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# Bacteriological Composition of Wastewater From Poultry Factories and Sanitary and Hygienic Condition of Soils of Irrigation Field

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**Abstract**
The article highlights the bacteriological composition of wastewater from the Tashkent poultry farm and the Urtachirchikparranda poultry farm and the sanitary and hygienic state of irrigation fields when used for irrigation of crops, as well as the processes of soil self-purification from enterobacteria. The titer of Escherichia coli was 10-6, the number of microbes ranged from 48.5 x 106 to 61.6 x 106. Determining the suitability of wastewater based on generally accepted methods showed that they are quite suitable for irrigating crops without additional reclamation measures.

**Keywords:**
*wastewater from poultry farms, bacteriological composition of wastewater, sanitary and hygienic condition of irrigation fields, titer of Escherichia coli, enterobacteria, meadow soils, soil disposal of wastewater.*

## I.INTRODUCTION

Anthropogenic transformations of water in the Central Asian region have already reached global proportions: the intensive development of irrigated agriculture in the second half of the 20th century led to a significant increase in water intake from the Syrdarya and Amudarya basins, which caused the Aral Sea to become shallow. A. Kurtov argues that the lack of water for the Republic of Uzbekistan is a catastrophe in the truest sense of the word: due to the lack of water in a number of regions of the republic, especially in Karakalpakstan, one can already talk about a social and economic crisis [8]. There is not enough water not only for agricultural purposes, but also for purely household needs. If until 2000, water-poor years in the region were observed every 6–8 years, at present this phenomenon is repeated every 3–4 years. In 2019 and 2020, water availability has sharply decreased [8].

The problem of protecting the environment, in particular, water bodies from further pollution, is of particular importance for water management, social and sanitary and hygienic significance. As a result of discharge at an improper level, treated wastewater into open water bodies spoils a huge

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amount of natural water and the ability of water bodies to self-purify often becomes insufficient [12]. Fecal contamination of water worsens its quality, and pathogenic microorganisms that enter it with the secretions of warm-blooded animals can lead to an increase in the incidence of intestinal infections. Therefore, in the conditions of the Republic of Uzbekistan, such methods of releasing wastewater from microorganisms, which use soil cleaning methods and which are effective methods for their further purification in natural conditions and an important means of preventing pollution of water sources, are of particular relevance. [5].

Therefore, from the national economic and hygienic standpoint, soil disposal of wastewater seems to be very promising - a natural process of biological treatment based on the ability of the soil to self-purify due to the complex biological processes of mineralization of organic substances occurring in it. Particularly promising is the use of wastewater for irrigation of fodder and industrial crops - alfalfa, corn grown for grain and silage, wheat and kenaf.

Adoption Decree by the President of the Republic of Uzbekistan on November 27, 2017 “On the State Program for the Development of Irrigation in 2018-2019 and the Improvement of the Ameliorative Condition of Irrigated Lands” is aimed at more productive use of available water resources, including household waste and livestock waste waters and improvement of the ameliorative state and sanitary and hygienic state of irrigated lands [1, 2].

In the context of a significant shortage of irrigation water, the Tashkent State Agrarian University pays special attention to conducting research work on more careful and productive use of water resources, studying the suitability of using livestock, including poultry wastewater for irrigation, and the impact them on the sanitary-bacteriological condition of soils.

**The degree of knowledge of the issue.** In the CIS republics, including the former All-Union Research and Production Association VNPO Progress (All-Union Scientific Research Institute for the Agricultural Use of Wastewater), the Volgograd Agricultural and Ukrainian Institute of Irrigation, the Moscow University of Peoples' Friendship, the Uzbek Research Institute of Sanitation, hygiene and occupational diseases and other institutions, numerous studies have been carried out, mainly to study the suitability of domestic and animal wastewater for irrigation of agricultural crops. However, scientific studies on the study of the bacterial composition of wastewater from poultry farms and the processes of self-purification of soils from them were almost not carried out [4, 6, 8, 14].

**The purpose of the research:** to study the bacteriological composition of wastewater from poultry farms and their suitability for irrigation of agricultural crops in various soil and hydrogeological conditions of the republic as an effective measure to prevent pollution of water resources by enterobacteria and the sanitary and hygienic state of irrigation fields.

**Research objectives:** to study the bacteriological composition of wastewater from poultry farms and their influence on the sanitary and bacteriological state of soils when they are used for irrigation of crops, as well as the processes of soil self-purification from enterobacteria**.**

**Objects of research:** the objects of research are the bacteriological composition of wastewater from poultry farms, the sanitary and hygienic state of meadow soils irrigated by them, common in the Tashkent region, and the process of their self-purification from enterobacteria.

