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ASSESSMENT OF THE CURRENT STATE OF DIGITAL MARKETING OF DIETARY SUPPLEMENT BRANDS

Bondarieva I.V., Hlukhomanova M.Yu..... 168

ANALYSIS OF CORPORATE CULTURE DEVELOPMENT IN THE PHARMACEUTICAL SECTOR

Bondarieva I.V., Kyselova O.V..... 170

FEASIBILITY OF YEAST-BASED DOMESTIC GLUTATHIONE PRODUCTION IN UKRAINE

Dolia L., Starovoitova S. 172

FEATURES OF INITIATION AND GERMINATION OF *ARNICA MONTANA* SEEDS ON VARIATIONS OF MURASHIGE–SKOOG CULTURE MEDIUM

Domashovets A., Petrina R..... 174

APPLICATION OF ENZYME-ASSISTED EXTRACTION WITH PECTINASE FOR OBTAINING TANNINS FROM *MALVA SYLVESTRIS* L.

Kulakivska A., Konechna R. 175

MOLECULAR MODELLING IN SEARCH OF AN EXPLANATION OF THE STRUCTURE-ACTIVITY CORRELATION FOR SELECTED THIOSULFONATES

Makieieva N., Kupka T., Konechna R., Lubenets V. 177

PHYSICOCHEMICAL CHARACTERISTICS AND POTENTIAL APPLICATION OF SELENIUM NANOPARTICLES SYNTHESIZED USING YEAST

Protsenko M.D., Skrotska O.I..... 178

STUDY OF THE AMINO ACID COMPOSITION OF POWDER AND TABLETS BASED ON CRYOLYOPHILIZED PORCINE XENODERMIS

Ravliv Y.A..... 180

RESEARCH ON THE ANTIBACTERIAL EFFICACY AND STABILITY OF A KIND OF MEDICAL CREAM BASED ON THE EXTRACTS OF THE *HERB SPERANSKIA TUBERCULATA (BUNGE) BAILL*

Sun Z., Derkach T.M. 181

FEATURES OF POLLUTANT ACCUMULATION IN *TILIA CORDATA* MILL. RAW MATERIALS IN A MEGACITY

Andriienko S.Ye., Minarchenko V.M.. 183

FEASIBILITY OF YEAST-BASED DOMESTIC GLUTATHIONE PRODUCTION IN UKRAINE

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Glutathione (GSH) is an intracellular tripeptide that plays a key role in maintaining redox homeostasis, detoxifying xenobiotics, and protecting against oxidative stress. Impaired GSH metabolism may contribute to the development of central nervous system disorders, infections, sarcopenia, chronic liver pathologies, metabolic, cardiovascular, and pulmonary diseases. GSH deficiency is one of the pathogenetic factors in the progression of chronic liver diseases, including hepatitis B and C. According to data from the Ministry of Health of Ukraine, the number of patients with viral hepatitis in 2021 was approximately 1.9 million, while projections for 2025 estimate around 1.5 million patients. Considering an average therapeutic requirement of 15 g of GSH per treatment course, the total demand amounts to 22,500 kg. Currently, there is no industrial production of GSH in Ukraine, resulting in complete import dependence.

Research objective: to assess the feasibility of establishing domestic GSH production through microbiological synthesis using *Saccharomyces cerevisiae*, taking into account biotechnological parameters and economic efficiency.
Research material and methods. Five *S. cerevisiae* strains differing in GSH productivity, cultivation duration, and culture medium cost (according to recent peer-reviewed studies) were analyzed. Evaluation criteria included GSH concentration, production rate, cost of 1 L of culture medium, and the calculated cost of 1 g of the target product.
Research results. Comparative analysis demonstrated that *S. cerevisiae* HBSD-W08 is the most economically feasible producer strain (table).

Table – Economic and biotechnological characteristics of GSH-producing strains

Biological agent	GSH concentration, g/L	Cultivation time, h	GSH production rate, g/h	Cost of 1 L medium, UAH/L	Estimated cost per 1 g GSH, UAH/g	Reference
S. cerevisiae CGMCC 2842	5,76	108	0,053	73,94	12,84	1
S. cerevisiae HBSD-W08	3,73	48	0,0777	6,23	1,67	2
S. cerevisiae ATCC 7754	0,17872	96	0,0018	65,1	364,25	3
S. cerevisiae ATCC 7754	0,155	72	0,0021	57,7	372,2	4
S. cerevisiae SCZ40	0,05262	36	0,0014	135,95	2583,6	5

The optimized medium for the HBSD-W08 strain contained (g/L): glucose – 34.0; peptone – 2.5; $MgSO_4$ – 10.0; $(NH_4)_2SO_4$ – 10.0; KH_2PO_4 – 0.13. Supplementation with glutamic acid (0.10 g/L) at the production stage, as a direct biosynthetic precursor, increased GSH yield to 3.73 g/L and 16.7 g/L of biomass (48 h, 30 °C, 200 rpm). Although *S. cerevisiae* is a facultative anaerobe, aerobic conditions are essential during microbial synthesis since oxygen availability promotes biomass accumulation and enhances GSH biosynthetic productivity.
As of 2025, no enterprise in Ukraine manufactures this antioxidant. Only one company produces a dietary supplement using imported Japanese raw materials. The main global producers of GSH are the USA, Italy, Poland, and Japan. Given the predominance of imported products on the Ukrainian market, it is proposed to produce GSH to meet 0.8% of the national demand, corresponding to approximately 180 kg per year.

To obtain 180 kg of GSH, the required culture liquid volume is estimated at 48.3 m^3. Considering a 30% technological loss during centrifugation, cell lysis, drying, and grinding stages, the actual culture volume should reach 69 m^3. With 300 working days per year, the required fermentation volume per cycle is 0.23 m^3, yielding 0.6 m^3 of product per cycle. Based on this volume and a filling coefficient of 0.6, the geometric volume of the fermenter is determined to be 1 m^3. Seed material preparation occurs in three successive stages under these conditions.

Conclusions.

1. The *S. cerevisiae* HBSD-W08 strain demonstrates the best "productivity-to-cost" ratio and is the most promising candidate for industrial GSH biosynthesis.
2. The establishment of domestic GSH production in Ukraine could cover approximately 0.8% of the national demand and reduce import dependency within the pharmaceutical sector.