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VERMITECHNOLOGY ASA PROMISING WAY TO OBTAIN INNOVATIVE COMMODITY PRODUCTS

Abstract. Nowadays for protection of the environment the most important streamline is to implement safe technologies for processing of agricultural and industrial wastes on the economic and environmental viewpoint. On one hand the wastes refer to basic pollutants of the environment and on the other hand they contain valuable parts which can be recycled and reused. The world literature pays much attention to new types of biotechnology, in particular to vermitechnology. This technology enables to get pure product in the agriculture, as well as fertilizer ameliorant can be obtained increasing the soil fertility.

The article describes the history of development, the scope of vermitechnology, availability and description of commodity products obtained on its basis. The characteristic of the new accelerated vermitechnology method is given. The possibility of using this method for obtaining ecologically clean organic substances from crop and livestock wastes is shown. Namely, the implementation of the proposed method, you can get organic fertilizer - biohumus (vermicompost) in solid and liquid form, as well as high-quality biomass of earthworms.

Subject of researchare agricultural wastes and products of their recycling, solid-household wastes, red Californian worms, fermentative manure of large and small cattle.

Key words: vermicompost, vermitea, earthworms, biomass, Californian red worms.

Introduction. At the present time, a special attention is given to the solution of two global problems: improvement of environmental situation and health promotion of population. These problems can be decided to a great degree by utilizing organic and inorganic production wastes by means of rational and effective use of new perspective, intensively developing up-to-date technologies. Vermitechnology or vermiculture is widely spread among them. The method of various livestock and vegetable organic wastes with the use of natural or artificial hybrids of compost earthworms is laid at the heart of vermitechnology. In a scientific literature the worms are called vermiculture.

The statement of Aristotle that a worm is “a world stomach” should be considered as the first message about the usefulness of earthworm [1]. Earthworms (from Latin *Lumbricina*) are large invertebrate soil animals. They belong to saprobes (from Greece sapros – rotten and phagos – predator), i.e. to animals, eating the rotting remainders of vegetable or animal bodies or excretions of animals and birds. They inhabit in all continents, except Antarctica. Altogether there are 100 species; representatives of some species are spread due to the introduction by mankind. The most familiar European earthworms belong to the family *Lumbricidae*. Earthworms eat animal manure, chicken manure, straw, cuttings, fallen leaves, weeds, offshoots of a plant and bushes, wastes of processing industry, vegetable stores and various plant residues.

The first ideas about the positive role of earthworms in soil forming processes were stated from the second half of XVIII century. M.V.Lomonosov wrote in his composition "About land layers" (1763): "There is no doubt, that black earth is not a primeval material, but it takes place from rotting of animal and growing bodies". And first attempts to use coprolites (biohumus), i.e. excretory products of earthworms refer to Ancient Egypt times. Here the wrap of Nile River processed with earthworms was used

successfully for growing the agricultural crops. Ancient Egyptians made a god of earthworm, thought of it as saint animal andprohibited to bring out of the country [2].

For the first time, an artificial rearing of earthworms and getting of biohumus with its help was organized in USA (California). The idea of industrial cultivation of earthworms belongs to American doctor Tomas Barrett (Thomas J. Barrett, 1884 – 1975).Thomas J. Barrett was over 50 when he heard from George Oliver, whom he was friendly with, the true story about a farm of George Sheffield – Oliver's grandfather. During 60 years (1830-1890), a 64-hectare farm flourished through the use of earthworms for soil cultivation. This story inspired Barrett to begin research of earthworms and study the soil cultivation technologies. In 1936, he organized a farm "Earthmaster Farms" ("Agricultural Farms") in the state of California. His decision was undoubtedly influenced by study of Charles Darwin on the role of earthworms in a soil-forming process on Earth. «Earthworms are creators of soil, everything else - plants, animals, human and bacteria are food for worms, whose function is to mix living matter with mineral particles and in cycle of matters. The problem faced by modern civilization today is restoration of soil for food production. It nature this process goes on slowly and from 500 to 1000 years are required for creation of soil cover with thickness of 1 inch. Under favourable conditions using worms it can be done in five years», – told so doctor Barrtet [3].

