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THERMAL METHOD TO PROCESSING ORGANIC ANIMAL WASTE IN A VACUUM

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Abstract:

The article scientifically substantiates the modes of disinfection of organic waste on the basis of litter in the thermal method of their processing in vacuum. Disinfection of organic animal waste during the technological process of vacuum drying is achieved at an installation temperature of plus 75 °C and more, at a humidity of 75-80 mm Hg, an exposure of at least 50 minutes and allows you to get a safe and sanitary product recycling.

Key words: *organic waste, disinfection, heat treatment in a vacuum.*

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INTRODUCTION:

One of the adverse factors affecting the environment and the veterinary well-being of farms is the waste of livestock enterprises and poultry farms. The operation of livestock farms, complexes and poultry farms showed that the manure and litter produced in significant quantities were contaminated by pathogens of infectious and invasive diseases, including those that are dangerous to humans. Under conditions of intensive livestock and poultry farming, even weakly virulent and conditionally pathogenic microflora, as a result of recycling, can increase virulence and create a serious epizootic threat to livestock breeding enterprises.

According to WHO, more than 100 pathogens of infectious and invasive animal diseases, including common to humans and animals, have been found in manure and litter [14].

The practice of livestock farms and poultry enterprises shows that with a high degree of contamination with organic waste from the territories of farms and the surrounding area, it is impossible to carry out effective antiepizootic measures and to achieve the full realization of the productive and genetic potential of farm animals and poultry. [8].

The accumulation of large amounts of non-disinfected manure and litter creates a danger to human health, animals and has not only medical, veterinary, economic, but also environmental importance, and in emergency situations can lead to serious consequences associated with the spread of diseases among the population [7].

At the same time, it is necessary to take into account that organic waste (manure and manure) are an integral part of the technological process of obtaining products in poultry farms and livestock farms [9, 10, 11, 12, 13].

The use of manure as an organic fertilizer in the practice of agriculture is possible in the absence of pathogenic microorganisms, causative agents of infectious diseases (GOST 20432-82 "Fertilizers. Terms and definitions"; GOST R 53117-2008 "Organic fertilizers based on animal waste", "Methodical recommendations on the technological design of disposal systems and preparation for the use of manure and litter"- RD-APK 1.10.15.02-17) [1, 2, 3, 4, 5].

Veterinary legislation provides for measures to prevent the spread of pathogens with manure and litter.

When infectious diseases are the most dangerous in epizootological and eco nomic respect, it is necessary to burn manure (anthrax, glanders, beshenstzo, emkar, cattle plague), while less dangerous, disinfect biothermally or by other means (physical or chemical).

Depending on the stability of the microflora (vegetative forms, spore-forming microorganisms) it is advisable to regulate the mode of disinfection and energy costs.

For the disinfection of manure and litter from pathogens of infectious diseases currently developed and used chemical, biological and physical methods.

From the physical methods of disinfection of liquid manure, litter and drains proposed and tested: ultraviolet irradiation, the action of ultrasound, ionizing irradiation, electro-hydraulic methods of treatment in an electromagnetic field of direct and alternating current of different frequencies, thermal effects.

Research and practice have shown that some of these methods: ionizing radiation, ultraviolet action, etc., are promising, but due to the high cost of the equipment concerned, the complexity of its operation is not widely used at present to disinfect large volumes of manure.

Among thermal methods, the most common are litter and manure drying, heat treatment of liquid manure and manure using parastatic units.

Despite a fairly complete degree of disinfection of manure and litter, as a result of heat treatments, these methods are expensive and require large energy costs. In addition, with the usual drying of manure and manure, toxic gases are released, and due to the large loss of nitrogen, the quality of the organic fertilizer produced decreases.

In recent years, domestic and foreign scientists and engineers of the engineering and technological profile are searching for more economical and less energy-intensive methods for preparing, processing and disinfecting manure and litter.

One of the directions in solving this problem is the use of technological processes for the processing of organic animal waste under low-temperature parameters in vacuum conditions.

The development of technological parameters and modes of disinfection of manure and litter with the

thermal method of their processing in vacuum, as the most economical and with the least negative environmental impacts, is an alternative to the traditional, very expensive methods of disinfecting organic livestock waste and relevant scientific direction in the creation of environmental and antiepizootic systems events.

The purpose of the research is a scientific substantiation of the modes of disinfection of organic animal waste (manure and litter) during their thermal drying in a vacuum.

MATERIAL AND METHODS:

Organic waste (manure and dung) humidity 70.0-80.0% served as the material and object of research.

A series of experiments to determine the modes of disinfection of organic animal waste during their thermal processing method was carried out in a **Vacuum Eco Dry** drying chamber loaded with prepared initial organic substrate into which test objects contaminated with suspensions from various groups of microorganisms were laid: E. coli, St. aureus - 209 P, an atypical strain of mycobacteria B-5 and B. cereus, differing in different degrees of resistance in the external environment and to the action of unfavorable factors (chemical means and physical factors) and evaluated from the results of their survival in the process of vacuum heat treatment (drying) organic waste.

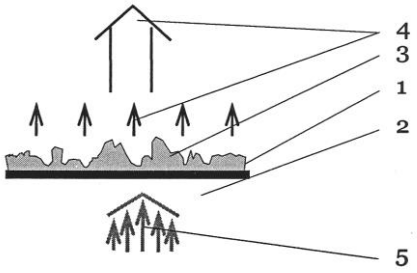
The test objects were bags of coarse calico fabric with a sample of manure and litter contaminated with 2 billion suspension of the above microbiological cultures at a dose of 1 ml per 1 g of sample. The test objects were removed after the end of the vacuum temperature process of processing organic waste and were subjected to microbiological studies.

