



Modelling adsorption of proteins and cells on biomimetic hydroxyapatite

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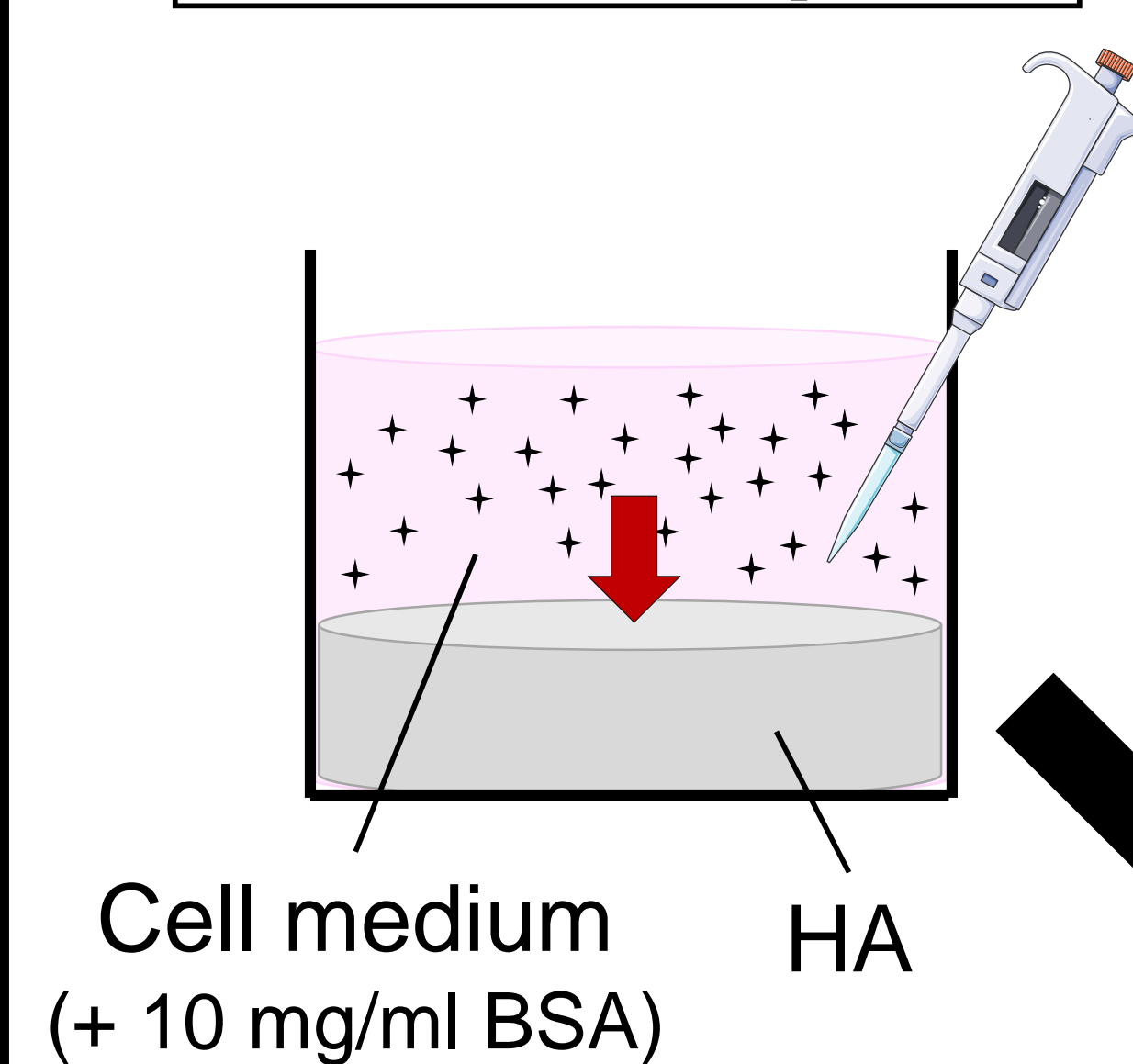
Introduction

During implantation, hydroxyapatite (HA) is exposed to blood, thus enabling plasma protein deposition on the material surface (e.g. albumin). The adhered proteins then act as an intermediary between the HA surface and migrating cells, aiding in adhesion.

