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Antagonistic Potential of the *Weissella cibaria* Strain Against Opportunistic Pathogenic Bacteria and Phytopathogenic Fungi

Guzal Jumaniyazovna Kutlieva[1], Bahora Ismailovna Turaeva[2], Tulkin Erkinovich Shonakhunov[3], Khulkar Fozil qizi Kamolova[4]
[1,2,3,4]Academy of Sciences of the Republic of Uzbekistan, Uzbekistan

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ABSTRACT
Objective: *The antimicrobial activity of the Weissella cibaria culture against opportunistic bacteria and phytopathogenic fungi was studied.* ***Method:*** *Antimicrobial activity was assessed using the drop-spot method. Antifungal activity was evaluated using the agar block method.* ***Results:*** *High activity was demonstrated against Proteus morganii 399 with a growth inhibition zone of 39 mm, Proteus mirabilis - 42 мм, against Candida albicans 40 mm and Pseudomonas aeruginosa 32 mm. Antagonistic activity against phytopathogenic fungi was noted for Verticillium dahliae – 40 mm, Aspergillus flavus – 32 mm, Alternaria alternata – 30 mm, Aspergillus oryzae – 28 mm, and Aspergillus oryzae – 25 mm.* ***Novelty:*** *These results show that the strain can suppress bacteria, yeasts and filamentous fungi, which makes it a promising candidate for biocontrol agents, food preservation and probiotic development.*

INTRODUCTION

Bacteria belonging to the genus *Weissella* are Gram-positive, catalase-negative, non-spore-forming microorganisms with coccoid or rod-shaped morphology. They belong to the group of bacteria known as lactic acid bacteria (LAB). Phylogenetically, *Weissella* belongs to the phylum *Firmicutes*, class *Bacilli*, order *Lactobacillales*, and family *Leuconostocaceae*. These bacteria are heterofermentative, producing CO_2 during carbohydrate metabolism, with lactic acid and acetic acid being the major end products of sugar fermentation [1]. To date, 19 validly described species of *Weissella* have been reported. Members of this genus inhabit diverse environments, including animal skin, milk and feces; human saliva, breast milk, feces, and vaginal microbiota; plants and vegetables; and various fermented products, such as European sourdoughs and traditional Asian and African fermented foods.

Certain *Weissella* strains are considered potential probiotics. In particular, strains of *W. cibaria* have attracted considerable attention because of their potential for controlling periodontal diseases [2]. Furthermore, strains of *W. confusa* and *W. cibaria* can produce substantial quantities of novel nondigestible oligosaccharides and extracellular polysaccharides (EPS), primarily dextran. These polymers have attracted increasing interest because of their potential applications as prebiotics and in various industrial processes [3]. However, some species of *Weissella*, including *W. viridescens*, *W. cibaria*, and *W. confusa*, have also been associated with opportunistic infections in humans. In addition, *W. ceti* has been identified as the etiological agent of weissellosis, a disease

affecting farmed rainbow trout. Therefore, comprehensive investigations of this genus are important from both technological and medical perspectives, and these aspects should be considered when developing biotechnological applications [4].

The functional properties of *Weissella cibaria* JW15 (JW15) were investigated by evaluating its antagonistic and antioxidant activities. *Lactobacillus rhamnosus* was used as a reference strain. JW15 inhibited the growth of several pathogenic bacteria, including *Listeria monocytogenes*, *Salmonella Typhimurium*, *S. Enteritidis*, and *Escherichia coli*. Compared with *L. rhamnosus*, *W. cibaria* JW15 produced higher amounts of lactic and acetic acids and demonstrated significantly greater antagonistic and antioxidant activities in the assays performed ($p < 0.05$) [5]. These findings indicate that JW15 may have potential for alleviating conditions associated with pathogenic bacteria and oxidative stress.

Another study examined the antagonistic activity and probiotic potential of LAB isolated from plant-based fermented foods. Cell-free supernatants (CFS) of *Lactobacillus curvatus* KCCM 43119, *Leuconostoc mesenteroides* KCCM 43060, *Weissella cibaria* KCTC 3746, and *W. koreensis* KCCM 41517 completely inhibited the growth of foodborne pathogenic bacteria [6]. The LAB strains exhibited high coaggregation with foodborne pathogens and considerable tolerance to acidic conditions. All tested strains were resistant to chloramphenicol, kanamycin, streptomycin, gentamicin, and erythromycin, whereas only *W. cibaria* KCTC 3746 and *W. koreensis* KCCM 41517 showed resistance to vancomycin [7].

