THE INFLUENCE OF DIFFERENT IODINE SOURCES AND DOSES ON THE BIOMASS INCREASE OF RED CALIFORNIAN WORMS

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The ecological and trophic research was carried out at the BilaTserkva national agrarian university to investigate the influence of different iodine sources and doses on the biomass increase of red Californian worms in order to use the worms as feed additive in the ration of farm animals and poultry. It was identified that an efficient iodine source for the vermiculture is iodine adsorbed on the modified saponite.

Key words. Vermiculture, red Californian worms hybrid, substrate, saponite, utilization of organic waste.

Acceleration of scientific and technical advance in national economy is accompanied by increase of the anthropogenic influence on the environment and results into pollution of environment by chemicals and organic compounds of industrial, domestic and agricultural origin. The problem of organic waste utilization is a very acute one [1].

One of the ways for solution of this problem is application of vermiculture biotechnology. The vermiculture (cultivation of red Californian worm hybrid) allows to recycle the agricultural production waste.The obtained worm biomass is a valuable protein additive to the rations of farm animals and organic fertilizer – bio-humus. At the same time, a number of ecological problems is solved [2,3].

When utilizing the organic waste, a special attention has to be addressed to the accumulation of macro- and microelements in the worm biomass serving as a feed additive.

The application of biomass of the red Californian worm in the feeding of farm animals and poultry is a good supplement to the ration of the protein of animal origin, containing all indispensable aminoacids, including lysine amounting

7,3 g per 100 g of worm protein [4]. Besides, the worm biomass contains other biologically active substances, in particular vitamins, unsaturated fat acids and minerals [5].

It should be pointed out, that the chemical characteristics of worms largely depend on the type of their feed. It was found out, that the increase of microelements in the nourishment resultsdirectly proportional into increase of these elements in the worms biomass [5, 6]. This ability applies also for iodine.

Thus, enriching the nutrient environment by iodine, it is possible to obtain the worms biomass with a high content of this element. The application of this feed additive allows balancing the rations for animals not only by amino acids, vitamins, but also by iodine, as this element was lacking in the feed of the western and northern biogeochemical zones of Ukraine.

In the nature, the iodine is known mainly in the form of sodium, potassium, calcium and magnesium salts of hydroiodic and iodic acids. From the earth and the soil, the iodine is washed out by rain, snow and wind into the rivers and is accumulated in the seas and oceans. The ions of iodine are getting oxidized by the sunlight to thevolatile elementary iodine [7].

The iodine can be found in all tissues, liquids and cells of the body, however mainly it is deposited in the thyroid gland.The iodine is located in the gland in different forms: in the form of nonorganic iodide and mineral organic compounds. The organic forms of iodine are part of monoiodotyrosine(MIT), diiodotyrosine (DIT), 3,5,3',5'-tetraiodothyronine(thyroxin, T_4), 3,5,3'-triiodothyronine(T_3), thyreoglobulin and possibly other iodine containing compounds.

The iodine influences the development of reproductive organs and functions. Thetypical disorders occur during thyreoidectomy and in the sexual sphere. The state of skin is closely connected with the function of thyroid gland. One of the preconditions for normal functioning of the gland is a regular supply of iodine to the body. The iodine influences the activeness of the tyrosinase. During the non-optimal supply of this element, the synthesis of nucleic acids in bodyis getting disturbed, which results into decrease of genetic potential.

The iodine directly influences the development of thymus and the functioning of immune cells (T- and B-cells, macrophages) and antigen properties of thyreoglobulin. The iodine implies the antimicrobial and disinfecting properties.

The deficiency of iodine in the soil, water and food leads to decrease of its concentration in the human and animal bodies living in some biogeochemical zones. The iodine limits in the mixed fodder for poultry results into hypofunction of thyroid gland and endemic craw. In particular this goes for young poultry. The deficiency of iodine in the human body can cause mental retardation, hypothyroidism and to some degree cretinism and abnormal growth and development. One of the main signs of the iodine deficiency in the ration of farm animals is deterioration of reproductive function. The iodine and iron deficiency impacts the hemoglobin synthesis [7, 8, 9].

Thus, the perspective for investigation is finding an optimal rate of enrichment the worms' biomass by iodine.

The research objective. The research objective is investigating the influence of different iodine doses and sources in the substrates on the quantity increase of red Californian worm hybrid and its biomass.

The materials and research methods. The research was carried out in the laboratory of the Research Institute of ecology and biotechnology and in the vivarium of the Bila Tserkva national agrarian university.

The substrate for cultivation of the red Californian worm hybrid was dung biomass from the cattle and the straw of the winter barley. The starting components have been mixed and fermented for seven months. The prepared fermented substrate was put into micro-bed (0,7 m x 0,4 m x 0,25 m) of 12 kg by the gravimetric method. Into the check micro-beds the substrate was put without any content iodine forms. The micro-bed I was charged by 40 mg iodine (in the form of potassium iodide) per 1 kg substrate. The substrate of the beds II and III contained 80 mg/kg and 160 mg/kg of potassium iodide.

