EVALUATION OF THE SANITARY AND HYGIENIC CHARACTERISTICS OF CHICKEN MEAT AND SEMI-FINISHED PRODUCTS

ANNOTATION

This article presents research on sanitary and bacteriological evaluation of the quality of semi-finished chicken meat and whole chicken carcasses sold in Kostanay. The quality of products was evaluated by organoleptic, biochemical and bacteriological indicators. A total of 32 samples were analyzed, including whole chicken carcasses of domestic poultry and industrial chicken carcasses, as well as semi-finished chicken products (shank, thigh, wings on a substrate). During organoleptic and biochemical analysis of the quality of the samples 5 samples did not meet the requirements of normative documents. Sanitary and bacteriological examination showed excess of total microbial contamination. In a sample of imported semi-finished products the presence of Bacteroidetes was detected. Salmonella and L. monocytogenes bacteria were identified in two samples of domestic chicken. In order to facilitate faster identification of pathogens in food, chromogenic selective media were used, which have a high sensitivity and facilitate their identification. Due to the presence of markers of specific enzymatic activity, the colonies of the bacteria in question are stained with a characteristic colour and the growth of extraneous microflora is inhibited. The use of modern nutrient media saves time for routine laboratory tests.

Key words: sanitary and hygienic assessment, chicken meat, semi-finished products, bacteria, microbiological tests.

Introduction. Meat has always been present in the human diet [1,2]. Scientists believe that meat consumption by early upright primates such as the Australopithecines played a crucial role in the evolution of the human brain. The high protein and nutrient content of meat allowed the development of a larger and more complex brain, which in turn led to the emergence of Homo erectus and ultimately Homo sapiens [3,4].

Poultry meat, especially chicken, is a good source of nutrition. It is rich in protein, which is important for building and repairing body tissues. Chicken also contains essential amino acids, which are the building blocks of protein. It is low in fat and is a good source of B vitamins such as niacin and vitamin B6. This meat is also a good source of minerals, including phosphorus, selenium and zinc [5].

It is important to note that the nutritional value of poultry can vary depending on how it is cooked. For example, a chicken breast without skin and bones is less fatty and contains fewer calories than a chicken that still has skin and bones. Cooking chicken using methods such as grilling, baking or boiling also retains more nutritional value compared to deep-frying or eating it in highly processed forms. It is also worth noting that poultry meat is a good source of iron for vegetarians and vegans. Iron from animal sources is haemic iron, which is easier for the body to absorb than non-haemic iron of plant origin. Poultry meat, especially chicken, is one of the most popular meats consumed worldwide. It is a
relatively inexpensive and versatile source of protein, widely available in most countries. According to the Food and Agriculture Organization of the United Nations (FAO), global poultry meat production reached almost 140 million tonnes in 2019, making it the most produced meat in the world [6].

Chicken is considered easy to prepare because it is a versatile meat that can be cooked in many different ways, such as grilling, roasting, braising and boiling. It can also be seasoned with various herbs, spices and marinades, allowing for a variety of dishes. Since chicken is relatively inexpensive and widely available a lot of people are often inclined to buy this type of meat [7].

Poultry meat, especially chicken, is a popular product among young people because it is often considered a healthy and affordable source of protein. Chicken is also versatile and can be cooked in a variety of ways, making it a popular choice for dishes. In addition, poultry is often perceived as a more humane meat production option compared to other options such as beef or pork.

In addition to food, poultry is also used for other purposes. For example, birds’ feathers are used to make pillows and blankets, and bird droppings are used as fertiliser in agriculture.

Relevance. Poultry farming is an important industry in Kazakhstan, with chickens being the most common poultry species. The industry has seen significant growth in recent years, driven by increased domestic demand for poultry meat and eggs. There are a number of large modern poultry farms in the country, as well as many small-scale poultry farmers.

The Kazakh government actively promotes the poultry industry through initiatives such as providing subsidies and loans to farmers and supporting the construction of new poultry farms.

Poultry meat is a popular food source in Kazakhstan and its consumption has been increasing in recent years. The increase in poultry meat consumption in Kazakhstan can be explained by several factors. One of the main reasons is cheapness along with other types of meat, which has led to an increased demand for poultry meat specifically as a cheap source of protein.

