***Supplementary information***

# EFFECT OF DIFFERENT LIGNOCELLULOSIC FIBRES ON POLY(ε-CAPROLACTONE)-BASED COMPOSITES FOR POTENTIAL APPLICATIONS IN ORTHOTICS

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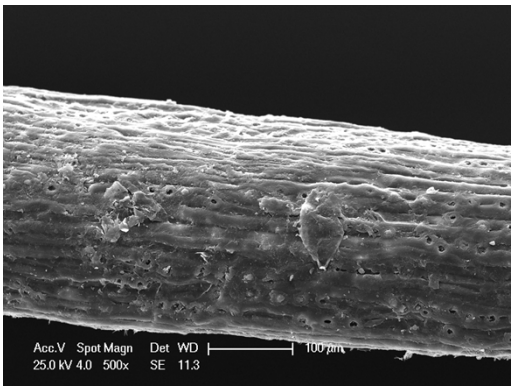
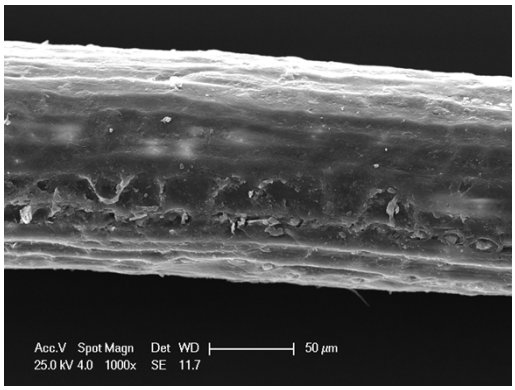
**Table 1S.** Literature survey on poly(ε-caprolactone)-based composites reinforced with natural fibres

| *Matrix* | *Reinforcement* | *Manufacturing technique and references* |
|---|---|---|
| PCL | Cotton<br>Cellulose from cotton<br>Hydrolyzed cellulose | Melt mixing+compression moulding[1] |
| PCL | Oil palm empty fruit bunch | Melt mixing+compression moulding[2] |
| PCL | Rice husk | Melt mixing+compression moulding[3] |
| PCL | Flax | Melt mixing+injection moulding[4] |
| PCL | Flax | Melt mixing+injection moulding and compression moulding[5] |
| PCL | Wheat gluten | Twin-screw extrusion+injection moulding[6] |
| PCL | Wood flour and lignin | Twin-screw extrusion+injection moulding[7] |
| PCL | Almond skin | Melt mixing+compression moulding[8] |
| PCL | Hemp | Twin-screw extrusion+injection moulding[9,10] |
| PCL | Coconut | Melt mixing+compression moulding[11] |
| PCL | Electrospun poly(methyl methacrylate) fibres loaded with multiwall carbon nanotubes or graphene nanoplatelets | Solvent casting+film stacking[12] |
| PCL | Cellulose nanocrystals from *Luffa cylindrica* | Solution mixing-casting[13] |
| PCL | Cellulose whiskers from sisal<br>Microfibrillated cellulose from sisal | Solution mixing-casting[14] |
| PCL | Chitin Whiskers from *Riftia* Tubes | Solution mixing-casting[15] |
| PCL | Sea algae fibres | Twin-screw extrusion+compression moulding or calendering[16] |
| PCL/Starch (MaterBi) | Sisal | Twin-screw extrusion+calendering and injection moulding[17–19] |
| TPS/PCL | Sisal | Twin-screw extrusion+single-screw extrusion[20,21] |
| PLLA/PCL | Ramie | Solvent casting+compression moulding[22] |




(a)

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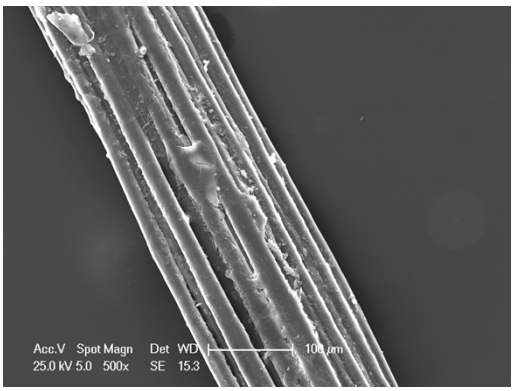