**Material and research methodology.** The materials of the research are the wastewater of the Tashkent poultry farm and the Urtachirchikparranda poultry farm, located on meadow soils in the Tashkent region of the Republic of Uzbekistan.

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Long-term field experiments were carried out according to the following scheme:

**Experience Scheme**

| No. | Experience options | Irrigation rates, m3/ha | Application rates of mineral fertilizers, kg/ha | | |
|---|---|---|---|---|---|
| | | | N | $P_2O_5$ | $K_2O$ |
| 1. | Irrigation of corn with river water (control) | 4400 | 180 | 100 | 90 |
| 2. | Irrigation with river water (absolute control) | 4400 | without fertilizer | | |
| 3. | Irrigation with sewage | 4400 | without fertilizer | | |
| 4. | Irrigation with sewage | 4400 | 180 | 100 | 90 |
| 5. | Irrigation with diluted wastewater in the ratio of river: wastewater - 1:1 | 4400 | 180 | 100 | 90 |

The experiments were laid in 4-fold repetition. The plots were arranged in one tier by a systematic method. The area of the plot is 250 m2, the total area under experiments is 1 ha. Between each plot, 4 rows of protective strips were left. Accounting rows - 4.

**Agrotechnical practices, adoption on experimental plots.** On the experimental plots at the Tashkent poultry farm and the Urtachirchikparranda poultry farm, agrotechnical measures were carried out, generally accepted for the cultivation of corn for grain on meadow soils with close groundwater in the conditions of the Chirchik-Angren valley.

The agrotechnical measures carried out in the experiments on the study of self-purification of the soil after irrigation with waste water were identical to those generally accepted for these conditions.

According to the recommended irrigation regimes for corn, 4 furrow irrigations with variable jets were carried out every year. Irrigation dates were assigned when soil moisture was reduced before irrigation to 70-75-65% of the soil LWL. Irrigation rates during the years of research ranged from 1000–1240 m3/ha, and irrigation rates ranged from 4400 to 4650 m3/ha.

**Research results.** Long-term studies to determine the quality of wastewater by sanitary and bacteriological indicators indicate that wastewater and river water contain a large number of microorganisms that require careful study when used for irrigation of crops. The results of the conducted sanitary and bacteriological studies indicate that the wastewater used for irrigation of agricultural crops was significantly polluted according to the studied indicators. Thus, the titer of Escherichia coli was equal to 10-6, the number of microbes ranged from 48.5 x 106 to 61.6 x 106. 1012 pcs. microorganisms (Table 1).

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**Table 1. Sanitary and bacteriological characteristics of waste and river water used for irrigating corn**
(for the period June-July-August)

| No | Water type | Coli-titer | | | The number of microbes in 1 ml of water | | |
|---|---|---|---|---|---|---|---|
| | | Tashkent poultry farm | | Poultry farm Urtachirchik-parranda | Tashkent poultry farm | | Poultry farm Urtachirchik-parranda |
| | | 2019 | 2020 | 2021 | 2019 | 2020 | 2021 |
| 1. | River water | 0,0004 | 0,0004 | 0,0004 | $4,1 \times 10^6$ | $4,5 \times 10^6$ | $3,7 \times 10^6$ |
| 2. | Wastewater before treatment at artificial structures | $10^{-6}$ | $10^{-6}$ | $10^{-6}$ | $59,5 \times 10^6$ | $48,5 \times 10^6$ | $61,6 \times 10^6$ |
| 3. | Wastewater after treatment in artificial structures (mechanical + biological + chlorination + sand traps) | $10^{-4}$ | $10^{-4}$ | $10^{-4}$ | $48,2 \times 10^6$ | $40,9 \times 10^6$ | $52,0 \times 10^6$ |

The results of sanitary and bacteriological studies showed that soil samples taken from option 1 on days 1–3 after irrigation with river water in combination with mineral fertilizers were characterized by the following indicators: the number of microbes was from 15.1 x 106 to 18.3 x 106, if the titer is 10-3. Soil samples taken from the second option, where river water was irrigated without the use of fertilizers, had fewer microbes: from 11.3 x 106 to 13.4 x 106, coli-titer - 10-3. Soil samples taken from variants 3, 4 and 5 were more contaminated. Thus, the number of microbes in 1 g of soil in the variant of irrigation with waste water without fertilizers ranged from 30.7 x 106 to 35.0 x 106, if the titer was 10-5; in the variant of irrigation with wastewater in combination with mineral fertilizers, the number of microbes per 1 g of soil ranged from 20.0 x 106 to 32.3 x 106, the titer of Escherichia coli was 10-4 and 10-5, and when irrigated with diluted wastewater in the ratio river: waste - 1:1 in combination with mineral fertilizers, the number of microbes in 1 g of soil ranged from 23.8 x 106 to 28.4 x 106, the titer of Escherichia coli was 10-3 and 10-4 (see Tables 1 and 2, Fig. 1 and 2).