The functional properties of two *W. cibaria* strains isolated from cows raised on breeding farms in Kuwait were investigated. Phenotypic and genomic analyses of *W. cibaria* SP7 and SP19 demonstrated their ability to grow under acidic conditions and in the presence of bile salts in vitro, compared with the reference probiotic *Lacticaseibacillus rhamnosus* GG. Both strains inhibited *Escherichia coli* ATCC 25922 and *Salmonella enterica* UC3605, an effect ultimately associated with the low pH of their culture supernatants. Among the two strains, *W. cibaria* SP19 exhibited the most promising in vitro probiotic characteristics and genetic markers associated with these properties [8].

In another study *W. cibaria* MW01, isolated from Chinese sauerkraut, demonstrated functional properties, including tolerance to gastric juice and bile salts, as well as antagonistic activity against pathogenic bacteria. In an intestinal barrier cell model, *W. cibaria* adhered to Caco-2 cells more effectively than *L. rhamnosus* GG. The findings suggested that *W. cibaria* MW01 could act as a potential probiotic by protecting intestinal epithelial barrier function and regulating inflammatory responses [9].

Researchers isolated LAB from broiler feces using a fermentation-based approach. Nine of the sixteen isolates were identified through biochemical and molecular methods as *Lactobacillus crispatus* (n = 1), *Lactobacillus pentosus* (n = 1), *Weissella cibaria* (n = 1), *Pediococcus pentosaceus* (n = 2), and *Enterococcus hirae* (n = 4). The isolates were assessed for lactic acid production, tolerance to acidic pH and bile salts, antimicrobial susceptibility, and antagonistic activity [10]. The researchers selected *Lactobacillus pentosus* LB-31, which demonstrated a strong capacity to modulate immune responses.

Its administration to broiler chickens was associated with beneficial effects on their morphophysiological and productive performance [11].

The effectiveness of LAB isolated from fresh fruits and vegetables as biological control agents against phytopathogenic bacteria and fungi was evaluated in another study. The target organisms included *Xanthomonas campestris*, *Erwinia carotovora*, *Penicillium expansum*, *Monilinia laxa*, and *Botrytis cinerea*. The antagonistic activity of 496 LAB isolates was tested in vitro. Four strains (TC97, AC318, TM319, and FF441) reduced the diameter of fungal lesions on apples by 20%, whereas *Weissella cibaria* TM128 reduced the infection level by 50%. Investigations of cell-free supernatants from selected antagonistic bacteria further supported the potential of LAB as biological control agents against postharvest fruit decay.

In a study of potential probiotic LAB isolated from kimchi bacterial cultures were identified by 16S rRNA gene sequencing as *Lactobacillus brevis* G1, *L. brevis* KU15006, and *Lactobacillus curvatus* KCCM 200173. All strains survived incubation at pH 2.5 in the presence of 0.3% pepsin for three hours and in 0.3% Oxgall for 24 hours. *L. brevis* G1 and KU15006 exhibited high adhesion capacity, autoaggregation, and cell-surface hydrophobicity relative to the reference strain *L. rhamnosus*. Furthermore, *L. brevis* KU15006 demonstrated anti-adhesion activity against *Escherichia coli* and *Salmonella typhimurium* [12].

A *Lactobacillus* strain was isolated from the rhizospheres of medicinal plants, including *Ocimum tenuiflorum*, *Azadirachta indica*, and *Ficus carica*. The isolates were evaluated for safety. Of 115 strains, 29 (25%) were negative for hemolytic activity. Three of these 29 isolates also lacked gelatin-degrading activity and were considered potentially safe. Isolate T-2 was identified as *Lactobacillus agilis* by 16S rRNA gene sequencing and evaluated in vitro for antibacterial, antioxidant, antidiabetic, and anti-inflammatory activities [13]. Its free-radical-scavenging activity and inhibition of α-amylase were assessed against standard reference values. The results suggested that *L. agilis* could have potential applications as a probiotic strain and in nutraceutical production.

