EVALUATION OF THE PORK QUALITY AND SAFETY INDICATORS IN VARIOUS STAGES OF THE ECHINOCOCCUS LARVAL CYSTS AFFECTION

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Abstract. Food quality and safety are important criteria for state security. One of the dangerous factors is the contamination of the products of slaughter of pigs by the echinococcus larvae. Meat and other products of slaughter, obtained from animals affected by echinococcus larvae, are potential sources of food poisoning in humans.

The material for the study was the samples of the longest back muscle from 10 pig carcasses, depending on the intensity of the damage to the liver of the echinococcus larvae.

It was found that significantly (p≤0.05) more than 10,9 % were moisture, 118 % – the number of microorganisms and 22,5 %, 21,4 %, 2,33 % – the pH value in pork at high intensity of invasion. However, the dry matter content was significantly (p≤0,05) lower by 28,0 % in pork with a high intensity of invasion.

According to other indicators of chemical composition, a tendency to an increase in the content of protein, fat and oxyproline, and a decrease in the content of tryptophan, and a protein-quality indicator in pork during intensive invasion were established.

Samples of pork taken from the carcasses of pigs with different intensity of echinococcosis invasion were contaminated by staphylococcus, Salmonella and Escherichia.

Key words: pork, echinococcosis, quality, safety, methods of determination

Relevance. Quality and safety of food products are important safety criteria for any state. Experts believe that the health of a person depends on the health system only by 8–12 %, 20–25 % – on the environment, and 18–20 % on genetic factors, but the main part – 52–55 % – on the socio-economic conditions and lifestyle, where the nutrition is one of the decisive components of this aspect [1].

Today, animal husbandry development is one of the promising and strategically important branches of Ukraine. Livestock products are the most demanded by the domestic
consumer. However, this market does not receive any state support and, as a result, stability. Insufficient quality of the functioning of the technical and technological systems in pig farming leads to overage of feed during the production of pork, which necessitates modeling of the feed conversion into livestock products; and by improving the quality of functioning of the technical and technological systems in pig farming one can improve the quality of pork [2].

Thus, it is necessary to ensure the quality of the food products, which, due to the stability of the composition and consumer properties during the shelf life, can meet human's needs in energy, nutrients and aromatics. Quality assurance, including the safety of food products for human life and health, is, above all, a lack of risk for genetic, pathological and other changes in the body [3].

In the Law of Ukraine "On Basic Principles and Requirements for the Safety and Quality of Food Products", Article 36 specifies basic rules for the circulation of food products; in particular, it states that whole carcasses or parts of carcasses of artiodactyls or other ungulates, can be sold on agro-food markets after the confirmation of their suitability by the results of tests (studies) of an accredited laboratory located at this agro-food market, made by a public inspector working on the same market [4].

One of the most dangerous factors is the affection of the pork slaughter products with echinococcus larval cysts. Meat and other slaughter products, obtained from echinococci affected animals, are a potential source of food poisoning of people. Slaughter products obtained from affected animals should be sent to bacteriological studies to exclude contamination by their pathogenic microflora, and their sanitary assessment should be made depending on the results obtained [5].

**The aim of the study** is to study the quality and safety of the pork samples depending on the degree of the affection of liver with larval cysts of echinococci.

**Materials and research methods.** Materials for the research were samples of the longest muscle in the back of 10 carcasses of pigs subjected to examinations in the accredited laboratory of the agro-food market. Tests were carried out in accordance with the "Rules of pre-slaughter veterinary inspection of animals and veterinary and sanitary examination of meat and meat products" [6].

To determine the degree of the meat freshness they conducted organoleptic studies according to GOST 7269-2015 [7]. During the organoleptic study of meat, a special attention was paid to the appearance, smell, color, consistency of muscle tissue on the surface and in the cutting area, the state of the fat and tendons, the transparency of the broth; and
conducted tasting evaluation of this pork.

