spinnability. The fineness of the hand spun yarns largely depended on the quality of the fibres and skill of the spinner. Though corn husk fibres were pliable and spinnable into yarns, but to obtain better results these were blended in different ratios with viscose rayon and hemp fibres.

MATERIAL AND METHODS

Procurement of materials :

Dry waste corn husks were collected from Ludhiana market to extract the fibres. Viscose rayon fibres were procured from the Dev Woollen Mills, Ludhiana and hemp fibres from the Uttrakhand Bamboo Fibre Development Board (UBFDB) Dehradun, Uttrakhand. The chemicals procured from Thames Chemicals, Ludhiana (Punjab) for extraction of corn husk fibres were sodium hydroxide (NaOH), acetic acid, silicone emulsion, sodium hypochlorite (NaClO).

Extraction of corn husk fibres :

Chemical extraction process was followed to extract the corn husk fibres. Dry corn husks were washed with distilled water. To extract fibres from husks, the raw material was treated in 1% NaOH solution keeping material to liquor ratio 1:20 at 85–90^0 C for 1 hour and was rinsed thoroughly. The residues were neutralized with 5% acetic acid and rinsed again to set pH 7. The fibres were treated with silicone emulsion (0.5% by weight of fibres) at room temperature to make these soft and pliable for spinning.

Fig. A : Chemically extracted corn husk fibres

Process for development of blended yarns :

Blending, carding and spinning processes were carried out in Uttarakhand Bamboo Fibre Development Board (UBFDB), Dehradun for the development of yarns. To obtain the blend of corn husk fibres with viscose rayon and hemp fibres in the ratio of 70c:30v and 30c:70h, respectively, the fibres were machine opened and fed into the blow room. These were carded in card rollers and handspun on *Charkha* (spinning wheel) to make yarns. The blended yarns were bleached by the cold process at room temperature using sodium hypochlorite (NaClO) with 1:10 material to liquor ratio for 7-8 hours. The yarns were washed thoroughly with distilled water and then dried in air.

Testing of extracted fibres and blended yarns :

The testing of physical properties of the extracted fibres and blended yarns was done at North Indian Textile and Research Association (NITRA), Ghaziabad using standard testing methods which are given below in the parenthesis.

Fibre properties :

Fibre denier (ASTM-1577:2007), Bundle strength (ASTM 3776), Fibre length (IS: 10014(pt.2) (Reaffirmed-1999), Moisture content (IS: 1670-91(Reaffirmed-2007).

Yarn properties :

Yarn count (IS: 1315-1977 (Reaffirmed-1999), Yarn TPI (IS: 832-1985 (Reaffirmed-2006), Breaking force

(IS: 1670-91(Reaffirmed-2007), Elongation at break (IS: 1670-91 (Reaffirmed-2007).

RESULTS AND DISCUSSION

The results of the work done are explained below:

Physical properties of corn husk fibres :

Higher denier value for corn husk fibres (70.09 and CV%- 33.54) is apparent (Table 1) in contrast to hemp (5.18 and CV%- 40.20) and viscose rayon (1.97 and CV%- 9.15) which clearly indicated the possibility of attaining heavier blended textile materials than what could have been possible from each of the blending fibres. During the present study corn husk fibres of 70.09 denier were obtained under optimum conditions of treatment with 1% alkali solution (1:20 material to liquor ratio) at 85-90^{0}C for one hour (Table 1). But Archana *et al.* (2017) in a similar study reported to have obtain 130 denier corn husk fibres with bundle strength of 1.59 g/ denier after the treatment of corn husks using 4g/l NaOH solution (1:40 material to liquor ratio) at temperature of (98-100^{0}C) for 60 minute. The investigator finally obtained 86 denier corn husk fibres with 1.33 g/denier bundle strength after the bleaching treatment. This difference in the extracted fibres of both the experiments might be due to the variation in raw materials, and chemicals and process used for extraction. According to Franck (2005), the physical properties of the fibres are the key factors in deciding the end-uses to which fibres could be put and utilized for exploiting their potential to the maximum. The investigator also highlighted that the nettle fibres ranging between 20-80 denier with tenacity 5.65g/denier was found to be suitable for home textiles and technical applications. Sutusanee (2012) has reported that fibres from trunk sheath of *hibiscus tiliaceus* could be successfully extracted by water retting.