The immunomodulatory properties of LAB have also been investigated. *Weissella cibaria* JW15, isolated from kimchi, demonstrated immunostimulatory activity in vitro. In the animal experiment, 18-month-old female mice received JW15 daily at either a low dose (JW15-L; 1×10^8 CFU/mouse) or a high dose (JW15-H; 1×10^9 CFU/mouse), or received *L. rhamnosus* GG (LGG) by oral gavage. Two-month-old female mice served as the young control group. After four weeks, leukocyte and erythrocyte counts were significantly higher in the JW15-L group than in the aged control group. Proliferative capacity was also higher in all probiotic-treated groups than in the aged control group. In addition, the expression of several cytokine mRNAs changed in the JW15-treated groups. These findings indicate that JW15 supplementation may exert immunomodulatory effects and improve immune function in aged animals [14].

The anti-inflammatory potential of *W. cibaria* JW15 was further investigated in a lipopolysaccharide (LPS)-induced inflammation model. The study examined inflammatory mediators and cellular signaling pathways following treatment with heat-

killed JW15. This treatment suppressed the expression of pro-inflammatory cytokines, including interleukin-1β (IL-1β), IL-6, and tumor necrosis factor-α (TNF-α). The observed anti-inflammatory effects were associated with the modulation of mitogen-activated protein kinase signaling and suppression of nuclear factor-κB (NF-κB) activation.

Kimchi, one of the most widely consumed traditional foods in Korea, contains abundant LAB and has been associated with chemopreventive effects. *Weissella cibaria* and *Lactobacillus plantarum*, among the LAB associated with kimchi fermentation, have been investigated for their potential anticancer properties. Research continues to examine the mechanisms by which these bacteria may influence carcinogenic processes and improve immune function [15].

A study evaluated 32 LAB isolates obtained during the fermentation of cassava puree and African soft cheese. The isolates were tested for tolerance to cadmium and lead at concentrations of 550–1,050 mg/L and for probiotic potential. *W. cibaria* WD2 and *L. plantarum* CaD1 exhibited comparatively high antioxidant activity. Rats receiving these bacterial cultures alongside heavy-metal exposure showed improvements in indicators of kidney and liver function, whereas animals receiving only cadmium and lead exhibited organ damage. The findings supported the potential probiotic properties of *W. cibaria* WD2 and *L. plantarum* CaD1, although further safety and efficacy assessments are required.

The antifungal activity of 116 LAB strains isolated from flour and fermented cassava was investigated in another study. Three strains, *Lactobacillus plantarum* VE56, *Weissella cibaria* FMF4B16, and *W. paramesenteroides* LC11, were selected because of their strong inhibitory activity against food spoilage molds under acidic conditions. Antifungal compounds were detected in cell-free supernatants, and the concentration of phenyllactic acid (PLA) was determined. The highest concentration, 0.56 mM, was recorded for *L. plantarum* VE56. In *Weissella* strains, antifungal activity was associated with compounds including PLA and 2-hydroxy-4-methylpentanoic acid [16].

A comparative genomic analysis of 23 sequenced *W. cibaria* genomes and seven *W. confusa* genomes obtained from corn-bran fermentation starters was conducted . The analysis did not identify distinct, established virulence factors in the examined genomes. Some putative virulence-associated genes found in *Weissella* genomes were also present in other LAB strains. Most of the strains demonstrated rapid acidification, reducing activity, EPS production, arabinoxylan degradation, and growth in the presence of fructooligosaccharides. These characteristics indicate their potential for applications in food fermentation and biotechnology, although strain-specific safety assessments remain necessary.

Researchers investigated probiotic bacteria isolated from dairy products for their potential therapeutic properties. Strain MYPS5.1 was identified as *Weissella paramesenteroides* by 16S rDNA gene sequencing. The strain exhibited resistance to several antibiotics and produced EPS at a concentration of 380.42 mg/L. Functional groups, including C–H, C=C, N=N, N–H, and C=O, were identified in the EPS by Fourier-transform infrared (FTIR) spectroscopy. Computational analyses suggested interactions

between the EPS and cyclin-dependent kinase (CDK), a molecule associated with cancer-related pathways. These findings require further experimental validation before therapeutic applications can be established [17].

