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BIOTECHNOLOGICAL PROCESSING OF POULTRY WASTE AND ITS IMPACT ON *ACER CAMPESTRE*

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ABSTRACT

This article is devoted to the study of biotechnological methods of poultry waste processing and the influence of organic fertilizers on the growth of field maple (Acer Campestre). Biotechnology plays an essential role in organic waste processing which in turn helps to transform poultry droppings into environmentally friendly fertilizers that can significantly improve soil fertility and yields. Currently, no more than 20% of poultry manure is used as fertilizers in Uzbekistan. The use of poultry droppings at poultry farms in Uzbekistan has been poorly addressed today. Poultry manure is discarded outside the poultry farms, where it is either filled with pits not suitable for storage or unloaded in a specially designated area. Afterwards, it is not used and causes tremendous damage to the environment. At the same time, bird droppings contain high macro and microelements which form the core value as organic fertilizers. Physicochemical analysis has shown that the fertilizer contains 70% moisture, 17.3% ash content, pH 6.7, 1.9% N, 2.10% P_2 O5, 0.93% K_2 O.

KEYWORDS: ***biotechnological processing, poultry waste, anaerobic digestion, biofertilizer, soil fertility, field maple, greening, ecology.***

INTRODUCTION

For combating the environmental issues in Uzbekistan, it is worth paying attention to the operations of poultry farms, organic waste of which should be promptly processed by biotechnological methods. Organic poultry waste includes bird droppings, low-value feathers, blood and organs, which represent an aggressive substance that contains a vast number of harmful microorganisms such as disease-causing bacteria, helminth eggs, larvae, and weed seeds; besides, it has an unpleasant odour.

In the past, under intensive farm management cows with small dairy production and chickens were kept primarily for manure. The concentration of cattle or bird per unit of land was minimal. Manure was accumulated near the farms or taken to fields, where it gradually turned into humus.

Today, this method of application raises several problems. Firstly, the transportation of a vast amount of sewage (the content of dry matter 2-5%) requires a lot of money. Secondly, soil, underground and surface waters are infected with invasive, toxic elements. Thirdly, it leads to concentration of nitrates, copper and zinc in grain, grass and water resources. As a result, some U.S. states, for example, have banned the application of unprocessed bird droppings as a fertilizer (Voronkova M.N., Voronkova N.A., 2015).

Biotechnological disposal using methane digestion, thus, is one of the right solutions for recycling poultry waste. Raw materials, gained with the help of this process, can be widely used in agriculture as an environmentally friendly fertilizer, methane, animal feed additives and fuel gas. Like any other biological process, composting needs some factors to ensure satisfactory results, including the most important ones: temperature, moisture, pH and chemical composition of the material; the latter is the most challenging to be controlled and thus leads to varied results during the process (Orrico Junior et al., 2010). Huang et al. (2008) and Perez et al. (2002) showed that the composition of the fibrous fraction of plant materials (cellulose, hemicellulose and lignin) significantly influences the degradation rate of these compounds, mainly when the lignin comprises the major part of the substrate. According to Averyanov A., 2010, the Russian scientist, the dung contains microelements: 100 g of dry matter contains 15-38 mg of manganese, 12-39 mg of zinc, 1-1.2 mg of cobalt, 1-2.5 mg of copper and 300-400 mg of iron. Most of the food elements in bird droppings are in water-soluble form.

Uzbek farmers do not use the chicken droppings as a fertilizer because they do not know how to use it properly. When stored in large piles, bird droppings heat up and release ammonia that evaporates quickly. In 2-3 months, nitrogen losses may reach 30-50%.

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Nagy, L. and Ducci, F., 2004 recommend the use of field maple wood in landscape design for single and group planting, greening of streets, creation of parks, squares and hedges. *Acer Campestre* can tolerate heat, drought and frost, strong sea winds and air pollution, deep shade, heavy pruning and road salt (Fenaroli, L. and Gambi, G., 1976).

The Article Analyzes and summarizes the practical use of biotechnological processing of bird droppings into a fertilizer and its further application on field maple as one of the reasonable solutions to the economic and environmental safety of poultry production under industrial conditions as well as landscaping and improvement of territories in Tashkent region.

