Nano-Ag and lactate Na complex as food product protection

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Abstract – **The aim of this study was the assessment of nano-silver (nano-Ag) antibacterial activity in foods and possibility to increase shelf life of cooked sausages. Nano-Ag was obtained by the reaction of AgNO3 with tannin and NaHCO3 at 71°C for 2 h. The nano-Ag mean particle size was 30 nm according to the Rayleigh scattering data. The amino acid content was measured by the standard method. 0.05% nano-Ag water dispersion and the mixture of 0.05% nano-Ag and 1% sodium lactate were used. Nano-Ag antibacterial activity was tested microbiologically by growth zones of Aspergillus niger, Escherichia coli and Mucor heterosporum at 30 °C for 7 days. The free amino acid content monitoring was used to assess nano-Ag antibacterial activity in food. Addition of 0.5% of nano-Ag and sodium lactate to the sausages allowed to double the sausage shelf life at +4°C. The silver content in 3 mm layer under the sausage casings was low (<0.0001 mg/kg). The analysis of the microbial growth inhibition zones revealed the prominent antibacterial effect, especially for its synergistic composition with lactate. Thus, nano-Ag and its complex with lactate are the effective preserving agents for meat products.**

Keywords – **antibacterial activity, amino acids, sausage**

I. INTRODUCTION

In this study we made an attempt to evaluate the antibacterial activity of nano-silver regarding food produce and the possibility of extending shelf life of meat products (cooked sausages). It is known that incorporation of lactic acid derivatives into product composition allow to stabilize a product, thereby extending its shelf life. It is also known that nano dispersed materials, particularly nano-Ag has antimicrobial activity. It was interesting to assess the effect of action of silver nano particles and the complex of nano-Ag and sodium lactate in use for technologies of meat products manufacture.

II. MATERIALS AND METHODS

Nano-Ag was obtained by the reaction of the equivalent quantity of $AgNO_3$ with tannin E 181 and $NaHCO_3$ at 71^0C for 2 h. The nano-Ag mean particle size was 30 nm according to the Rayleigh scattering data. We also used sodium D-lactate. The total amino acid content in protein was measured in hydrolizate obtained by the standard method in 6M HCl at 120^0C during 24 hours in Ar current with subsequent dilution of the test specimen with a buffer at pH 2.2. The free amino acids were detected by extraction with 85% ethanol. Nano-Ag antibacterial activity was also tested microbiologically on solid medium. *Aspergillus niger*, *Escherichia coli* and *Mucor heterosporum* were used as test cultures. The growth zones were measured at 30^0C for 7 days.

0.05% nano-Ag water dispersion and the mixture of 0.05% nano-Ag and 1% sodium lactate were used for food products treatment and in the tests. Previously we found that the concentration of nano-Ag 0.05-0.1% is an almost complete inhibitor of growth of these microorganisms.

In order to obtain the aggregatively stable highly dispersed metal nano-particles of Ag, we used the chemical method of dispersion of this metal by reduction of ionic silver from its nitrate salt to the molecular state in aqueous-alcoholic medium under the influence of food grade tannin used as a reducer. The reaction of obtaining nano-Ag was carried out in

two ways. The first approach included the application of the components solution onto the meat product casing. The mixture contained or did not contain the 1% sodium lactate additive. According to the second variant, the nano-particles of Ag were obtained in model solution. The size of the formed particles was assessed by turbidimetric method measuring the attenuation of light intensity during its passing through the liquid disperse system.

For the evaluation of the antibacterial activity of nano-forms of silver we used the following idea. The effect of microflora on the product matrix leads to the development of the hydrolytic disintegration of it constituents, specifically the most important component of food – proteins. Intensive disintegration of proteins increases the free amino acids proportion that was determined using the amino acid analyser.

III. RESULTS AND DISCUSSION

Our previous research demonstrated that the incorporation of the preserving agent sodium lactate (0.5%) into sausages allowed to double the shelf life of the meat produce at + 4^0C.

Our study shows that the slow disintegration of the part of the protein occurs due to the hydrolysis. Thus, the amount of released amino acids increases. The total amino acid composition of total protein virtually has not changed during the experimental period. Of the most interest is the integral index of the free amino acid content, which has shown that in the case of use of lactate and especially the material with nano-Ag the deceleration of the undesirable disintegration processes in the food product has been observed.

The independent investigations by atomic absorption spectroscopy showed that the silver content in 3 mm layer of sausage adjoining the sausage casings was less than the sensitivity of the metal detection (<0.0001 mg/kg).

The results of the analysis of the microbial growth inhibition zones in the presence of nano-Ag revealed the prominent antibacterial effect, and its composition with lactate has strong, apparently synergistic effect. More detailed investigations will help to reveal pronounced antibacterial activity of nano-forms of metals with mixed valence.

IV. CONCLUSION

Therefore, it was established that the new preserving composition on the basis of silver nano-particles and its complex with the lactic acid salts are quite effective preserving agents. This can be used for the protection of food products from the development of the undesirable processes of biochemical disintegration and the prevention of microbial spoilage of meat based food products, that allow to prolong the shelf life of food produce.