In addition to the above ingredients, waste and river water contains a large number of microorganisms that require careful study when using water for irrigation of crops. The results of sanitary and bacteriological studies indicate that the wastewater used for irrigation of agricultural crops was significantly polluted according to the indicators studied. Thus, the titer of Escherichia coli was equal to 10-6, the number of microbes ranged from 48.5 x 106 to 61.6 x 106. x 1012 pcs. microorganisms [7].

After cleaning in artificial facilities, these indicators were respectively equal: the titer of Escherichia coli - 10-4, the number of microbes in 1 ml of water - from 40.9 x

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106 to 52.0 x 106 pcs. River water was characterized by the following indicators: the number of microbes in 1 ml of water was from 3.7 x 106 to 4.5 x 106, and the coli titer was 0.0004.

**Table 2. Results of sanitary and bacteriological studies of the soil on the experimental plot at the Tashkent poultry farm** (average for 4 irrigations)

| No | Timing of research after irrigation | Number of samples | Coli-titer | The total number of microbes in 1 g of soil, pcs. |
|---|---|---|---|---|
| 1. | On the 1st–3rd day | 12 | $10^{-3}$ | 17,2 x $10^6$ |
| | On the 5th–10th day | 16 | $10^{-1}$ | 7,0 x $10^6$ |
| | On the 15th day | 12 | $10^{-1}$ | 3,0 x $10^6$ |
| | On the 20th day | 6 | $10^{-1}$ | 2,0 x $10^6$ |
| 2. | On the 1st–3rd day | 12 | $10^{-3}$ | 11,5 x $10^6$ |
| | On the 5th–10th day | 16 | $10^{-1}$ | 8,0 x $10^6$ |
| | On the 15th day | 12 | $10^{-1}$ | 4,0 x $10^6$ |
| | On the 20th day | 6 | $10^{-1}$ | 2,0 x $10^6$ |
| 3. | On the 1st–3rd day | 12 | $10^{-5}$ | 35,0 x $10^6$ |
| | On the 5th–10th day | 16 | $10^{-2}$ | 17,0 x $10^6$ |
| | On the 15th day | 12 | $10^{-2}$ | 6,0 x $10^6$ |
| | On the 20th day | 6 | $10^{-1}$ | 1,6 x $10^6$ |
| 4. | On the 1st–3rd day | 12 | $10^{-4}$ | 27,0 x $10^6$ |
| | On the 5th–10th day | 16 | $10^{-2}$ | 11,0 x $10^6$ |
| | On the 15th day | 12 | $10^{-2}$ | 6,0 x $10^6$ |
| | On the 20th day | 6 | $10^{-1}$ | 1,6 x $10^6$ |
| 5. | On the 1st–3rd day | 12 | $10^{-4}$ | 23,8 x $10^6$ |
| | On the 5th–10th day | 16 | $10^{-2}$ | 14,0 x $10^6$ |
| | On the 15th day | 12 | $10^{-1}$ | 5,0 x $10^6$ |
| | On the 20th day | 6 | $10^{-1}$ | 1,5 x $10^6$ |

The results of sanitary and bacteriological studies of the soil occupied by corn crops and watered with sewage, on the 5th–10th day after irrigation, showed that in all the studied areas there is an intensive self-purification of the soil: the number of microbes decreased by 1.5–2 times, and the titer of Escherichia coli increased by 2–36 orders of magnitude. This is apparently due to the fact that corn is watered in May, June, July and August, i.e., months that differ somewhat from each other in terms of temperature, which is reflected in the intensity of soil self-purification processes.

