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Original article

# CREATION OF A COLLECTION OF PATHOGENS OF TOMATO FRUITS IN CENTRAL AND NORTHERN KAZAKHSTAN AND THEIR CULTURAL AND MORPHOLOGICAL CHARACTERISTICS

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## ABSTRACT

This article examines the study of one of the important vegetable crops - tomato, and its position in the country's market. Tomato fruits are rich in nutrients, have pharmacological properties, and their cultivation has a significant impact on the agricultural economy. According to the effect of various factors on the plant, tomatoes are susceptible to diseases that change the quality and taste of fruits. They can be exposed, as well as to local factors of cultivation, and are affected by infectious diseases, which are conditionally divided into bacterial, fungal and viral.

The aim of the study is to identify the main pathogens of tomato fruits in central and northern Kazakhstan and their cultural and morphological characteristics. Creating a collection of pathogens. To achieve these goals, we use such techniques as collecting affected tomato fruits with identified lesions, isolating pathogens of phytopathogens from infected tissues of tomato fruits by the CTAB method of DNA isolation, cultural and morphological characteristics of pathogen strains using microscopy, conducting genetic identification of isolated strains by PCR test and sequencing.

As a result of the study, about 50 tomato fruits from various regions of Kazakhstan were selected, from which 36 samples of pathogens belonging to the genera *Alternaria* spp., *Apiospora* spp. and *Fusarium* spp. were isolated, with characteristic cultural-morphological and physiological-biochemical signs, and molecular genetic identification was carried out, during which the species of *Alternaria* were identified alstroemeriae, *Apiospora sacchari* and *Fusarium equiseti*.

Based on the data obtained, the study of tomato diseases and their pathogens is key to developing effective measures to protect and increase the resistance of this important agricultural plant to infections, which in turn contributes to improving the quality and increasing its production volumes. For a more effective diagnosis of plant diseases, identification of pathogens and their number, we recommend conducting a polymerase chain reaction. This is due to the fact that PCR diagnostics is the most accurate and fastest analysis to identify the pathogen present in the studied materials. This method allows you to determine the presence of the pathogen, even if only a few DNA molecules are present in the sample.

**Keywords**: tomato, diseases, pathogens, *Alternria* spp., *Apiospora* spp., *Fusarium* spp.

## 1. INTRODUCTION

One of the most important vegetable crops in the world is tomato. Under optimal conditions, due to its nutritional qualities, it is cultivated in open and closed ground. Tomato fruits are rich in nutrients, have pharmacological properties, and their cultivation has a significant impact on the agricultural economy. Veronique Bergouni in his article described tomato as an incredible source of important nutrients such as lycopene, beta-carotene and vitamin C, which have a positive effect on human health [1]. According to the effect of various factors on the plant, tomatoes are susceptible to diseases that change the quality and taste of fruits. They can be exposed, as well as to local factors of cultivation, and are affected by infectious diseases, which are conditionally divided into bacterial, fungal and viral.

According to available data, 177,118,248 tons of tomatoes are produced in the world per year. China is the largest producer of tomatoes in the world with a production volume of 56,423,811 tons per year. India ranks second with an annual production of 18,399,000 tons. Kazakhstan ranks 27th in tomato production with a volume of 705,550 tons per year [2]. Due to the natural and climatic conditions, the production and sale of fruits and vegetables in most of Kazakhstan has a pronounced seasonal character, so the bulk of products are sold in the second half of the year. Between 1999 and 2019, the global harvest area increased by 27%, production by 66%, as of 2021. This increase in productivity is the result of research in many areas, in particular, the improvement of tomato varieties through breeding [3].

According to a report published by the Food and Agriculture Organization of the United Nations, more than a third of annual production losses are caused by diseases of vegetable crops. Annual tomato crop losses from viral diseases range from 25% or more. The widespread increase in the area under tomato culture, non-compliance with phytosanitary conditions pose a threat of infection of plants with viral diseases, which threatens the vegetable production of the republic.Tomatoes also produce a large number of important primary and secondary metabolites that can serve as intermediates or substrates for the production of new valuable compounds [4].

The relevance of studying diseases of tomato fruits is due to their wide spread and harmfulness. Today, the needs of society have set an accelerated pace in the rapid development of new directions in agricultural technology. Providing the

population with vegetable raw materials is possible with a significant increase in vegetable production, their yield and a decrease in cases of diseases. Fungal pathogens are a key limiting factor for vegetables, causing a sharp decrease in yields, which leads to serious economic losses [5]. Junjie Ding in his article considered the signs of infection of vegetables with widespread anthracnose, which had a bad effect on the overall harvest [6]. Chamran Hemate in his article spoke about the cytoplasm associated with fruit crops, vegetables, cereals and oilseeds, trees, ornamental plants and weeds, which have recently been growing at an alarming rate [7]. It is known that there are changes in the concentrations of macro- and microelements in the tomato plant when infected with phytoplasma Candidatus solani [8]. Conservation of biological diversity, reproduction of plant resources, creation and expansion of the range of domestic varieties of vegetable crops are a priority for ensuring the country's food independence. Tomato consumption is growing with the growth of the entire consumer market. Demand is growing by an average of 10% per year [8-10].

In addition, knowledge of diseases and the presence of strains will make it possible to analyze measures to combat the incidence of vegetables, in particular tomatoes [11]. In order to develop a system of protective measures and reduce crop damage caused by phytopathogens, it is necessary to study the species composition of pathogens, their cultural, morphological and biochemical properties.

