On the issue of obtaining safe poultry products in veterinary and sanitary terms

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Abstract. The release of good-quality and safe poultry products depends on the sanitary condition, compliance with preventive measures and the development of technologies aimed at improving the safety of the products. Microbiological studies and meat quality indicators were determined using standard methods. A method of cooling in 0.01% solutions of HIT AseptoDes has been developed to control the contamination of the cooling medium and prevent microbial contamination of the surface of poultry carcasses. It has been shown that to reduce microbial contamination and decontamination of the surface of carcasses from Salmonella, 0.02% solutions of the agent can be used with a cooling time of 25 minutes and 0.01% solutions with a cooling time of 35–40 minutes. The quality indicators of meat of carcasses chilled with solutions of the studied product, in comparison with carcasses chilled in ice water, do not differ significantly, with the exception of the acquisition of the surface of the carcasses of a paler color. It was found that after 6 hours of storage, the presence of a residual amount of peracetic acid in washes from carcasses was not detected.

1. Introduction

Poultry products are an important component of the diet of the rural and urban population of the country. Therefore, the issues of quality and safety of these products do not lose their relevance. At a number of technological operations during the slaughter of poultry, there is a high probability of secondary microbial contamination of the surface of carcasses with extraneous microflora, which can cause food poisoning, which necessitates the development of technologies to eliminate this problem.

To reduce the rate of growth of bacteria that cause spoilage of food, to improve the quality of meat, poultry carcasses are cooled. Cooling in water promotes additional microbial contamination of the carcass surface, including pathogenic bacteria. Back in Soviet times, to control the microbial contamination of ice water, 10–20 mg/l of active chlorine was added to the cooling baths [1-3].

Relatively recently, after the ban on the use of solutions of chlorine-containing agents for cooling poultry carcasses, other agents began to be offered for these purposes, and the market for such agents is becoming more and more extensive. One of these is the technological auxiliary agent HIT AseptoDes (hereinafter referred to as TAA)—a transparent liquid without color having a specific odor.
and containing hydrogen peroxide (HP) in the amount of 18.0±2.0% and peracetic acid (PAA) in the amount of 15.0±2.0%, as well as auxiliary components.

The purpose of this work was to study the possibility of using TAA for water cooling of carcasses.

2. Materials and Methods
The research was carried out at the All-Russian Research Institute of Poultry Processing Industry. The disinfecting activity of the agent was studied according to R 4.2.2643 [3] using a test culture of S. typhimurium strain 55 (hereinafter referred to as S. typhimurium).

Microbiological studies were carried out in accordance with GOST 7702.2.0-2016, GOST 7702.2.1-2017, GOST 31468-2012 [3-7], meat quality indicators were determined according to GOST 31470-2012 [8].

At the first stage, the disinfectant activity of the agent was studied using test objects made of batiste tissue contaminated with test cultures. The TAA solutions were prepared at concentrations from 0.00001 to 0.01% (by PAA) in sterile distilled water at the rate of 0.5 ml of solution for each test object. Batiste test objects contaminated with the test culture were immersed in solutions of the agent, after maintaining a certain exposure, 2 test objects were taken out and, after 2 times washing in water (5 min each), inoculated on meat-peptone broth. The inoculations were thermostated at a temperature of (37±1) °C. The results were recorded daily for 7 days.

At the next stage of work, to study the disinfecting efficiency of TAA, the process of water cooling of carcasses of broiler chickens (hereinafter referred to as carcasses) was modeled. The carcasses were artificially contaminated with a test culture: 0.1 ml of a daily culture of S. typhimurium was added to one liter of cooling medium in a container with cold tap water (at a rate of 2.0 L per carcass) and the chickens were immersed in it for 5 minutes. Then, TAA was added to the vessel in certain quantities (by PAA), to create the required concentrations, and kept for 25–40 min. The number of mesophyll aerobic and optional-anaerobic microorganisms (QMA&OAMO), the presence of Salmonella and E. coli bacteria in the cooling medium and in washes from carcasses before and after cooling were determined.

3. Results and Discussion
At the first stage of the work, batiste test objects were used to study the disinfecting activity of TAA in relation to S. typhimurium. It was found that solutions of 0.00001-0.001% concentration of TAA at exposures of 25-40 minutes do not provide inactivation of S. typhimurium. Inactivation of S. typhimurium is provided by TAA solutions of 0.005% and 0.01% concentration (by PAA) in 25–40 minutes.

At the next stage, we studied the disinfecting efficiency of TAA in relation to the microflora of the cooling medium when cooling carcasses artificially superficially contaminated with S. typhimurium (Table 1).