Similar data were obtained on the 15th day of observation after watering. On the

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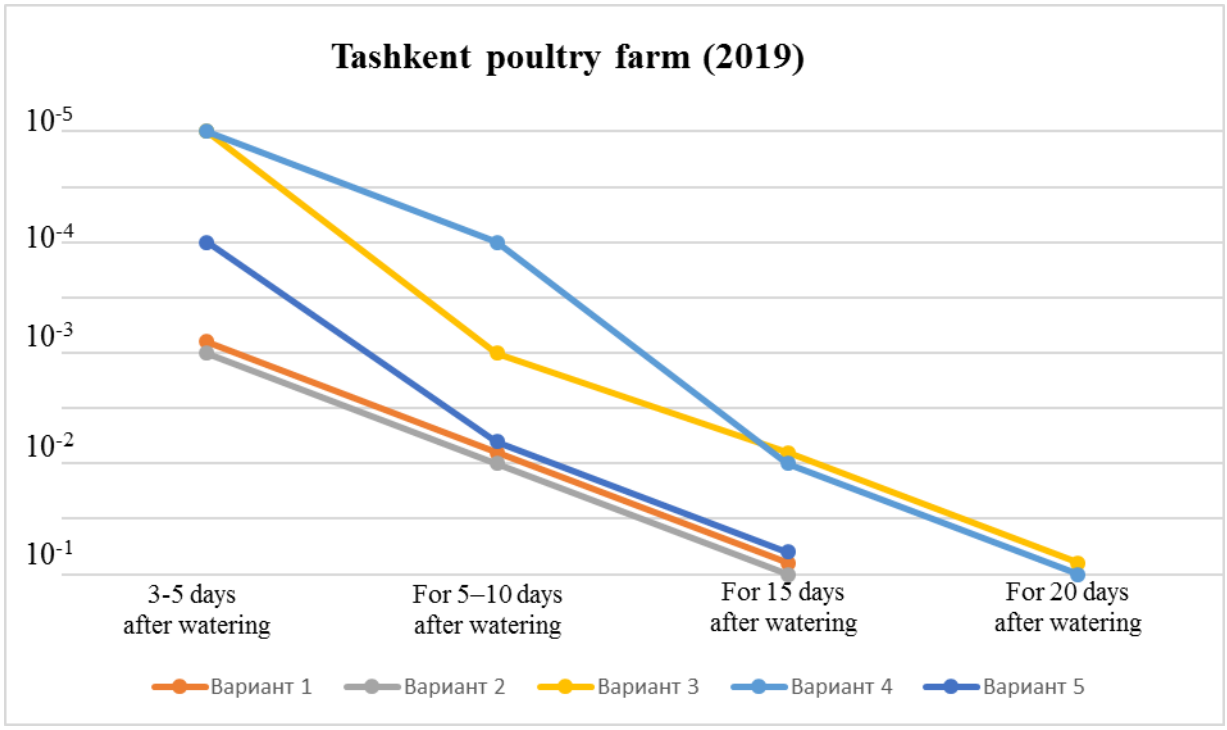
20th day after irrigation, the soils in all experimental plots were characterized as conditionally clean according to the proposed classification by K.S. Zairov and A.Z. Zakhidov (1954) on sanitary indicators (microorganisms) for the hot climate of Uzbekistan.

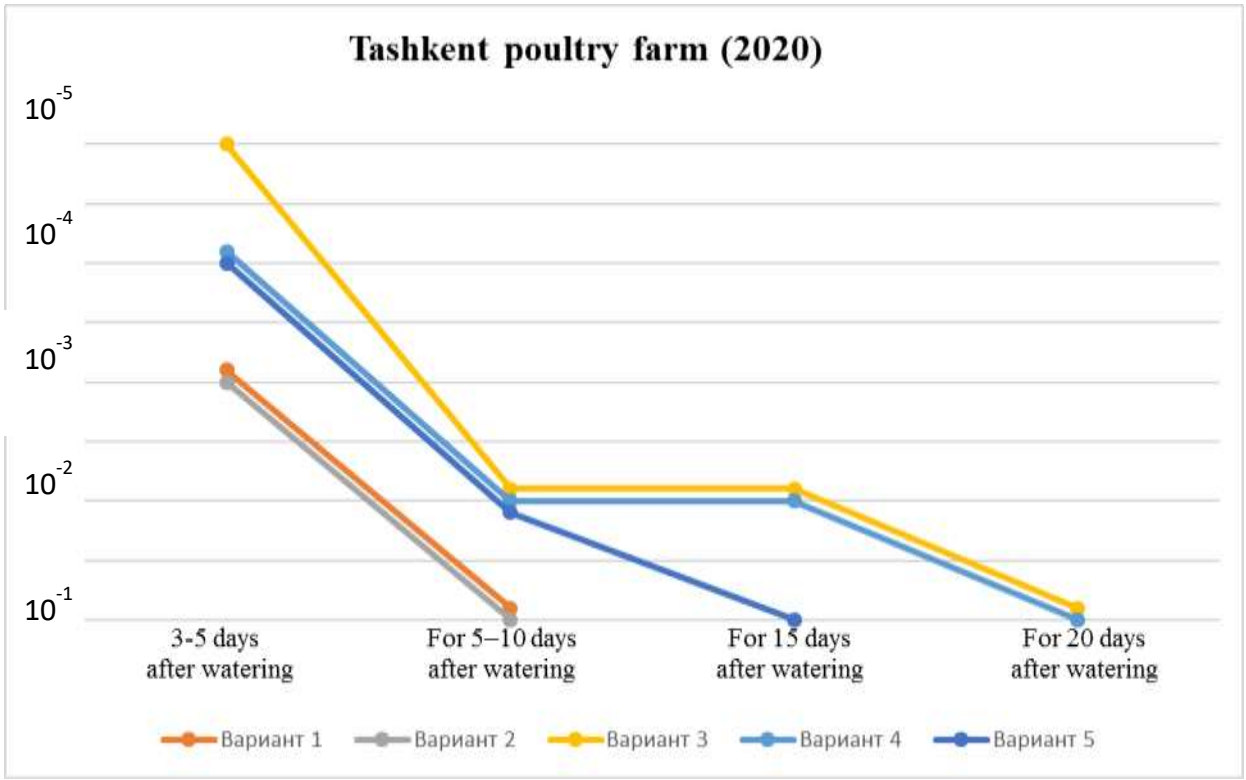
**Table 3. Results of sanitary and bacteriological studies of the soil on the experimental plot at the Urtachirchikparranda poultry farm**
(average for 4 irrigations)