The purpose of the study:Identification of the main pathogens of tomato fruits in central and northern Kazakhstan and their cultural and morphological characteristics. Creating a collection of pathogens.

## 2. MATERIALS AND METHODS

The object of the study was the tomato culture grown in the central and northern regions of Kazakhstan: Akmola region, Karaganda region, Kostanay region, Pavlodar region, North Kazakhstan region and Abai region. We used standard methods of collecting, transporting and storing damaged tomato fruits.

The sampling was carried out using a visual assessment. Fruits with visible external signs of spoilage, such as mold, darkened spots, general deformation of the fruit, unpleasant odor, discoloration of the peel, were selected for the study.

*2.1 Isolation of pathogens from infected tissues of tomato fruits*

Inoculation with a Koch loop on the surface of the nutrient medium in a Petri dish with potato dextrose agar (PDA). A bacteriological loop is used to take the material, then the lid of the Petri dish is slightly opened with the fingertips of the left hand to form a small gap where the loop with the material intake will freely pass. The test material is applied to 3-4 points on the surface of the nutrient medium.

To isolate the pure culture of the pathogens under study, we selected 6 samples of the obtained primary crops based on an external assessment of the growth pattern of pathogens. The isolation of a pure culture was based on the use of the Koch method, a method common in microbiological practice for isolating a pure culture using solid media. The essence of the method is that we obtain a pure culture from a separate colony that grew on a solid nutrient medium as a result of reproduction of a single cell. When applying microorganisms from the seed material, individual cells will be fixed on a solid medium, that is, they will be immobilized at a certain point in the medium, and, multiplying, give offspring of the studied microorganism.

*2.2 Cultural and morphological characteristics*

Sowing was carried out at 3 points on the surface of the nutrient medium of Saburo Agar with dextrose and Chapek-Doxa. The seeding technique was based on the method of isolating pure culture using solid media – the Koch method. A bacteriological loop is used to take material from previously isolated pure cultures, then open the lid of the Petri dish with the fingertips of the left hand to form a small gap where the loop with the introduced material will freely pass.

*2.2 Biochemical signs of microorganisms*

To analyze the physiological and biochemical characteristics of the studied microorganisms, a Gis medium with mannitol, lactose and maltose was used. We have carried out in vitro seeding. Microbial cells are selected by a bacteriological loop and injected into a test tube with an agarized medium. Then, slightly touching the bacteriological loop with the surface of the medium, we inject it by injection.

*2.3 Microscopic studies*

We used the technique of microscopy of unpainted preparations – a crushed drop. A drop of sterile water is applied to the slide. Then a part of the colony is inserted into this drop with a sterile microbiological loop, stirred and covered with a cover glass. The drop with the analyzed material should be such that after pressing it with a cover glass, the suspension does not protrude from under the glass. The drug is viewed under a microscope.

*2.4 Creation of a collection of pathogens*

Based on thedataobtained from the cultures of the mainpathogens of tomatofruitsandtheircharacteristics,weshould have created a collection of pathogens.Tocarry out thiswork, weneeded to carry out sowingon the surface of the mowedagarin a test tube.When sowing the identified cultures of pathogen colonies on sterile mowed agar, the plugs from the test tubes are removed with the right hand with the fifth and fourth fingers, the loop is held in the right hand, sterilized in a flame and allowed to cool. After removing the stopper, the tubes should be held in an inclined position. A loop with a material intake from Petri dishes is inserted into a test tube and lowered to the surface of the nutrient medium, then a stroke is applied from bottom to top with sliding movements.

*2.5 Extraction of fungal genomic DNA*

DNA isolation from the cells of the studied fungi was carried out using a modified CTAB method. The technique is based on the fact that at high concentrations of salts, nucleic acids bind to cetyltriethylammonium bromide and form soluble compounds. With a decrease in the concentration of salts, nucleic acids precipitate. After cell destruction, the proteins are denatured and extracted with a mixture of chloroform and isoamyl alcohol. STAB, or cetyltrimethylammonium bromide, is removed by precipitation with ethanol.

*2.6 DNA concentration measurement*

The nucleic acid concentration was measured using a

Thermo Scientific NanoDrop One spectrophotometer. We determine the «DS DNA» mode, with a single-channel dispenser we add 1 µl of TE buffer to the spout of the spectrophotometer and conduct a Blank. Next, we add 1 µl of DNA sample with a dispenser and count the Measure.

*2.7 Formulation of PCR products*

PCR was performed in the Mastercycler, nexus gradient program using a set of reagents manufactured by Thermo Scientific. BD1 primers were used for amplification. Marker genes were amplified in a reaction mixture with a volume of 25 µl. The mixture consisted of DreamTaq™ Green Master Mix (2X) (Thermo Scientific, USA), 1 picomole of primers and 1 ml of DNA preparation.

PCR with ITS1-F-TCCGTAGGTGAACCTGCGG and ITS4-R-TCCTCCGCTTATTGATATGC was performed under the following thermal cycling conditions: initially, the denaturation stage was 5 minutes at 95 °C, 32 amplification cycles of 30 seconds at 95°C, 55°C for 30 seconds, 72°C for 60 seconds, 10 minutes the elongation stage at 72°S.

PCR with ITS4-F-TCCGTAGGTGAACCTGCGG and ITS5-R-TCCTCCGCTTATTGATATGC was performed under the following thermal cycling conditions: 95°C for 30 seconds, 52°C for 40 seconds, 72°C for 50 seconds, 5 minutes elongation stage at 72°C.