The substrate IV of the experimental micro-bedswas charged by 40 mg/kg of iodine in adsorbed condition on the modified saponite.

The time of experiment was 45 days. The temperature in the room was maintained by 24,0–25,0 ?C. The substrate humidity in the check and experiment micro-beds was maintained by 64–65 %. The fresh substrate was added each 15th and 30th day of experiment.

To calculate the number and mass of worms, a probe was used (10 cm x 10 cm x 50 cm) for the tests of substrate with oligohaetes.

The research results and their discussion. At the beginning of the experiment, the worms number in one test (10 cmx 10 cm) was 20,0pieces, and their mass was between 14,40 g – 14,47 g (table 1).

Recalculated per one standard bed (2 m x 1 m) the worms' number made 4000 pieces. Also the bed groups were leveled according to the individual mass of the red Californian worms' hybrid.

Table 1 – **Number and mass of red Californian worms' hybrid at the beginning of experiment**, M±m, n=5

Bed groups	Worms per test (10 cm x10 cm)		Recalculated per bed 2 m^2	
	Number, pieces	Mass, g	Number, pieces	Mass, g
Check	20	14,41±0,123	4000	2882,0±2,34
Experiment I	20	14,43±0,201	4000	2886,0±3,42
Experiment II	20	14,42±0,142	4000	2884,0±5,13
Experiment III	20	14,40±0,201	4000	2880,0±6,26
Experiment IV	20	14,40±0,134	4000	2880,0±5,72
Experiment V	20	14,45±0,208	4000	2890,0±4,98
Experiment VI	20	14,47±0,251	4000	2894,0±7,81

Table 2 - **Number and mass of red Californian worms' hybrid at the end of experiment**, M±m, n=5

Bed groups	Nubilous and non-nubilous worm sintest(10cmx10 cm)		Recalculated per bed 2 m^2	
	Кількість, шт	Маса, г	Кількість, шт	Маса, г
Check	140,0±3,23	26,4±0,59	28000±987,4	5280±149,7
Experiment I	156,0±9,37	28,0±1,96	31200±1200,5	5600±423,7
Experiment II	152,0±8,89	27,6±0,95	30400±994,3	5520±210,4

Experiment III	110,0±7,73*	23,4±0,23*	22000±756,3**	4680±96,5*
Experiment IV	175,0±6,45**	31,4±0,64**	35000±1300,4**	6280±137,6**
Experiment V	172,0±9,56*	31,1±0,75**	34400±1020,7**	6220±142,8**
Experiment VI	129,0±13,01	25,3±1,04	25800±1400,2	5060±152,9

***Note*:** * – $p \leq 0,05$; ** – $p \leq 0,01$

Itwasfoundoutthattheiodineconcentrationanditsforminfluencethenumberand massgrowthofworms. When applied of 40 mg/kg iodine in form of potassium iodide, the number and individual mass of worms per one test is increased by 11,4 % and 6,0 % compared with the control check. However the difference was not probable (table 2).

A trend was noticed concerning the increase of worms' number and mass also in the experimental group beds II compared with the control check. The difference was 8,5 % and 4,5 % respectively.

The excessive application of potassium iodide in the substrate (group bed III) evoked decrease of worms' mass growth by 21,4 % and 11,4 % ($p \leq 0,05$) compared to the control check.

A similar trend for increase of worms' number and mass recalculated per one bed can be traced in the experimental groups I and II.

The addition of 40 mg/kg iodine adsorbed on the modified saponite to the substrate for vermicultivation stimulated the worms' reproduction and its mass growth. Thus, their number and mass were higher than in the control check by 25,0 % and 18,9 % ($p \leq 0,01$) respectively. The probable increase of worms' number and mass in one test was observed after application of iodine dose of 80 mg/kg (experimental group bed V). The difference to the control check was 22,8 % and 17,8 %respectively.It should be pointed out that the worms' quantity and mass in the V experimental group beds hardly differed from those of the group beds with substrate containing 40 mg/kg iodine adsorbed on the modified saponine.

The iodine increase in the substrate up to the 160 mg/kg by iodine adsorbed on modified saponite caused a trend towards decrease of worms' quantity and mass.

Thus, the iodine adsorbed on modified saponinemakes the red Californian worm hybrid number and mass grow more intensively compared with the iodine in the form of potassium iodide. This can be explained by the fact that the potassium iodide is not stabilized and quickly eliminates into the air and accordingly it has less biological impact on the worms. But the high dose of iodine (160 mg/kg substrate) negatively influences the worms' reproduction.

Conclusions and prospects of further studies

1. It is possible to influence the biomass growth of the red Californian worms by different iodine concentrations in vermiculture substrate.

2. Iodine adsorbed on modified saponite is better source of this element compared to potassium iodide.

A promising research direction is the influence of different iodine sources on its accumulation in the worms' biomass.

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