APPLICATION OF A CHITOSAN BASED NANOPARTICLE FORMULATION AS AN EDIBLE COATING FOR SLICED DRY CURED HAM ANTIOXIDATION

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Abstract –A new type of sustained-release antioxidant active packaging film based on chitosan/montmorillonite incorporated with α-tocopherol chitosan nanoparticles (TOC-CSNPs) was investigated, which was applied to the sliced dry cured ham for antioxidation during storage. The release pattern of sustained-release film to the antioxidants and its antioxidant effects was discussed. Through sustained release antioxidants, it was expected to improve the utilization rate and prolong its working time, which could provide theoretical basis for long-term antioxidation method of dry cured meat products. The results showed that, compared with the traditional method of antioxidant spray and coating, the composite sustained-release film incorporated with TOC-CSNPs showed a sustained and stable antioxidant effects in 120 days of sliced dry cured ham storage.

Key Words –active packaging film, sliced dry cured ham, antioxidation, chitosan nanoparticles, sustained release

I. INTRODUCTION

Lipid peroxidation of dry cured ham is seriously during storage process, which has greatly affected the quality of the products. The traditional method of antioxidant spray and coating for ham preservation is inefficient, and the antioxidants was prone to rapid inactivation by direct spraying as most of the natural antioxidants are sensitive to the environment. Therefore, the purpose of this paper is to search for a new type of antioxidant coating material to replace the traditional antioxidant treatment. A sustained-release active packaging film based on chitosan/montmorillonite incorporated with TOC-CSNPs was developed, which can reduce the waste of antioxidants while extending the antioxidant time, thus prolong the shelf life of sliced dry cured ham. Study on the sustained-release active film for antioxidation coating was more and more popular on the preservation of meat products [1, 2].

II. MATERIALS AND METHODS

2.1 Material

Chitosan (CS), Sodium tripolyphosphate (TPP), montmorillonite (MMT) and α-tocopherol (TOC) were obtained from Sigma Reagent Co., Ltd. Dry cured ham was made by the Lab of Nanjing Agriculture University.

2.2 Preparation of active packaging film

TOC-CSNPs were prepared via a two-step method according to Hosseini [2], i.e., oil-in-water emulsion and ionic gelation of chitosan with TPP. The formula of TOC-CSNPs: 1 mg/mL CS concentration, mass ratio of CS to TPP was 7:1, pH 4.5, stirring speed 900r/min. Then 2% CS and 5% MMT were composited by intercalation [3], 10% TOC-CSNPs solution were added. Then a type of sustained-release active packaging film was formed through tape casting at 55℃. Physicochemical properties, release properties in vitro, antioxidant effects of the composite film was studied.

2.3 Treatment of sliced dry cured ham by antioxidation coating

Sliced dry cured ham was selected with the same weight about 300±15g and shape of 7×7×10 cm^3. Then samples were randomly divided into four groups. The group 1 (CK) had no coating treatment; group 2 was coated with 2% CS; group 3 was sprayed with tocopherol, then coated with 2% chitosan; group 4 was coated with TOC-CSNPs composite sustained-release film. All groups were vacuum packed and stored at 4 ℃ for 120 days. The POV value, TBARs value and color of each group were measured every 30 days.

III. RESULTS AND DISCUSSION

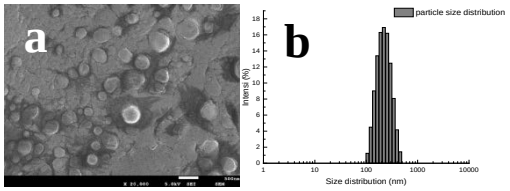

Figure 1. Morphology and size distribution of TOC-CSNPs

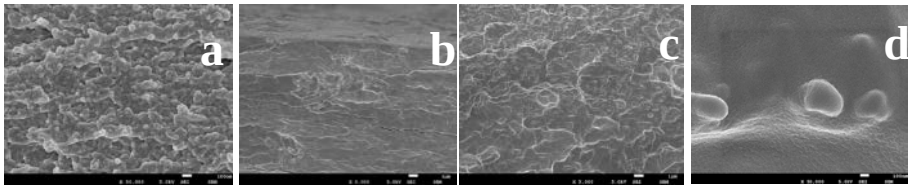

Figure 2. Morphology and structure of different membrane materials: a. CS, b. CS/MMT, c. TOC-CSNPs/CS/MMT, d. TOC-CSNPs in composite films

The SEM images of TOC-CSNPs were shown in Figure 1(a), the morphology of the particles were close to spherical, with good dispersibility. Figure 1(b) showed the particle size distribution, which was uniform and the average particle size was 214 nm. Figure 2 showed the SEM images of the film morphology structure formed by different components. The fracture surface of single CS film was rough (Fig.2 a), the polymer layer spacing was large, the molecular ordering was uneven, and there were many voids. The surface of CS/MMT composite film was smoother than CS film (Fig.2 b), and the lamellar structure was obvious, which was composed of CS and MMT intercalation [4]. Compared with the former two groups, the TOC-CSNPs/CS/MMT composite film showed the smoothest fracture surface (Fig.2 c), which indicated that CSNPs can fill the gap of the composite film layer, and combine with the positive and negative charge sites in the MMT layer to improve the compactness and compatibility of the composite film.

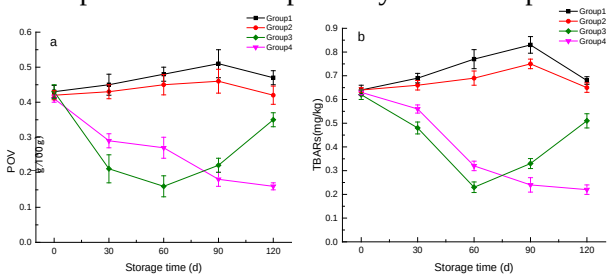

Figure 3. Effects of different antioxidant treatments on POV and TBARs during storage of sliced ham: Group1-CK, Group2-CS coated, Group3-spray TOC+CS coated, Group4-TOC-CSNPs composite film coated

As the Figure 3 showed that, compared with the traditional method of antioxidant spray and coating, the composite sustained-release film incorporated with α-tocopherol chitosan nanoparticles showed a sustained and stable antioxidant effect in 120 days of ham storage, which can effectively inhibit the peroxidation of biceps femoris muscle and always maintain a low level of POV and TBARs values within the limits. Hu et al. [2] studied chitosan nanoparticles loaded with cinnamon essential oil, which were incorporated with the low density polyethylene (LDPE) films and exhibited the excellent antimicrobial and antioxidant property for the pork during refrigerated storage.

IV. CONCLUSION

Compared with the traditional method of antioxidant spray and coating, the composite sustained-release film incorporated with TOC-CSNPs showed a sustained and stable antioxidant effect in 120 days of ham storage, which could provide theoretical basis for long-term antioxidation method of sliced dry cured ham and other dry cured meat products.

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