

Study the effect of curcumin microparticles on structure and properties of blood cells membranes by the atomic force microscopy

D.L. Radyukevich¹, G.B. Melnikova¹, A.S. Petrovskaya¹, T.N. Tolstaya¹, S.A. Chizhik¹,
N.Th. Binh², N.T. Tinh²

¹A.V. Luikov Heat and Mass Transfer Institute of National Academy of Science of Belarus,
220072, Minsk, Belarus
galachkax@gmail.com

²Institute of Applied Physics and Scientific Instruments of Vietnam Academy of Science and Technology,
Ha Noi, Vietnam

Curcumin has a number of useful pharmacological properties: antioxidant, antibiotic, antiviral, anti-inflammatory. The interaction of curcumin particles and blood cells is an interesting research topic in the pharmacological industry. Atomic force microscopy (AFM) allows determining local changes in structure and mechanical properties of the cell membranes. The aim of the work is to determine influence curcumin microparticles on blood cells properties.

Curcumin microparticles were obtained by spray drying method. For this spray dryer LU-222 Advanced device (Labultima, India) was used, the parameters of the spray drying process: drying air temperature 90 °C, vacuum 1680 Pa, nozzle fluid pressure 4 kg/cm². Microparticles were obtained from 1.25 mass.% suspension of curcumin (Chem-Impex Int'l Inc., Mw 368.38, purity 98.24%) in acetone.

For determine effects of curcumin on cells a suspension of obtained microparticles in physiological solution were used ($C = 1$ mg/ml). Cell samples isolated from the venous blood of healthy patients. Curcumin was incubated with erythrocyte and platelet masses during 60 min at room temperature. Then cells were fixed with glutaraldehyde, washed twice with phosphate buffer and distilled water, formed swab and dried at room temperature on mica substrates.

The effects of curcumin particles on the structure and properties of blood cell membranes were studied by the AFM method (NT-206, produced by MTM, Belarus) and standard silicon probe of V-shaped type CSC 21 B, stiffness 2 N/m, (produced by "Mikromasch", Estonia). Elastic modulus of cells membrane was calculated by the Johnson-Kendall-Roberts model.

It was established, that after effect curcumin microparticles on cells, the elastic modulus of erythrocytes increased from 80.4 to 110.8 MPa, value of adhesion force was halved. An increase in elastic modulus indicates a decrease in cell deformability, as well as their ability to aggregate. The elastic modulus of platelets was decreased, which is associated with an increase in the degree of cells aggregation. Value of adhesion force was not changed.

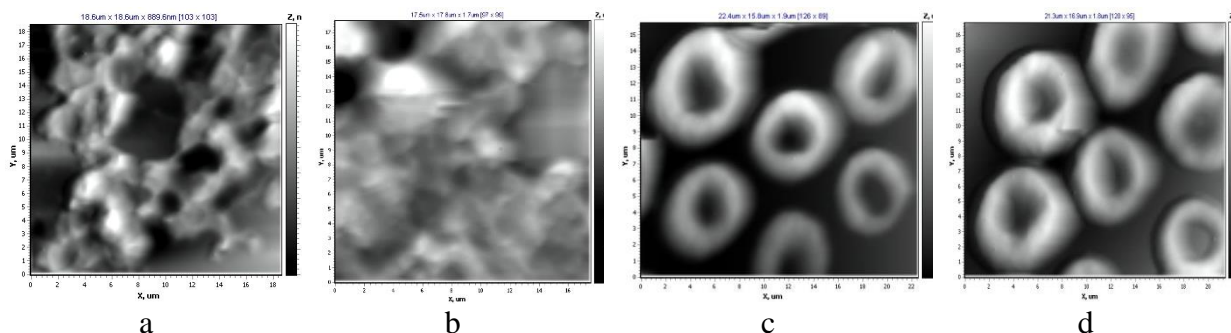


Figure 1. AFM-images of (a, b) initial structure of cells and (b, d) after incubation with curcumin microparticles.

So, by AFM method the changes mechanical properties of two types blood cells after incubation with curcumin microparticles were demonstrated, which can be the result of various biochemical reactions in the process of their interaction.