Fibre strength is the next important property after the fibre denier. Among the blending fibres, the bundle strength of the hemp fibres was highest (79.04 g/tex) followed by of viscose rayon fibres (35.04 g/tex). It is apparent from Fig. 1 that corn husk fibres exhibited the least bundle strength of 5.00 g/tex. Thus, blending of viscose rayon with corn husk is likely to improve the strength of resultant yarn. The hemp fibres showed maximum length (184.2 mm) followed by 145.71 mm length of corn husk fibres. Moisture content in the fibres is most important and desirable property for comfort. It

Table 1 : Physical parameters of corn husk fibres

Test Parameters	Corn husk fibre	Viscose rayon	Hemp fibre[1]
Fibre denier	70.09	1.97	5.18
CV (%)	33.54	9.15	40.20
Bundle strength (g/tex)	5.00	35.04	79.04
Fibre length (mm)	145.71	38.00-50.00	184.2
CV (%)	24.16	-	-
Moisture content (%)	8.34	13.00	10.14

*CV=Co-efficient of variation, [1]Source: Tripathi *et al.* (2013)

Table 2 : Analysis of physical properties of corn husk blended yarns

Physical properties	Proportions	
	70% corn husk:30% viscose rayon CH/VR	30% Corn husk : 70% hemp CH/HA
Yarn TPI	5.28 ± 0.11	5.97 ± 0.14
CV (%)	6.52	7.38
Twist direction	Z	Z
Breaking force (g)	759.5 ± 50.08	740.9 ± 82.73
CV (%)	20.8	31.6
Elongation at break (%)	1.90 ± 0.34	1.61 ± 0.21
CV (%) of elongation	57.0	35.7
Tenacity RKM (g/tex)	0.95 ± 0.06	1.66 ± 0.17
CV (%)	20.8	31.6

*CV=Co-efficient of variation
CH/VR = Corn husk/viscose rayon blended yarns (70:30)
CH/HA = Corn husk/hemp blended yarns (30:70)

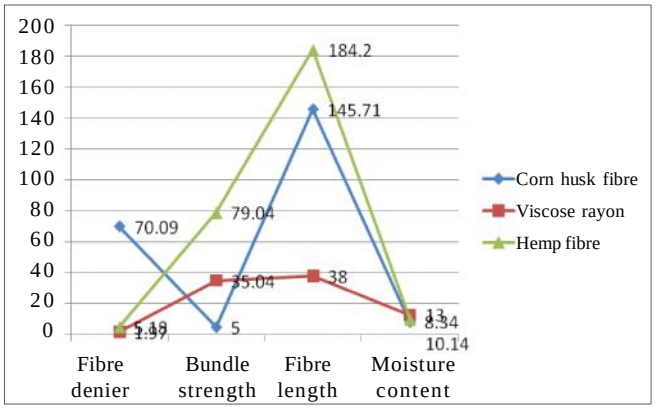

Fig. 1 : Comparative representation of physical properties of CH, VR and HA fibres

was observed that moisture content of corn husk fibres (8.34%) was lower than viscose rayon (13.00%) and hemp fibres (10.14%). Rao (2007) revealed that bamboo and sisal fibres have almost same moisture content (9.16% and 9.76%) as corn husk and hemp fibres.

Physical properties of the blended yarns:

The data presented in Table 2 indicates that the higher TPI (5.97 ± 0.14) were found in the case of 30CH:70HA yarn with CV% - 7.38 followed by yarn TPI - 5.28 ± 0.11 in the case of 70CH:30VR yarn with CV% - 6.52. The higher yarn count (1.31 Ne) was observed in the case of single ply CH/HA yarns with blending ratio of 30:70 whereas the yarn count of single ply CH/VR (70:30) yarn was 0.74Ne.

