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Modulation of the synthesis of antimicrobial compounds in Lactobacillus acidophilus due to oxidative stress

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Limited knowledge exists on the effects of oxidative stress on probiotic bacteria, like Lactobacillus. Studies show varying impacts of oxidative stress on these bacteria, with implications for their growth and bactericidal activity. Understanding how oxidative stress influences the production of antimicrobial compounds is crucial. This research could have applications in the pharmaceutical industry by enhancing antibacterial metabolite synthesis without genetic manipulation.

The aim of this research is studying the oxidative stress impact induced by TiO2 nanoparticles on the antibacterial capacity of Lactobacillus acidophilus ATCC 4756. To fulfill this aim the study of oxidative stress influence on probiotic bacteria growth and antibacterial activity of probiotics to planktonic and biofilm forms of pathogens were performed.

The growth of L. acidophilus ATCC 4756 was measured by spectrophotometry and CFU seeding. Antibacterial activity of probiotics was estimated by co-cultivation and agar wells methods.

Results showed that the optical density with increasing TiO2 concentration in the range from 15 to 1000 μg/ml varied from 0.2 to 0.5, with a control of 0.175. CFU at range of concentration 15-125 μg/ml was more than control, only 250 μg/ml equals the control - 1 * 108 CFU/ml. Based on the inverse relationship between the CFU and the OD of the solution, it can be concluded about the possible effect of nanoparticles on the growth and metabolite synthesis of Lactobacillus.

Co-cultivation study of Lactobacillus + TiO2 combination influence on planktonic pathogens showed that for Escherichia coli K12 TiO2 decreases cell survival up to 56% at a concentration of 1 mg/ml. With a joint culture of Lactobacillus and TiO2, the survival rate decreased to 25.7% at the same concentration. For Staphylococcus aureus, similar values were 72.5% and 19.7%, respectively.

Significant effects were observed in a co-cultivation experiment with E. coli K12 and S. aureus biofilms, showing inhibition zones when Lactobacillus + TiO2 were used. No inhibition zones were present in the control group. Lactobacillus + TiO2 in concentrations of 15, 250, and 500 μg/ml resulted in varying inhibition zone diameters 1.12 ± 0,04 cm, 1.13 ± 0,05 cm, 1.2 ± 0,03 cm cm respectively.

This study emphasizes the positive effect of oxidative stress on producing antibacterial compounds in Lactobacillus. Future research will aim to understand the mechanisms involved in this process. The research also validates the use of TiO2 to boost the production of antimicrobial compounds in probiotic bacteria against pathogens.