| No | Timing of research after irrigation | Number of samples | Coli-titer | The total number of microbes in 1 g of soil, pcs. |
|---|---|---|---|---|
| 1. | On the 5th day | 16 | $10^{-3}$ | $15,1 \times 10^6$ |
| | On the 10th day | 16 | $10^{-1}$ | $7,0 \times 10^6$ |
| | On the 15th day | 12 | $10^{-1}$ | $2,9 \times 10^6$ |
| | On the 20th day | 6 | $10^{-1}$ | $2,4 \times 10^6$ |
| 2. | On the 5th day | 16 | $10^{-3}$ | $11,3 \times 10^6$ |
| | On the 10th day | 16 | $10^{-1}$ | $5,9 \times 10^6$ |
| | On the 15th day | 12 | $10^{-1}$ | $1,8 \times 10^6$ |
| | On the 20th day | 6 | $10^{-1}$ | $3,0 \times 10^6$ |
| 3. | On the 5th day | 16 | $10^{-5}$ | $32,8 \times 10^6$ |
| | On the 10th day | 16 | $10^{-2}$ | $24,4 \times 10^6$ |
| | On the 15th day | 12 | $10^{-2}$ | $5,7 \times 10^6$ |
| | On the 20th day | 6 | $10^{-1}$ | $4,4 \times 10^6$ |
| 4. | On the 5th day | 16 | $10^{-4}$ | $20,0 \times 10^6$ |
| | On the 10th day | 16 | $10^{-2}$ | $15,1 \times 10^6$ |
| | On the 15th day | 12 | $10^{-1}$ | $2,5 \times 10^6$ |
| | On the 20th day | 6 | $10^{-1}$ | $3,5 \times 10^6$ |
| 5. | On the 5th day | 16 | $10^{-3}$ | $28,4 \times 10^6$ |
| | On the 10th day | 16 | $10^{-2}$ | $7,6 \times 10^6$ |
| | On the 15th day | 12 | $10^{-1}$ | $4,0 \times 10^6$ |
| | On the 20th day | 6 | $10^{-1}$ | $1,9 \times 10^6$ |

Fig. 1. **Dynamics of soil self-purification (titer of Escherichia coli) after irrigation with wastewater according to the experimental options**