The Relevance of the topic. The solution to the problem of manure recycling is to improve the environmental situation, soil fertility and greening.

The research is aimed at processing organic poultry waste and the impact of organic fertilizers on soil fertility and *Acer Campestre* growth.

The laboratory and field studies on poultry waste management have been carried out on the territory of OOO Silver Eagle Plus (LLC) poultry farm in Tashkent region using the method of anaerobic fermentation and assessment of organic fertilizer quality as the most rational one for agriculture.

The studied objects have been organic waste from OOO Silver Eagle Plus (LLC) poultry farm in Tashkent region, meadow soil and field maple seeds and seedlings.

The research results have shown that the method of methane digestion is effective against pathogens in organic poultry waste; the process increases the number of useful bacteria and the generation of metabolites such as organic acids. Biotechnological poultry waste disposal reduces the processing time of the source material by 1.5 times.

The study has revealed that the application of organic fertilizers based on chicken droppings has had a positive impact on soil structure, which has enhanced its aeration and ensured proper vegetative root system development of *Acer Campestre*.

Experimental

During a year one chicken gives 6-7 kg of dung (Salimov K., 2012). The poultry farm Silver Eagle Plus LLC, where the research has been carried out, receives about 622080 kg of poultry waste per year. The poultry farm with 8640 broilers of floor housing produces 1728 kg of excrements per day. The calculation of droppings is presented in the tables 1 and 2. Fresh manure contains about 76% water. 1000 hens produce 65 tons of fresh manure, on the dry basis as sold (approximately 30% water), 25 tons is produced by 1000 hens per year **(**Tashkuziyev M.M., 2012**)**.

Table 1: Calculation of bird droppings produced per day in Silver Eagle Plus LLC

Number of heads	Chicken droppings (per day/g)	Total (kg)
8640	**200**	**1728**

Table 2: Calculation of bird droppings produced per year in Silver Eagle Plus LLC

Chicken droppings (kg)	Months	Total (kg)
51840	12	622080

Fresh chicken droppings contain 1.5-2.5% nitrogen, 1-2% phosphorus and about 1% potassium (Table 3).

Table 3: Chemical composition of bird droppings, %

Manure	H_2O	N	P_2O_5	K_2O	CAO	MGO	SO_3
Chicken	56	1,6	1,5	0,8	2,4	0,7	0,4

Poultry droppings with feathers were digested in mini-bioreactors. Different methods of treatment were used to reduce the loss of nutrients which the droppings lose when processed and stored. Therefore, the variations 1, 2 and control one had different additional components. The Sample 1 had water, sawdust and soil, while the Sample 2 included water, sawdust, wood residues and dry leaves. The Control sample was mixed with water. The temperature and pH were controlled each day. The list of factors was taken into account (Table 4). Bacteriological and parasitological control of poultry manure as well as ready fertilizers based on it was conducted by specialists from veterinary laboratories.

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Table 4: Factors affecting the fermentation process

- Temperature; - Ambient humidity; - PH level; - C : N : P ratio;	- Raw material particle surface area; - Substrate feed frequency; - Retarding substances; - Stimulating additives.

Top soil sample (0-20 cm) was obtained from a plot of land in Tashkent region. The physico-chemical properties of the soil; pH, particle size, organic carbon, cation-exchange capacity, phosphorus nitrogen, nitrate and sulphate, were determined by Standard Methods according to Dospekhov B.A., 1985. The seeds of *Acer Campestre* were taken in Tashkent Botanical Garden named after F. N. Rusanov where they were planted as well.

The data were subjected to statistical analysis. Student t-test was employed to estimate the significance of results obtained.

RESULTS AND DISCUSSION

Each sample of biofertilizer had its own period of processing. The Sample 1 needed 65 days in summer period; the sample 2 – 105 days and the control sample took 44 days (Table 5). During the tests, it has been found that the smaller the part of the substrate, the better. The larger the interaction area for bacteria and the more fibrous substrate, the easier and faster it is for the bacteria to decompose the substrate. In addition, it is easier to stir, mix and heat without creating a floating crust or sediment. Grinded raw materials have an impact on the amount of gas produced through the duration of the fermentation period. The shorter the fermentation period, the better the material has to be crushed. The organic fertilizer of Sample 2 has been obtained in two forms: liquid and solid. The liquid fraction was light brown, while the solid fraction was dark brown (Pic.1).