When determining the intensity of the liver infestation with echinococci, a qualitative method for determining the level of infestation intensity, developed by I. S. Goncharuk [8], was used. The liver, obtained from infested animals, was subjected to helminthic post-mortem examination. The affected parts of the liver were rejected and weighed. The difference between the weight of the liver and the rejected parts determined the intensity of the affection, which was conventionally shown in quarters to the liver, namely:

1 – affected less than 1/4 of the liver with echinococci means low intensity of the affection (experimental 1);

2 – affected ¼ – ½ of the liver – a medium intensity of the affection (experimental 2);

3 – affected less than 3/4 of the liver, or the whole liver – a high intensity of the affection (experimental 3);

Meat obtained from healthy animals was a control group.

The following physical and chemical parameters were determined: pH of meat, reaction with copper sulfate in broth, reaction to peroxidase, ammonium salt, amount of the amino-ammonia nitrogen [9,10].

The moisture content in the meat from pig carcasses was evaluated by drying in a drying cabinet at a temperature of 150±2°C, according to DSTU ISO 1442:2005; ash – by an accelerated method of mineralization in a muffle furnace; protein – by Keldal mineralization method according to GOST 25011-2017, fat – in Soxhlet apparatus according to DSTU ISO 1443:2005; tryptophan – by hydrolysis, oxyproline – according to GOST 23041-78. The protein-quality index was determined basing on the ratio of tryptophan to oxyproline [11, 12, 13, 14, 15].

Bacteriological studies were carried out in accordance with GOST 21237-75 and DSTU EN 12824:2004 [16, 17].

**Research results and discussion.**

Results of the organoleptic evaluation of pig carcasses show that carcasses obtained from healthy and infested animals differ in their quality indicators. The meat obtained from healthy pigs had better organoleptic characteristics: muscle tissue had a light pink color; elastic consistency; a well-defined, pleasant, characteristic pork scent; the cutting surface is dense, shiny, moderately moist, elastic; the fat is shiny, solid, white; broth has pleasant flavoring properties; fatty balls were of the same size and were evenly distributed over the broth surface.

Organoleptic study of a pork meat at various degrees of echinococcosis showed: for a low degree of infestation - meat of a light pink color, a good draining of blood, the consistency is dense, the smell of meat is pleasant, tendons are elastic, white, shiny, the
broth is transparent with pleasant scent; for a medium degree of infestation – meat of a light pink color, fat with a yellowish tinge, a consistency is dense, a specific pleasant smell, a good draining of blood, the broth is slightly misty with a pleasant aroma; for a high degree of infestation – red meat, dense consistency, fatty tissue of a yellow color, a degree of draining of blood is satisfactory, the broth contains flakes, the fragrance is weakly pronounced.

The aroma of the meat (Table 1) from pigs of experimental groups was pleasant, quite pronounced, the score ranged from 5,6 to 8,1 points.

1. Tasting evaluation of meat and broth of the experimental groups of pigs, M±m, n=3

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Animals groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>control</td>
</tr>
<tr>
<td>Appearance</td>
<td>8,3±0,45</td>
</tr>
<tr>
<td>Aroma</td>
<td>8,2±0,26</td>
</tr>
<tr>
<td>Taste</td>
<td>8,3±0,36</td>
</tr>
<tr>
<td>Succulence</td>
<td>8,6±0,15</td>
</tr>
<tr>
<td>Tenderness</td>
<td>8,3±0,20</td>
</tr>
<tr>
<td>Total score</td>
<td>8,2±0,15</td>
</tr>
</tbody>
</table>

Note * p≤0,05 – compared to the control, 1 and 2 experimental groups

According to the indicators left, it was found that the meat of the control group had better organoleptic parameters than experimental ones, namely, there was a probable difference (p≤0,05) between the indicators of appearance, aroma, taste and the overall assessment between the third experimental group and other experimental and control groups.