During selected works the scientists of USA in 1959 a red Californian worm was bred so-called subspecies of earth compost worm *Eiseniafoetida Andrei*. It had high capability to reproduce in comparison with wild precursors. Except that their fertility depended on conditions of their cultivation, highest was observedunder the conditions of closed greenhouses in comparison with fieldon outdoor areas. As differentiated from its wild congeners, which give only 4…6-fold reproduction, californian-worm is able to give more than 500-fold reproduction a year. Red californian earthworm obtained through selection method from the USA was imported to Europe in 1978, later to Asia, Australia and other countries [4].

The founder of vermiculture in Russia is AnatoliyMikhailovichIgonin - MD, professor, retired colonel of medical service. The name of Igonin became history as the founder of the movement "Earthworms - a source of soil fertility". The first successes in obtaining a highly productive and technologically acceptable compost worms' line were achieved as a result of selection work in 1985-1986. Due to the crossing of local (northern) and Chui (southern) earthworms, a unique hybrid was obtained, later named "Staratel". But the hybrid received deserved its name only in 2002. "The first large-scale experience in the introduction of vermiculture technology was carried out in the greenhouse plant Vesna near Uzhgorod t. (Ukraine). This first success in Ukraine has remained the first and the last,"- wrote A.M. Igonin with grief in his book "Earthworms: how to increase the fertility of soils into ten times, using the earthworm "Staratel". Igonin A.M. filed an application for invention on method of obtaining technological (specialized) species of the compost earthworm. And in 1995 his first book, "How to increase soil fertility into dozens of times using earthworms" was published, in 1999, the second one was published: "How to increase soil fertility into ten times using earthworms (organic farming)." He understood that only ecological farming, based on the restoration of natural soil fertility using earthworms, can save Russia's agriculture, restore health and well-being to the people [5].

Igonin A.M. ideas were not interested to the general director of JSC "MNPK "PIK" S.S. Konin. In December 1999, the entrepreneur invited Anatoly Mikhailovich to work in his corporation, in 2000 a biotechnological experimental laboratory was created, and then a production on technology called "Green-PIK" was started. In 2002, the corporation bought out the ownership of patented technology for raising the elite worm, and professor Igonin became the leading scientific consultant-expert of the corporation. In the same year Konin S.S. "christened" the worm and named "Staratel", which became a trademark [6].

Earthworms have great significance for agriculture. Even Ch.Darwin specified their useful influence on soil fertility. First of all, they made a track to roots of plant for penetration into soil depth. Besides the worm channels promote penetration of water and air in soil, where equal moistening and airing of soil is achieved that is very important for successful plant growth. Finally, the wormsgraduallyswallow ample quantity of lands and loose soil. As a result of worms' life activity the mixing of soil takes placed, at the same time soil surface layers gradually get rid of small stones, going deeper to soil. In addition to all the worms fertilize the soil, pulling leaves and otherplant residues to their burrows and promoting their quick putrescence and humusification.

Red Californian worm eatsas many wastes as it weighs itself per day. At average weight of worm in half-gram and their quantity of 100 nos./m^2 (id est 1 mln. per ha), then it gets that per day they let pass through itself 50 g of earth per square meter or half-ton of earth per ha.And more than half it separates is biohumus. 1 ton of worms per day produce about 0,5 ton ofabsolute biological fertilizer, loaded with organic. After complete processing of organic material by worms so-called vermicompost is obtained, i.e. the product enriched with valuable microorganisms. Majority of these microorganisms are nitrogen fixers and actinomycetes, which promote active plant growth. In biohumus the pathogenic microorganisms are absent practically. The concentration of magnesium and calcium increases in 2, potassium in 10, phosphorus in 7 times in this substance. Thanks to content of so-called biostimulants in biohumus it has a strong stimulating effect on plant and its yield [7].

In the XXIcentury many foreign countries were covered by industrial producing of vermicomposts and biomass such as Japan,Germany, Canada, Holland, Spain, Denmark, Hungary, Great Britain, France, Poland, Russia, Ukraine, Belorussia, China, Kazakhstan,and others. Italian research workers have already been involved in the development of semi-industrial technology since 1975. For year-round growth of the worms they proposed plastic film greenhouses of tunnel type. As a support medium for growing of worms the cow, horse, rabbit manures were used fermented during 3-4 months, garden soils, chopped straws or other cellulose-containing materials and calcium carbonate [8].

Saudi Arabia had shown adaptability of agricultural industry on desert zone. Not having soils suitable for farming this country exported not only wheat, but dairy products many years, having in hand aconsiderable cattle stock. The basis of this achievement was application of biohumus obtained from manure as a fertilizer while growing wheat and fodders in greenhouse conditions.