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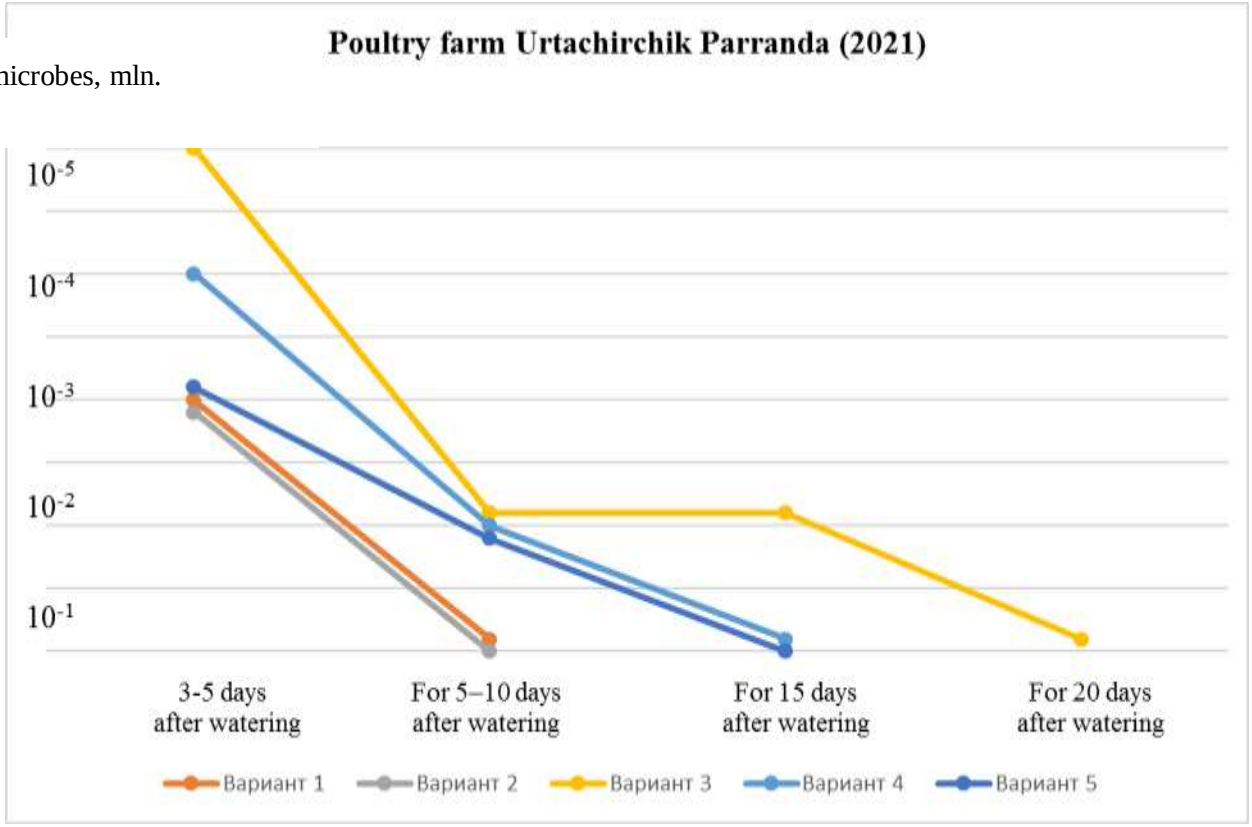
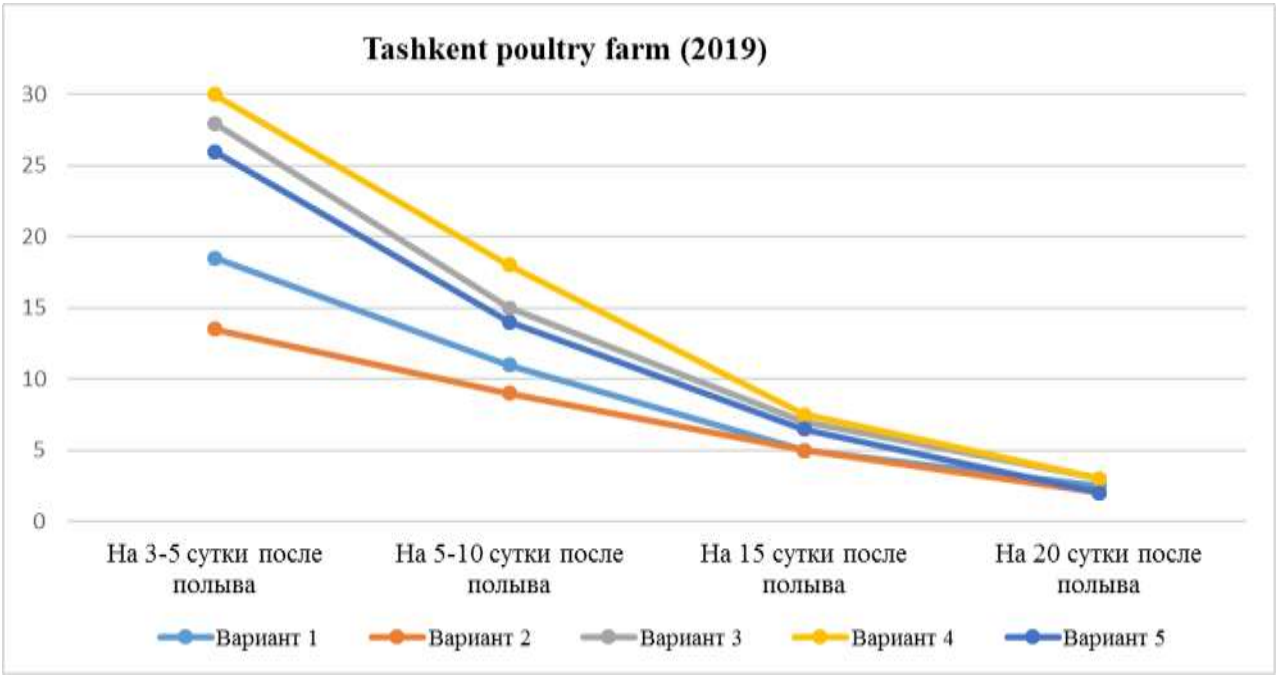