2. Physical and chemical indicators of pork, M±m, n=3

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Animals groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>control</td>
</tr>
<tr>
<td>Number of microorganisms observed</td>
<td>not found</td>
</tr>
<tr>
<td>Reaction with CuSO₄</td>
<td>-</td>
</tr>
<tr>
<td>pH</td>
<td>5,37±0,03</td>
</tr>
<tr>
<td>Reaction to peroxidase</td>
<td>blue-green color</td>
</tr>
<tr>
<td>Amino-ammonia nitrogen content, mg</td>
<td>1,22±0,04</td>
</tr>
<tr>
<td>Reaction to NH₃</td>
<td>-</td>
</tr>
</tbody>
</table>

Note * p≤0,05 – compared to the control and 2 experimental group
° p≤0,05 – compared to the 1 experimental group.
It follows from the table that a probable (p≤0,05) increase in the number of microorganisms by 118% in the microscope field of view in the third experimental group was detected, compared with the second one. In this case, rod-shaped microorganisms prevailed, indicating the lifetime penetration of microorganisms to muscle tissue. The pork pH of the third experimental group was also significantly higher (p≤0,05) higher by 22.5%, 21.4%, 2.33% compared to the control group, the first experimental group and the second experimental group, respectively.

The remaining physical and chemical indicators ensure compliance with current requirements.

Based on the results presented in Tables 1 and 2, we concluded that the chemical composition of pork should be determined by comparing the control and the third experimental group (Table 3).

### Table 3. Chemical composition of the pork, %, M±m, n=3

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Control group</th>
<th>Experimental 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>71.8±2.50</td>
<td>79.6±2.15*</td>
</tr>
<tr>
<td>Dry matter</td>
<td>28.2±1.23</td>
<td>20.3±1.87*</td>
</tr>
<tr>
<td>Ash</td>
<td>1.20±0.45</td>
<td>1.25±0.28</td>
</tr>
<tr>
<td>Protein</td>
<td>17.4±2.35</td>
<td>23.8±2.27</td>
</tr>
<tr>
<td>Fat</td>
<td>2.85±0.24</td>
<td>3.12±0.22</td>
</tr>
<tr>
<td>Tryptophan, mg %</td>
<td>356.2±11.8</td>
<td>323.5±13.2</td>
</tr>
<tr>
<td>Oxiprolin, mg %</td>
<td>68.0±4.0</td>
<td>74.5±2.67</td>
</tr>
<tr>
<td>Protein qualitative index</td>
<td>5.24</td>
<td>4.34</td>
</tr>
</tbody>
</table>

Note * p≤0.05

According to Table 3, it is evident that the moisture indicator of pork in the third experimental group was significantly (p≤0,05) higher by 10.9%, compared with control. At the same time, the dry matter content index was (p≤0,05) lower by 28.0% in pork in the third experimental group compared to the control. Other chemical indicators showed a tendency to increase of the protein, fat and oxiprolinine content; and reduce of the content of tryptophan and protein qualitative index in pork in the third experimental group, as compared to the control.

Indicators of bacterial insemination of pork of different degrees of infestation are shown in Table 4.
4. **Bacterial insemination of pork of different degree of echinococci infestation, M±m, n=3**

<table>
<thead>
<tr>
<th>Isolated microorganisms</th>
<th>Infestation intensity</th>
<th>Control group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td>S. aureus</td>
<td>–</td>
<td>+</td>
</tr>
<tr>
<td>S. enteritidis</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>S. cholera suis</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>E. coli</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

Note: "+" – positive," –" – negative

The research was conducted to find pathogenic microflora in meat samples, namely Escherichia, Staphylococcus, Salmonella and Proteus.

The study found that pig slaughter products contained various microorganisms. As can be seen from Table 4, pork is contaminated with Staphylococcus, Salmonella and Escherichia for the medium and high degree of liver affection with Echinococcus larval cysts.

**Conclusions**

1. Samples of meat, obtained from carcasses of healthy pigs, had better organoleptic parameters than experimental ones.

2. It was found that the moisture value of pork in the third experimental group (p≤0,05) was higher by 10,9% compared to the control. At the same time, dry matter content index was significantly (p≤0,05) lower – by 28,0% in pork of the third experimental group, compared to the control. Other chemical indicators showed a tendency to increase in the protein, fat and oxyproline content; and reduce of the content of tryptophan and protein qualitative index in pork of the third experimental group, as compared to the control.