In the last 5 years an application of composting with worms and vermiculture in the southern regions of Kazakhstan has begun to get various fertilizers on basis ofsulfuric production and livestock farm wastes, including poultry breeding as well as getting of different purpose biopreparations [9].

Formation and development of vermitechnologyis conditioned by solubility of a variety of pending environmental-economic tasks on biological basis. Vermitechnology is directed to accomplishment of two main tasks: prevention and exclusion of habitation environmental pollution and effective direct waste use or products produced from these. While using vermitechnology the following four main objectives are pursued: waste utilization, increasing of soil fertility, production of fodder protein and pharmaceutical preparations [10-12].

While carrying out the vermitechnology two main processes take place – it is composting with worms and vermiculture. The scientists of USA, Great Britain showed the possibility to use some types of earthworms (Eiseniafetida, Eiseniaandrei, Perionyx excavates, Eudriluseu genial, Dendrobaenaveneta) by research investigations for processing of organic food, agricultural and industrial wastes (sewage sludges) with obtaining two end products simultaneously - high humus organic fertilizer (coprolite) andfull animal fodder protein (biomass of worms)[13].

Earthworms have found a very interesting definite application while conducting Olympiad in Sydney (Australia) in 2000. The facilitators of Olympiad decided to use decontaminating, deactivating properties of these worms and used them for processing of domestic wastes generated immediately in thecrowded places. for the purpose of own idea the facilitators of Olympiad placedmanygarbagecans filled with worms similar todomestic refrigerators by size and form in the areas of Sydney Olympic organising committee, central press centre, international broadcasting center, Olympic park and other facilities. Moreover they improved the environment, and got appreciable quantity of high-quality fertilizer from processed waste necessary forincrease of land fertility [14].

The worms are grown not only for sake of getting biohumus, but also other biological products. In USA, Russia and some other countries the earthworms are widely used for obtaining the supplementary feeds various by composition. Flour or minced meat from worms by its chemical composition can compete with fish-flour, but cheaper than it. Dry vermiculture is not only a source of energy and protein, but also vitamins D and group B including B_{12}. On the majority of non-replaceable amino acids the flour from vermiculturenotedly leaves behind the meat-and-bone meal tankage. 16 amino acids are included in the chemical composition of red Californian worm, while animal meat contains 6 amino acids, tomato only 3. Thanks to high calorific capacity and chemical composition, the worms were main components of many foods of ethnic cuisine of China and South-East Asia. Even Americans don't perceive "worm

holding" as exotics by now. At present, in America, the worm biomass is the main additive to the infant food. They consume wormsin form of meat additive; eat them cooked, fried and even alive, like oysters.

The investigations on determination of protein content in the worm biomass and its use for a healthy diet were carried out for the first time by Laurence and Millar [15]. According to their investigation results the earthworms' biomass of type *Lumbricus* in terms of dry weight the protein is from 62.0 to 71.5 % and common fat 1.5% with length of carbon chain from C_{10} to C_{22}.

The scientists of China, Japan and South Korea detected and separated the ferments from bowel and tissue fluids of earthworms, which can dissolve fibrin. Use of these ferments will allow boosting the present-day medicine to new level of development in treatment of cerebral thrombosis and myocardial infarction. Sun (1998) detected and separated an acid antimicrobial peptide, which ensures disease resistance as well as he got a preparation from earthworms, which can be used while growing both plants and animals. There is ferment in the earthworms' tissues which can dissolve the worm itself under certain conditions [16].

In many countries of the world (Germany, Russia, China, Viet Nam, Philippines, Japan, India and others) a number of studies on determination of chemical composition, biological activity of earthworms were conducted. Methods of obtaining were developed on the basis of proteinic dry powder-like and paste-like preparations of food and supplementary feeds, cosmetic and pharmaceutical means for medical purposes [17].

For growing of California worm and obtaining of biohumus the plants of various structures are used. It can be in indoor areas, wooden or plastic boxes, boxes, baskets, containers and automatic reactors of continuous operation or other process tanks, in outdoor areas – storing bunkers (ridge technology), boxes.