*2.8 Electrophoresis formulation*

The separation of amplification products was carried out by horizontal electrophoresis in 0.8% agarose gel with ethidium bromide (0.5 mcg/ml) using a TAE buffer (1x). The results were identified using the digital imaging system «ChemiDoc MP», «BioRad». A set of reagents «DNA Cycle Sequencing Kit – PCR-401S» was used for the sequencing reaction. The size of the fragments was determined based on the electrophoretic mobility in the agarose gel.

*2.9 DNA sequencing*

To purify PCR fragments, a set of «MinElute PCR Purification Kit» was used, carried out according to the protocol. The products of the sequencing reaction were detected using a DNA analyzer «4300 DNA Analyzer», the results of the nucleotide sequence were carried out using the eSeq V.3.1 program.

## 3. RESULTS

As a result of sampling, 36 affected tomato fruits were selected from the cities of Northern and Central Kazakhstan: Akmola region, Karaganda region, Kostanay region, Pavlodar region, North Kazakhstan region and Abai region (Figure 1).

Sample a: The lesion of the fetus manifests itself in the form of a change in color to white, the appearance of dark spots stretching along the wound site and general rot of the tomato.

Sample b: Fetal lesion manifests itself as the appearance of a black spot with a diameter of 5-10 mm.

Sample c: The lesion of the fetus manifests itself as a general deformation with black spots over the entire surface with a diameter of 10 mm.

Sample d: The lesion of the fetus manifests itself in the form of black rot with a diameter of 2-3 cm. with the subsequent appearance of a white plaque on the surface.

Sample e: The lesion of the fetus manifests itself as rot over the entire surface with a change in color.

Sample f: Fetal lesion manifests itself as a general deformity and the appearance of a black spot with a white coating around a diameter of 5-8 mm.

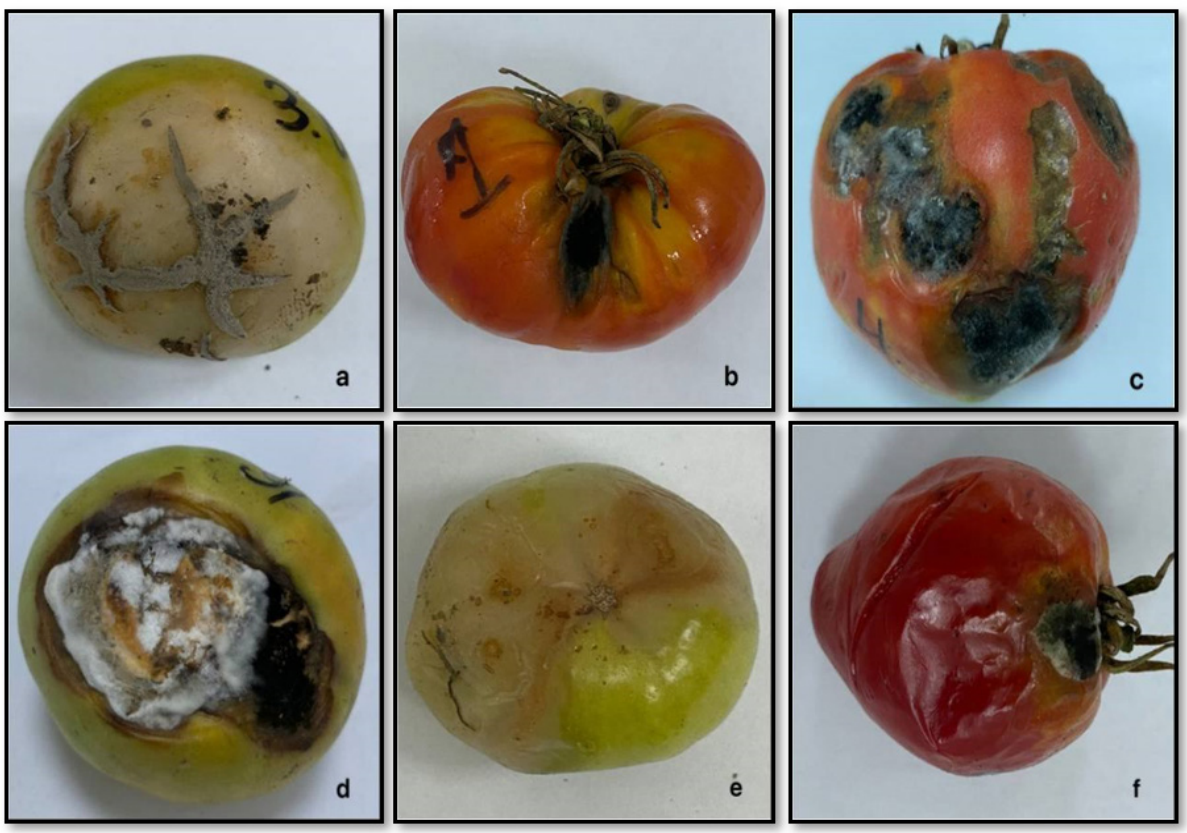


**Figure 1** – Visually selected affected tomato fruits.

The isolation of a pure culture was carried out by selecting the results of the primary isolation of pathogens. The cultures studied were subject to visual external evaluation. The following samples were selected: 01_4, 01_5 – Astana, 01_6 – Kosshy, 10_4, 10_6 – Kostanay, 15_3 –Petropavlovsk (Figure 2).