**Fig. 2. Dynamics of the decrease in the number of microbes in 1 g of soil after irrigation with wastewater according to the variants of the experiment**



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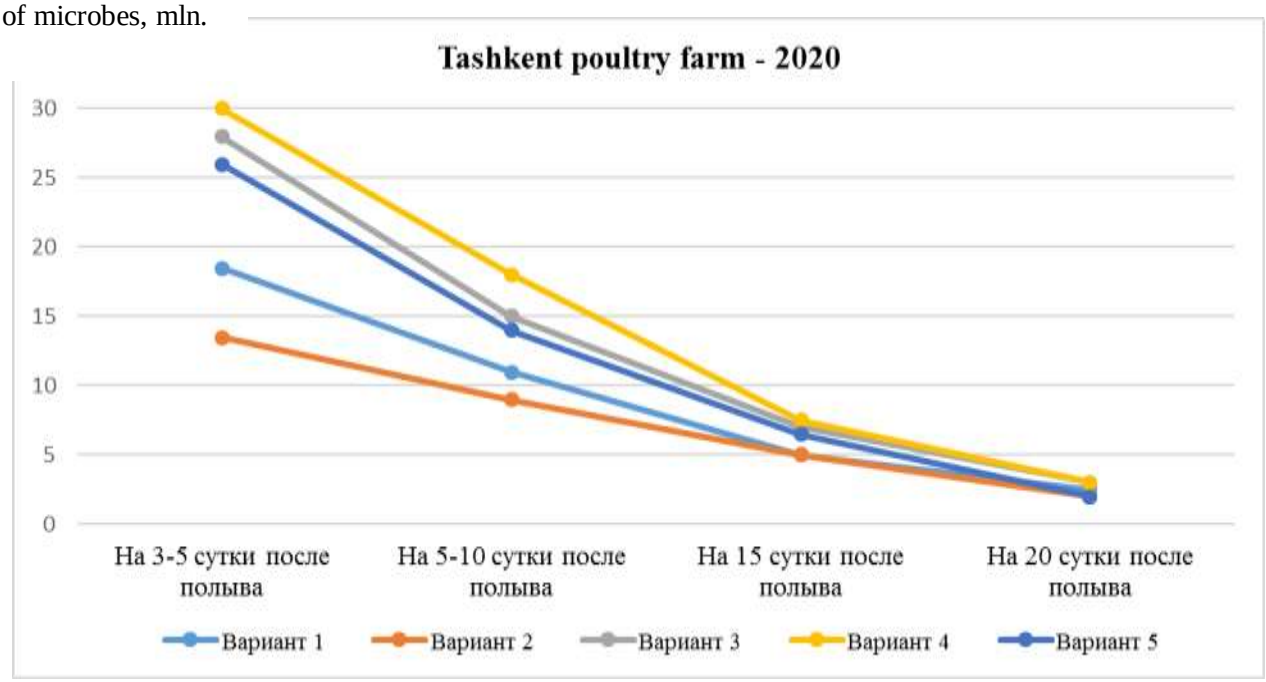



**Fig. 3. Dynamics of soil self-purification (titer of Escherichia coli) after irrigation with wastewater according to the experimental options**