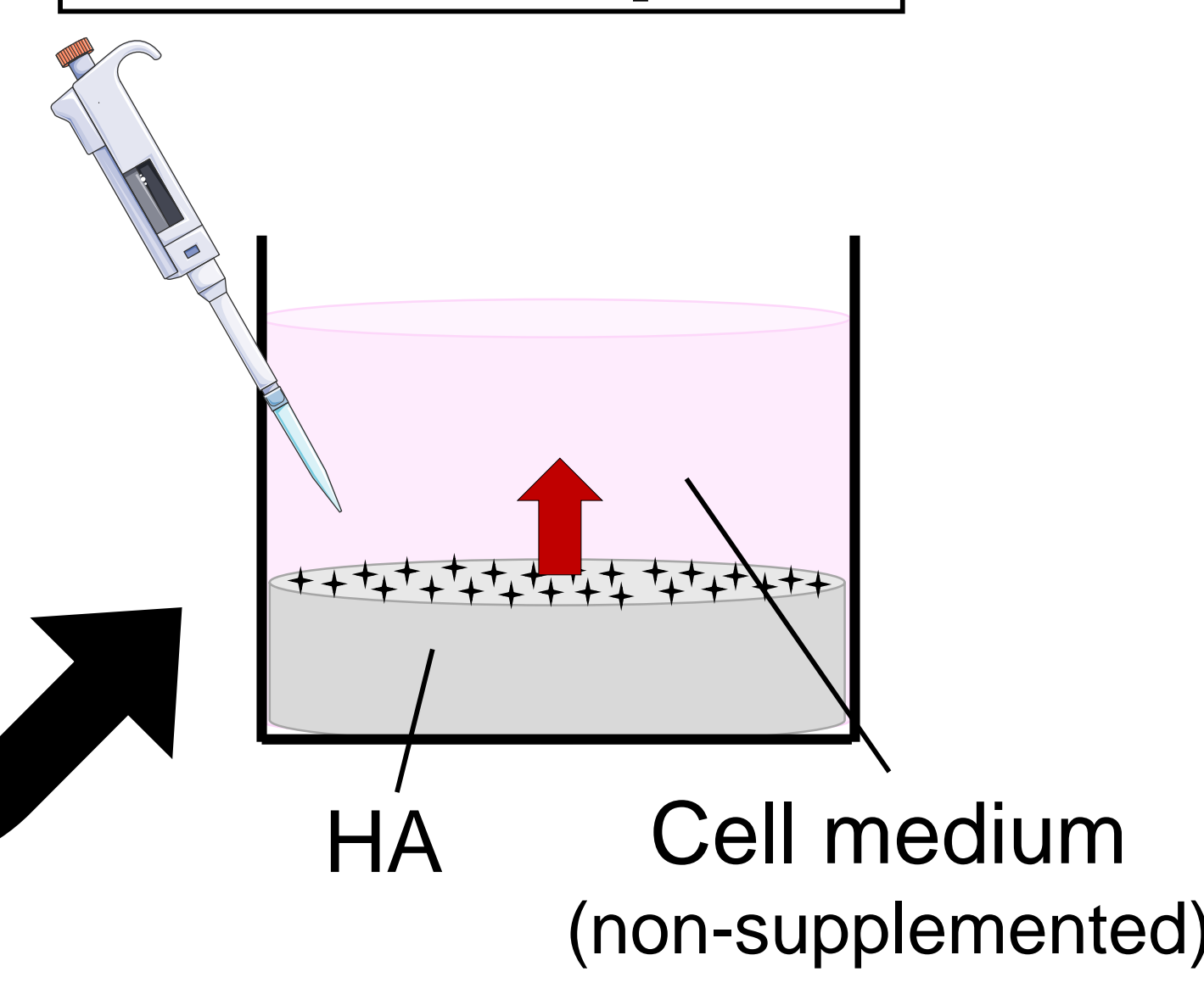
The aim of this study was to investigate the feasibility of computational modelling as a tool for the study of biological biomaterial properties. Using the diffusion equation and Langmuir isotherm as a basis, protein adhesion and subsequent cell adhesion on HA were investigated and modelled.