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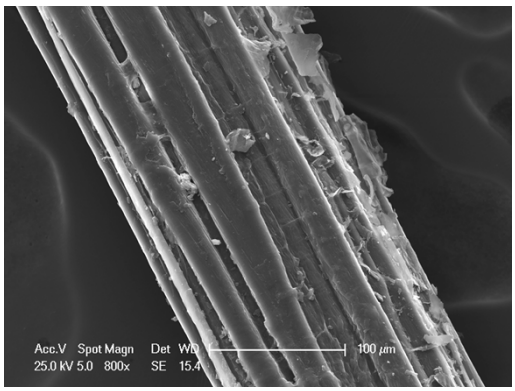


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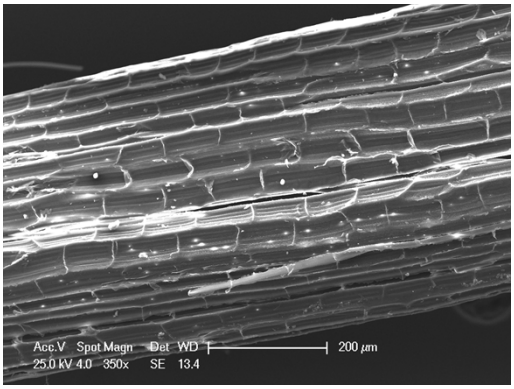


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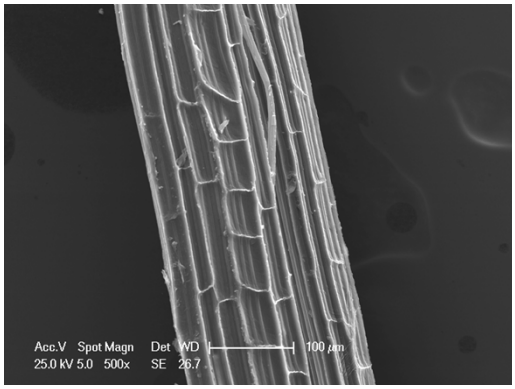
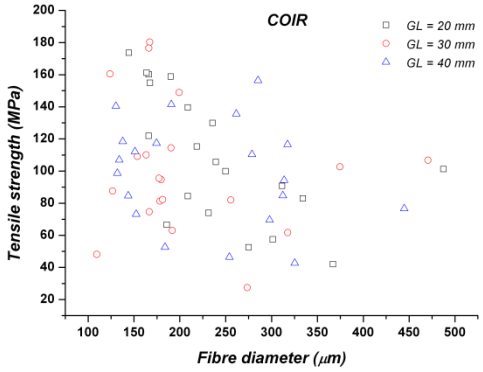
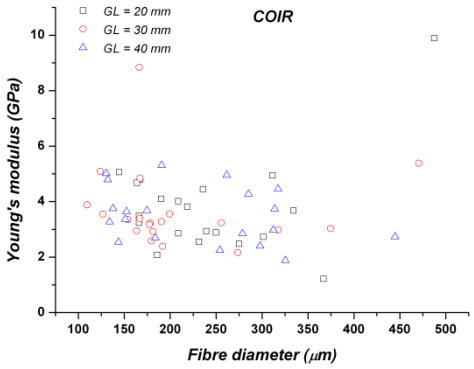



(f)

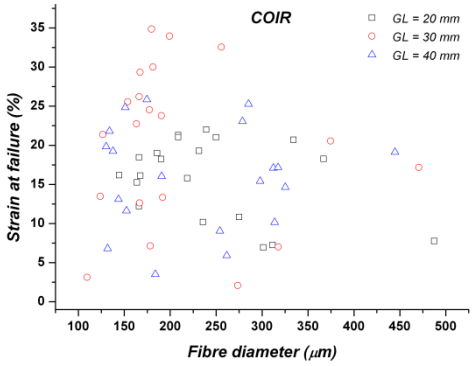
**Figure 1S** SEM micrographs at different magnifications of (a-b) coir, (c-d) hemp and (e-f) sisal fibres