Another study reported the isolation and identification of *W. confusa* from the gut of migratory locusts. The *W. confusa* LM1 strain was reported as the first insect-derived genome of this species to contain a complete chromosome and a plasmid. Among the examined *W. confusa* strains, LM1 had the largest genome. Most strains possessed unique genes, suggesting possible adaptations to different ecological niches and host organisms. This work provided a basis for further investigation of the biological functions of *W. confusa* LM1 in locusts and its potential applications in locust-related research.

A review highlighted the probiotic potential of *W. cibaria*, *W. confusa*, and *W. paramesenteroides*, particularly their ability to ferment prebiotic fibers and survive passage through the gastrointestinal tract. Some *Weissella* strains possess properties potentially beneficial to human health. However, their safety cannot be assumed at the genus level because safety-related characteristics, including virulence-associated genes and antibiotic resistance, may vary between species and strains [18].

Five strains of *W. paramesenteroides*, designated FX1, FX2, FX5, FX9, and FX12, were isolated from different fruits. The strains were selected based on their ability to survive at pH 2.5 and in 1.0% sodium taurocholate, high cell-surface hydrophobicity, bile-induced biofilm formation, antimicrobial activity against selected enteropathogens, and utilization of prebiotics. In vitro safety assessments indicated that the strains were susceptible to most tested antibiotics, with the exception of vancomycin, and lacked several undesirable characteristics, including biogenic amine production, hemolysis, and DNase activity. Strains *W. paramesenteroides* FX5 and FX9 exhibited promising probiotic properties and were proposed for further investigation of their potential synbiotic applications [19].

In another study 94 LAB strains were isolated from newborn rabbits. Only 29% (28/94) were capable of metabolizing inulin, demonstrating species- and strain-specific variation. *Lacticaseibacillus paracasei* YT170 showed the strongest inulin-degrading activity and efficiently utilized both short-chain and long-chain inulin fractions, as demonstrated by thin-layer chromatography.

Overall, the literature indicates growing interest in the genus *Weissella* and its potential applications in medicine, the food and pharmaceutical industries, and agriculture. Research has demonstrated diverse functional properties, including antagonistic activity against pathogenic bacteria and phytopathogenic fungi, antioxidant effects, EPS production, and potential probiotic functions. Nevertheless, these properties vary among strains, and their practical use requires systematic evaluation of efficacy, safety, and mechanisms of action. In particular, the antagonistic potential of *W. cibaria* against opportunistic pathogenic bacteria and phytopathogenic fungi warrants further investigation to assess its suitability for developing biological control agents and other biotechnological applications.

RESEARCH METHOD

The material used in this study was a lactic acid bacterial strain, *Weissella cibaria*, isolated from a fermented dairy product (cheese). The cheese sample was homogenized and inoculated into MRS broth, followed by incubation at 37°C for 48 h for enrichment. Serial dilutions were prepared from the enrichment broth, and each dilution was spread-plated onto MRS agar in duplicate. One plate from each duplicate set was incubated in an aerobic incubator, while the second plate was placed in an anaerobic jar in which the air was replaced with gaseous nitrogen to establish anaerobic conditions. All plates were incubated at 37°C for 48 h.

After incubation, well-isolated colonies with distinct morphological characteristics were selected and subcultured onto MRS agar plates supplemented with 2–3 drops of an alcoholic bromocresol purple indicator solution to assess acid production. The plates were incubated at 37°C until visible growth appeared. Isolates that changed the medium color from purple to yellow were selected for further investigation.

Determination of Antimicrobial Activity

Antimicrobial activity was assessed using the drop-spot method. A 24-hour culture of the probiotic strain was applied to the surface of MRS agar plates using a bacteriological loop with a diameter of 3 mm. The plates were kept at room temperature until the droplets had been completely absorbed by the agar surface.

Subsequently, a droplet of the test microorganism culture was placed 1–2 mm from the edge of the first spot. The spreading droplet of the test culture was allowed to overlap the probiotic culture spot by approximately half of its diameter. The overlapping area enabled the assessment of competitive interactions between the cultures.