Poultry meat, like any other meat, can contain dangerous bacteria if it is not transported, stored, or cooked correctly. Some of the most common bacteria that can develop in this type of meat include:

- **Salmonella**: these bacteria can cause food poisoning and symptoms such as diarrhea, vomiting, fever and stomach cramps [8, 17].
- **Campylobacter**: this bacterium can also cause food poisoning and salmonella-like symptoms [9].
- **Escherichia coli (E. coli)**: these bacteria can cause severe diarrhea, stomach cramps and fever [10].
- **Listeria**: This bacterium can cause listeriosis, a serious infection that can lead to severe illness or even death, especially in pregnant women, newborns, the elderly and people with weakened immune systems [11].
- **Staphylococcus aureus**: these bacteria can cause food poisoning and symptoms such as nausea, vomiting and stomach cramps [12].

Although Kazakhstan produces meat products of good quality and implements systems such as HACCP and ISO, infectious poisonings, especially among the young population of the country from poor-quality meat do not disappear [14]. Therefore, due to the increase in poultry meat production, continuous monitoring of the condition of the final product is necessary [18] as it can fatally affect the health of the nation.

The purpose of this study was to assess the sanitary and hygienic indicators of chicken meat and semi-finished products sold in retail outlets in Kostanay.

The objective of the study was to conduct organoleptic, physico-chemical and microbiological analysis of chicken carcasses, as well as semi-finished products for compliance with the parameters established in TR EEC 051/2021 and TR CU 021/2011.

Materials and methods. The work on this article was carried out in the microbiology laboratory of KRU named after A. Baitursynov, as well as during the scientific internship on the basis of Kostanay regional branch of RSE "Republican Veterinary Laboratory” in the department of food safety.

Object of study: 15 samples of domestic and imported chicken carcasses, 5 domestic chicken carcasses, 12 types of semi-finished poultry meat. The samples were taken during 2022 from different retail outlets of Kostanay city.

Sampling and preparation for research was carried out in accordance with GOST 7702.2.0-2016 "Poultry slaughter products, semi-finished poultry meat products and objects of surrounding production environment" and GOST ISO 7218-2015 "Microbiology of food products and animal feed. General requirements and recommendations for microbiological tests".
Organoleptic and physico-chemical studies were conducted in accordance with GOST31470-2012 "Poultry meat, poultry by-products and semi-finished products. Methods of organoleptic and physico-chemical research".

Microbiological tests were carried out in accordance with regulatory documents: GOST 31468-2012 "Poultry meat, poultry by-products and semi-finished products. Salmonella detection method", GOST 32031-2012 "Methods for detection of Listeria monocytogenes bacteria".

A total of 32 samples of domestically and commercially produced chicken carcasses and semi-finished chicken meat were analysed and assigned sequential numbers to the samples. Samples were taken from the samples by cutting out pieces of tissue. Sampling was carried out in accordance with GOST 7702.2.0-2016.

The organoleptic compliance studies were carried out according to the following criteria: appearance, surface colour, skin condition, muscle on cut, consistency, odour, transparency and flavour of the broth. Physico-chemical indicators included pH and Nessler reaction.

All samples were examined for microbiological indicators in accordance with the Technical Regulation of the Eurasian Economic Union "On safety of poultry meat and poultry products" (TR EEU 051/2021) and the Technical Regulation of the Customs Union "On food safety"(TR CU 021/2011).

Samples were tested for the presence of coliforms, BECG, Salmonella and L. monocytogenes bacteria

The nutrient media used in the study were: Fraser medium, BPW (buffered peptone water), PALCAM agar, Yeast tryptone-soya agar, Oxford agar, RVM (Rapport-Vassiliadis medium), BSA (bismuth-sulphite agar).

Modern chromogenic media were used for the detection and rapid identification of pathogens: Listeria chromogenic agar (ALOA-agar) and Salmonella chromogenic agar.

Melted nutrient agar was used for the cultivation of coliforms (mesophilic aerobic and facultative anaerobic micro-organisms). By seeding a diluted sample of the product into the nutrient medium, the cup with the sample is placed in a thermostat at t=37°C for 24 hours. The colonies grown are then counted.

To determine the presence of coliforms, tubes of selective enrichment medium were used, in which a dilution of a product suspension was added and incubated at t=37°C for 24 hours. Afterwards, transplantation into Endo medium from tubes in which gas formation was detected was performed. The formation of red colonies on Endo medium indicates the presence of coliform bacteria.

