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METABOLIC PROFILE OF THE PROBIOTIC STRAINS *BACILLUS VELEZENSIS* AS THE POTENTIAL BIOAGENTS OF THE WOUND HEALING COMPOSITION

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Abstract. The metabolic profiles of the probiotic strains *Bacillus velezensis* IMV B-7142 and IMV B-7143 were investigated. Differences were identified in the metabolite spectra of lipid and nitrogen metabolism in the investigated strains, which complement each other, providing synergistic antimicrobial, antioxidant, and immunomodulatory potential of the probiotic composition. The efficacy of the developed composition was demonstrated in a model of infected wounds in Chinchilla rabbits.
Keywords: probiotics*, Bacillus velezensis,* metabolic profile, infected wounds, treatment.

Research and development of the latest probiotic preparations is currently a highly relevant field in microbiology, biotechnology and medicine. This opens up new prospects for the practical use of metabolites from probiotic bacterial strains to support the physiological homeostasis of the microbiome, and for the prevention and treatment of pathological conditions (Fu et al., 2023).

At present, aerobic spore-forming bacteria of the genus *Bacillus* are of considerable interest as a basis for the development of antimicrobial biopreparations. This is particularly relevant in view of the rapid spread of antibiotic-resistant pathogenic microorganisms (Safronova et al., 2024). *Bacillus* strains are components of probiotic preparations for the treatment of various pathological conditions in humans and animals, including infections of the skin and adjacent tissues, owing to their ability to synthesize a complex of biologically active metabolites (antibiotic substances, enzymes, antioxidants, amino acids, polysaccharides, vitamins and others) (Lu et al., 2022).

The aim of this study was to investigate the metabolic profiles of the probiotic strains *Bacillus velezensis* IMV B-7142 and IMV B-7143 and to determine the potential for using a composition of these strains in the prevention and treatment of infected wounds.

Metabolomic profiling of ethyl acetate extracts of cell-free supernatants from the *B. velezensis* IMV B-7142 and IMV B-7143 strains was carried out using gas chromatography-mass spectrometry (GC-MS). It was found that their profiles contained similar classes of compounds with anti-inflammatory and antiseptic activity (organic acids, fatty acids, nitrogenous bases), but differed significantly in the relative content of major components. Thus, the *B. velezensis* IMV B-7142 strain was characterized by a significantly higher level of synthesis of lipid metabolism metabolites – derivatives of glycerol and fatty acids. In particular, the content of glycerol monopalmitate and glycerol monostearate in its metabolome exceeded 20 per cent for each, whereas in the *B. velezensis* IMV B-7143 strain these figures were less than 1 per cent.

The exometabolome of the *B. velezensis* IMV B-7142 strain also revealed significantly higher levels of nitrogen metabolism compounds: the urea content was 17.35 %, whereas in the *B. velezensis* IMV B-7143 strain it was 0.79 %; at the same time, the uracil content was five times higher than that in the *B. velezensis* IMV B-7143 strain.

Urea, as a natural moisturizing factor, can maintain an optimal moist environment within the wound, which is critical for the rapid migration of keratinocytes and wound closure. It can also help to soften and exfoliate necrotic tissue and dry scabs without damaging living cells. Urea has the ability to stimulate the production by keratinocytes of their own protective antimicrobial peptides, which reduces the risk of wound infection. Uracil (and its clinical analogue, methyluracil) is a potent reparative agent. Uracil derivatives are capable of enhancing the phagocytic activity of macrophages, thereby accelerating the biological cleansing of the wound, and modulating inflammation, shifting it into the recovery phase.

Phenylalanine (2.13 %) has been identified from the amino acid pool in the metabolic profile of the *B. velezensis* IMV B-7142 strain; it is absent from the major metabolites of the *B. velezensis* IMV B-7143 strain. Phenylalanine is an important substrate for the synthesis of tissue proteins and acts as a mediator that activates regeneration and collagen formation processes.

At the same time, the *B. velezensis* IMV B-7143 strain had a more complex profile with a large number of small peaks (over 160), including various specific components – derivatives of organic acids, particularly 2-furancarboxylic acid (0.32 per cent), known to have detoxifying, antimicrobial and biocontrol properties.

Thus, the *B. velezensis* IMV B-7142 strain demonstrated a specialized metabolism directed towards the synthesis of monoglycerides, while the *B. velezensis* IMV B-7143 strain had a more balanced and diverse lipid composition containing unsaturated compounds and sterol precursors, in particular, squalene, which is responsible for antimicrobial, immunemodulatory and antioxidant effects.

Laboratory experiments have confirmed the protective activity of *B. velezensis* IMV B-7142 and IMV B-7143 against infectious agents. Under *in situ* and *in vivo* conditions, the composition based on these strains has been shown to play an antagonistic and adaptogenic role in enhancing local immunity and resistance to pathogens. The efficacy of the formulation was demonstrated in model experiments on Chinchilla rabbits during the treatment of purulent wounds infected with *Staphylococcus aureus* B-4001 ATCC 6538A and *Klebsiella pneumoniae-R* at a dose of 100 µl ($1 \cdot 10^8$ cells/mL), where its use significantly accelerated wound healing.

Consequently, the probiotic *B. velezensis* IMV B-7142 and IMV B-7143 strains are promising bioagents for the development and clinical implementation of new safe preparations for the treatment of wounds complicated by infection.

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MONITORING OF BACTERIAL DISEASE OUTBREAKS IN RAINBOW TROUT (*ONCORHYNCHUS MYKISS*) TO IMPROVE PREVENTIVE STRATEGIES FOR THE NATIONAL AQUACULTURE

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Abstract. During monitoring studies of trout farms 3 strains of *A. salmonicida* (A.salmUA1/2025RTV, A.salmUA1/2026WFV and A.salmUA2/2026BTCh), 2 strains of *F. psychrophila* (F.psyUA1/2025RTV and F.psyUA1/2026RTCh) and one strain of *Y. ruckeri* bacteria (Y.ruckUA1/2026RTZ) were isolated from rainbow trout, whitefish and brook trout. Using PCR, fragments of species-specific genes and the 16S rRNA gene of the isolated bacteria were amplified for further genetic characterization. Development of inactivated autogenous vaccines for oral administration based on isolated bacterial strains will help to decrease antibiotic use at the local level and prevent economic losses of trout farms in Ukraine.
Keywords: bacterial diseases, aquaculture, PCR, 16SrDNA, vaccine, rainbow trout.

Today, aquaculture is the most dynamic and fastest growing sector of the animal agriculture and is crucial for food security in many countries. Like other livestock sectors, aquaculture requires adequate veterinary support and control of infectious diseases (Buchatsky et al., 2020). Vaccination of fish with locally developed autogenous vaccines can provide a local and cost-effective means of reducing mortality in aquaculture facilities, as well as contributing to the rational use of antibiotics. A comprehensive scientific and methodological approach to assessing the possibilities of introducing autogenous vaccination in national aquaculture will allow using a number of key advantages of immunobiotechnological tools in terms of efficiency and flexibility of animal welfare, transboundary biosecurity, and the economy of local farms (Rud et al., 2022).