Each type of vermitechnology has many options: static, continuous operation. At the static option the base and feeding support mediums are mixed, then the worms are housed in this mixture and left prior to final completion of the composting with worms process. At continuous – housed worms in the main support medium are fed by new portions offeeding support medium from time to time. At that feeding support medium is laid on the system surface, and final product - vermicompost is removed from the vermisystem on a regular basis. In the vermisystem of continuous operation the size of vermiboxes is limited only by dimensions of available premise, optimal height of support medium is not more than 70 cm. The bed of vermibox represents a special grid, equipped by door with hydraulic drive, with its help usually the final product – vermicompost is removed. The advantage of this system is absenceofdisturbing actions in the vermibox for worms, the fodder is provided from above on a regular basis, and migration of producers – worms into feeding support medium is carried out by natural way according to their food requirement. Duringseveraldecades the system of automatic reactors of continuous action is widely used in Great Britain, USA, Hong-Kong and Australia. At the present timethis system of composting with worms is one of the most effective among well-known[18].

In Belarus the multistage modular plant for production of biohumus was proposed. As working boxes the endless band conveyers are used, where three operations are connected in one continuous cycle at once: loading of fodder to the box, processing of fodder by worms and simultaneously unloading of done biohumus. Multistage structure of module allows using the areas and height of shop and volumes of premise quite effectively [19].

As a support medium the organic wastes are used: pig manure, cattle, sheep and goats manure, manure of horses, camels, chicken manure, herbage of plants, fallen leaves, straw, woodchips, cuttings, food and vegetable wastes, cardboard, paper and others. Apart from organic substances for normal life activity and development the worms need minerals. For example, for supply of calcium usually the gypsum, chalk, dolomite powder in view 0.5% of calcium are added to the support medium. The easiest and available source of calcium is a powder-like eggshell. The favourable conditions of the environment for worms is pH within 6.5-7.5; temperature 15-30 ^{0}C; moisture content not more than 75% and not less than 50%. Quantity of worms is not less than 20 thousand pieces per 1m^3.

Based on experimental studies the dependence ofreproductive activity and biomass of worms on the abiotic and biotic factors such as temperature, moisture, qualitative composition of support medium, availability of microbiota different by nature was detected[20].

At vigorous activity the worms, consuming ample quantity of plant residues, microorganisms, mushrooms, sea grasses and other matters, together with coprolites segregate ample quantity of gut organisms,

which possessantibiotic properties, preventing development of pathogenic flora and putrefactive processes. From 1 ton of support medium on average 600-650kg of biohumus and 10-15kg of worms are obtained (in terms of dry basis).

The analysis of published data testifies to the wide practical application of vermitechnology for utilization of organic waste. Unfortunately, the duration of the process of waste processing by vermitechnology takes at least 5-6 months. In this regard, the improvement of this technology, aimed both at speeding up the process and obtaining vermic products with improved quality indicators is an urgent task.

This paper presents the results of our research aimed at developing an accelerated version of vermitechnology with obtaining certain types of marketable products.

RESEARCH METHODOLOGY. Biohumus components are determined by known classical methods. Potassium and phosphorus in biohumus were determined with the method of Kirsins[21], the form of ammonium nitrogen was determined with the method nitrateCorifilda [22], nitrate nitrogen - by measuring the electrical conductivity using the ecotester "Union expertise the determination of mobile phosphorus in the soil - by the method of Machigin, humus - by the method of Tyurin, [23], ammoniation activity photoelectric colorimeter [24], the average reaction of pH - meter.

To remove pure microorganisms from biohumus, their morphological and physiological properties, etc. The agar-agar medium of the layer was used as the center for conducting microbiological studies. The composition of the shaft: glucose (sucrose) – 30.0 g, magnesium sulphate– 0.5 g, potassium chloride – 0.5 g, potassium dioxide – 1.0 iron sulphate– 0.01 g, water – 1000.0 ml and this medium is introduced into 2-4% agar [25].

RESULTS AND THEIR DISCUSSIONS. Based on our experimental data and literature reviews, themethods for producing a number of products using vermitechnologyare considered. In figure 1 thevermitechnological implementation process of waste recycling and types of generated recycling products is given in diagram form.