As a result of the conducted studies, 4 pathogens affecting tomato fruits were identified, which are attributed from their cultural characteristics to the following genera: *Alternaria* spp., *Apiospora* spp., *Fusarium* spp. The isolated cultures showed typical cultural properties of their kind (Table1).

Microscopic studies were carried out based on the results of growing the studied pure culture of pathogens at 40x magnification of the microscope.

01_5: The microscopic picture is characterized by the presence of a septic mycelium, multicellular, dark-colored pin-shaped conidia with longitudinal or transverse partitions. Conidia sit singly on poorly developed conidiophores. Short conidiophores extend from the mycelium.

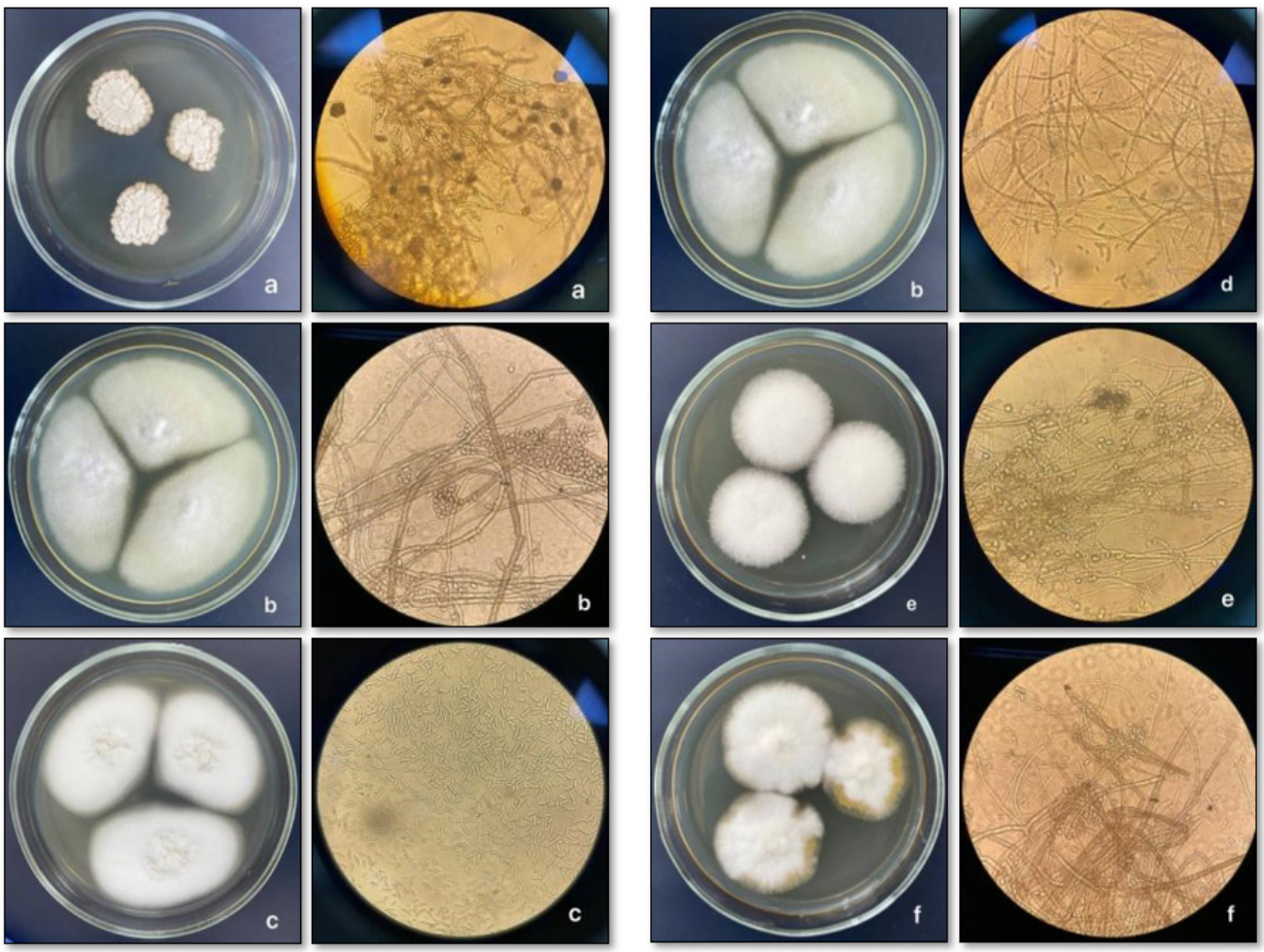


**Figure 2** – Pure crop growth and microscopy: a – sample 01_5, b – sample 01_6, c – sample 10_4, d – sample 15_3, e – sample 01_4, f – sample 10_6.

**Table1** – Comparison of colony characteristics

| Parameter | 01_5 | 01_6 | 10_4 | 15_3 | 01_4 | 10_6 |
|---|---|---|---|---|---|---|
| Shape | Round with jagged edges | Semi-circular | Oval with smooth edges | Semi-circular | Round | Round with jagged edges |
| Diameter (mm) | 8-10 | 15-20 | 10-15 | 15-20 | 8-10 | 10-15 |
| Color | White and beige | White | Snow-white | White | Snow-white | White with golden edges |
| Relief | Convex, patterned | Convex | Convex, hilly | Convex, patterned | Convex | Convex, patterned |
| Surface | Uneven | Smooth and fluffy | Uneven | Uneven and fluffy | Smooth and fluffy | Uneven and fluffy |
| Edge | Jagged, with irregularities | Uniform | Uniform | Heterogeneous | Uniform | Uneven |
| Consistency | Dense, matte | Dense, matte | Dense, matte | Dense, matte | Dense, matte | Dense, matte |

01_6: The microscopic picture is characterized by an airy mycelium, not separated. There are conidiophores, multiple conidia of elongated oval shape. Conidia form pear-shaped microconidia, slightly curved.

