

Title Effect of molecular weight reduction by gamma irradiation on the antimicrobial activity of chitosan

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Abstract

The antimicrobial effectiveness of lower molecular weight (LMW) chitosan solutions was tested against *Listeria innocua* inoculated on TSA and MOX agar plates by the direct droplet method. The chitosan solutions were prepared by dissolving chitosan in 1% (v/v) acetic acid at concentrations ranging from 0.5 to 2.0% and irradiating with Co⁶⁰ gamma rays ranging from 1 to 20 kGy. MW measurements of chitosan were determined by using HPSEC-MALLS-RI. The MW of chitosan varied from 114.8 kDa to 17.4 kDa and decreased with increasing irradiation dosages. Plate counts on TSA agar from shaker flask assays showed no significant differences among chitosan solutions irradiated up to 10 kGy and non-irradiated chitosan solutions. The inhibition of *L. innocua* by these solutions was 4 logs CFU/ml. However, after 12 hours the mean total plate count for irradiated as well as non-irradiated chitosan increased continuously. Chitosan solutions irradiated over 10 kGy were found to be ineffective against *L. innocua*, indicating that chitosan loses antimicrobial properties at higher irradiation levels with corresponding MW below 22.4 kDa. Chitosan and LMW chitosans were coated to 2.62 mg/in² on corona treated Cryovac® HangPak(TM) film and examined for inhibition zones on direct contact with 10⁵ CFU/ml inoculated *L. innocua* TSA agar plates. The results clearly showed neither inhibition zones nor diffusion for non irradiated as well as irradiated chitosan samples. The same results were obtained with paper disks dipped in chitosan and dried for 24 hours. The average amount of chitosan absorbed was found to be 26mg/disk. Native and LMW chitosan bound in the paper disk matrix and was not released into the surrounding media. However, wet paper disks showed clear inhibition zones around the disks for native as well as LMW chitosan.