After the droplets had dried, the plates were incubated at 37°C for 24 h under microaerophilic conditions in an anaerobic jar. The results were evaluated by measuring the growth inhibition zones of the test cultures in millimeters (mm). The presence and degree of antimicrobial activity of the probiotic strain were determined based on the size of the inhibition zones.

Determination of Antifungal Activity

Antifungal activity was evaluated using the agar block method. The exponential-phase culture of the test strain was spread uniformly over the surface of MRS agar plates and incubated at 37°C for 72 h under optimal growth conditions.

The antagonistic activity of the isolated lactic acid bacterial strain against pathogenic fungi was assessed on solid Czapek agar medium using the agar block method. The experiments were performed in duplicate. A six-day-old conidial suspension of each test fungus was spread uniformly over the surface of Czapek agar plates. After 15–20 min, agar blocks containing three-day-old cultures of the lactic acid bacteria were placed on the fungal lawns.

The plates were subsequently incubated under conditions suitable for the growth of the test fungi. Antifungal activity was evaluated after 24 h of incubation at 37°C by measuring the diameters of the zones of fungal growth inhibition in millimeters (mm). The presence and degree of antagonistic activity were determined based on the size of the inhibition zones surrounding the agar blocks.

The isolated bacterial strains were identified using matrix-assisted laser desorption/ionization time-of-flight mass spectrometry (MALDI-TOF MS).

RESULT AND DISCUSSION

Results

The antimicrobial activity of the isolated and identified *Weissella cibaria* strain was evaluated using the drop-spot method on MRS agar after 72 h of cultivation. Antagonistic activity was classified according to the diameter of the pathogen growth inhibition zone as follows: ≤15 mm, low activity; 15–30 mm, moderate activity; and ≥30 mm, high activity.

As shown in Table 1, *W. cibaria* exhibited antagonistic activity against the tested opportunistic and pathogenic microorganisms, including *Proteus morganii* 399, *Serratia marcescens* 367, *Escherichia coli* NC 101, *Pseudomonas aeruginosa* 003841/114, *Bacillus cereus*, *Citrobacter freundii* 002801/27, *Klebsiella pneumoniae* B-1823, *Staphylococcus aureus* 003594/wood 46, *Enterococcus faecalis* OGIFR I, *Proteus mirabilis*, *Listeria monocytogenes* ATCC 1911, and *Candida albicans*.

The results demonstrated inhibition of all 12 tested microorganisms, although the magnitude of the effect varied among the test strains. The largest reported inhibition zones were 39 mm against *P. morganii* 399, *Proteus mirabilis* 42 mm and 40 mm against *C. albicans*. An inhibition zone of 39 mm was also reported for *P. morganii* 399; this value should be verified against the original experimental data because the same strain is associated with two different measurements. Lower activity was observed against *K. pneumoniae* B-1823 and *S. aureus* 003594/wood 46, with inhibition zones of 28 and 25 mm, respectively.

The inhibition zones against *E. coli* NC 101, *P. aeruginosa* 003841/114, *B. cereus*, and *C. freundii* 002801/27 ranged from 15 to 32 mm, indicating strain-dependent differences in susceptibility to the antagonistic activity of *W. cibaria* (Fig. 1).

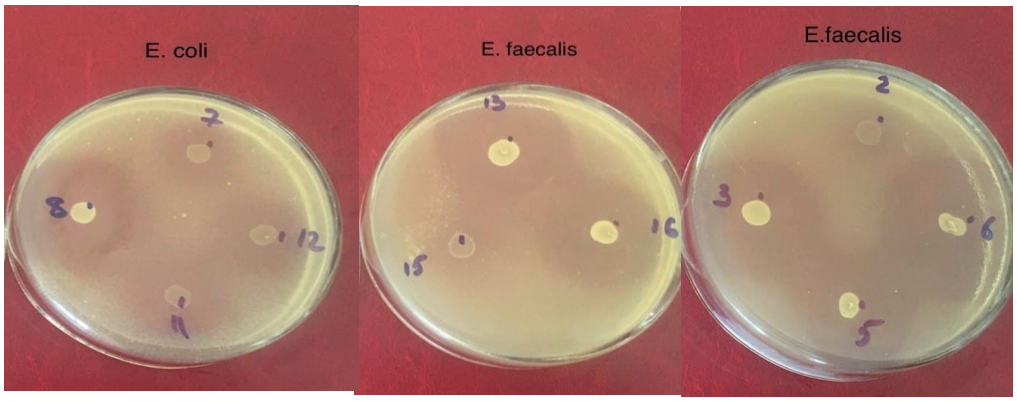




Figure 1. Antagonistic activity of the *Weissella cibaria* strain against opportunistic pathogenic bacteria.

