Antimicrobial Activity of Silver Nanoparticles in the Nanosilver Food Packages

Bi Hongmei1*, Zhang Xiaojiao2, Liang Ying1, Ding Dongxue1, Li Xue1, Wang Juntao1

1College of Science, Heilongjiang Bayi Agricultural University, Daqing 163319, PR China
2Department of Finance and Property, Qingbei Service Company of Daqing Oilfield, Daqing 163454, PR China

Nowadays, nanosilver materials are widely used in the field of food packaging, which could significantly prolong the storage time of food. The migration of silver nanoparticles in nanosilver packages is increasing continuously, while the case of the growth of Escherichia coli (E. coli) is not the same. In this paper, the antimicrobial activity to E. coli of silver nanoparticles is evaluated, which is useful to the evaluation of nanosilver food packages.

**Key words:** Food package, Silver nanoparticles, Escherichia coli (E. coli), Antimicrobial activity.

**INTRODUCTION**

Nowadays, food packaging is not only packages of food; it could promote the quality of food to a certain extent. For this aim, the nanosilver food packages are competitive in this field. Silver-based material is a kind of antibiotic with a broad spectrum of activity, which have also attracted great interest owing to its photocatalytic properties of semiconductor photocatalysis, antibacterial activity and the presence of nanocrystallites [1]. It is reported that the more the silver nanoparticles are, the better the antimicrobial activity would be.

The effects of silver nanoparticles on organisms and plants have been revealed in recent years [2, 3]. Many studies have reported that the silver nanoparticles (AgNPs) do have influence on viruses and bacteria [4-6]. Ahmed fabricated olyquaternary phosphonium oligochitosans-AgNPs nano-biocomposites (NBC1,2) to against hepatitis A virus (HAV), norovirus (NoV) and Coxsackievirus B4 (CoB4) infections with great virucidal activities [4]. Sondi reported that silver nanoparticles could suppress the growth of Gram-negative bacteria and Gram-positive bacteria [5]. Sandra used the mixture of the disinfectant Ca(OCl)2 and AgNPs against isolated bacteria, as well as inactivation of coliforms and pathogenic bacteria during percolation through bactericidal filter paper [6]. That is to say that a great amount of silver nanoparticles could do harm to animals. And too much intake into human body may have influence on the health of people, it is very important to detect the amount of silver nanoparticles in food packages [7], and it is useful to evaluate the antimicrobial to Escherichia coli (E. coli) of silver nanoparticles migrated from the nanosilver food packages.

**MATERIALS AND METHODS**

**Materials and apparatus**

Four commercially available nanosilver/polypropylene milk storage packages were selected as research objects, and marked as A, B, C, D, respectively. Fresh milk of the same date was poured into the above four packages, and the packages were soaked for 30 days at room temperature. Every 5 days, milk samples were poured into petri dishes with violet red bile agar (VRBA).

**Antimicrobial activity of silver nanoparticles by plate counting method**

Because of the sensitivity of silver nanoparticles to E. coli, the milk samples were detected for the growth situation of E. coli by food microbiology detection with plate counting method.

**RESULTS AND DISCUSSION**

According to plate counting method, the milk samples were diluted to suitable concentration and mixed with VRBA on a superclean table. And then the
milk samples were placed in constant temperature incubator for 24 h. The number of E. coli was counted by digit auto-counter.

The antimicrobial mechanism of silver nanoparticles on E. coli can be explained as follows: firstly, silver nanoparticles enter into cell walls, and have effect on cell membranes; secondly, when the concentration of silver nanoparticles reaches a certain amount, the DNA of bacteria lost the ability of copy, and E. coli could not metabolize, reproduce, and then die ultimately. While in the nanosilver packages, the migration of different samples of different brands were obviously different.

CONCLUSION

In this paper, the antimicrobial to E. coil of silver nanoparticles were evaluated here. The result showed that antimicrobial ability of the 4 brands of packages was better in the former 20 days, and the D brand package behaved much better. The reason was attributed to the different production technics of producing packages (includes polymer constituents, additive agents added, the particle diameter of silver nanoparticles etc).

ACKNOWLEDGEMENTS

This work was supported by Directive science and technology project of Daqing in China (Study on the migratory behavior of silver nanoparticles in food packages, 2020).

REFERENCE