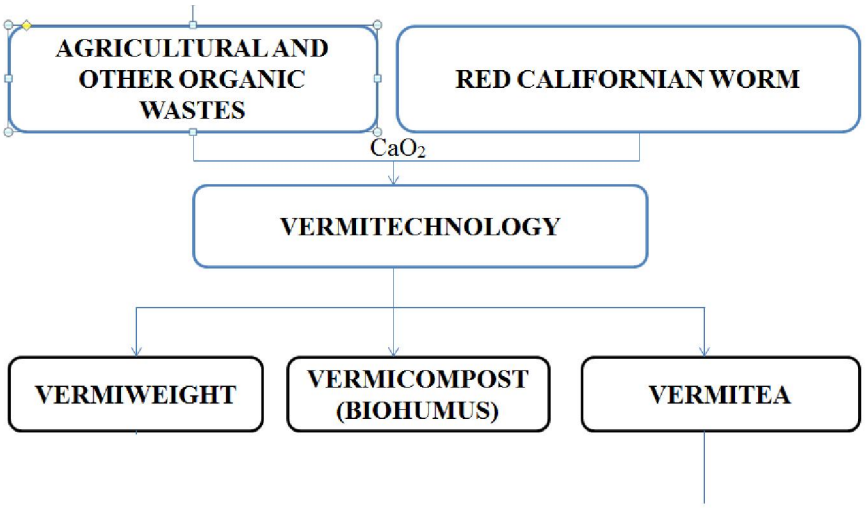

Figure 1 – Diagram of organic wastes' recycling by vermitechnology

For activation of composting with worms and vermiculture process the calcium peroxide is inserted into the support medium composition. Calcium peroxide, having dissolved slowly in water-containing system, disengages oxygen and contributes to aeration of whole support medium areas. In this case anaerobic zones are eliminated, which are environmental pollution sources with harmful substances, working capacity of producer-worms becomes better. Final products, generating during decaying of calcium peroxide, are harmless for biological resources (O_2, H_2O, $CaCO_3$):

$$CaO_2 + 2H_2O \rightarrow Ca(OH)_2 + H_2O_2 \quad (1)$$

$$2H_2O_2 \rightarrow 2H_2O + O_2 \quad (2)$$

$$Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O \quad (3)$$

The data for determination of worms' biomass were obtained by experiment while inserting different concentrations of calcium peroxide into the processes support mediums (table 1). Optimal is limiting content of calcium peroxide within 2.0-3.5 of mass %. Application of calcium peroxide less than 2.0 of mass % does not cause significant increase both the number of producer-worm and their biomass. Application of calcium peroxide into support medium above 3.5 of mass % is inappropriate, because the sharp rise of worm's culture biomass is not observed [26].

Table 1 – Condition of worm biomass during experimental observation from 05.01.2018 to 07.03.2018

Variants	Quantity of worms, piece		Biomass of worms, gr		growth in 2 month	
	05.01	07.03	05.01	07.03	Quantity of worms, piece	Biomass, gr
When a calcium peroxide is added to the substrate, %:						
1.0	2000	2128	440	631	128	191
1.5	2000	2135	452	669	135	217
2.0	2000	2210	446	927	210	481
3.5	2000	2533	461	1660	533	1199
5.0	2000	2527	459	1670	537	1211
Without adding calcium peroxide in the substrate	2000	2130	450	620	130	170

Technology provides for selection of the following optimal content of components for support medium composition: correlation carbon to nitrogen (C:N) (25:1)÷(30:1); humidity –70÷80%, oxygen not less than 11-14%; density – 1.3 -1.4; temperature – 19-28^{0}C.

Application of calcium peroxide additives to processed support medium reduces the content of generated toxins smelling strong while rotting the plants, pH of environment is regulated, additional oxygen and calcium entry to worms' organism is ensured, which maintain their vigorous activity. Applied calcium peroxide helps to Californian worms to conduct the microorganisms' selection process more active, the eggs of insects and helminthes collapse.

Technological cycle of animals waste and plant residues conversion to final product is not more than 2 months, i.e. the process is expedited practically for 2-3 times. The possibility to obtain about 550-650 kg of biohumus and 10-15 kg of biomass of Californian red worms (in terms of dry mass) from 1 ton of processed product was determined based on conducted experimental researches.

Resistance to water of obtained biohumus - 95-97%, full water capacity – 200-250%. It evidences about possibility to apply biohumus as anameliorant and a soil improver. As it can be seen for experimental data, given in table 2, biohumus contains ample quantity of humus substances (up to 32.3%), which give it high agrochemical and growth stimulating properties.