The detection of L. monocytogenes bacteria was carried out in 3 stages. The first stage was primary enrichment of the sample in liquid medium with a reduced concentration of selective components (semi-concentrated Fraser broth) at t=30°C for 24 hours. Secondary enrichment of the seed obtained from the semi-concentrated broth was transferred into medium with a full concentration of selective components (Fraser broth) at t=37°C for 24 hours. Next, inoculations were performed on PALCAM-agar and chromogenic Listeria agar (ALOA-agar) media and cultured at t=37°C for 24 hours.

On PALCAM medium, small greyish-green or olive-green colonies with a black halo of 1 to 1.5 mm diameter, sometimes with a black centre, consistent with the culture properties of the genus Listeria, are formed after 24 hours of incubation.

Modern chromogenic nutrient media were used in the microbiological study. In this case, Chromocult Listeria Selective Agar, Base acc. Ottaviani and Agosti - ALOA-agar. This medium contains inhibitors that inhibit the growth of associated Gram-positive and Gram-negative bacteria as well as yeasts and fungi. Listeria has β-D-glucosidase enzyme activity, which allows the presence of this bacterial species on nutrient media to be detected with the naked eye. On ALOA-agar L.monocytogenes form blue-green colonies when interacting with the chromogenic substrate.

In addition, transplantation from PALCAM agar to Oxford and Yeast tryptone-soya Agar was carried out to confirm the presence of this species of bacteria in the samples. Oxford is incubated at t=35°C for 48 hours and L. monocytogenes forms brownish green colonies with a black halo and on Yeast trypton-soya Agar at t=30°C and incubated for 24 hours, colonies of Listeria appear solid white or iridescent white, resembling broken glass. Colonies of other microorganisms are yellowish or orange. Gram stained smears were microscopically examined.

According to GOST 31468-2012 to determine Salmonella bacteria in poultry meat and semi-finished products initially 25g of sample was placed in 225 ml of peptone buffered water (PBW) was cultured at t=37°C for 24 hours. Next, selective enrichment was performed on RVM (Rapport-Vassiliadis medium) at t=42°C for 24 hours. If the RVM became discoloured or cloudy and opalescent, the presence
of Salmonella bacteria was detected by crossing onto bismuth sulphite agar (BSA) as well as onto chromogenic Salmonella agar. On bismuth sulphite agar the cultures were cultured for 24 hours at $t=37^\circ\text{C}$. Growth manifested as the presence of round, black colonies, with a shiny area around them, 1.0-3.0 mm in diameter; the medium under the colonies was stained black, indicating the presence of bacteria of the genus Salmonella. Gram stained smears were microscopically examined.

The identification of the genus Salmonella with Salmonella Chromogenic Agar consists of a combination of two chromogenic substrates: X-gal and Magenta-caprylate. X-gal is in the medium for imaging microorganisms capable of synthesizing the enzyme $\beta$-D-galactosidase. When the enzyme is present in the medium, blue-green colonies are formed. The purple colonies are due to hydrolysis of Magenta-caprylate by Salmonella genus, which cannot break down the other chromogenic substrate. The bacteria were cultured at $t=37^\circ\text{C}$ for 24 hours.

**Research results.** During organoleptic and physico-chemical examination five samples out of 32 had deviations according to the indicators established by GOST 31470-2012. The results are shown in Table 1.

Table 1—Results of organoleptic and physico-chemical testing of samples

<table>
<thead>
<tr>
<th>Name of indicator</th>
<th>Sample number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>№2</td>
</tr>
<tr>
<td>Appearance</td>
<td></td>
</tr>
<tr>
<td>Surface colour</td>
<td>Yellowish colour with a grey tinge</td>
</tr>
<tr>
<td>Condition of the cover</td>
<td>Clean, free of abrasions, scratches, stains, tears and bruises</td>
</tr>
<tr>
<td>Muscle in section</td>
<td>Wet, slightly sticky, darker colour than fresh</td>
</tr>
<tr>
<td>Consistency</td>
<td>Muscle of medium density, fossa slowly disappears when pressing with finger</td>
</tr>
<tr>
<td>Smell</td>
<td>Specific, peculiar to poultry meat</td>
</tr>
<tr>
<td>The clarity and flavour of the broth</td>
<td>The broth is cloudy, with fine flakes</td>
</tr>
<tr>
<td>pH</td>
<td>6.5</td>
</tr>
<tr>
<td>The Nessler reaction</td>
<td>positive (I)</td>
</tr>
</tbody>
</table>

As can be seen from Table 1, three samples showed deviations in the parameters of organoleptic examination: surface appearance and colour of №2, №31 (had, grayish tint, normal without tint), muscle on section №2, №12, №31 (had damp/sticky surface, normal dry surface), consistency of №2, (when
pressed, the dimple slowly disappeared, while normal, quickly), transparency and smell of the broth № 2, 12, 31 (the broth is turbid with formation of flakes/smell not typical for fresh broth, while normal, clear broth with aromatic smell).