Table 1. Antimicrobial activity of the Weissella cibaria strain against opportunistic pathogenic bacteria

Cultures	**Diameter of the growth inhibition zone, mm**											
	Proteus morganii 399	*Serratia marcescens 367*	*E.coli NC 101*	*Pseudomonas aeruginosa 003841/114*	*Bacillus cereus*	*Citrobacter freundii 002801/27*	*Klebsiella pneumonia B-1823*	*Staphylococcus aureus 003594/wood 46*	*Enterococcus faecalis OGIFR I*	*Proteus mirabilis*	*Listeria monocytogenes ATCC 1911*	*Candida albicans*
Weissella cibaria	39	25	15	32	20	20	28	25	19	42	28	40

Table 2. Antagonistic Activity of the *Weissella cibaria* strain against Phytopathogenic Fungi

Cultures	*Aspergillus flacus*	*Aspergillus oryzae*	*Verticillum dahlia*	*Alternaria alternate*	*Fusarium species*
Weissella cibaria	32 мм	28 мм	40 мм	30 мм	25 мм

The antagonistic activity of the strain was tested against five phytopathogenic fungi: *Aspergillus flavus, Aspergillus oryzae, Verticillium dahliae, Alternaria alternata,* and *Fusarium spp*., as presented in Figure 2 and Table 2. The results showed that *Weissella*

cibaria exhibited antagonistic activity against the tested fungi, with inhibition zone diameters of 40 mm for *Verticillium dahliae*, 32 mm for *Aspergillus flavus*, 30 mm for *Alternaria alternata*, 28 mm for *Aspergillus oryzae*, and 25 mm for *Fusarium* spp. (Fig. 2).

