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BIO ENERGY EVALUATION OF GROWING OYSTER MUSHROOM ON THE STRAW SUBSTRATES

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The indicators of bio energy evaluation of two strains of oyster mushroom, grown on the straw substrates in conditions of the room basement are calculated. The energy spent on the output production as well as the energy saved with the economic valuable part of the yield is determined. The pea straw substrate in conditions of growing the strain HK-35 was characterized with the highest coefficient of bio energetic efficiency, where the coefficient indicator increased to 3,37.

Key words: strain, substrate, straw, efficiency, energy, coefficient, yield capacity.

Problem setting. Great interest in the growing of edible mushrooms appears both due to the fruit body color and shape, and their biological as well as consumer characteristics. Among the great variety of mushrooms, about 13 kinds of them are grown in artificial conditions, containing a considerable amount of protein, carbohydrates, vitamins, 18 irreplaceable amino acids and organic acids. Mushrooms grown in the protected soil have higher content of the above mentioned compounds in comparison with mushrooms grown in the natural environment [8]. Chinese people, who started growing shiitake at the beginning of our era, are considered to be pioneers in fungi culture. Agaricus bisporus was grown on the European continent at the beginning of XVIII century in France, and oyster mushroom – in Germany on the tree stumps, while the production started in the 60s of XX century. Today mushrooms are grown in the countries of Europe, South America, and also in Australia, Africa, South-Eastern Asia, where their cultivation has great success [11].

Filling food market with ecologically safe and relatively cheap mushroom products rich in protein is the basis for their digestion by human body. In future 2/3 of human needs in protein will be satisfied with the industrial production of mushrooms.

About 80 countries of the world are growing agaricus bisporus, oyster mushroom, shiitake, armillaria, winter mushroom, wine cap strophania and other kinds of fungi [5].

The trade program of agro-industrial development of edible mushroom production in Ukraine during the period up to 2015 takes into account the application of new strains and technological elements, the development of fungi culture infrastructure, and the decrease in the export of output from other countries. At the same time, mushroom growing is aimed at the stimulation of small and medium-size business and the mobilization of labour resources in the rural area, the increase in the use of fertilizers for recreation of soil fertility, as well as the use of bio diesel, bio ethanol, and bio gas. New production models which take into account the elements of fungi growing technologies and the selection work are created by scientists. Introduction of the scientific results will contribute to the significant extension of mushroom production, the increase in the consumption of their products, the provision of special technical devices and equipment. While selecting new strains, much attention should be paid to their resistance to environmental factors and to the suitability for intensive growing [6, 7, 9].

Creation of specialized business entities conforms to the world trend of industrial consolidation. In accordance with the enterprise consolidation system, about 50 thousand of fungi were produced in 2011, 5 thousands of which were oyster mushrooms. The European leaders in fungi production are Spain, Italy, and Ukrainian producers take the third place leaving behind Russia, France, Hungary, Poland, Germany, and Turkey. The share of Ukrainian fungi in European production is about 9 %. Thus, domestic producers have the task to hold the rate of growth of their own production for timely filling of market with the qualitative products [4].

The aim of the research is determining the bio energetic efficiency of growing oyster mushroom on the straw substrates in conditions of the room basement.

The research methods. Experiments were performed in the adapted room basement during the period of 2008-2010. While carrying out the research, bio energetic evaluation of growing oyster mushroom in accordance with the recommendations of Dudka I. A. was determined [3]. Two strains of fungus: HK-35 and P-24, grown on the straw substrate were investigated. Wheat, barley, or pea straw served as the substrate basis, being processed in the hydro thermal way. Wheat straw substrate served as a control variant. Bio energetic evaluation of technologic measures was carried out on the basis of the designed technologic plan of fungi growing according to the method of O. S. Bolotskich, N. N. Dovhal [1, 2]. Experiments are laid in three-time repetition by the method of randomized blocks [10].

Results of the research work. Economic efficiency of oyster mushroom production is determined in the first place by the general yield capacity, the price of products and expenses connected with the production of the output. During the experiments the yield capacity of oyster mushroom varied from 3,7 to 4,6 kg/m^2. The conducted analysis of economic indicators of growing showed the necessity of the straw substrate application. In the result of growing mushrooms on the pea straw substrate the profitability of production and its quality greatly increase. The mentioned substrate has higher rate of profitability in comparison with the control variant by 23-28 % in relation to strains HK-35 and P-24 accordingly. The substrate prepared on the basis of the barley straw had lower indicators of economic efficiency compared with the pea straw substrate, though it exceeded indicators of the control variant. The cost price on production of the experimental strains in the mentioned variant amounted 6,3 hr/kg, where the net income didn't exceed 20,4 hr/m^2.