The original organic substrate was directed through a receiving hopper into a vacuum chamber for drying. Its supply was carried out by the loading system in volumes agreed with the equipment capacity (up to 100 tons / day). In the process of drying, the original product moved through conveyors through heat exchangers.

Vacuum heat treatment of the original organic substrate (litter) was carried out at temperatures of + 60 ° C; 75 ° C; 90 ° C and 105 ° C, at a pressure of 75.0-80.0 mm Hg. Art. and duration 30 min., 50 min. and 70 min.

The process control of thermal vacuum processing of organic waste for temperature and pressure in the installation was also carried out in automatic mode - by a controller through a computer.

The result of reducing the moisture of manure was achieved by maintaining the balance of the input heat flow required for the drying process and the mass flow of water vapor released and removed during the dewatering process. The process flow diagram of waste drying in vacuum is shown in Figure 1.



1 – heat exchanger; 2 – heater; 3 – organic matter (manure); 4 – the mass of water vapor; 5 – heat flux

Figure 1: Flow chart of drying organic waste

Evaluation of the results of microbiological research was carried out in accordance with the "Instructions for laboratory monitoring of treatment facilities at livestock farms" approved. USSR Ministry of Agriculture 1982, "Recommendations for the use of filter membranes" VLADIPOR "brand MFA-MA for sanitary and bacteriological analysis of water", Ministry of Housing and Communal Services of the RSFSR - M., 1982; “Guidelines for determining the total microbial number in products of animal origin and environmental objects” Ministry of Agriculture and Food of the Russian Federation. 1999; "The veterinary-sanitary rules of preparation for the use as organic fertilizer of manure, litter and drains in infectious and invasive diseases of animals and birds" approved. Department of Veterinary Medicine of the Ministry of Agriculture and Natural Resources of Russia, 1997; "Methods of analysis of organic fertilizers", M., 2003.

RESULTS AND DISCUSSION:

The survival rate of indicator sanitary-indicative microflora (by the example of E. coli, St. aureus, mycobacteria - atypical strain B-5 and B. cereus) in organic waste during their vacuum heat treatment at different temperatures and the duration of the technological cycle is presented in Table 1.

Table 1: Survival of indicator sanitary-indicative microorganisms in organic waste in the process of their vacuum heat treatment

The name of the test microorganisms	The pressure in the installation for drying mm.rt.st.	The results of bacteriological studies											
		Installation temperature, ºC											
		60			75			90			105		
		Duration of drying, min.											
		30	50	70	30	50	70	30	50	70	30	50	70
E.coli	70-80	+	+	+	-	-	-	-	-	-	-	-	-
St. aureus	70-80	+	+	+	-	-	-	-	-	-	-	-	-
Atypical Mycobacterium B-5 Strain	70-80	+	+	+	-	-	-	-	-	-	-	-	-
B. cereus	70-80	+	+	+	+	-	-	+	-	-	+	-	-

Note: a plus sign (+) means that the culture is highlighted; minus sign (-) - culture is not selected.

The results of microbiological studies showed that during the process of thermal processing of organic waste in vacuum (at a pressure of 75-80 mm Hg) and the temperature in the installation plus 60 ° C, death does not occur as bacteria of the group of intestinal sticks (by the example of E. coli O139) belonging to the group of pathogens of infectious diseases unstable in the external environment (the first group), so coccal microflora (by the example of S. aureus 209P aureus) and mycobacteria (by the example of an atypical strain B-5) belonging to the group are resistant x and highly resistant to the action of external factors pathogens of infectious diseases of poultry and farm animals (the second and third groups, respectively), as well as spore microflora (**B. cereus**).

Disinfection of organic waste from vegetative pathogenic microflora in the thermal process of their processing in vacuum is achieved by observing the temperature in the drying chamber plus 75 ° C, pressure 75-80 mm Hg. Art. and exposure processing of organic matter for at least 30 minutes.

Compliance with these technological regimes in the thermal method of processing organic animal waste in a vacuum ensures the death of resistant pathogenic vegetative microflora and the production of a safe and sanitary organic fertilizer.

The data presented in Table 1 shows that during the process of drying organic waste in vacuum, the disinfection of infected (contaminated) manure and litter with **B.cereus** spores was achieved at an installation temperature of at least + 75 ° C and a pressure of 70-80 mm Hg. in 50 minutes.

Reducing the duration of heat treatment of organic waste for less than 50 minutes does not ensure complete heating of the dispersed inclusions of the organic substrate and inactivation of the resistant spore forms of microorganisms (**B.cereus**) contained in it that are resistant to thermal effects. The obtained data confirm that the thermal disinfection of organic waste (litter) is associated with complex physicochemical and structural transformations of organic substances contained in them. Under the influence of high temperatures, inactivation of pathogenic microorganisms and decomposition of organic substances occur. Moreover, part of the decay products goes into a dissolved state, and some is released in the form of gases. One of the causes of the death of microorganisms during heating is denaturation of protein and nucleic acid compounds. The death of the spores after heat treatment is also explained by the removal of dicalic acid from the spores [6].

CONCLUSION:

Disinfection of organic animal waste from vegetative pathogenic microflora in the thermal process of their processing in vacuum is achieved at a temperature in the drying chamber + 75 ° C, pressure 75-80 mm Hg. Art. and exposure processing of organic matter for at least 30 minutes.

Disinfection of organic animal waste contaminated with spore forms of infectious agents (for example

B.cereus) in the process of vacuum drying is achieved at an installation temperature of 75 ° C or more, pressure 75.0 - 80.0 mm Hg. and exposure for at least 50 minutes. Heat treatment of organic waste under vacuum in these modes ensures their disinfection and obtaining a sanitary and safe waste product.

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