

NANO-PAPERS FROM ELEPHANTIDEA MANURE

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The interest in cellulose fibres, especially micro- or nanofibrillated cellulose, utilized in paper and composite materials as alternative to conventional fibre materials has recently grown significantly. Thereby, particularly in countries without access to large forest areas [1], an alternative to wood to as raw material for natural fibres is highly desirable. In order to promote an environmentally sustainable, widely available and cheap raw material, elephant manure was proposed as potential source. As elephants digest only 30 to 40% of their diet, their manure contains large quantities of fibrous cellulosic material [2] [3]. In addition, the mechanical, acidic and enzymatic pre-treatment during ingestion and digestion initiates break down of the fibres. This makes this animal waste a suitable candidate for the use as precursor for the production of micro- or even nanofibrillated cellulose. Nanocelluloses are commonly prepared by mechanical disintegration of plant material, optionally with chemical pre-treatment, thus requiring a lot of energy and chemicals during the fibrillation process. Thus utilizing the elephant as the first-stage bioreactor for the defibrillation of cellulose fibres by mechanical and chemical means would be an energy-efficient approach.

We demonstrate that by chemically purification of elephant manure, microfibrillated cellulose with controllable properties can be isolated. The fibrils were characterized regarding their cellulose content and physico-chemical properties in order to optimize the extraction process. Optimized fibrils were initially used for the preparation of papers that were characterized regarding their physico-chemical and mechanical properties and served as reference material. Moreover, the fibrils were further mechanically refined and compared to paper pulp-derived cellulose nanofibrils. Ultimately, papers were produced from mechanically refined elephant manure fibrils and compared to the non-refined elephant papers and cellulose nanopapers.

[1] FAO. State of the World's Forests 2009. Rep. no. ISBN 978-92-5-106057-5. FAO, 2009

[2] Meissner HH, Spreeth EB, De Villers PA, Pietersen EW, Hugo TA, Terblanche BF, Quality of food and voluntary intake by elephants as measured by lignin index, *S Afr J Wildl Res*, 1990, 20(3), 104-110.

[3] Roehrs JM, Brockway CR, Ross DV, Reichard TA, Ullrey DE, Digestibility of timothy hay by African elephants. *Zoo Biol*, 1989, 8, 331-337.