CHAPTER 5

CONCLUSIONS

This study comprises of the physicochemical characterization of a novel natural fiber from *Prosopis juliflora* bark. To improve the properties of the PJFs, various chemical modifications were attempted. Finally the properties of the PJFs especially their dimensions were discussed for their suitability of paper production. The following conclusions could be drawn from this successful characterization.

- The PJF consisted of phloem fibers that belonged to gelatinous or mucilaginous type as evidenced by bark anatomy.
- It consisted of a highly lignified outer primary wall and a secondary wall that consisted of mucilaginous substance and a cell lumen.
- Higher lignin content of the PJF can offer relatively higher rigidity in comparison to the existing bark fibers and relatively lower density of the PJF may obviously enable light weight applications.
- The PJFs possess desirable tensile properties that make them an ideal alternative reinforcement material to the conventional fibers such as glass and carbon in polymer matrices.
• Relatively higher strength and lower elongation will essentially be conferred to the PJFs by virtue of CI and crystallite size, respectively.

• Thermogravimetric analysis indicated that the PJF was thermally stable up to 217 °C.

• The kinetic activation energy was 76.72 kJ/mol which has been estimated within the temperature range of 200–350 °C.

• Alkali treatment of the PJFs optimized at 5% (w/v) NaOH and 30 min soaking time.

• Undoubtedly, alkali treatment performed under optimal conditions resulted in improved tensile strength due to increase in the cellulose content and CI.

• On the contrary, such a treatment was found to cause a significant decrease in Young’s modulus.

• Changes in chemical properties coupled with reduction in the hydrophilicity of the PJF were determined by chemical analyses.

• Reduction of the amorphous contents (hemicellulose and lignin) of the optimally treated PJFs was appreciated by FTIR spectroscopy.

• Thermal stability of the optimally treated PJFs indicated a considerable improvement in cellulose degradation temperature conferred due to the alkali treatment.

• Various chemically modified PJFs had reduced hydrophilicity and improved adhesion between fiber and matrix.
• The effect of chemical treatments which effectively influenced and enhanced the physicochemical properties of the PJFs through improvement of CI, greater thermal stability and removal of wax and cementing materials (hemicellulose & lignin).

• It is evident from the results that the SPJF has superior physicochemical properties in comparison to others.

• The properties of raw and modified PJFs make them potential reinforcement for polymer matrices in composite structures and textile industries.

• The derived parameter of PJFs especially the slenderness ratio with a low runkel ratio can play a vital role in paper production and possibly offer relatively mechanical strength, thus making it suitable for writing, printing, wrapping, and packaging purposes.

5.1 SCOPE FOR FUTURE RESEARCH

This study on the characterization of natural PJFs is done for the first time. The physicochemical properties of raw and various chemically modified PJFs were clearly discussed. However, further research on the PJFs can be planned in the following lines;

• Development of cellulose composites film through utilization of the PJFs cellulose with different molecular weight.

• Utilization of the PJFs as reinforcement for various polymeric matrices.

• Evaluation of various coupling agents for PJFs in preparation of polymeric composite structures and determination of their effective performance.
There is a large scope for further study in PJF polymer composites, such as

- Machinability study
- Dynamic mechanical analysis
- Energy absorption analysis
- Quasi-static study
- Wear analysis
- Thermal properties
- Electrical properties
- Acoustic properties
- Characterisation of PJFs woven fiber unidirectional and bidirectional composites.
- Hybridization of PJF polymer composites with other natural fibers such as jute, ramie, kenaf, hemp, banana etc, and assessment of their properties.
- Hybridization of PJF polymer composites with synthetic fibers such as glass, and assessment of their properties.

- Development of industrial products using the PJFs to exploit their biodegradable nature.