THE HYDRATION OF CUTICLE OF CHOSEN WEEVIL SPECIES (COLEOPTERA: CURCULIONIDAE) AS RECORDED BY PROTON RELAXATION AND SORPTION ISOTHERM

H. Harańczyk¹, M. Florek¹, P. Nowak¹ and S. Knutelski¹

¹Institute of Physics and ²Institute of Zoology, Jagiellonian University, Cracow

Cuticle forms the outer shell of Arthropoda body. It prevents the organs from environmental stresses, among them dessication shock and decreased temperature [3]. Several beetle genera differ in water loss through the cuticle layers, e.g. Carabidae cannot resist drying periods longer than several days, whereas Tenebridae deal with much longer periods of water shortage [1].

The resistivity of some beetle species for dessication stress may be compared with those for other living organisms like lichnized fungi [4]. As the cuticle is a multilayer composite structure, the molecular mechanisms of water level decrease may be connected with different layering of cuticle in different insect genera [6].

Elytra of two Curculionidae species (Liparus glabrirostris and Donus comatus) were collected in Southern Poland in Spring [5].

For both investigated species the hydration courses were performed from the gaseous phase, showing: (i) a very tightly bound water ($\Delta m/m_0 = 0.036$ for L. glabrirostris and $\Delta m/m_0 = 0.044$ for D. comatus); (ii) a tightly bound water (with $\Delta m/m_0 = 0.03$ for L. glabrirostris and 0.05 for D. comatus, with the hydration times $t_{hyd} = 3.1$ h, and $t_{hyd} = 1.7$ h, respectively) and finally (iii) loosely bound water pool (with the hydration times $t_{hyd} = 25.5$ h, and $t_{hyd} = 12.2$ h, for L. glabrirostris and D. comatus, respectively). The sorption isotherm is sigmoidal in form. Dent model [2] is significantly better fitted than BET-approach. The relative mass of water saturating primary binding sites is $\Delta M/m_0 = 0.036$, and 0.046 for L. glabrirostris and D. comatus, respectively.

Proton FIDs show solid component, well described by Gaussian function, and one or two liquid, exponential, components (with $T_2^* \approx 80$ μs – tightly bound water, and with $T_2^* \approx 300-350$ μs – loosely bound water fraction). The sorption isotherm fitted to NMR data (with $L/S$, as a measure of cuticle hydration level) shows the presence of water ‘sealed’ in pores of D. comatus elytra [6].

Address for correspondence: H.Harańczyk, D. Sc., Institute of Physics, Jagiellonian University, ul. Reymonta 4, 30-059 Cracow, e-mail: hubert.haranczyk@uj.edu.pl

References