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Effect of titanium dioxide on certain bacterial and yeast cultures

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Abstract: In the present investigation, the effect of different concentrations of ethanol (0; 0,4; 2; 4; 6; 8; 10; 12; 14; 16; 18; 20 %), or titanium dioxide prepared in 40% ethanol (0, 1, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50 mM) on different bacterial cultures (*Escherichia coli*, *Staphylococcus aureus*, and *Enterobacter cloacae*), and fungi cultures (*Candida albicans*) was observed.

Introduction

Titanium dioxide is a chemical compound used in a wide range of products and fields, including paints, coatings, adhesives, paper, plastics and rubber, printing inks, textiles, ceramics, cosmetics, soaps, toothpaste, water treatment agents, food dyes, pharmaceuticals, automotive products, sunscreens and catalysts. In food industry, titanium dioxide or E171, is used as coloring food additive. Recent studies have shown that titanium dioxide is no longer considered a safe food additive due to its accumulation and toxic effects.

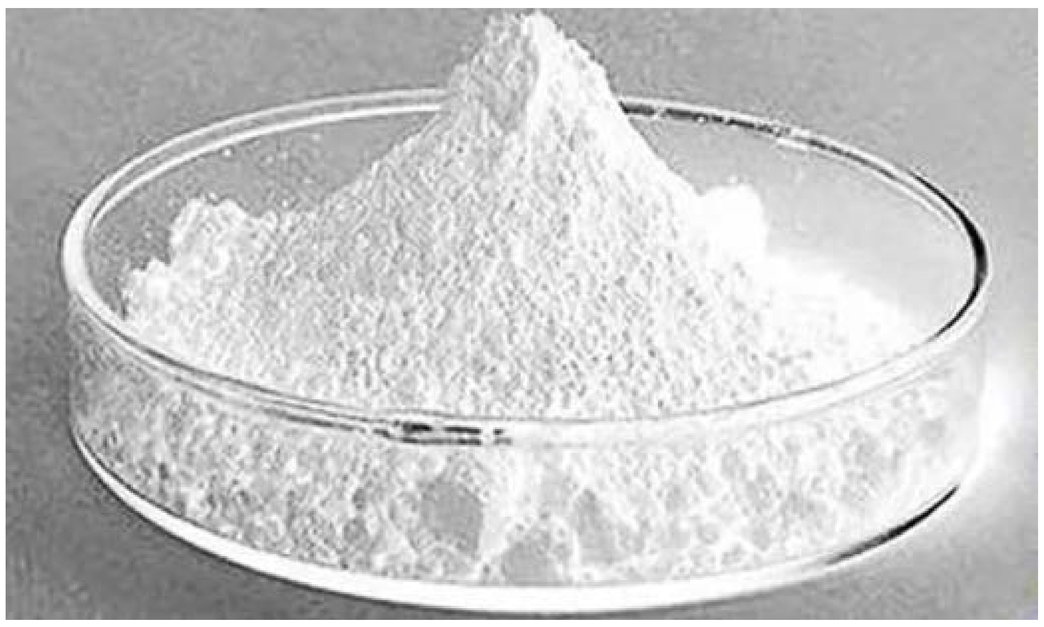
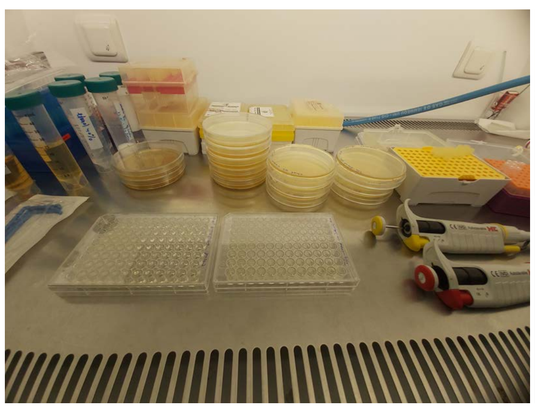


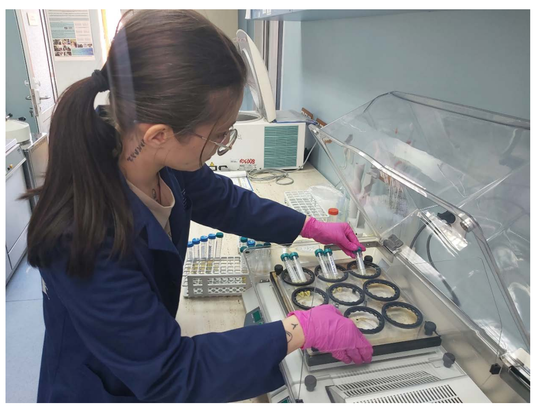
Fig.1. Titanium dioxide (TiO_2) powder

Material and method

Inoculation of microorganisms strains in specific culture media supplemented with different concentration of ethanol, or titanium dioxide prepared in ethanol.