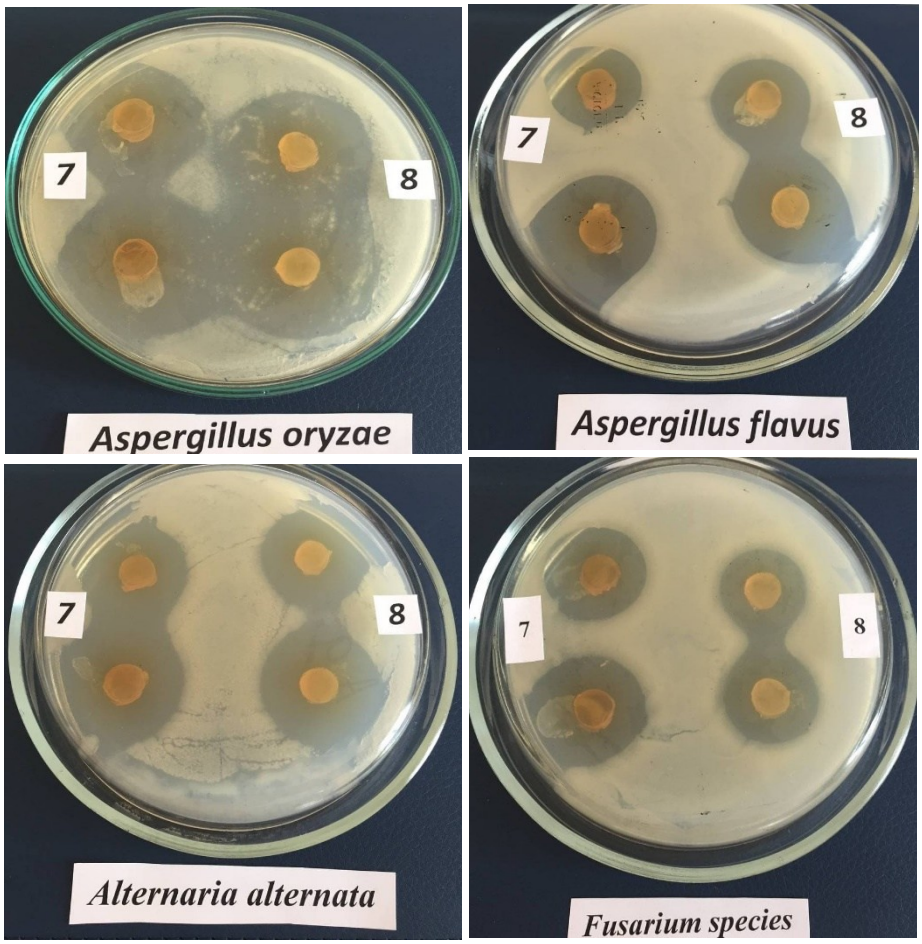


Figure 2. Antifungal Activity of the *Weissella cibaria* Strain Against Phytopathogenic Fungi.

Discussion

Thus, the results indicate that the isolated and identified lactic acid bacterial strain belonging to the species *Weissella cibaria* exhibits antimicrobial and antifungal properties, suggesting its potential application in various sectors of the economy. Its antagonistic activity is important for human health, food preservation, and probiotic development, as lactic acid bacteria can effectively inhibit opportunistic pathogenic bacteria and micromycetes, including moulds and yeasts [20].

CONCLUSION

Fundamental Finding: The Weissella cibaria strain isolated from cheese showed broad antagonistic activity against all 12 tested opportunistic and pathogenic microorganisms. The strain also inhibited all five phytopathogenic fungi. **Implication:** These results show that the strain can suppress bacteria, yeasts and filamentous fungi, which makes it a promising candidate for biocontrol agents, food preservation and probiotic development. **Limitation:** These properties vary among strains, and their

practical use requires systematic evaluation of efficacy, safety, and mechanisms of action. **Future Research:** Further work is needed to identify the active metabolites, such as organic acids, and to assess the strain's safety, including antibiotic resistance and virulence-associated genes, before practical application.

REFERENCES

[1] M. Quattrini, D. Korcari, G. Ricci, и M. G. Fortina, «A polyphasic approach to characterize Weissella cibaria and Weissella confusa strains», *J. Appl. Microbiol.*, т. 128, вып. 2, сс. 500–512, 2020.

[2] A.-R. Choi, J. K. Patra, W. J. Kim, и S.-S. Kang, «Antagonistic activities and probiotic potential of lactic acid bacteria derived from a plant-based fermented food», *Front. Microbiol.*, т. 9, 2018, [Онлайн]. Доступно на: https://pubmed.ncbi.nlm.nih.gov/30197633/

[3] H.-S. Yu, N.-K. Lee, A.-J. Choi, J.-S. Choe, C. H. Bae, и H.-D. Paik, «Antagonistic and antioxidant effect of probiotic Weissella cibaria JW15», *Food Sci. Biotechnol.*, т. 28, вып. 3, сс. 851–855, 2019.

[4] A. N. Khan и others, «Antagonistic, anti-oxidant, anti-inflammatory and anti-diabetic probiotic potential of Lactobacillus agilis isolated from the rhizosphere of the medicinal plants», т. 28, вып. 11, сс. 6069–6076, 2021.

[5] H.-S. Yu, N.-K. Lee, A.-J. Choi, J.-S. Choe, C. H. Bae, и H.-D. Paik, «Anti-inflammatory potential of probiotic strain Weissella cibaria JW15 isolated from kimchi through regulation of NF-κB and MAPKs pathways in LPS-induced RAW 264.7 cells», *J. Microbiol. Biotechnol.*, т. 29, вып. 7, сс. 1022–1032, 2019.

[6] D. Ndagano, T. Lamoureux, C. Dortu, S. Vandermoten, и P. Thonart, «Antifungal activity of 2 lactic acid bacteria of the Weissella genus isolated from food», *J. Food Sci.*, т. 76, вып. 6, сс. M305–M311, 2011.

[7] V. Patrone и others, «[Article title not specified in supplied reference]», *Probiotics Antimicrob. Proteins*, т. 13, вып. 3, сс. 809–823, 2021.