(a)

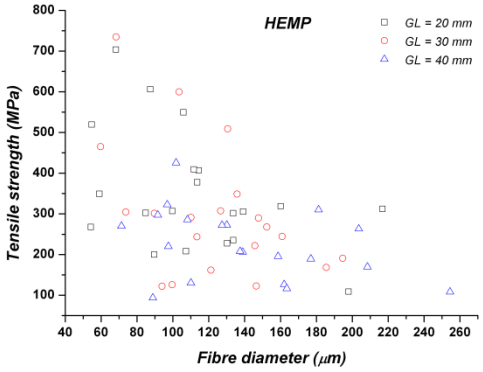



(b)

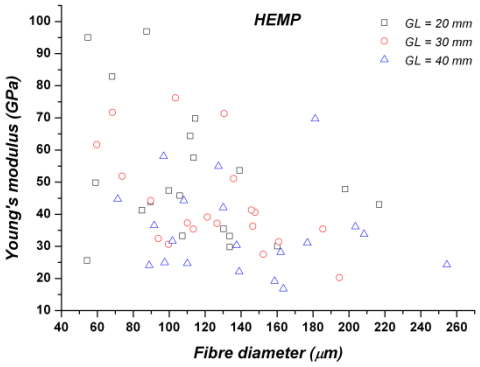



(c)

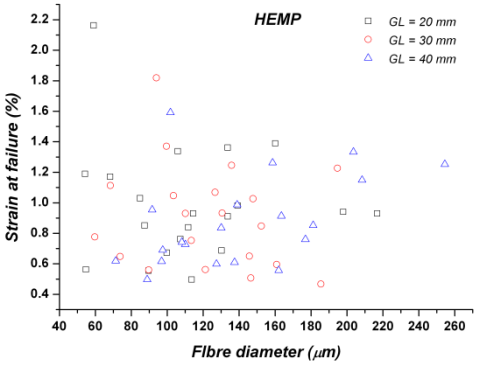
**Figure 2S** Dependence of the tensile properties versus coir fibre diameter at different gauge lengths




(a)

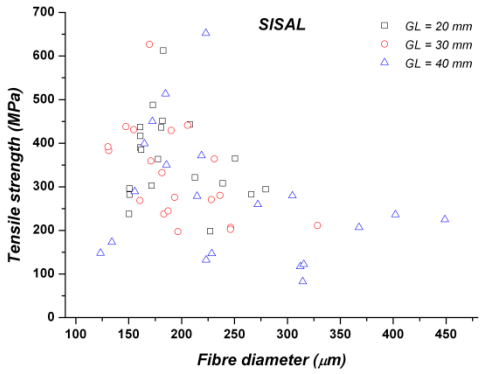



(b)

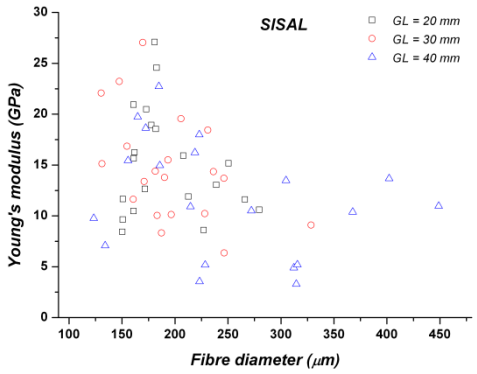



(c)

**Figure 3S** Dependence of the tensile properties versus hemp fibre diameter at different gauge lengths




(a)

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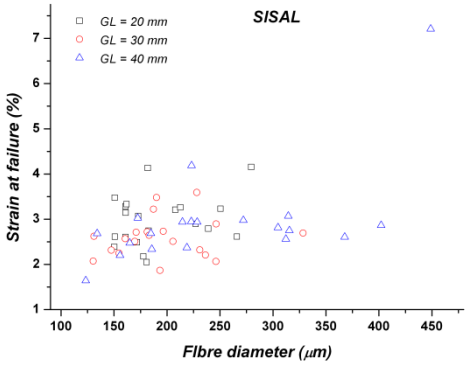