Incubation of plates cultures at 30°C, 500 rpm. The optical density was read before and after 22 h of incubation.



Experimental steps

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Results and discussions

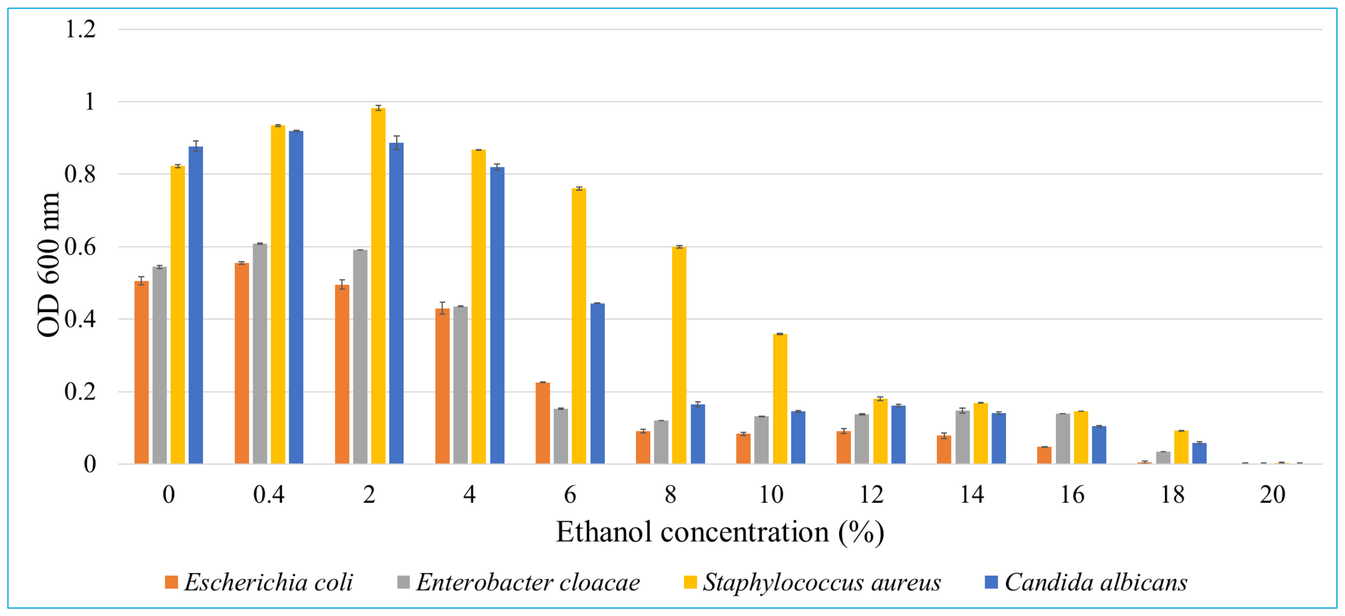

Fig.2. Inhibitory activity of ethanol on different strains of microorganisms. Dilutions of ethanol started from 40% and have pairs supplemented with TiO_2 –see the next graph.