[8] S.-H. Kwak, Y.-M. Cho, G.-M. Noh, и A.-S. Om, «Cancer preventive potential of kimchi lactic acid bacteria (Weissella cibaria, Lactobacillus plantarum)», *J. Cancer Prev.*, т. 19, вып. 4, сс. 253–258, 2014.

[9] S. Yuan, Y. Wang, F. Zhao, и L. Kang, «Complete genome sequence of Weissella confusa LM1 and comparative genomic analysis», *Front. Microbiol.*, т. 12, 2021, [Онлайн]. Доступно на: https://pubmed.ncbi.nlm.nih.gov/34650545/

[10] A. I. Netrusov, *Comprehensive Practical Manual of Microbiology*. Moscow, Russia, 2005.

[11] K. Pabari и others, «Evaluation of probiotic properties and prebiotic utilization potential of Weissella paramesenteroides isolated from fruits», *Probiotics Antimicrob. Proteins*, т. 12, вып. 3, сс. 1126–1138, 2020.

[12] H.-E. Park, K.-W. Kang, B.-S. Kim, S.-M. Lee, и W.-K. Lee, «Immunomodulatory potential of Weissella cibaria in aged C57BL/6J mice», *J. Microbiol. Biotechnol.*, т. 27, вып. 12, сс. 2094–2103, 2017.

[13] O. Ojekunle, K. Banwo, и A. I. Sanni, «In vitro and in vivo evaluation of Weissella cibaria and Lactobacillus plantarum for their protective effect against cadmium and lead toxicities», *Lett. Appl. Microbiol.*, т. 64, вып. 5, сс. 379–385, 2017.

[14] S.-H. Son, H.-L. Jeon, S.-J. Yang, N.-K. Lee, и H.-D. Paik, «In vitro characterization of Lactobacillus brevis KU15006, an isolate from kimchi, reveals anti-adhesion activity

against foodborne pathogens and antidiabetic properties», *Microb. Pathog.*, т. 112, сс. 135–141, 2017.

[15] Sidorenko, «Mass Spectrometry in Microbiology: Achievements and Prospects», Research Institute of Children's Infections, St. Petersburg, Russia, 2014.

[16] Y.-T. Zhu и others, «Prebiotics inulin metabolism by lactic acid bacteria from young rabbits», *Front. Vet. Sci.*, т. 8, 2021, [Онлайн]. Доступно на: https://pubmed.ncbi.nlm.nih.gov/34660762/

[17] S. M. Yadav и P. Shukla, «Probiotic potential of Weissella paramesenteroides MYPS5.1 isolated from customary dairy products and its therapeutic application», *3 Biotech*, т. 12, вып. 1, 2022, [Онлайн]. Доступно на: https://pubmed.ncbi.nlm.nih.gov/34956812/

[18] V. Fusco *и др.*, «The genus Weissella: Taxonomy, ecology and biotechnological potential», *Front. Microbiol.*, т. 6, 2015, [Онлайн]. Доступно на: https://pubmed.ncbi.nlm.nih.gov/25852652/

[19] L. Huang и others, «Weissella cibaria attenuated LPS-induced dysfunction of intestinal epithelial barrier in a Caco-2 cell monolayer model», *Front. Microbiol.*, т. 11, 2020, [Онлайн]. Доступно на: https://pubmed.ncbi.nlm.nih.gov/33013748/

[20] C. G. Teixeira и others, «Weissella: An emerging bacterium with promising health benefits», *Probiotics Antimicrob. Proteins*, т. 13, вып. 4, сс. 915–925, 2021.

***Guzal Jumaniyazovna Kutlieva (Corresponding Author)**
Academy of Sciences of the Republic of Uzbekistan, Uzbekistan
Email: aziz0761@gmail.com

Bahora Ismailovna Turaeva
Academy of Sciences of the Republic of Uzbekistan, Uzbekistan
Email: turaevabakhora@mail.ru

Tulkin Erkinovich Shonakhunov
Academy of Sciences of the Republic of Uzbekistan, Uzbekistan
Email: brus_li89@mail.ru

Khulkar Fozil qizi Kamolova
Academy of Sciences of the Republic of Uzbekistan, Uzbekistan