Biohumus as a fertilizer can be used both in solid form and liquid form called vermicompost tea. Vermicompost tea or aqueous extract of biohumus are used for additional fertilizing of sprouts, houseplants, for spraying of fruit and vegetable crops as a growth stimulating preparation for seeds soaking. To get vermicompost tea 10 liter of water is poured to 1 glass(100 g) of biohumus and keep for one day at room temperature. Vermicompost "tea" contains water-soluble factions of biohumus itself (vitamins, plant hormones, humates, fulvates etc.). Nearly all nutrient substances and microflora useful for soil and plants are passed from boihumus to liquid fraction. In 1 ml of vermicompost tea there are several billions of microorganism cells. Biohumus and vermicompost tea possess high fermentation activity.

Apart from biohumus and vercompost tea the thirdmarket product is a biomass of Californian red worms (CRW).

CRW is a renewable natural crude preparation of animal origin. From year to year the scope of application and assortment of pharmaceutical preparation and biologically active food additives based on their biomass is broadened. The value of this biological resource is that CRW body contains about 70% (from worm weight) of digestible protein. Such quantity of digestible protein is not contained in any agricultural crop or in the body of any animals.

Table 2 – Chemical composition of biohumus – product of agricultural waste recycling by Californian worms without application and with application of calcium peroxide to support medium

Main components	Average content, %	
	Without calcium peroxide	According to proposed invention (CaO_2 -2,0-3,5%)
Humidity	45,0	40,1- 45,4
Ash content	36,1	35,5-40,3
Organicsubstance	55,8	55,0-65,1
Humicsubstance	17,4	25,7-32,3
Total nitrogen	1,1	1,0-2,0
Total phosphorus(P_2O_5)	1,7	1,5-3,0
Total potassium (K_2O)	2,1	1,2-2,0
Calcium	1,7	4,0-6,0
Magnesium	0,6	0,6-2,3
Ferrum	notdetermened.	0,6-2,5
Manganese	notdetermened.	60-80 mg/kg
Weight percentage heavy metal, mg/kg	Below MAC for soil	Below MAC forsoil
Pathogenicflora	none	none
Helmint eggs	none	none

CRW biomass is harmless for animals and human, does not possess allergic, anaphylactogenic, teratogenic, embryotoxic and carcinogenic properties therefore they can serve as a basis for development of new biopreparations differing by composition and purpose. We have shown the possibility to create environmentally clean natural supplementary feeds and veterinary preparations in the form of ointments, pastes, suspended solutions based on worm biomass for birds, agricultural animals, fish, domestic pets as well as various cosmetic and therapeutic agents for human being.

Conclusion. Based on the literature,the effective methods to use wastes from different areas of agriculture, housekeeping, organic composite wastes from industry was suggested. One of them is vermi-compost technology with accelerated motion. The technology of waste recycling using vertically treated waste was demonstrated.

The accelerated version of vermitechnology allows obtaining high-efficiency organic fertilizers - biohumus (vermicompost). Determined ofchemicalcomposition of biohumus – product of agricultural waste recycling by Californian worms without application and with application of calcium peroxide to support medium. Resistance to water of obtained biohumus - 95-97%, full water capacity – 200-250%. It evidences about possibility to apply biohumus as anameliorant and a soil improver. As it can be seen for experimental data biohumus contains ample quantity of humus substances (up to 32.3%), which give it high agrochemical and growth stimulating properties.

REFERENCES

[1] Bityutsky I.A., Kudryasheva N.V., Solovyova A.N., Lukina E.I. The influence of earthworms on the availability of micro-elements to plants // Proceedings of the 2nd International Scientific Prakt. Conf. "Earthworms and fertility of the soil". Vladimir, 2004. P. 77-79 (in Rus.).

[2] Perel T.C. Distribution and patterns of distribution of earthworms of the USSR fauna. M.: Nauka, 1979. P. 117 (in Rus.).

[3] Thomas J. Barrett. Harnessing the Earthworm. 1947 (in Eng.).

[4] Edwards C.A. The use of earthworms in the breakdown and management of organic waste // In: Edwards C.A. (ed.), Earthworm Ecology. St. Lucie Press, Boca Raton, FL. 1998. P. 19 (in Eng.).

[5] Patent of RFN o.2058737, priority 29.10.91. Igonin A.M. (in Rus.).