It is clear from the Table 2 that the sample of 70CH:30VR yarn showed higher breaking force 759.5 ± 50.08g (CV%- 20.8) followed by 30CH:70HA yarn with 740.9±83.73g breaking force (CV%- 31.6). Yarn of 70CH:30VR had higher elongation with a mean value of 1.90 ± 0.34 per cent and CV%- 57.0. The lower elongation was found for yarn 30CH:70HA (mean value 1.66 ± 0.21 %) with CV%- 35.7. The higher tenacity (1.66 ± 0.17g/tex and CV% - 31.6) of yarn 30CH:70HA was observed compared to 70CH:30VR yarn (0.95 ± 0.06g/tex and CV%- 20.8).

Conclusion :

Low bundle strength of corn husk fibres was compensated by the blending fibres viscose rayon and hemp, as apparent from good strength of 70CH/30VR (0.95 g/tex) and 30CH/HA (1.66 g/tex). The developed yarns were considerable suitable for heavy weight fabrics for various end-uses such as home textiles and apparel like blazer, jackets and stoles.

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REFERENCES

Ashori, A. and Nourbakhsh, A. (2009). Mechanical behavior of agro-residuereinforced polypropylene composites. *J. Appl. Polym. Sci.,* **111**: 2616.

Debnath, S. and Madhusoothanan, M. (2011). Thermal resistance and air premeability of jute-poly-propylene blended needle-punched nonwoven. *Indian J. Febire Text. Res.,* **326** (2) : 122-131.

Franck, R. (2005). Bast and other Plant fibres, (Woodhead Publishing in Textiles, Cambridge England) 2005, 331-339, 332-327, 228-242.

Huda, S. and Yang, Y. (2008). Chemically Extracted Cornhusk Fibers as Reinforcement in Light-Weight Poly(propylene) Composites. *Macromole Mater & Engg.*, **293** (3) : 235-143.

Jin-qui Zhang and Jian-chum Zhang (2010). Effect of finishing treatment with softening agent on spinnability of hemp fibre. *Indian J. Fibre Text. Res.,* **35** (2) : 115-120.

Ministry of Agriculture, Government of India (Department of Agriculture, Punjab) 2015, 3-5.

Nam, S. and Netravali, A.N. (2006). Green composites. I. physical properties of ramie fibres for environment-friendly green composites. *Fiber Polym,* **7**(4) : 372-379.

Norashikin, M.Z. and Ibrahim, M.Z. (2009). The potential of natural waste (Corn Husk) for production of environmental friendly biodegradable film for seedling. *World Acad. Sci. Engineer. Tech.,* **58** : 176-180.

Panthapulakkal, S., Law, S. and Sain, M. (2006). Effect of water absorption, freezing and thawing, and photo aging on flexural properties of extruded HDPE/Rice Husk composites. *J. Appl. Polymer Sci.,* **100** (5) : 3619-3625.

Reddy, N. and Yang, Y. (2005). Long natural cellulosic fibers from cornhusks: structure and properties, *AATCC Review,* **5** : 5-7.

Reddy, N. and Yang, Y. (2005). Properties and potential applications of natural cellulose fibers from cornhusks. *Green Chemistry,* **7**(4) : 190-195.

Shubhra, QTH, Alam, A., Gafur, M.A., Shamsuddin, S.M., Khan, M.A. and Saha, M. (2011). Characterization of plant and animal based natural fibers reinforced polypropylene composites and their comparative study. *Fibers & Polymers,* **11** (5) : 725-731

Sutusanee, B. (2012). RMUTP International Conference, *Text and Fashion*, Bangkok, Thailand pp. 5-10.

Standard test methods for physical properties of Textile Fibres, ASTM D1577 07, 3776 (ASTM, West Consshohocken, PA), 2007.

Tripathi, N., Lepcha, S.T.S. and Singh, C.J. (2013). Characterization of industrial Hempand *Girardinia heterophylla* and factor affecting fiber properties. *Internat. J. Fiber & Tex Res.*, **3**(2) : 49-51.

Yilmaz, N.D., Banks-Lee, P., Powell, N.B. and Michielsen, S. (2012). *J Appl Polym Sci*, **121**(2011) 2056.

Zaman, H.U., Khan, M.A., Khan, R.A., Arifur, R.M. and Das, L.R. (2010). Role of potassium permanganate and urea on the improvement of the mechanical properties of jute polypropylene composites. *Fiber Polym*,**11**(3) : 455-463.