APPLICATION STUDIES OF NANOTECHNOLOGY FOR ENHANCING QUALITY AND SAFETY OF SOME FOOD PROUDECTS

By

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B.Sc. Agric. Sc. (Food Science and Technology), Fac. Agric., Ain Shams University, 2012

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ABSTRACT

Ibrahim Amin Ibrahim: Application Studied of Nanotechnology for Enhancing Quality and Safety of Some Food Products. Unpublished M.Sc. Thesis, Department of Food Science, Faculty of Agriculture, Ain-Shams University, 2020

The present study was conducted to prepare nano-chitosan particles (CN) by ultrafine grinding from crude chitosan powder (CC) using a ball mill. Physical, functional, rheological properties, antioxidant, antiradical characteristics DPPH•, radical scavenging activity, ferric reducing antioxidant power FRAP, reducing power of nano-chitosan solutions were determined in comparison to crude chitosan solutions. In addition, the effect of different concentrations of crude chitosan and nano-chitosan on Prepared chilled chicken burger samples (physicochemical, microbiological analysis, cooking quality and sensory characteristics) were determined during storage at (4±1˚C) for 15 days. The results revealed that ultrafine grinding has effectively milled the chitosan particles to nanoscale. Prepared chitosan nanoparticles were characterized by X-Ray Diffraction (XRD), Zetasizer particle sizes and zeta potential (after milling for 30, 60 and 90 minutes). The particle size of nano-chitosan was distributed in a range of 250-600 nm. With a polydispersity index <1. The particle electric charge was increased to the level of +24 to +33 mV. X-ray diffractogramms showed lower intensity and a shift in the peak to the lower 2° θ angle due to the charge in particles cristllinity. The nano-chitosan solutions were superior in their emulsifying and foaming properties compared to crude chitosan solutions where CN90 was the best followed by CN60 then CN30, finally CC at different pH values 3, 5, 7, 9. Also, in model casein system the CC or CN does not have the ability to form foam in all pH values. Also, seen with decreasing the nanoparticles size lead to improve the foaming activity index and foam stability index. The rheological parameters from power law at 25 ˚C were obtained using a rotational coaxial viscometer. The results showed that the studied polymer solutions exhibited non-Newtonian behavior with shear-thinning.

Form the obtained data it can be concluded that the CC, CN30, CN60 and CN90 had antioxidant activity. The CN solutions have more potential radical scavenging activity than CC solutions reached to 97% at 9 mg/ml. The highest FRAP value was observed at concentration 9mg/ml for CN90 at holding time 90 min. Also, CN90 showed high potential reducing power. The antibacterial activities of chitosan and nano-chitosan were examined against two gram-negative bacteria (*Escherichia coli* O157:H7 and *Salmonella typhimurium*), two gram-positive bacteria (*Staphylococcus aureus* and *Bacillus cereus*), and one yeast strain *Candida albicans*) by the paper disc diffusion technique. In general, the solutions of chitosan were more effective on Gram-positive bacteria than Gram-negative ones. Also, the results showed that yeast strain *Candida albicans* was the most sensitive tested microorganisms and the effect of CN30, CN60 and CN90 was stronger than CC. Formulation of chitosan into nanoparticles form was found to increase its antifungal effect significantly. The most sensitive fungal strain was *Aspergillus niger* and the most effective solutions were CN60 and CN90, while the least active one was CC solution. Chicken burger samples were prepared by adding 0.1% CC (T1), 0.2% CC (T2), 0.1% CN30 (T3), 0.2% CN30 (T4), 0.1% CN60 (T5), 0.2% CN60 (T6), 0.1% CN90 (T7) and 0.2% CN90 (T8). The effects of adding various levels of CC and CN as natural antimicrobials and antioxidants additives on keeping different quality and safety attributes of prepared chicken burger product were determined during storage at (4±1°C) for 15 days. The values of TVN, TBARs, WHC, pH, plasticity, were gradually and significantly increased ($p \leq 0.05$) during storage of different prepared chicken burger samples. Cooking loss of all chicken burger samples were showed significant increasing ($p \leq 0.05$). Cooking yield of all samples of chicken burger were showed a remarkable significantly decrease ($p \leq 0.05$). Change in diameter (% shrinkage) at zero time of the samples: control, T1, T5, T6, T7 and T8 showed the highest reduction in diameter at zero time whereas after 15 days of cold storage samples of control and T1 showed the highest reduction. The values of

total viable bacterial count (TC) were ranged from (3.49 to 3.82 log cfu/g) at the beginning of cold storage period. Samples containing chitosan nanoparticles (0.1and 0.2%) showed a progressive reduction in yeast and mold counts overtime during cold storage in comparison to control chicken sample. The presence of coliforms in all chicken burger samples under investigation were in the accepted limit and decrease progressively overtime during cold storage. For Sensory evaluation, the samples containing (0.2% CN) had higher scores compared with control sample. The results indicate the possibility of safe using nanoparticles of chitosan in food applications as a result of increased efficiency and use as an antioxidant and antimicrobial with reducing the amount used to deliver the desired purpose. Additional research is required to further investigate the potential value-added utilization of these chitosan derivatives in improving the quality and safety of food.

Keywords: nano-chitosan, wet ball mill, nanotechnology, apparent shear viscosity, chemical, Physical, rheological properties, antioxidant antimicrobial, chicken, and burger,

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