[6] Pavlovskaya N.E., Yushkova E.I., Danilenko A.N., Botuz N.I., Polozova E.Yu., Borzenkova G.A. Physico-chemical characteristics and biological activity of biohumus: Monograph. Eagle: Publisher ORAGS, 2007. 140 p. (in Rus.).

[7] Yushkova E.I., Takanaev A.A. Vermiculture as a source of biologically active compounds for pharmacology and medicine // Matches of a scientific journal, scientists notes Orlovskogo State University. 2009. N 2. P. 109-111 (in Rus.).

[8] Edwards C.A., Arancon N.Q. 2006. The science of vermiculture: the use of earthworms in organic waste manangement // In: Guerrero R.D. III, Guerrero-del Castillo MRA (eds.). Vermi Technologies for Developing Countries. Proceedings of the International Symposium-Workshop on Vermi Technologies for Developing Countries. Nov. 16-18, 2005. Los Baños, Laguna, Philippines. Philippine Fisheries Association, Inc. P. 1-30 (in Eng.).

[9] Akbasova A.D., Uysimbaeva Z., Sainova G.A., Sunakbaeva D.K., Abdimutalip N. The pe(a)rlitesulphur-containing waste products effects upon the lead inflow into planta // International journal of experimental education. 2013. N 12. P. 22-23 (in Eng.).

[10] Akbasova A.D., Imangaliev A.K., Tashimov L.T., Sainova G.A., Turebekov O.T., Toichibekova G.B. The method of treatment of trichophytosis of large and small cattle. Innovative patent № 26560.№ 12, December 25, 2012 (in Rus.).

[11] Bekzhanov M.A., Akbasova A.D., Guzovsky K.Z., Sainova G.A., Kudasova D.E. Fertilizer-meliorative agent // Innovative patent of the Republic of Kazakhstan. № 29739. 2015. Bul. № 4 (in Rus.).

[12] Akbasova A.D., Sainova G.A., Beisenbaeva L.S., Abdimutalip N.A. Effect of sulfur-perlite-containing waste products of sulfuric acid production on the behavior of heavy metals in the soil-plant system // Modern problems of geographical science. 2014. N 1. P. 45-48 (in Rus.).

[13] Sharma S., Pradhan K., Satya S., Vasudevan P. Potentiality of Earthworms for Waste Management and in Other Uses – A Review // The Journal of American Science. 2005. Vol. 1(1). P. 4-16 (in Eng.).

[14] Renuka Gupta, Garg V.K. Vermiremediation and nutrient recovery of non-recyclable paper waste employing Eiseniafetida // Journal of Hazardous Materials. 2009. N 162. P. 430-439 (in Eng.).

[15] Lawrence R.D., Millar R.H. Protein content of earthworms // Nature (London). 1945. N 3939. P. 517 (in Eng.).

[16] Sun Zhenjun. Vermiculture & Vermiprotein. China: China Agricutural University Press. Beijing, 2003. 366 p. (in Eng.).

[17] Xinquan Du Process for preparing "Dilongjing" (earthworm extract) capsule and oral liquid // Patent of China People Republic № 1114202 from 1996-01-03 (in Eng.).

[18] Akbasova A.D., Isakov O.A., Sainova G.A. Ecologization of agriculture through rational use of vermiculture and biopreparations on their basis: monograph. Almaty: NurlyAlem, 2015. 132 p. (in Rus.).

[19] Grinin A.S., Novikov V.N. Industrial and household waste: Storage, utilization, processing. M.: FAIR PRESS, 2002. P. 336 (in Rus.).

[20] Wang X., Chang L., Wang G., Sun Z., Ma H., Sun Q., Li J. Protein extraction from the earthworm Eisenia foetida for 2-DE // Proteomics. 2010. N 10(5). P. 1095-1099 (in Eng.).

[21] State standard 54650-2011. SOILS. Determination of mobile compounds of phosphorus and potassium by the Kirsanov method in modification CRIAS (in Rus.).

[22] Queen I.E., Shkode E.I. On the application of the method of Coryfield to determine the requirements of soils in nitrogen fertilizers // Chemistry in the rural economy. 1968. N 2 (in Rus.).

[23] State standard 26213-91. Soils.Determination of organic matter by the Tyurin method in the modification of CRIAS (in Rus.).

[24] Tsitovich I.K. Chemistry with agricultural analysis. M.: Kolos, 1974. 117 p. (in Rus.).