Methods

BSA adsorption

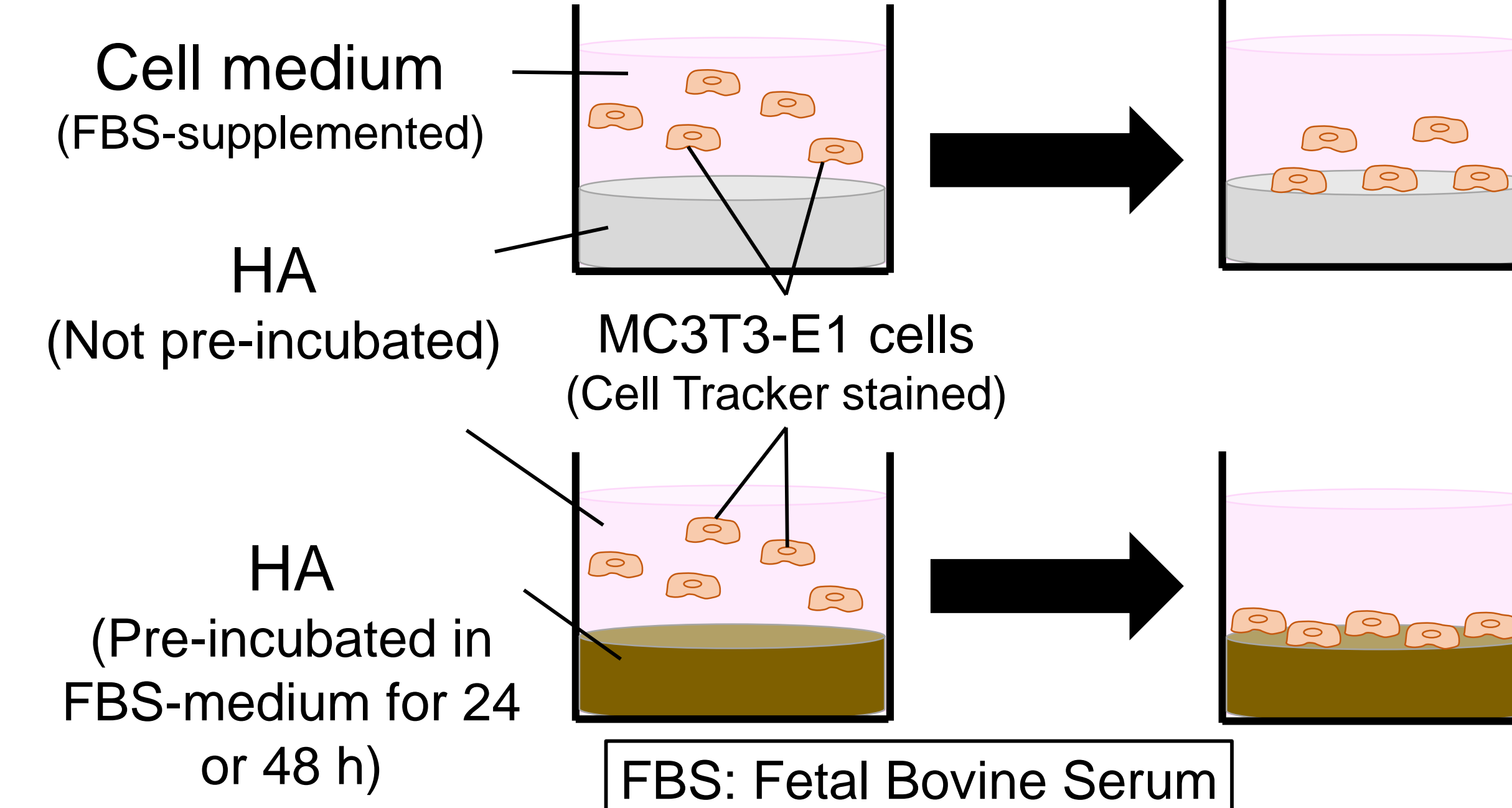


BSA desorption



+: BSA (Bovine Serum Albumin)

Cell adhesion



$$D \frac{\partial c}{\partial z} = -k_a(c_s - c_s^m)c - k_d c_s$$

D = BSA diffusion coefficient.

