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Binding affinity ovalbumin on different type of microplastics using Langmuir isotherm

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Microplastics are plastic fibers, particles or films with diameters smaller than 5 mm and they have shown different effects on proteins [1]. Microplastics (MPs) are small in size, have low densities, can exist in the atmosphere for a long time and can easily be spread by wind [2]. The objective of this study was to investigate adsorption affinity of different types of MPs (polyethylene terephthalate (PET), polystyrene (PS) and polyvinyl chloride (PVC)) with ovalbumin. In this study ovalbumin, isolated from chicken egg white, was used. Plastics were mixed with ovalbumin for 1, 2, 4 and 19 h and then the absorbance of the remaining protein in the solution was measured at 280nm. In addition, Langmuir isotherm mathematical model to calculate the adsorption affinity of ovalbumin for MPs was used. We determined affinity constants by using Langmuir isotherm models for different particle size (PS 120 μm and PS 500 μm), different types of plastics (PET, PS and PVC) and pH values (3 and 7,2). Adsorption experiment results showed that adsorption depends on type of plastics. Our results showed that PVC did not adsorb ovalbumin, however, PET and PS have interacted with protein. Adsorption capacities of all analysed MPs increase with pH of solution. Under different pH values, MPs and protein have different charges that may affect adsorption characteristics. With increase of pH from 3 to 7, the affinity for protein adsorption increased 1.4 times for PS (smaller in size) while for PS (bigger size) and PET protein affinity was two times higher at pH 3.

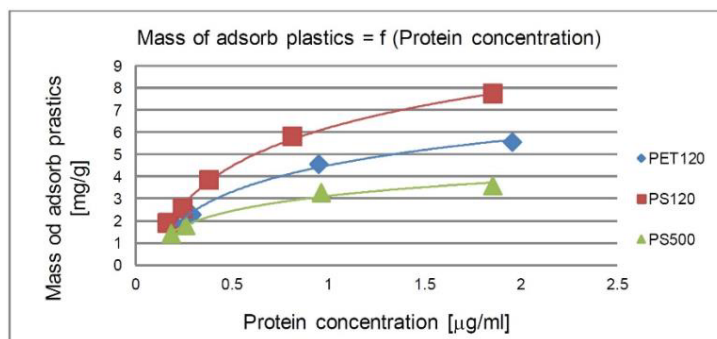


Fig. 1. Langmuir isotherm model; Mass of all type adsorb plastic in function of protein concentration, pH 7,2.

Table 1. Values of determined affinity constants, K_L , by using Langmuir isotherm models and ratio between different pH levels.

Plastics type and size	K_L pH 3,0	K_L pH 7,2	K_L pH 3,0/ K_L pH 7,2
PS 120 μm	3,423 E+04	4,888 E+04	0,7
PS 500 μm	4,293 E+04	2,285 E+04	1,9
PET 120 μM	6,940 E+04	3,483 E+04	2,0

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