Giss media with maltose, lactose and mannitol were used in the analysis. Control samples have been prepared for the study. Changes were recorded within 6 days in figure 3

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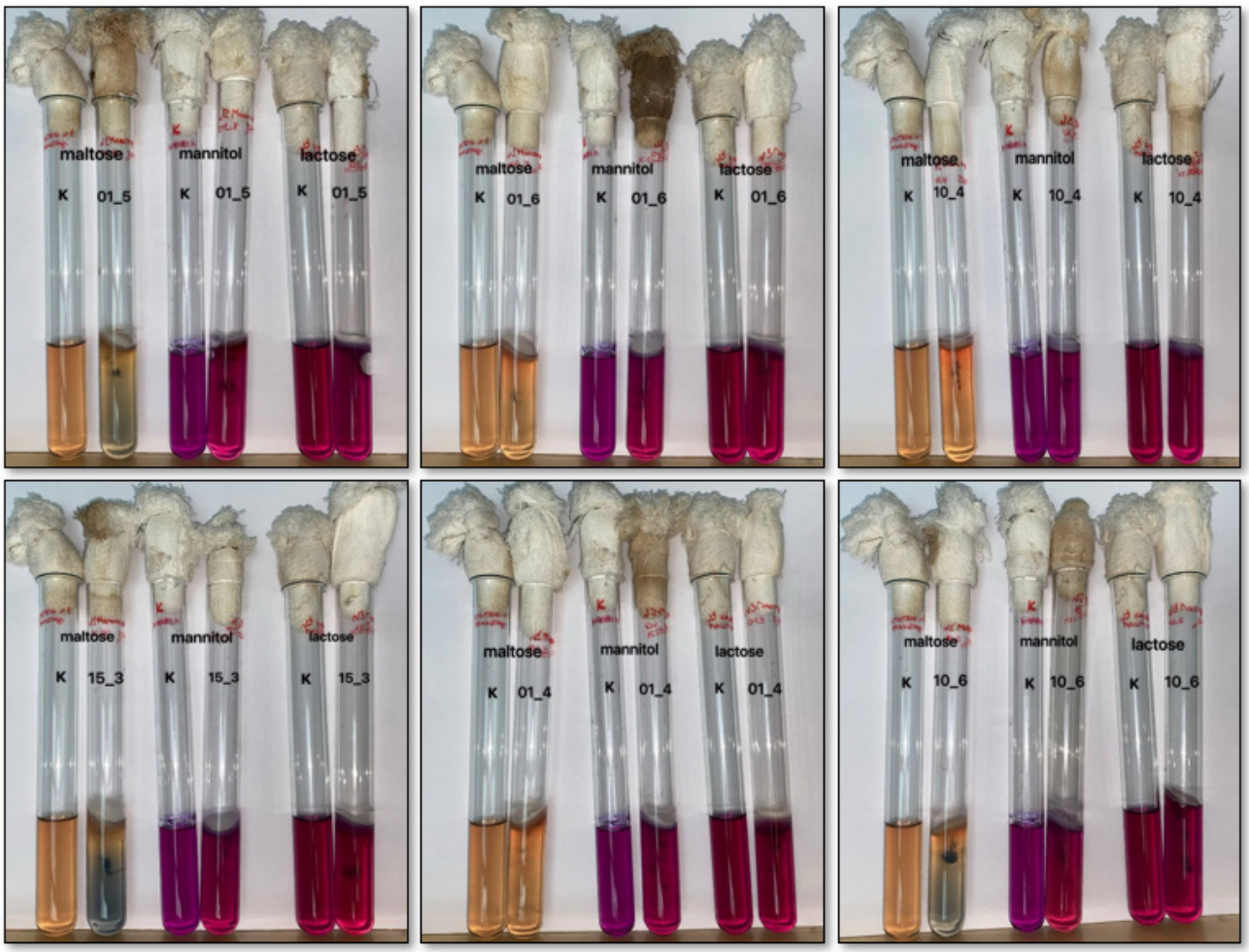


**Figure 3** – Saccharolytic properties of microorganisms on Gis media on day 6.

10_4: The microscopic picture is characterized by macroconidia, which form septate, crescent-shaped or crescent-shaped conidia. The macroconidia are slightly curved and narrowed towards each end, fusiform. There are single- or two-celled conidia, known as microconidia.

15_3: The microscopic picture is characterized by the presence of mycelium, not separated. There are conidiophores with conidia, multiple macroconidia of elongated oval shape, fusiform. The macroconidia have a characteristic crescent-shaped shape, with several transverse partitions.

01_4: The microscopic picture is characterized by the presence of mycelium, not separated. There are conidiophores with conidia. Multiple microconidia are small, oval in shape. Conidia form pear-shaped microconidia, slightly curved. Conidiophores are straight, with sparse septa.

10_6: The microscopic picture is characterized by the presence of a septic mycelium. There are conidiophores with multiple elongated oval microconidia.