3. Samples of pork obtained from experimental carcasses of pigs have been contaminated with Staphylococcus, Salmonella and Escherichia.

**References**


Ветеринарна медицина, якість і безпека продукції тваринництва

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ОЦІНКА ПОКАЗНИКІВ ЯКОСТІ І БЕЗПЕЧНОСТІ СВІНИНИ ЗА РІЗНОГО СТУПЕНЯ УРАЖЕННЯ ЛАРВОЦИСТАМИ ЕХІНОКОКІВ.
С. А. Ткачук, І. В. Забарна, І. С. Пасочник, Д. В. Чуприна

Анотація. Якість і безпека продуктів харчування є важливими критеріями безпеки держави. Одним з небезпечних чинників є ураження продуктів забою свиней ларвоцистами ехінококів. М’ясо та інші продукти забою, отримані від уражених продуктів ехінокока тварин, є потенційним джерелом харчових отруєнь людей. Матеріалом для дослідження слугували зразки найдовшої м’яза спини від 10 туш свиней, в залежності від інтенсивності ураження печінки ларвоцистами ехінококу.

Встановили, що вірогідно (р≤0,05) більшими на 10,9 % були показники вологи, на 118 % – кількість мікроорганізмів і на 22,5 %, 21,4 %, 2,33 % – значення рН в свинині за високої інтенсивності інвазії. Разом з тим, показник вмісту сухої речовини був вірогідно (р≤0,05) нижчим на 28,0 % в свинині за високої інтенсивності інвазії.

Загідними показниками хімічного складу встановили тенденцію до підвищення вмісту протеїну, жиру та оксипроліну та зменшення вмісту триптофану та білково-якісного показника в свинині за інтенсивності інвазії.

Зразки свинини відібрани від туш свиней з різною інтенсивністю інвазії ехінококозом контаміновані стафілокооками, сальмонелами та ешеріхіями.

Ключові слова: свинина, ехінококоз, якість, безпекість, методи визначення

ОЦЕНКА ПОКАЗАТЕЛЕЙ КАЧЕСТВА И БЕЗОПАСНОСТИ СВИНИНЫ ПРИ РАЗЛИЧНОЙ СТЕПЕНИ ПОРАЖЕНИЯ ЛАРВОЦИСТАМИ ЭХИНОКОККА.
С. А. Ткачук, И. В. Забарная, И. С. Пасочник, Д. В. Чупрына

Аннотация. Качество и безопасность продуктов питания являются важными критериями безопасности государства. Одним из опасных факторов является поражение продуктов убоя свиней ларвоцистами эхинококов. Мясо и другие продукты убоя, полученные от пораженных ларвоцистами эхинококков, являются потенциальными источниками пищевых отравлений людей.

Материалом для исследования послужили образцы длиннейшей мышцы спины от 10 туши свиней в зависимости от интенсивности поражения печени ларвоцистами эхинококка.

Установлено, что достоверно (р≤0,05) больше на 10,9 % были показатели влаги, на 118% – количества микроорганзмов и на 22,5 %, 21,4 %, 2,33 % – значение рН в свинине при высокой интенсивности инвазии. Вместе с тем, показатель содержания сухого вещества был достоверно (р≤0,05) ниже на 28,0 % в свинине при высокой интенсивности инвазии.

По другим показателям химического состава установили тенденцию к повышению содержания протеина, жира и оксипролина, и уменьшение содержания триптофана, и белково-
Ткачук С. А., Забарна І. В., Пасочник І. С., Чуприна Д. В.
качественного показателя в свинине при интенсивной инвазии.

Образцы свинины отобраные от туши свиней с разной интенсивностью инвазии эхинококкозом были контаминированы стафилококками, сальмонеллами и эшерихиями.

Ключевые слова: свинина, эхинококкоз, качество, безопасность, методы определения