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MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
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PROGRAM

The Fourteenth International Scientific Conference

"AVIA-2019"

April 23-25, 2019

Kyiv

Nataliia Ischenko, Dmytro Novakovsky, National Aviation University, Ukraine.

6. The possibility of using drones in geodesy and land management.
V.V. Babii, National Aviation University, Ukraine.

7. Perspective of spatial potential of united territorial communities.
O. Kostyshin, V. Savchuk, Lviv National Agrarian University, Ukraine.

8. Economic-organizational problems of land resources rational use in the modern conditions of land relations development in the creation of united territorial communities.
O.O. Bredikhin, National Aviation University, Ukraine.

9. Perspectives for implementation of geoinformation systems in regional airports.
O.L. Boyko, National Aviation University, Ukraine.

10. Accuracy of determination of coordinates of interference landscapes in cadastrown lands.
N.M. Chucarina, Valeria Bulykh, National Aviation University, Ukraine.

11. Monitoring of the ecological state of soils within the coastal zones left in flows of Podolsk part of the Dnister river.
M. Kapelista, National Aviation University, Ukraine.

24. Biotechnology and biomedical engineering in aviation and cosmonautics

Chairman – K. Garkava, National Aviation University, Ukraine.
Secretary – V. Karpenko, National Aviation University, Ukraine.

23 April, 14:30, room 5.601

1. Isolation of hydrogen-synthesizing spore-forming microbial associations that ferment organic wastes.

L.S. Yastremskaya, S.D. Kalsina, National Aviation University, Ukraine.

2. Monitoring biological indicators of homeostasis.
O.B. Ivanets, M.Y. Burichenko, National Aviation University, Ukraine.

3. New approaches and prospects for obtaining aviation and rocket biofuels using microalgae.
T.A. Bohdanovych, B.I. Karpenko, National Aviation University, Ukraine.

4. Biological value of pectin.
O.A. Vasylchenko, O.T. Sylenko, National Aviation University, Ukraine.

25. Remote sensing research

Chairman – O. Zeleznyak, National Aviation Univercity, Ukraine
Secretary – L. Hebryn-Baydi, National Aviation Univercity, Ukraine

23 April, 14:00, room 3.506

1. Identification and evaluation of the soil fertility indicators based on satellite observation methods.
L.V. Hebryn-Baydi, E.S. Kuzmenko, National Aviation University, Ukraine.

2. Use of GIS for analyzing the energy consumption efficiency.
A.E. Nikolaenko, V.Y. Belenok, A.A. Ralko, National Aviation University, Ukraine.

3. Streams of cadastral information.
V.M. Gladilin., V.Y. Yanytska, National Aviation University, Ukraine.

4. General requirements for airport mapping.

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L.S. Yastremskaya, PhD, S.D. Kalsina,
(National Aviation University, Ukraine)

Isolation of hydrogen-synthesizing spore-forming microbial associations that ferment organic wastes

Anaerobic spore-forming H_2-forming microbial associations, that actively synthesized hydrogen at a temperature 30°C Eh = -150 мV, pH=7.0, were distinguished from different ecosystems. Discovered that the associations consist of gram-positive rod-shaped bacteria, which form bacillary or clostridial types of spores. Selected crops will be used for bioconversion of various organic wastes.

There is an active search for alternative sources of energy nowadays, and one of the priorities in the energy sector is to produce biohydrogen. Hydrogen is an environmentally friendly energy source, because the product of its combustion is water. Molecular hydrogen is obtained by physical and chemical methods, but they are unprofitable [1]. Microbial methods are an alternative: direct and indirect water biophotolysis, photo fermentation and dark fermentation [2]. It is known [3,4] that bacteria of the genus *Clostridium* are the most promising biotechnologies for the production of H_2. The advantages of using clostridia are the high rate of H_2 production, the fermentation of a wide range of substrates and the ease of the technological process. In addition, microbial groups consisting of bacteria of genera *Bacillus* and *Clostridium* are known to be the most stable [3].

Bacteria of the genera *Bacillus* and *Clostridium* oxidize and ferment a wide range of polymeric and monomeric carbohydrates, proteins, fats, alcohols and other compounds. The biological role of representatives of the genus *Bacillus* is particularly important for the industrial use of such associations in the technology of obtaining biohydrogen: 1) absorbing O_2 in the medium and gas phase, they reduce redox-potential (Eh) and create optimal conditions for anaerobes to start growth and formation of H_2, thus eliminating the need for such an operation as extracting O_2 from the nutrient medium; 2) representatives of *Bacillus* also hydrolyze starch to mono- and bicarbonate sugars, which are metabolic precursors of the formation of H_2 by clostridia; 3) produce growth factors for representatives of *Clostridium* (vitamins, peptides, etc.). The search, isolation and selection of active associations of hydrogen-synthesizing and spore-forming microorganisms that can ferment a wide range of organic substances is an urgent topic.