As a result of the microscopic examination, based on the description obtained, pathogens affecting various tomato fruits were identified, which, depending on cultural characteristics, were assigned to the following genera: *Alternaria spp., Apiospora spp., Fusarium spp*.

01_5: On day 1, a slight change in the color of the medium is noticeable at the place of application of the sample. On the 4th–6th day, a strong color change was noticed. With maltose, the color of the medium changed to blue, with mannitol, the color changed to bright pink, with lactose, the color of the medium became slightly turbid. The abundant growth of culture has been noticed.

01_6: No changes were noticed on day 1. On the 4th–6th day, a color change was noticed. With maltose, the color of the medium changed to more orange towards the top, with mannitol, the color became slightly brighter, pink, with lactose, the color of the medium became darker towards the top. The abundant growth of culture has been noticed.

10_4: On day 1, minor changes are noticeable at the place of application of the sample. On the 4th–6th day, a color change was noticed. With maltose, the color of the medium changed to a more orange towards the top, with mannitol, the color changed slightly, with lactose, the color changed slightly. The abundant growth of culture has been noticed.

15_3: On day 1, a good change in the color of the medium is noticeable at the place of application of the sample. On the 4th–6th day, a strong color change was noticed. With maltose, the color of the medium changed to blue, with man-

nitol, the color changed to bright pink, with lactose, the color of the medium became slightly brighter. The abundant growth of culture has been noticed.

01_4: On day 1, slight changes in the color of the medium are noticeable at the place of application of the sample. On the 4th–6th day, a slight color change was noticed. With maltose, the color of the medium changed to orange, with mannitol, the color changed to bright pink, with lactose, the color of the medium became slightly brighter. The abundant growth of culture has been noticed.

10_6: On day 1, a good change in the color of the medium is noticeable at the place of application of the sample. On the 4th–6th day, a strong color change was noticed. With maltose, the color of the medium changed to blue, with mannitol, the color changed to bright pink, with lactose, the color of the medium became slightly brighter. The abundant growth of culture has been noticed.

The growth of culture on media leads to the accumulation of organic acids, which changes the pH of the medium and the color of the medium, respectively, as well as neutral products, gases, where foam or bubbles form inside the medium. The results after 48-96 hours are included in Table 2.

The collection of the main pathogens of tomato fruits covers more than 40 identified colonies of strains from such regions as: Akmola region, Karaganda region, Kostanay region, Pavlodar region, North Kazakhstan region and Abai region.

According to the results of the selected samples, DNA was isolated according to the developed methodology using a modified CTAB method.

The concentration of the obtained nucleic acids was calculated using a NanoDrop One spectrophotometer. The results are listed in table 3.

The ratio of indicators from 2.10 to 2.21 is considered pure for DNA, with an absorption ratio of 260 and 280 nm. The ratio of 260 and 230nm is used as a secondary purity indicator, where values from 1.78 to 2.33 are considered pure, in the range up to 2.0 indicates a low content of impurities.

Using species-specific and multiplex PCR, we analyzed 6 selected pathogens of tomato fruits using ITS universal primer with isolates *Alternaria spp., Apiospora spp., Fusarium spp*. According to the results of PCR, electrophoresis should be performed, and the availability and quantity of the PCR product should be checked.

The separation of amplification products was carried out by horizontal electrophoresis in 0.8% agarose gel with ethidium bromide and the addition of a TAE buffer (Figure 4).

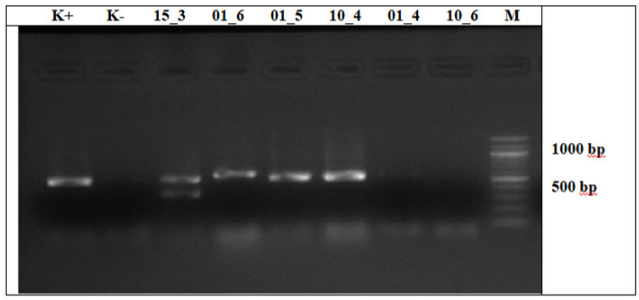


**Figure 4** – Electrophoregram of PCR products.

After DNA sequencing, 3 genera of pathogens were identified, among which the following species were identified: *Alternaria alstroemeriae, Apiosporasacchari, Fusarium equiseti*. The sequencing results are shown in Figure 5.

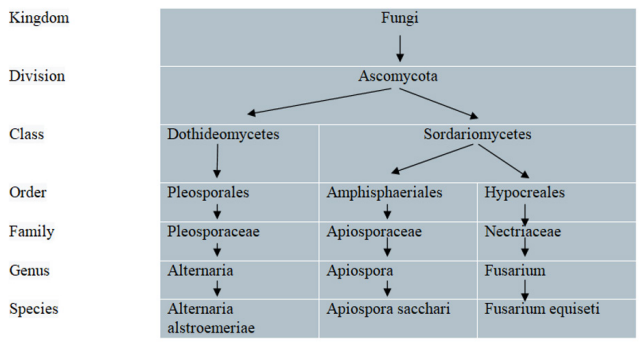


**Figure 5** – Identified sampeles and their classification.

**Table 2** – Biochemical signs: a – acid formation: a change in the color of the medium from blue-green to yellow-green or yellow; g – gas formation: the presence of bubbles in the depth of the medium or on its surface; «-» – absence of signs; * – a weak reaction is possible.

