Search for approaches to producing organic fertilizers from raw materials of plant and animal origin

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Abstract. Due to the annual increase in emissions of animal and poultry waste into the environment, scientists around the world are increasingly interested in improving technologies to accelerate the processing of agricultural waste. In the presented work, 6 microorganisms were selected: Lactobacillus spp., thermophilic bacteria (Bac. subtilis), Clostridium spp., Penicilillium spp., Saccharomyces cerevisiae, Micrococcus nishomyaensis) to accelerate the processing of animal waste. The toxicity and toxigenicity of newly isolated strains of microorganisms was assessed. At the same time, it was found that the strains of microorganisms do not have toxicity and toxigenicity.

1 Introduction

Around livestock enterprises accumulate huge deposits of manure, characterized by a high content of environmentally dangerous components, in particular: heavy metals, pesticides, pathogens of infectious and invasive diseases, ammonia, hydrogen sulfide, mercaptan, phenol, and others [1]. The soil after applying organic waste is largely seeded with microbiota, which creates a certain environmental and sanitary hazard [2, 3, 4]. The introduction of manure into the soil without pretreatment does not exclude soil contamination with ecotoxics that enter the food chain into food [7, 8, 9, 10]. Given the above, it should be noted that in modern industrial society there is an urgent need for effective means of restoring the ecological balance [11, 12, 13, 14]. The solution of environmental problems is directly related to the development of applied biotechnology aimed at creating tools for the rehabilitation of the natural environment [16, 17, 18].

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The aim of this research was to study the biological properties of selected microorganisms to accelerate the processing of organic waste of plant and animal sources.

2 Methods

Various organic raw materials (animal husbandry, poultry, crop production, oil processing industry, etc.), various strains of microorganisms and fungi with pronounced properties of biodegradation of organic compounds were used as the object of research. The selection of microbial and fungal strains was performed on dense nutrient media (MRS medium, M8 medium, and others), followed by the study of their morphological, tinctorial, and biological characteristic [5, 14, 15].

The cellulolytic characteristic of the strains were determined by their ability to use insoluble cellulose as the sole carbon source. Amylolytic properties were determined by seeding the strains in a starch gel. Catalase was determined gasometrical method [23-26].

Selected strain was tested for antagonistic activity using agar blocks [19-22] in relation to pathogenic microorganisms-E. coli, Salmonella enteritidis, St. aureus and in relation to each other [27-31].

The toxicogenicity of the culture was studied by intraperitoneal administration of a centrifuge to white mice (n=10), which was obtained by centrifugation of culture fluid for 15 minutes at 3000 g. The control group was a group of mice that received a sterile nutrient medium [32-38].

3 Results and Discussion

In this connection, at the initial stage of research, qualitative reactions were used to evaluate the enzymatic activity of the isolates. The presence of pathogenic and toxigenic properties was also detected.

The enzymatic activity and pathogenicity/toxigenicity of isolates are shown in table 1.

The six new microorganisms Lactobacillus spp., thermophilic bacteria (Bac. Subtilis), (Clostridium spp., Penicililum spp., Saccharomyces spp., Micrococcus spp.) were selected based on the data obtained in studies of biochemical properties (cellulolytic, saccharolytic activity, starch hydrolysis).

The toxicity of isolated strains of microorganisms on protozoa was assessed. At the same time, it was found that the isolated strains of microorganisms do not have toxicity. In addition, tests were conducted on the harmlessness of microorganisms Penicililum spp., Saccharomyces spp., Bacillus spp., Lactobacillus spp. used for the destruction of organic raw materials. It was found that a single intraperitoneal and multiple oral administration of inactivated microbial suspension of the studied strains did not lead to the death of experimental animals and visible changes in the clinical condition, which indicates the absence of toxic properties. During the entire observation period, the animals remained active, ate well food rations, and did not lose weight. The strains do not show toxigenic properties, the introduction of the centrifuge did not lead to the death of animals and visible deviations in the clinical state.
Table 1. Enzymatic activity and pathogenicity/toxicity of isolates.

