

Valorisation of chicken feathers: Characterisation of thermal, mechanical and electrical properties

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ABSTRACT:

Increasing consumption of chicken results in generation of large amounts of wastes that need to be disposed of properly. Chicken feathers constitute about 5–10% of the weight of the chicken and thus they comprise a significant portion of the poultry wastes. Disposal of waste chicken feathers is problematic in that they do not readily degrade after landfilling, there is increasing shortage of landfill space, and they are contaminated with microbial biomass that makes them hazardous waste. Feathers contain ~91% keratin protein and thus, potentially, feathers can be beneficiated into high-value compounds or products comprised of keratin proteins or keratin fibres. Thus, valorisation of feathers could be a viable option for sustainable disposal of the waste. Characterisation of physicochemical properties of the chicken feather is an essential step to identifying possible avenues for valorisation of this waste biomass. While chemical, physical and morphological properties of chicken feathers and related potential valorisation routes have been described by the authors, identification of their mechanical, thermal and electrical properties have not been reported and this information is necessary to have a complete and comprehensive characterisation of waste chicken feathers. Hence, in this research, the mechanical, thermal and electrical properties of feathers were determined and evaluated to ascertain suitability of the feathers for production of high-value materials. The

feathers and fractions thereof were characterised by TGA/DSC, Instron (material and structural testing), Dynamic Mechanical Analyser, and a two-probe measurement of resistivity instrument. Under heated conditions, the TGA of chicken feathers confirmed the occurrence of three zones of weight loss. The TGA/DSC results revealed a glass transition temperature around 67 °C and a melting temperature ~230 °C in the crystalline phase. The tenacity of chicken feather barbs at maximum load was ~16.93 cN/tex. The results from electrical properties indicated that chicken feather fractions have low conductivity. Overall, the results indicate that chicken feathers have potential to be used in a variety of applications such as electrical insulator materials, yarn production for use in textiles, nonwoven fabric production, filler for winter clothing, geotextile and construction materials.