Evidently from Table 1, 0.001–0.005% solutions of fuel assemblies at exposures of 25–40 minutes reduce microbial contamination of the cooling medium, for example, QMA&OAMO on the surface of carcasses varied from (3.9±0.7)-10³ to (6.2±1.1)-10³ CFU/cm³, but this cooling mode does not provide inactivation of Salmonella and coliforms in the cooling medium. With regard to the use of 0.01% solutions of TAA, this cooling mode makes it possible to inactivate Salmonella and coliforms in a cooling medium at a 25–40 minute exposure, while QMA&OAMO decreases to 50 or less CFU/cm³.

At the next stage of the work, we studied the disinfecting efficiency of TAA solutions in relation to the microflora of the surface of carcasses contaminated with S. typhimurium.

Comparative analysis of the results of evaluating the effectiveness of solutions of the agent presented in Table 2 indicates that 0.005% solutions of TAA during an exposure of 25-40 minutes reduce QMA&OAMO from (4.6 ± 0.11)x10⁶ to (4.5 ± 0.12)x10⁶–(4.3 ± 0.13)x10³ CFU/cm³. However, these cooling modes do not provide inactivation of coliforms and Salmonella on the surface of carcasses.
Table 1. Disinfecting efficiency of TAA solutions in relation to microflora of the cooling medium (n=10)

| Cooling time, min | Indicators | Control | Concentration of TAA solutions, % |
|------------------|------------|---------|----------------------------------|
|                  |            |         | 0.001   | 0.005   | 0.01    | 0.02    |
| 25               | QMA&OAMO, CFU/cm³ | (1.7±0.3)·10²** | (6.2±1.1)·10³ | (3.1±0.8)·10² | 50      | <10     |
|                  | Coli/cm³  | 10⁴     | 10¹     | 10¹     | —**     | —       |
|                  | Salmonella/25 cm³ | 4***    | +        | +        | —        | —       |
| 35               | QMA&OAMO, CFU/cm³ | (1.4±0.5)·10⁴ | (5.1±0.7)·10³ | (1.8±0.3)·10² | <10     | <10     |
|                  | Coli/cm³  | 10³     | 10¹     | 10¹     | —        | —       |
|                  | Salmonella/25 cm³ | +        | +        | +        | —        | —       |
| 40               | QMA&OAMO, CFU/cm³ | (1.3±1.0)·10⁴ | (3.9±0.7)·10³ | (1.2±0.6)·10² | <10     | <10     |
|                  | Coli/cm³  | 10³     | 10¹     | 10¹     | —        | —       |
|                  | Salmonella/25 cm³ | +        | +        | +        | —        | —       |

Note: hereinafter * means (M±m); ** “—” means that microorganisms were not found; *** “+” means that microorganisms are found.

Table 2. Disinfecting efficiency of TAA solutions in relation to surface microflora of carcasses contaminated with S. typhimurium (n = 10)

| Cooling time, min | Indicators | Control | Concentration of TAA solutions, % |
|------------------|------------|---------|----------------------------------|
|                  |            |         | 0.005   | 0.01    | 0.02    | 0.03    |
| 25               | QMA&OAMO, CFU/cm³ | (4.6±0.11)·10⁶ | (4.5±0.14)·10⁴ | (1.3±0.06)·10³ | (1.8±0.08)·10² | <10     |
|                  | Coli/cm³  | 10⁵     | 10³     | 10¹     | —        | —       |
|                  | Salmonella/25 cm³ | +        | +        | +        | —        | —       |
| 35               | QMA&OAMO, KOE/cm³ | (4.5±0.12)·10⁶ | (7.1±0.15)·10³ | (8.3±0.38)·10² | (1.2±0.05)·10² | <10     |
|                  | Coli/cm³  | 10³     | 10¹     | —        | —        | —       |
|                  | Salmonella/25 cm³ | +        | +        | —        | —        | —       |
| 40               | QMA&OAMO, CFU/cm³ | (3.9±0.16)·10⁶ | (4.3±0.13)·10³ | (6.5±0.31)·10² | (9.1±0.33)·10¹ | <10     |
|                  | Coli/cm³  | 10³     | 10¹     | —        | —        | —       |
|                  | Salmonella/25 cm³ | +        | +        | —        | —        | —       |

TAA solutions of 0.01% concentration contribute to a decrease in microbial contamination (QMA&OAMO) in 25 minutes to (1.3±0.06)·10³ CFU/cm³; however, they do not inactivate salmonella and coliforms. With an increase in the cooling time (35 and 40 min), QMA&OAMO on the surface of carcasses decreases to (8.3±0.38)·10²–(6.5±0.31)·10² CFU/cm³, salmonella and coliforms were not isolated in any of the studied cases.