[25] Polyak M.S., Suharevich V.I., Suharevich M.E. Nutrient media for medical microbiology. SPb., 2002. 28 p. (in Rus.).

[26] Patent of the Russian Federation No. RU 2577059."Accelerated method of complex vermicomposting and vermicultivation" Akbasova A.D., Isakov O.A. Date of publication 10.03.16.Federal Service for Intellectual Property (Rospatent) (in Rus.).

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ВЕРМИТЕХНОЛОГИЯ – ИННОВАЦИЯЛЫҚ ТАУАРЛЫҚ ӨНІМДЕРДІ АЛУДЫҢ ЗАМАНАУИ ӘДІСІ

Аннотация. Қазіргі уақытта қоршаған ортаны қорғауға ауылшаруашылық және өндірістік қалдықтарды өңдейтін экологиялық тұрғыдан қауіпсіз технологияларды іске қосу ең маңызды бағыттардың бірі. Себебі қалдықтар бір жағынан қоршаған ортаны ластайтын басты ластағыштарға жатады. Екінші жағынан, қалдықтардың құрамында құнды бөліктер болғандықтан оларды өңдеу мен қайтара қолдануға болады. Дүниежүзілік әдебиеттерде биотехнологияның жаңа түрлеріне ерекше назар аударылуда, атап айтқанда, әсіресе вермитехнологияға. Бұл технология ауыл шаруашылығында таза өнім алуға мүмкіндік береді, сонымен қатар оларды кәдеге жарату арқылы басқа да құнды заттар алуға болады.

Мақалада вермитехнологияның даму жолдарының тарихы, қолдану аясы, қолжетімділігі, алынатын өнімдерге сипаттама келтірілген. Сонымен қатар вермитехнологияның жаңадан жасалғанжеңелдетілген нұсқасы сипатталған. Бұл әдісті қолдану арқылы өсімдік және мал өсіру шаруашылықтарының қалдықтарын тиімді түрде өңдеп, экологиялық тұрғыдан таза органикалық заттар алуға болатыны көрсетілген. Нақтылап айтқанда, қатты және сұйық түрдегі органикалық тыңайтқыштар – биогумус(вермикомпост), вермишай және сонымен қатар жауын құрттарының жоғары сапалы биомассасын алу жолдары ұсынылған.

Зерттеу нысаны ретінде ауылшаруашылығының қалдықтары және оларды утилдегендегі өнімдер, тұрмыстық қатты қалдықтар, қызыл калифорниялық құрттар, ірі мүйізді және майда мүйізді малдардың ферменттелген көңдері алынған.

Түйін сөздер: вермитехнология, вермикомпост, вермишай, жауын құрттары, биомасса, қызыл калифорниялық құрттар, кальций пероксиді.

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ВЕРМИТЕХНОЛОГИЯ – ПЕРСПЕКТИВНЫЙ СПОСОБ ПОЛУЧЕНИЕ ИННОВАЦИОННЫХ ТОВАРНЫХПРОДУКТОВ

Аннотация. В настоящее время с экономической и экологической точек зрения для защиты окружающей среды наиболее важным направлением является внедрение безопасных технологий переработки сельскохозяйственных и промышленных отходов. С одной стороны, отходы относятся к основным загрязняющим веществам окружающей среды, а с другой стороны, они содержат ценные части, которые могут быть переработаны и использованы повторно. В мировой литературе большое внимание уделяется новым видам биотехнологий, в частности к вермитехнологии. Эта технология позволяет получать чистый продукт в сельском хозяйстве, а также улучшать минеральное удобрение, повышая плодородие почв.

В статье описывается история развития, область применения вермитехнологии, доступность и описание товарных продуктов полученных на его основе. Приведена характеристика нового ускоренного метода вермитехнологии. Показана возможность применения данного метода для получения экологически чистых органических веществ из растениеводческих и животноводческих отходов. А именно, реализации предлагаемого способа можно получить органического удобрение – биогумус (вермикомпоста) в твердом и жидком виде, а так же высококачественную биомассу дождевых червей.

Предметом исследования являются сельскохозяйственные отходы и продукты их переработки, твердые бытовые отходы, красные калифорнийские черви, ферментативный навоз крупного и мелкого крупного рогатого скота.

Ключевые слова: вермикомпост, вермичай, дождевые черви, биомассакрасных калифорнийских червей.

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