In the physico-chemical examination, an excess of pH was found in the deviation, in samples № 2 (pH=6.5), № 23 (pH=5.9) and № 31 (pH=6.4), while the norm was 6.0-6.4.

The Nessler reaction in samples № 2, № 14 and № 31 showed a colour change in the test tube to orange and the appearance of flakes within 10 minutes, indicating the initial stage of protein degradation.

Thus, organoleptic analysis of 32 samples of chicken meat and semi-finished products revealed deviations in five samples: № 2 (domestic chicken), № 12 (semi-finished chicken), № 14 (imported chicken), № 23 (semi-finished domestic chicken), № 31 (domestic chicken).

The results of the sanitary-bacteriological examination are shown in Table 2.

### Table 2 – Results of sanitary and bacteriological examination of poultry meat

<table>
<thead>
<tr>
<th>Sample number</th>
<th>CMAFANM, CFU/g max.</th>
<th>BECG, in 1g/cm³ (coliforms)</th>
<th>L.monocytogenes at 25g</th>
<th>Salmonella at 25g</th>
</tr>
</thead>
<tbody>
<tr>
<td>TR EEU 051/2021, TR CU 021/2011</td>
<td>Chickens, unpacked, chilled-1*10⁴</td>
<td>Not allowed</td>
<td>Not detected</td>
<td>Detected</td>
</tr>
<tr>
<td></td>
<td>Packed chilled, frozen carcass - 5*10⁵</td>
<td>Not allowed</td>
<td>Not detected</td>
<td>Not allowed</td>
</tr>
<tr>
<td></td>
<td>Semi-finished meat and bone products, without breading-1*10⁶</td>
<td>Not allowed</td>
<td>Not detected</td>
<td>Not detected</td>
</tr>
<tr>
<td>№2</td>
<td>1.6*10⁴</td>
<td>Not detected</td>
<td>Not detected</td>
<td>Detected</td>
</tr>
<tr>
<td>№12</td>
<td>1.4*10⁶</td>
<td>Not detected</td>
<td>Not detected</td>
<td>Not detected</td>
</tr>
<tr>
<td>№14</td>
<td>5.8*10⁵</td>
<td>Detected</td>
<td>Not detected</td>
<td>Not detected</td>
</tr>
<tr>
<td>№23</td>
<td>1.3*10⁶</td>
<td>Not detected</td>
<td>Not detected</td>
<td>Not detected</td>
</tr>
<tr>
<td>№31</td>
<td>1.8*10⁷</td>
<td>Not detected</td>
<td>Detected</td>
<td>Not detected</td>
</tr>
</tbody>
</table>

According to Table 2, the examination of the samples revealed an exceedance of the established standard of CMAFANM in all five samples. The excess in samples №2 and №31 was 1.6*10⁴ CFU/g and 1.8*10⁷ CFU/g respectively (for chilled unpackaged carcasses it is allowed not more than 1*10⁴ CFU/g), sample № 12 and № 23 1.4*10⁶ - CFU/g and 1.3*10⁶ CFU/g (for semi-finished products no more than 1*10⁶ ), sample № 14 5.8*10⁴ CFU/g (for frozen, packaged carcasses no more than 5*10⁴).

When tested for coliforms, gas was detected in test tube №14. A crimson-red coloured colony formation was observed when transferred to Endo medium. Microscopy revealed Gram-negative, bacilliform bacteria.

Bacteria of the genus L..monocytogenes were detected in sample №31 (domestic chicken carcass). The growth of olive green colonies with a black halo was observed on PALCAM agar. To further confirm the presence of Listeria in the sample, transplantation from PALCAM agar to Oxford agar and Yeast trypton-soya agar was performed. After culturing on Oxford agar, brownish green colonies with a black halo were formed, while colonies on Yeast trypton-soya agar were iridescent white, which is characteristic of L.monocytogenes. Gram-positive, small, motile bacilli were detected in the smears. Thus, based on the bacteriological examination, bacteria of the genus Listeria were detected in sample № 31.