TAA solutions of 0.02% concentration reduce QMA&OAMO in 25-40 min to (1.8±0.08)·10²–(9.1±0.33)·10¹ CFU/cm³; solutions of 0.03% concentration, respectively, reduce QMA&OAMO to single colonies. These cooling modes ensure inactivation of Salmonella and coliforms on carcasses.
Next, the organoleptic and physicochemical characteristics of the carcasses, as well as the organoleptic assessment of the broth (transparency, aroma), prepared from poultry meat, cooled in the usual way and in TAA solutions, were investigated (Table 3).

As can be seen from the table, organoleptic microscopic and physicochemical studies of meat, as well as organoleptic assessment of broth (transparency, aroma), prepared from poultry meat, cooled in the usual way and in TAA solutions, revealed no significant differences. However, in the carcasses cooled in the TAA solution, in comparison with the control, a slight change in the color of the surface of the carcasses and internal fat is noted—their color becomes paler.

**Table 3.** Quality indicators of broiler chicken carcasses cooled in tap water and in 0.02% TAA solution (n=10)

| Indicators                                           | Control (cooling in tap water)                       | Experimental (cooling in TAA solution) |
|------------------------------------------------------|-----------------------------------------------------|---------------------------------------|
| Appearance and color of carcass surface              | Dry, whitish yellow with a pink tint                 | Dry, whitish-yellowish color, the surface of the carcasses is paler in comparison with the control ones, there is a whitening effect |
| subcutaneous and internal adipose tissue             | Yellow color                                         | Whitish yellow                        |
| serous membrane of the abdominal cavity              | Wet, shiny                                           | Wet, shiny                            |
| muscles in the cut                                   | Slightly damp, does not stain filter paper, pale pink in color | Slightly damp, does not stain filter paper, pale pink in color |
| Microscopy                                           | No traces of muscle tissue decay, microflora was not detected | No traces of muscle tissue decay, microflora was not detected |
| Smell                                                | Specific, characteristic of this type of bird        | Specific, characteristic of this type of bird |
| Broth                                               | Transparent, fragrant                                | Transparent, fragrant                 |
| Mass fraction of volatile fatty acids, mg KOH/g fat* | 2.03±0.05                                            | 2.04±0.06                             |
| Peroxide number of fat, mol (1/g O2)/kg*             | 1.82±0.08                                            | 1.84±0.09                             |
| Acid number of fat, mg KOH/g fat*                    | 0.15±0.007                                           | 0.15±0.007                           |
| Concentration of hydrogen ions, pH*                  | 6.0±0.19                                             | 6.0±0.21                             |

At the final stage of the research, the presence of residual amounts of PAA on the surface of the carcasses was determined after 1 and 6 hours of storage after they were cooled in a 0.02% solution of TAA (Table 4).

Evidently from Table 4, in washes from carcasses 1 hour after they were cooled in TAA solution, the residual amount of PAA was 23.7±1.12 mg/l; after 6 hours of storage in washes from carcasses, the presence of peracetic acid on them was not established.
Table 4. Presence of residual amounts of PAA on the surface of poultry carcasses after cooling in 0.02% TAA solution (n=10)

| Content of TAA in water,% (by PAA) | Residual amount of PAA in washings from carcasses after cooling, mg/l * | Extraneous odor on carcasses after cooling |
|-----------------------------------|-------------------------------------------------------------------------|------------------------------------------|
|                                   | After 1 hour | After 6 hours | After 1 hour | After 6 hours |
| 0.02                              |             |              |              |              |
|                                   | 23.7±1.12*  | –            | –            | –            |

4. Conclusions
To control the contamination of the cooling medium and prevent microbial contamination of the surface of poultry carcasses in cooling baths (exposure of 25-40 min), it is recommended to use 0.01% solutions of HIT AseptoDes.

To reduce microbial contamination and to decontaminate the surface of carcasses from Salmonella, it is recommended to use the solutions of the agent with a concentration of 0.02% (25 min) and 0.01% (35–40 min).

The quality indicators of the meat of carcasses cooled with solutions of the studied product, in comparison with the carcasses cooled in tap water, do not differ significantly, except for the acquisition of the surface of the carcasses of a paler color and meet the requirements of GOST 31962-2013 [9]. It was found that after 6 hours of storage, the presence of a residual amount of peracetic acid in washes from carcasses was not detected.

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