The analysis of energy costs connected with oyster mushroom growing determined that the process of output growing is rather power-consuming. Fungi's growing envisages performance of both mechanized and manual labour, and thus their power-consumption includes expenses which go on fuel, water, electricity, as well as the power spent on the preparation of the substrate, looking after fruit bodies and harvesting.

While growing the strain HK-35, irrespective of the straw substrate, power spent on the mechanisms' maintenance was the same and amounted 1385 M Joules. Power spent on the fuel was the same irrespective of the substrate, and amounted 2252 and 9 M Joules accordingly. Thus, calculated power spent on water increased as the yield capacity rose, and during the research it varied from 25 to 25 M Joules against 21 M Joules in the control variant. The largest amount of power on water was spent in the variant where the pea straw was applied. In the given variant it exceeded the control variant almost by 1,4 times. Energy analysis of the strain P-24 production was almost analogous (table 1).

1 Energy analysis of oyster mushroom production in the adapted room basement, MJ (average for 2008 – 2010)

Indicator	Straw substrate from					
	Wheat (C)	barley	pea	Wheat (C)	barley	pea
	HK – 35			P - 24		
Mechanisms	1385	1385	1385	1385	1385	1385
Fuel	2252	2252	2252	2252	2252	2252
Mycelium	9	9	9	9	9	9
Water	21	25	29	21	25	29
Electricity	192	192	192	192	192	192
Labour	27302	27320	27380	27234	27253	27466
Total amount	31161	31183	31247	31093	31116	31333

C - control

In the process of fungus production among all kinds of work labour played the most significant role and amounted 88 %, the amount of the spent energy greatly increases together with the rise in yield capacity. Thus, in the variant where the barley straw was used, energy costs for the strain P-24 were higher and amounted 27253 MJ, which exceeded the results in the control variant only by 19 MJ. Application of pea straw as the main component of the substrate resulted in higher energy costs as compared with the control variant: the strain HK-35 – by 18 MJ and the strain P-24 – by 232 MJ.

Total amount of energy spent on production of fungi while growing strain HK-35 was higher in the variant where pea straw was used. In the given variant this was 31247 MJ and exceeded control variant by 86 MJ. Application of the barley straw substrate resulted in higher energy costs than in the control variant only by 22 MJ. Under the pea straw application energy costs of the strain P-24 increased with the difference in its amount in relation to the control variant (table 2).

2 Energy efficiency of oyster mushroom production in conditions of the room basement in 2008-2010

strain	kind of the straw substrate	Energy, MJ		Coefficient of bio energy efficiency
		spent on production	accumulated by economic valuable yield share	
НК-35	wheat (C)	31161	59577	1,99
	barley	31183	48572	1,62
	pea	31247	101218	3,37
P – 24	wheat (C)	31093	59577	1,99
	barley	31116	48572	1,62
	pea	31333	103468	3,34

C- control

Energy, accumulated by the economic valuable yield share of oyster mushroom was more due to the accumulation of protein, carbohydrate, lipids, and nutritious elements in the straw by the plant in the open soil. Far larger amount of energy was got in conditions of the pea straw application for the investigated strains, and the increase was almost by 1,7 times compared with the control, while under the barley straw application the mentioned energy was the lowest.

Depending on the received values of energy, accumulated by the economic valuable yield share and the energy spent on production, the coefficient of bio energy efficiency while growing oyster mushroom varied from 1,62 to 3,37 and depended on the yield amount: with the increase in the yield capacity of oyster mushroom, the coefficient of bio energy efficiency increases too and vice versa. Its largest value was got while growing strains on the substrate from the pea straw, which amounted 3,37 of the strain НК-35 and 3,34 of the strain P-24, the excess was 1.7 times accordingly, and the least value was in the variant with the application of the barley straw, which amounted 1.62.

The strain HK-35 was characterized by the highest coefficient of bio energy efficiency in comparison with other investigated strains, where the coefficient value varied from 1,62 to 3,37.

Conclusions. 1. The substrate on the basis of the pea straw should be used in the room basement. Energy accumulated by the economic valuable yield share is higher due to the larger content of protein, carbohydrate, lipids, and nutritious elements. Higher energy was got in the variant with the application of the pea straw in both investigated strains, the excess was almost 1.7 times in comparison with the wheat straw.

2. Introduction of the strains with high yield capacity is a significantly cheaper measure in comparison with the expenses on the intensification of production. The strain HK-35 is characterized by the high coefficient of bio energy efficiency, where the value of the coefficient may increase to 3,37.

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