BIOCHEMICAL STUDIES ON EGYPTIAN COTTON STALK LIGNIN AND LIGNIN NANOPARTICLES AS ANTIMICROBIAL, ANTIOXIDANT AND ANTICANCER AGENTS

BY

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ABSTRACT

The aim of the current investigation is converting cotton plant stalks into lignin and lignin nanoparticles, then applying them to produce antimicrobial textile (using 7 pathogenic bacteria and 5 pathogenic fungi), and also studying their antioxidant and anticancer activity. Stalks of two cultivars; Giza 86, and Giza 90 were obtained from Cotton Research Institute experimental fields and be used in this study. Lignin was extracted from stalks by using two methods (one via organic acids and the other was alkaline treatment), and converting it into lignin nanoparticles by using ultra sonication procedure. The first stage, chemical analysis comparison, as economical assessment indicators, was conducted. The results showed that, Giza 86 excelled Giza 90 significantly in lignin amount; enclosed between 306 and 1770 kg/fed. Lignin extracted by alkaline treatment elevates organic acids method by 37.93% in amount. The second stage was the lignin and lignin nanoparticles identification. Organic acids method, gave higher negative zeta potential (about -30.2 to -41.7 mV for Giza 90 and Giza 86, respectively) than alkaline treatment. TEM images confirmed that, ultrasonication procedure succeded for transforming the large, heterogenized and agglomerated form of lignin particles to small, uniform size and smooth surfaces and regular spherical lignin nanoparticles. FTIR spectra characteristic bands enclosed in a range from 494 to 3907 cm^{-1}, where all samples have bands in common. Lignin nano particles has some new bands, whereas, some other bands disappeared. Some bands characterized alkali solvent lignin, whereas, some others bannered the organo solve lignin. The third stage was testing lignin (normal and nano particles size) bioactivities; the antimicrobial, antioxidant and anticancer. L90 and LNP90 as the best samples has antibacterial effect and also, they had the best antifungal effect with OL86 and OLNP86. Innovative technology; lignin and lignin nano particles treatment to surgical bandages to confront pathogens, was submitted to the Egyptian patent office with a submition number of 981/2020. Inhibition ratio, as antioxidant indicator, had positive association with lignin concentration. Extraction methods, as well as, used cultivars exhibited significant differences for inhibition ratio (%). Estimated IC_{50} values coincides inhibition ratio (%) values. Giza 90 lignin Giza 90 lignin nanoparticles extracted by organic acids method was selected as the best antioxidant sample to continue further invistigation as anticancer. No cytotoxicity effect was detected for sampled lignin on normal skin cell; line BJ1, whereas, lignin in nanostate exhibits nearly twice the lethal effect on human skin cancer cell; line A431, than lignin in natural state because of its small size, which led to its ability to penetrate the cancer cell more than natural lignin.

Key words: cotton stalk, lignin, nanoparticles, antimicrobial, antioxidant, zeta potential, TEM, FTIR, textile, skin cancer.

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