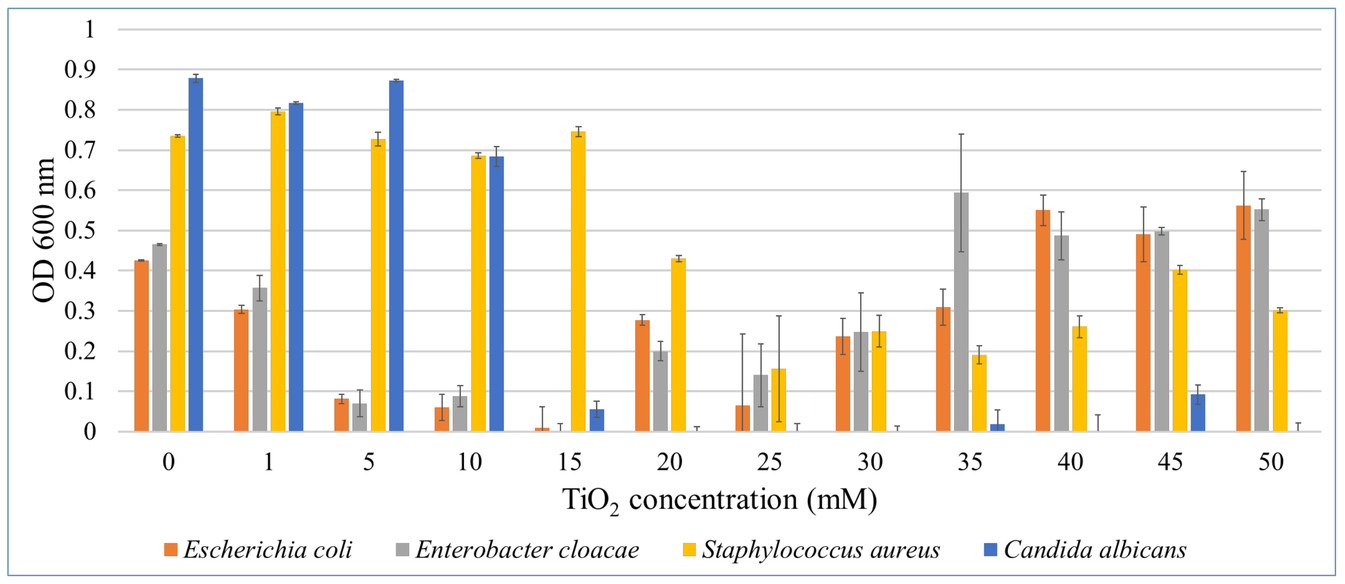

Fig.3. Inhibitory activity of TiO_2 solution prepared in 40% ethanol on different strains of microorganisms.

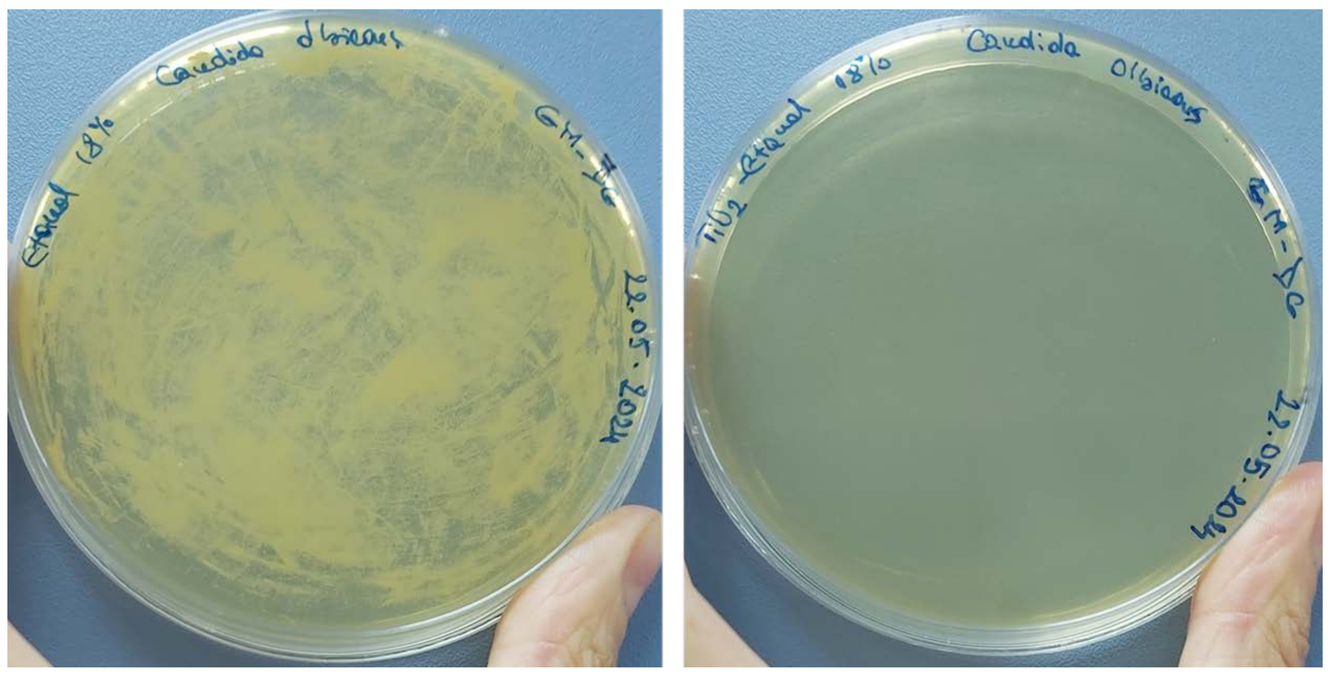

Fig.4. Viability test of *Candida albicans* on 18% ethanol, or 45 mM TiO_2 after 24 h of incubation at 30°C

Conclusions

The preliminary results revealed that *Escherichia coli* and *Enterobacter cloacae* were inhibited at 6-8% ethanol and 5 mM titanium dioxide in ethanol, while *Staphylococcus aureus* at 18 % ethanol and 35 mM titanium dioxide in ethanol. The viability test showed that *Candida albicans* grow at 18 % ethanol, but in 18% ethanol supplemented with 45 mM TiO_2 the fungi cells were death. All microorganisms strains grow on 6% ethanol, or 6% ethanol-15 mM TiO_2. All bacterial strains are death on 18% ethanol, or 18% ethanol-45 mM TiO_2. The high optical density values of the microorganisms in the TiO_2 solution prepared in 40% ethanol are due to the partial dissolving of titanium dioxide rather than to the density of the strains.