SUSTAINABLE FABRICATION OF CELLULOSE-BASED ANTIBACTERIAL NANOCOMPOSITE FILMS FOR ACTIVE PACKAGING TO PREVENT *LISTERIA* AND *SALMONELLA* CONTAMINATION

Pratiksha Shrestha[1] – Qinglin Wu[2] – Abouzeid, Ragab Esmail Mahmoud[2]
Witoon Prinyawiwatkul[1] – Karuna Kharel[1]

[1]School of Nutrition and Food Sciences, Louisiana State University AgCenter, Baton Rouge, Louisiana, USA,

[2]School of Renewable Natural Resources, Louisiana State University AgCenter, Baton Rouge, Louisiana, USA

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ABSTRACT

Packaged low moisture foods are prone to contamination by *Listeria monocytogenes* and *Salmonella* spp. indicating a need for post-process intervention. Sustainable antimicrobial packaging using cellulose-based biomaterials incorporated with natural antimicrobials offers a promising solution for controlled antimicrobial release and effective pathogen mitigation. This study aimed to develop an antimicrobial nanocomposite by incorporating natural antimicrobials into lignocellulose nanofibers derived from plant-based waste.

Nisin (0.33%) and oregano essential oil (OEO) at three different concentrations (0.5%, 1%, 1.5% were used to prepare 3 different formulations of lignocellulose nanofiber (LCNF) based nanocomposite films by solution casting on Teflon plates. The films were eventually punched into 9 mm disks for antimicrobial tests. *In vitro* antimicrobial activity was tested using disk diffusion method against four *Salmonella enterica* strains (PT 30, PT 9c, Oranienberg, Anatum), four *Listeria monocytogenes* strains (Scott A, V7, LCDC, 101M) and control on Mueller-Hinton agar. Film color was evaluated using L*, a*, b* colorimetric system. Differences in mean values were analyzed using ANOVA with *post-hoc* Tukey's test at $P<0.05$ in JMP® Pro 18.0.1. The antimicrobial film demonstrated broad-spectrum efficacy, with zone of inhibition ranging from 13.4–25.5 mm. It was significantly more effective ($P<0.05$) against Gram-positive bacteria, as evidenced by greater susceptibility of *L. monocytogenes* (19.11 ± 0.26 mm) compared to *S. enterica* (15.97 ± 0.26 mm). Among the tested strains, the most resistant were *Salmonella* PT 30 and Oranienberg (14.5–16.0 mm), while the most susceptible were *L. monocytogenes* Scott A and V7 (20.57–21.24 mm). For both organisms, the 15% OEO concentration showed the highest efficacy ($P<0.05$), though films at this concentration had a slightly darker color, as indicated by a significantly lower L* value (70.27±0.28).

Plant-based nanocomposite antimicrobial films offer a promising sustainable solution for enhancing food safety in packaged ready to eat low moisture foods, highlighting the need for further research.

Keywords:food packaging, antimicrobial properties, nanocomposite films

Contact Information: Pratiksha Shrestha, School of Renewable Natural Resources, Louisiana State University AgCenter, Baton Rouge, Louisiana, USA.