| The studied microorganisms | Enzymatic activity | Pathogenicity/toxicity | Source                   |
|-----------------------------|--------------------|------------------------|--------------------------|
|                             | Proteolytic       | Amyloytic              | Cellulosolytic           | Lipolytic                |
| Clostridium butyricum       | -                  | +                      | +                        | -                        |
| Bacillus subtilis           | ±                  | +                      | ±                        | -                        |
| Lactobacillus plantarum     | -                  | -                      | -                        | -                        |
| Penicililum expansum        | -                  | +                      | +                        | -                        |
| Saccharomyces cerevisiae    | -                  | +                      | -                        | ±                        |
| Micrococcus nishomyaensis  | -                  | +                      | +                        | -                        |

From the selected strains, 7 preparations of microorganisms were created, they processed bird excrement in laboratory conditions. The best results were shown by a consortium consisting of microorganisms from the genera Lactobacillus, Micrococcus and Saschagomus.

Sanitary and microbiological assessment of the litter was carried out on the basis of the results of studies to determine the total microbial contamination, bacteria of the group of E. coli, Salmonella, staphylococci. Studies of the sanitary and bacteriological state of samples of the initial litter mass, selected at different points, showed a high degree of microbial contamination. Thus, the total microbial number of bird droppings was $1.2 \pm 0.23 \times 10^2$ CFU/g, the number of Escherichia coli bacteria $– 2.1 \pm 0.3 \times 10^6$ CFU/g, Salmonella $– 1.5 \pm 0.27 \times 10^5$ CFU/g, Staphylococci $– 1.2 \pm 0.25 \times 10^7$ CFU/g.

When using the preparations, the dynamics was observed to reduce the specific smell starting from 3-4 days of the experiment. On day 15, there was no specific smell in the treated substrate.

The use of the drug for processing bird droppings can significantly reduce the level of microbial contamination. On the 15th day after treatment, the total number of anaerobes and aerobes was reduced by 5 orders of magnitude, compared to the background value. Pathogenic microorganisms (Salmonella, staphylococci, Escherichia coli bacteria), as well as ovum and larvae of helminths were not detected in the treated substrate.

The antagonistic activity of each of the three selected strains was tested in relation to pathogenic strains of microorganisms-E. coli, Salmonella enteritidis, St. aureus and in
relation to each other. Then the antagonistic activity of drugs consisting of the presented microorganisms was studied.

The results of the study of antagonistic activity are presented in table 2.

**Table 2. Antagonistic activity.**

| №  | The studied microorganisms | E. coli | Salm. enteritidis | St. aureus | Lactobacillus spp | Lactobacillus spp. | Saccharomyces spp. |
|----|----------------------------|---------|-------------------|------------|-------------------|--------------------|--------------------|
| 1  | Lactobacillus spp          | 5       | 4                 | 6          | ////////////////   | -                  | -                  |
| 2  | Micrococcus spp.           | 7       | 3                 | 5          | -                 | ////////////////   | -                  |
| 3  | Saccharomyces spp.         | 10      | 10                | 12         | -                 | -                  | ////////////////   |
| 4  | Preparation                | 15      | 12                | 15         | -                 | -                  | -                  |

From the data in table 2, it can be seen that the strains of microorganisms included in the preparation have antagonistic activity to pathogenic microorganisms of different degrees of severity and do not show antagonistic activity in relation to each other. The biopreparation from the selected microorganisms has a more pronounced antagonistic activity against pathogenic microorganisms than individual cultures of microorganisms.

**4 Conclusion**

Thus, as a result of search and appropriate selection, 6 new strains of genera were selected: Lactobacillus spp., Thermophilic bacteria (Bac. subtilis), Clostridium spp., Penicililum spp., Saccharomyces cerevisiae, Micrococcus nishomyaensis). The toxicity and toxigenicity of newly isolated microorganisms were evaluated. At the same time, it is established that microorganisms do not have toxicity and toxigenicity.

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