Samples of "aboriginal" microflora of soil of unpurified potato (SP), greenhouse soil (GS) of NAU, bird droppings (BD) were studied for obtaining an accumulation culture of anaerobic spore-forming H_2-synthesizing bacteria. Potatoes were used as a substrate. For this purpose, the potatoes were cut into small pieces (0.5-1cm) and, together with the soil particles (dropping), were placed in bottles of 250 ml with thread on the neck under cotton-gauze plugs. The tap water was poured up to 2/3 of the height of the vial, 0.1-0.2 mg of $CaCO_3$ was added to neutralize the fatty acids formed during the fermentation, and 1 ml of a 0.1% solution of the indicator sodium resasurinate was added, the pH of the medium was 7.5-7.8. Indicator sodium resasurinate was used as a redox indicator, namely: for the value Eh ≤ –50 mV he passed into the form resorufin - violet-red color, and for Eh ≤ –100 mV it is discolored and forms a form – leykoresorufin [4]. Further bottles were subjected to heat treatment in a water bath (100 °C, 10 min). After cooling the bottles, they were hermetically sealed with elastic rubber stoppers, and metal caps with a hole in the middle were hanging from above, and a water jacket for biogas harvesting was made. Samples were cultured at 30 °C for 5 days. Microscopy was performed according to generally accepted methods [5], the color of the spores was carried out using the Schaefer-Fulton method [5]. Growth criteria was the clouding of the liquid phase, the biogas bubbles (H_2, CO_2) in the medium and the formation of foam on the surface, ascension and destruction of the pieces of potatoes.

The destruction of potatoes by bacteria began at 12 hours of cultivation in all specimens – SP-1, GS-2, BD-3. In this case, the environment was cloudy, foam was formed on the surface, to 9.09 % of biohydrogen were synthesized, the potato was flooded (Fig.1, A). The oxidation-reducing potential began to decrease with Eh = +150 mV to Eh = +50 mV, pH from 7.8 to 7 (Fig. 2).

А Б В

Fig.1 Growth and formation of biogas by an anaerobic association of microorganisms: A – on the first day; B – the second day; C – the fifth day of cultivation

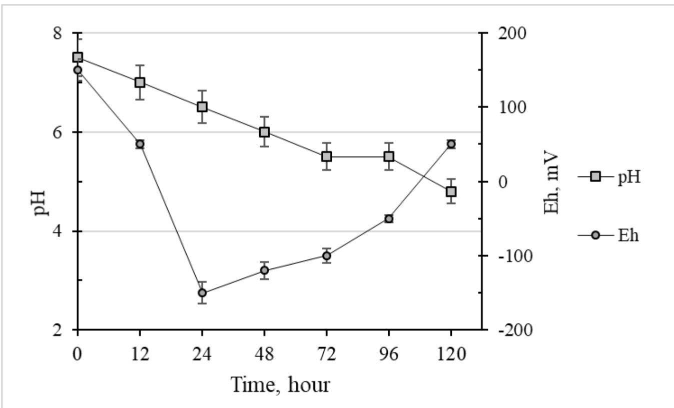

Fig.2. Changes in the pH and Eh in the process of potato degradation by anaerobic associations of microorganisms

At first day, until the process of aerobic cultivation of the microorganism of the genus *Bacillus* went on, there was no reduction of Eh or pH. On the second day, the redox-potential was equal to the maximum value of Eh = –150 mV – the medium was colorless. Microscopy revealed direct sticks of different lengths with rounded ends, singly or in chains of 2-4 cells, gram-positive (Fig. 3, c). At microscopy for the fifth day there was formation of spores that were located centrally or terminally, which are inherent in the bacillary and clostridial type of spores, respectively (Fig. 3, a,b).

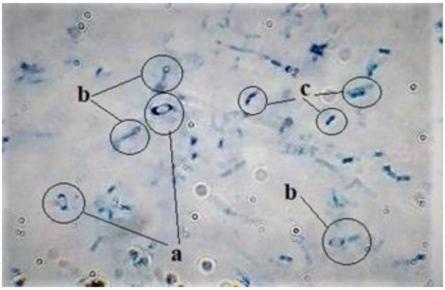

Fig.3 Cells of anaerobic association of microorganisms: a – spores of bacillary form; b – spores of clostridial form; c – vegetative cells

For the 3-4 day – 70 % of biogas was synthesized, the potato was on the bottom, some part in the form of small particles, pH = 6.0-5.5. On the fifth day – most of the potatoes are converted to a homogeneous mass, pH = 4.8, Eh = +50 mV, there is a small amount of foam (Fig.1,c). The largest amount of biogas was allocated by culture of SP-1 to 100% for 5 days (Fig. 4).

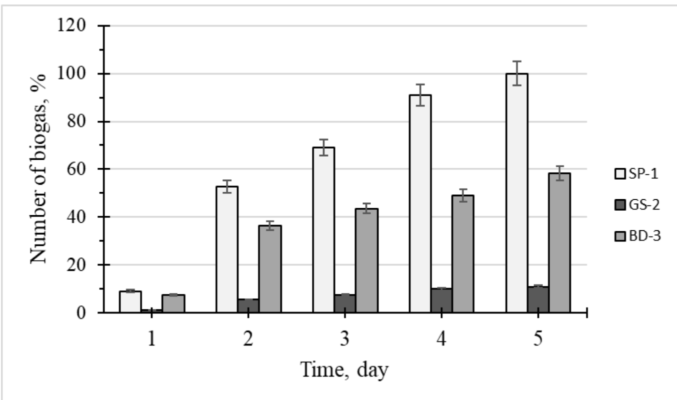

Fig.4. The amount of biogas isolated by anaerobic associations of microorganisms in the process of potato degradation within 5 days

The smallest amount of biogas was formed by the culture of GS-2 – up to 11% in five days.

Conclusions

Consequently, three anaerobic hydrogen-synthesizing spore-forming cumulative cultures from different ecosystems (potato soil, greenhouse soil, bird droppings) were isolated, which actively synthesized hydrogen at a temperature of 30 °C, Eh = –150 мV, pH = 7.0-6.5. It was found that associations consist of gram-positive rod-shaped bacteria that form bacillary or clostridial types of spores. Selected crops will be used further for bioconversion of various organic wastes.

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