(c)

**Figure 4S** Dependence of the tensile properties versus sisal fibre diameter at different gauge lengths

## References


1 L. Ludueña, A. Vázquez and V. Alvarez, *Carbohydr. Polym.*, 2012, **87**, 411–421.

2 K. Zaman and M. Dahlan, *J. Reinf. Plast. Compos.*, 2010, **29**, 2723–2731.

3 Q. Zhao, J. Tao, R. C. M. Yam, A. C. K. Mok, R. K. Y. Li and C. Song, *Polym. Degrad. Stab.*, 2008, **93**, 1571–1576.

4 A. Arbelaiz, B. Fernández, A. Valea and I. Mondragon, *Carbohydr. Polym.*, 2006, **64**, 224–232.

5 K. Leluk and M. Kozlowski, *Fibers Polym.*, 2014, **15**, 108–116.

6 V. L. Finkenstadt, A. A. Mohamed, G. Biresaw and J. L. Willett, *J. Appl. Polym. Sci.*, 2008, **110**, 2218–2226.

7 H. Nitz, H. Semke, R. Landers and R. Mulhaupt, *J. Appl. Polym. Sci.*, 2001, **81**, 1972–1984.

8 A. Valdés García, M. Ramos Santonja, A. B. Sanahuja and M. del C. G. Selva, *Polym. Degrad. Stab.*, 2014, **108**, 269–279.

9 J. Beaugrand and F. Berzin, *J. Appl. Polym. Sci.*, 2013, **128**, 1227–1238.

10 F. Berzin, B. Vergnes and J. Beaugrand, *Compos. Part A Appl. Sci. Manuf.*, 2014, **59**, 30–36.

11 C.-S. Wu, *J. Appl. Polym. Sci.*, 2010, **115**, 948–956.

12 F. R. Lamastra, D. Puglia, M. Monti, A. Vella, L. Peponi, J. M. Kenny and F. Nanni, *Chem. Eng. J.*, 2012, **195-196**, 140–148.

13 G. Siqueira, J. Bras, N. Follain, S. Belbekhouche, S. Marais and A. Dufresne, *Carbohydr. Polym.*, 2013, **91**, 711–7.

14 G. Siqueira, J. Bras and A. Dufresne, *Biomacromolecules*, 2009, **10**, 425–32.

15 A. Morin and A. Dufresne, *Macromolecules*, 2002, **35**, 2190–2199.

16 S. Iannace, G. Nocilla and L. Nicolais, *J. Appl. Polym. Sci.*, 1999, **73**, 583–592.

17 V. P. Cyras, C. Vallo, J. M. Kenny and A. Vazquez, *J. Compos. Mater.*, 2004, **38**, 1387–1399.

18 V. P. Cyras, S. Iannace, J. M. Kenny and A. Vazquez, *Polym. Compos.*, 2001, **22**, 104–110.

19 C. R. di Franco, V. P. Cyras, J. P. Busalmen, R. A. Ruseckaite and A. Vázquez, *Polym. Degrad. Stab.*, 2004, **86**, 95–103.

20 A. Campos, J. M. Marconcini, S. H. Imam, A. Klamczynski, W. Ortis, D. Wood, T. Williams, S. Martins-Franchetti and L. Mattoso, *J. Reinf. Plast. Compos.*, 2012, **31**, 573–581.

21 A. de Campos, G. H. D. Tonoli, J. M. Marconcini, L. H. C. Mattoso, A. Klamczynski, K. S. Gregorski, D. Wood, T. Williams, B.-S. Chiou and S. H. Imam, *J. Polym. Environ.*, 2012, **21**, 1–7.

22 H. Xu, L. Wang, C. Teng and M. Yu, *Polym. Bull.*, 2008, **61**, 663–670.