Blue-green colonies were detected on chromogenic agar, confirming that they belonged to the genus Listeria.

Salmonella bacteria were detected in sample № 2 (domestic chicken carcass). A discolouration of the medium was observed when these samples were transferred to Rappaport-Vassiliadis medium. To confirm whether these cultures belonged to the genus Salmonella, they were transferred in parallel to BSA (bismuth sulphite agar) and chromogenic Salmonella agar. Black colonies with a black halo were detected on bismuth sulphite agar, indicating that the bacteria belonged to the genus Salmonella. Microscopy revealed Gram-negative bacilli with rounded ends.

A purple coloured colony growth was detected on chromogenic Salmonella agar, identifying the presence of bacteria of the genus Salmonella.
Conclusion. Thus, based on the sanitary-bacteriological examination of 32 samples of chicken carcasses and semi-processed products, five samples showed an excess of the total microbial count. The significant microbial contamination is probably due to improper sale and storage of these products. The presence of opportunistic and pathogenic microflora accounted for 9.3% of the total number of samples tested. The use of chromogenic nutrient media made it possible to detect bacteria and immediately identify them on the basis of their unique enzymatic activity, rather than relying solely on the ability of bacteria to grow in the presence of certain antibiotics or nutrients. Specific substrates contained in the chromogenic media are broken down by the bacteria and lead to the formation of different coloured colonies. This allows a faster and more accurate identification of bacteria. The use of chromogenic media also eliminates the need for sample microscopy and therefore saves some time.

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ТУЙІН

Бұл мақалада Қостанай қаласында сатылатын тауық еті мен тұтас тауық етінің жартылай фабрикаттардың сапасын санитарлық-бактериологиялық бағалау ұсынылған. Өнімнің сапасы органолептикалық, биохимиялық және бактериологиялық көрсеткіштер бойынша бағаланды. 32 сынама алынды, оның ішінде тұтас құс еті мен өнеркәсіптік өндірілген тауық еті, сондай-ақ жартылай өңделген тауық еті (барабан таяқшасы, жамбас, субстраттағы қанаттар). Іріктелген үлгілердің сапасын органолептикалық және биохимиялық зерттеу барысында 5 сынама нормативтік құжаттардың талаптарына сәйкес келмеді. Санитарлық-бактериологиялық зерттеу кезінде жалпы микробтық тұқымның асып кетуі анықталды. Импорттық өндірістің жартылай фабрикатының сынамасында ИТТБ бар екендігі анықталды. Үйдегі тауықтың екі сынамасында Salmonella және L.monocytogenes тұқымдас бактериялар анықталды. Азық-түлік әрекеттері патогендерді тезірек қарастыру үшін жоғары сезімталдыға ие және оларды анықтауды едәуір жеңілдететін хромогенді селективті орталар қолданылды. Белгілі бір ферментативті белсенділіктің маркерлерінің болуына байланысты қажетті бактериялардың колониялары тән түске боялады, ал сыртқы микрофлораның өсуі тежеледі. Заманауи қоректік орталарды қолдану күнделікті зертхана үнемі ғылыми процесстерін үнеметілді.

РЕЗЮМЕ

В данной статье представлены исследования по санитарно-бактериологической оценке качества полуфабрикатов из мяса кур и цельных куриных тушек, реализуемых в г.Костанай. Оценивали качество продукции по органолептическим, биохимическим и бактериологическим показателям. Анализу было подвергнуто 32пробы, в том числе цельные куриные туши домашней птицы и тушки промышленного производства, а также полуфабрикаты курине (голень, бедро, крыльышки на подложке). В ходе органолептического и биохимического исследования качества отобранных образцов 5 проб имели несоответствия требованиям нормативных документов. При санитарно-бактериологическом исследовании установлено превышение общей микробной обсемененности. В пробе полуфабриката импортного производства было выявлено наличие БГКП. В двух пробах домашней курицы были идентифицированы бактерии рода Salmonella және L.monocytogenes. С целью более быстрой индикации патогенов в пищевом продукте, использовали хромогенные селективные среды, которые обладают высокой чувствительностью и значительно облегчают их идентификацию. Благодаря наличию маркеров специфической ферментативной активности, колонии искомой бактерии окрашиваются в характерный цвет, а рост посторонней микрофлоры ингибируется. Применение современных питательных сред позволяет экономить время на проведение рутинных лабораторных исследований.

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