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Nanocellulose: Types and reinforcements in edible food packaging

Pavithra Prakash

Nanotechnology has opened up the newest approaches in all disciplines for advancements and betterment. Likewise, edible food packaging has incorporated nanotechnology in producing edible films and coatings with superior properties. Though commercialisation of edible films is still under research, nano-edible films and coatings have taken this a step further. Cellulose is a polysaccharide formed by β-1,4 linked glucose units exclusively found in plants and algae. Nanocellulose can be obtained from various sources like agricultural plants, certain algae and bacterial species like Rhizobium, Acetobacter, Salmonella, Escherichia, etc. Nanocellulose is produced in three distinct physical structures namely cellulose nanocrystals (CNCs), nano-fibrillated cellulose (NFCs) and bacterial cellulose. CNCs are entirely crystalline structures produced from cellulose microfibrils while NFCs contain alternating regions of crystalline and amorphous cellulose. Out of the three, bacterial cellulose is considered as a highly pure form of nanocellulose extracted since it does not comprise other polymers like pectin, hemicellulose and lignin unlike plant cellulose.

Nanocellulose compounds can be reinforced to form both films and coatings for packaging. Reinforcement of nanocellulose in chitosan edible films has shown to improve the poor mechanical properties like dry and wet tensile strength, water permeability and thermal stability while the already existing antimicrobial characteristics of chitosan make it better for usage. Starch is used in procuring films as it is less expensive, easily available and releases fewer toxins while disposing of reinforcing nanocellulose in starch showed more homogenous surfaces, high rigidity, thermal and water retention properties. Augmenting nanocellulose completely or partially with pectin make the resulting compounds stiffer, stronger and resistant to water molecules enhancing their poor barrier traits and also reducing relative humidity making them suitable to form food coatings and nanofilms. From the above examples, nanocellulose can be indulged along with the biopolymers that exhibit good antimicrobial and environment interaction properties but lack satisfactory physico-mechanical properties like stiffness, strength, thermal stability and water vapour permeability. This is where the involvement of nanocellulose brings in an influence in the modern-day active food packaging techniques.

Keywords: Nanotechnology, Nanocellulose, Food packaging, Active packaging, Bacterial cellulose, Thermal stability

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