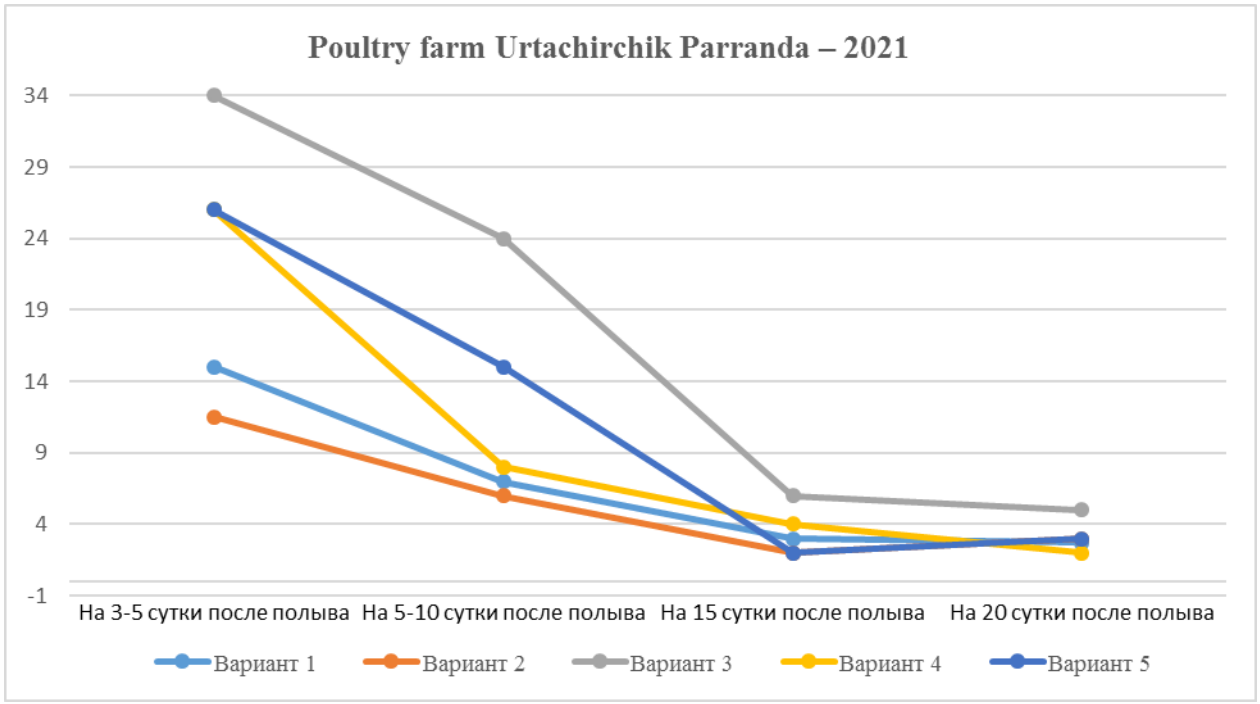



**Fig. 4. Dynamics of the decrease in the number of microbes in 1 g of soil after irrigation with wastewater in the experimental variants**

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Thus, wastewater not diluted with river water, and, accordingly, the soil watered by them, according to sanitary indicators (microorganisms) were more polluted than the soil watered with wastewater diluted with river water, since the self-purification process occurs on the 15th day after watering. When watering corn with wastewater from poultry farms, strict adherence to sanitary and anti-epidemic rules is necessary, especially in the first 20 days. Control over the sanitary and hygienic condition of the fields of "small" irrigation should be carried out on the 15th day after irrigation. Vegetative irrigation should be completed 15–20 days before harvesting corn.

The nutrients contained in wastewater are in a dissolved form, getting into the soil, they are easily absorbed by plants, while solving the problems of water and food regime for corn plants. In addition, many organic substances and microorganisms enter the soil with wastewater, as a result of which microbiological processes are activated and the potential and effective soil fertility increases.

It has been established that in the conditions of the hot climate of Uzbekistan, soils irrigated with wastewater become normatively clean on the 10–15th day after irrigation. With the proper organization and conduct of irrigation with wastewater by the surface method, pollution of the above-ground organs of plants and groundwater is completely excluded. In case of accidental contamination of individual parts of plants, they can be considered standard-clean for 10-15 days after watering.

**Conclusions**

Moisture-charging and fertilizing irrigation on gray soils should be carried out along deep furrows according to a dead-end scheme with a norm of 800–1000 m3/ha, and stop them 2–3 weeks before sowing. Control over the sanitary and hygienic condition of the soil when using wastewater for irrigation is carried out on the 15th day after irrigation. When irrigating with wastewater, it is necessary to comply with sanitary and anti-epidemic rules, especially in the first 20 days. When using wastewater for irrigation, the periods between irrigation should be at least 15–20 days to ensure the normal course of soil self-purification processes. In case of a delay in the process of self-purification of soils from pathogenic microorganisms, irrigation with river water should be carried out. Vegetative irrigation with wastewater is completed 15–20 days before harvest.

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