| Giss medium | Growth results | | | | | |
|---|---|---|---|---|---|---|
| | 01_5 | 01_6 | 10_4 | 15_3 | 01_4 | 10_6 |
| Maltose | a | a* | a | a | a* | a |
| Mannitol | a | a | a | a | a | a |
| Lactose | ag | a* | a* | a* | a* | a* |

**Table 3** – Data on the results of DNA concentration.

| № | Sample Name | mq/ml | A260/A280 | A260/A230 | A260 | A280 |
|---|---|---|---|---|---|---|
| 1 | 15_3 | 2802.1 | 2.21 | 2.24 | 56.04 | 25.37 |
| 2 | 10_6 | 3704.6 | 2.18 | 2.21 | 74.09 | 33.95 |
| 3 | 01_4 | 3247.1 | 2.16 | 2.22 | 64.94 | 30.10 |
| 4 | 01_5 | 349.6 | 2.10 | 1.78 | 6.99 | 3.33 |
| 5 | 01_6 | 547.9 | 2.10 | 1.81 | 10.96 | 5.22 |
| 6 | 10_4 | 4994.8 | 2.20 | 2.33 | 99.90 | 45.36 |

## 4. DISCUSSION

The cultivation of tomatoes is not only significant for their nutritional value but also for their economic impact on agriculture globally. As highlighted in the introduction, tomatoes are rich in essential nutrients such as lycopene, beta-carotene, and vitamin C, which contribute positively to human health. However, the susceptibility of tomato plants to various diseases poses a substantial challenge to their production, affecting both quality and yield.

The statistics provided indicate that tomato production has seen remarkable growth over the past few decades, with a notable increase in global harvest area and productivity. This growth can largely be attributed to advancements in agricultural research and breeding programs aimed at developing more resilient tomato varieties. However, despite these advancements, the threat of diseases remains a critical issue. The data indicating that over a third of annual production losses are due to diseases underscores the urgency for effective disease management strategies.

The prevalence of viral diseases, which can account for significant crop losses (up to 25% or more), is particularly concerning. The fact that non-compliance with phytosanitary conditions exacerbates this issue indicates a need for better regulatory measures and practices within the agricultural sector. It is essential for producers to adopt integrated pest management strategies that combine cultural practices, biological control, and resistant varieties to mitigate the impact of these diseases[12-14]. Moreover, the discussion on fungal pathogens highlights another layer of complexity in tomato cultivation. Fungal infections not only lead to decreased yields but also result in economic losses for farmers [15-17].

Detection of pathogens *Alternaria alstroemeria, Apiospora sacchari* and *Fusarium equiseti* in Northern and Central Kazakhstan can significantly improve methods of controlling tomato diseases. This allows for regular monitoring of diseases, which contributes to their early detection and prevention of spread. Knowledge of specific pathogens helps in the breeding of resistant tomato varieties and the introduction of agroecological practices such as crop rotation and the use of organic fertilizers, which improves soil health. This knowledge also makes it possible to use chemical plant protection products more effectively by choosing suitable preparations. In general, information about pathogens contributes to a more targeted and effective control of tomato diseases in the region.

## CONCLUSION

In summary, this study successfully identified and characterized four significant pathogens affecting tomato fruits across various regions of northern and central Kazakhstan, specifically the Akmola, Karaganda, Kostanay, Pavlodar, North Kazakhstan, and Abai regions. Through a systematic sampling process, a total of 36 affected tomato fruits were analyzed, leading to the isolation of pure cultures from selected samples. The pathogens were classified into three genera: *Alternaria spp., Apiospora spp.,* and *Fusarium spp.,* all exhibiting distinct cultural characteristics.

The biochemical analysis demonstrated notable changes in the growth media, confirming the pathogenic nature of the isolated strains. Additionally, microscopic examinations further corroborated the identity of these pathogens. The research also involved DNA isolation and subsequent sequencing, which identified specific species*: Alternaria alstroemeriae, Apiospora sacchari,* and *Fusarium equiseti.*

These findings underscore the diversity of pathogens present in the region and highlight the potential risks they pose to tomato cultivation. Continued monitoring and research into these pathogens are essential for developing effective management strategies to protect tomato crops in Kazakhstan.

Despite the significant results of our study, several limitations should be taken into account. Firstly, seasonal variability can affect the spread of pathogens, as climatic conditions and the time of year can have a significant impact on their activity and viability. Secondly, the geographical limitations of the sample may lead to insufficient representativeness of the data for the entire territory of Kazakhstan. These factors should be taken into account when interpreting the data obtained and planning further research.

## FUNDING

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## CONFLICT OF INTEREST

There are no conflicts of interest to declare.

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## СОЗДАНИЕ КОЛЛЕКЦИИ ВОЗБУДИТЕЛЕЙ БОЛЕЗНЕЙ ПЛОДОВ ТОМАТОВ ЦЕНТРАЛЬНОГО И СЕВЕРНОГО КАЗАХСТАНА И ИХ КУЛЬТУРАЛЬНО-МОРФОЛОГИЧЕСКАЯ ХАРАКТЕРИСТИКА