Table 5: Poultry waste processing in the summer period

Phase	Samples					
	1		2		Control	
	t°C	Period (days)	t°C	Period (days)	t°C	Period (days)
1	15	30	15	35	18	20
2	40	20	38	45	35	14
3	52	15	50	25	52	10
Total number of days:		65		105		44

Pic.1: Organic fertilizer from Sample 2

The result of the physicochemical properties of the experimental soil indicates that the soil is grey soils with high sand content of 65%. The soil was observed to be slightly acid this can pose a problem for agriculture due to lack of nutrients (Table 6).

Table 6: Chemical indicators of soil samples of Kibray in Tashkent region

pH	NO_3-	P_2O_5	K_2O	Humus
5.5-6.0	0.06 – 0.11%	0.07-0.11%	0,53-0,60%	0.7-0.9%

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The properties of biofertilizers show that the most nutritious one has been obtained in the Sample 2 which has had additional components to preserve nutrients from evaporation (Table 7).

Table 7: Chemical properties of organic fertilizers

Sample	Moisture	Ash content	pH	N gen.	N ammon.	P_2 O5	K_2 O
1	70	11,4	6,5	0,61	0,32	0,95	0,36
2	70	17,3	6,7	1,9	0,25	2,10	0,93
Control	70	10,2	6,3	0,40	0,18	0,50	0,21

The site in Tashkent Botanical Garden named after F. N. Rusanov has been fertilized and weeded 2 weeks before planting. The seeds were soaked in water and concentration of the organic fertilizer from the Sample 2. The impact of fertilizers is presented in the table 8.

Table 8: The impact of fertilizers on germination of *Acer Campestre*

	Amount of seedling	Shootout period	Period from sowing to sprouting	Germination%
Control of seeds	1	25.03.2022	156	0,6 %
Control of fruit	-	-	-	-
Seeds	18	23.03.2022	154	11,2 %
Fruit	2	28.03.2022	159	1,2 %
Total	21			13 %

As a result of the work on the treatment of fruits and seeds with biofertilizer, it has been found that the seeds that have undergone this type of treatment have a higher germination rate than the control option. The degree of rooting is high in all samples excluding the control one.

t-statistics. Student criterion. According to the Student table we find Ttable: Ttable (n-m-1;α/2) = (0;0.025) = 0

$$t_a = \frac{0.00191}{0} = >0$$

Statistical significance of coefficient a is confirmed. The estimation of parameter **a** is significant and the trend for the time series exists. $t_b = \frac{b}{Sb}$.

$$t_b = \frac{2.2567}{0} = >0$$

The statistical significance of coefficient **b** is confirmed.

CONCLUSION

The results from these studies have shown that the soil treatment with biofertilizers based on poultry dropping can improve soil fertility filling it with useful macro and microelements. It was also observed from this study that additional components such as wood residues, sawdust and leaves prevent the nitrogen, phosphorus and potassium from evaporation in big amounts. The survival and growth of the field maple can be considerably enhanced by soil amendment with organic fertilizers produced using anaerobic digestion. It has been also revealed that, various concentrations of biofertilizers had effects on growth and yield of *Acer Campestre*. The statistical data has shown that the results obtained have been confirmed. The results of this study have also revealed that the methane and carbon dioxide ratio is optimized in the Sample 2. The ammonia nitrogen has increased. The reaction of the produced organic fertilizer is alkaline (pH 7.2 - 7.8), which makes this fertilizer especially valuable for acidic soils. The study has found that the digestion process of bird droppings produces valuable, highly concentrated organic fertilizer without nitrites, weed seeds, pathogenic microflora, and helminthes. Such fertilizers enhance soil fertility, provide plants with easily accessible nutrients and reduce mineral fertilizer consumption.

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