

# Novel active packaging based on films of chitosan and chitosan/quinoa protein printed with chitosan-tripolyphosphate-thymol nanoparticles via thermal ink-jet printing

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© 2015 Elsevier Ltd. New active packaging films based on chitosan (Qo) and a blend of Qo and quinoa-protein (EPQ) were developed. The films were printed with chitosan-tripolyphosphate nanoparticles (NQos) and NQos loaded with thymol (NQoThs) using inkjet printing. Films were prepared by casting high-viscosity Qo and Qo/EPQ solutions (different ratios). Films suitable for printing were selected based on their mechanical properties and low levels of water uptake under simulated fresh-fruit storage conditions. The ionic gelation of low molecular weight Qo with tripolyphosphate produced 60-nm spherical nanoparticles, as seen with TEM. Before the NQoTh suspension was printed into films, 20% glycerol was added to modify the surface tension and kinematic viscosity of the suspension. Adding glycerol increased the Z-average and PDI by 24% and 12%, respectively, and decreased the Z-potential by 15%. Both NQoTh printed films had enhanced barrier properties compared with the control. The efficiency