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**АБСТРАКТ**

В данной статье рассматривается исследование одного из важных овощных культур –томата, а также его положения на рынке страны. Плоды томата богаты питательными веществами, обладают фармакологическими свойствами, и их выращивание имеет значительное влияние на сельскохозяйственную экономику. В зависимости от воздействия различных факторов на растение, томаты подвержены заболеваниям, которые изменяют качество и вкус плодов. Они могут подвергаться воздействию как местных факторов выращивания, так и инфекционным заболеваниям, которые условно делятся на бактериальные, грибковые и вирусные. Цель исследования –выявить основные патогены плодов томата в центральном и северном Казахстане, а также их культурные и морфологические характеристики. Создание коллекции патогенов. Для достижения этих целей используются такие методы, как сбор пораженных плодов томата с выявленными поражениями, изоляция патогенов фитопатогенов из инфицированных тканей плодов томата методом фенол-хлороформной экстракции ДНК, культурные и морфологические характеристики штаммов патогенов с использованием микроскопии, проведение генетической идентификации изолированных штаммов с помощью ПЦР-теста и секвенирования. В результате исследования было отобрано около 50 плодов томата из различных регионов Казахстана, из которых было выделено 36 образцов патогенов, принадлежащих родам *Alternaria* spp., *Apiospora* spp. и *Fusarium* spp., с характерными культурно-морфологическими и физиолого-биохимическими признаками, а также проведена молекулярно-генетическая идентификация, в ходе которой были выявлены виды *Alternaria alstroemeriae, Apiospora sacchari* и *Fusarium equiseti*. На основе полученных данных изучение заболеваний томатов и их патогенов является ключевым для разработки эффективных мер по защите и повышению устойчивости этого важного сельскохозяйственного растения к инфекциям, что, в свою очередь, способствует улучшению качества и увеличению объемов его производства. Для более эффективной диагностики заболеваний растений, идентификации патогенов и их количества мы рекомендуем проводить полимеразную цепную реакцию. Это связано с тем, что ПЦР-диагностика является самым точным и быстрым анализом для выявления присутствующего патогена в исследуемых материалах. Этот метод позволяет определить наличие патогена, даже если в образце присутствует всего несколько молекул ДНК.

**Ключевые слова:** *томат, болезни. Возбудители, Alternria spp., Apiospora spp., Fusarium spp.*

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## ОРТАЛЫҚ ЖӘНЕ СОЛТҮСТІК ҚАЗАҚСТАНДАҒЫ ҚЫЗАНАҚ ЖЕМІСТЕРІНІҢ ҚОЗДЫРҒЫШТАР ТОПТАМАСЫН ЖАСАУ ЖӘНЕ ОЛАРҒА КУЛЬТУРАЛДЫ-МОРФОЛОГИЯЛЫҚ СИПАТТАМА БЕРУ

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**АҢДАТПА**

Бұл мақалада маңызды көкөніс дақылдарының бірі –қызанақ, сондай-ақ оның ел нарығындағы жағдайы туралы зерттеу қарастырылады. Қызанақ жемістері қоректік заттарға бай, фармакологиялық қасиеттерге ие және оларды өсіру ауылшаруашылық экономикасына айтарлықтай әсер етеді. Өсімдікке әртүрлі факторлардың әсеріне байланысты қызанақ жемістердің сапасы мен дәмін өзгертетін ауруларға бейім. Олар жергілікті өсу факторларына да, шартты түрде бактериялық, саңырауқұлақ және вирустық болып бөлінетін жұқпалы ауруларға да ұшырауы мүмкін.

Зерттеудің мақсаты–Орталық және Солтүстік Қазақстандағы қызанақ жемістерінің негізгі қоздырғыштарын, сондай-ақ олардың мәдени және морфологиялық сипаттамаларын анықтау. Патогендер жинағын құру. Осы мақсаттарға жету үшін зақымдалған зақымданған қызанақ жемістерін жинау, фенол-хлороформды ДНҚ экстракциясы әдісімен жұқтырған қызанақ жемістерінің тіндерінен фитопатогендік патогендерді оқшаулау, микроскопияны қолдана отырып патогендік штаммдардың мәдени және морфологиялық сипаттамалары, ПТР сынағы мен секвенирлеу арқылы оқшауланған штаммдарды генетикалық сәйкестендіру сияқты әдістер қолданылады.

Зерттеу нәтижесінде Қазақстанның әртүрлі аймақтарынан 50-ге жуық қызанақ жемісі іріктеліп алынды, оның ішінде *Alternaria* spp тұқымдасына жататын патогендердің 36 үлгісі бөлінді., *Apiospora* spp. және *Fusarium* spp., тән мәдени-морфологиялық және физиологиялық-биохимиялық белгілермен, сондай-ақ молекулалық-генетикалық сәйкестендіру жүргізілді, оның барысында *Alternaria alstroemeriae*, *Apiospora sacchari* және *Fusarium equiseti* түрлері анықталды.

Алынған мәліметтерге сүйене отырып, қызанақ аурулары мен олардың қоздырғыштарын зерттеу осы маңызды ауылшаруашылық зауытының инфекцияларға төзімділігін қорғау және жақсарту үшін тиімді шараларды әзірлеудің кілті болып табылады, бұл өз кезегінде сапаны жақсартуға және оның өндірісін арттыруға ықпал етеді. Өсімдік ауруларын тиімдірек диагностикалау, қоздырғыштарды және олардың санын анықтау үшін полимеразды тізбекті реакцияны жүргізуді ұсынамыз. Себебі ПТР диагностикасы зерттелетін материалдардағы патогенді анықтау үшін ең дәл және жылдам талдау болып табылады. Бұл әдіс үлгіде бірнеше ДНҚ молекулалары болса да, патогеннің болуын анықтауға мүмкіндік береді.

**Түйін сөздер**: *қызанақ, аурулар, қоздырғыштар, Alternria spp., Apiospora spp., Fusarium spp.*