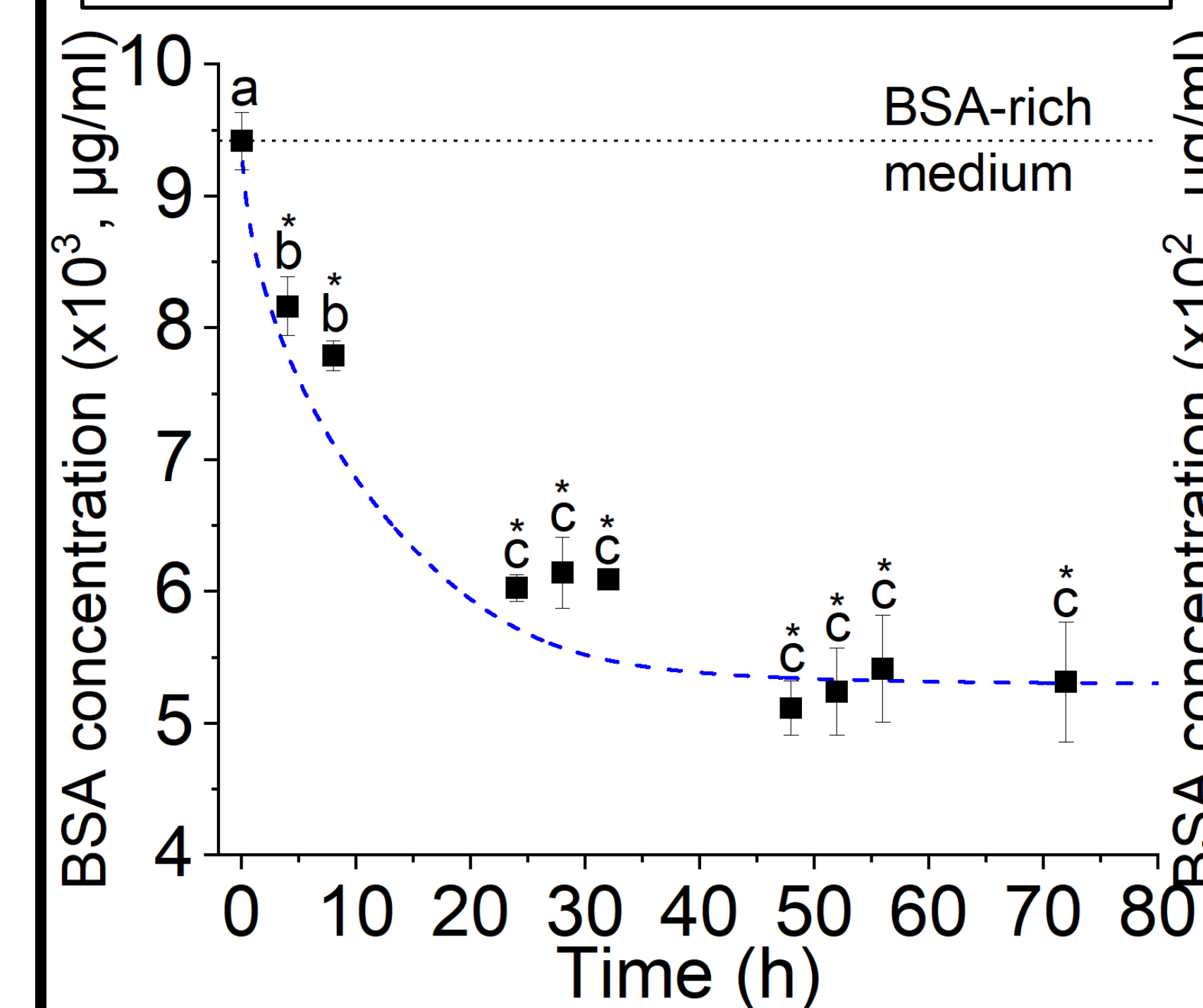
c and c^{OB} = BSA and cell concentration in medium. c_s and c_a^{OB} = BSA and cell concentration on HA surface.

$$\frac{dc_a^{OB}}{dt} = -k_a^{OB}(c_a^{OB} - c_m^{OB})c^{OB}$$

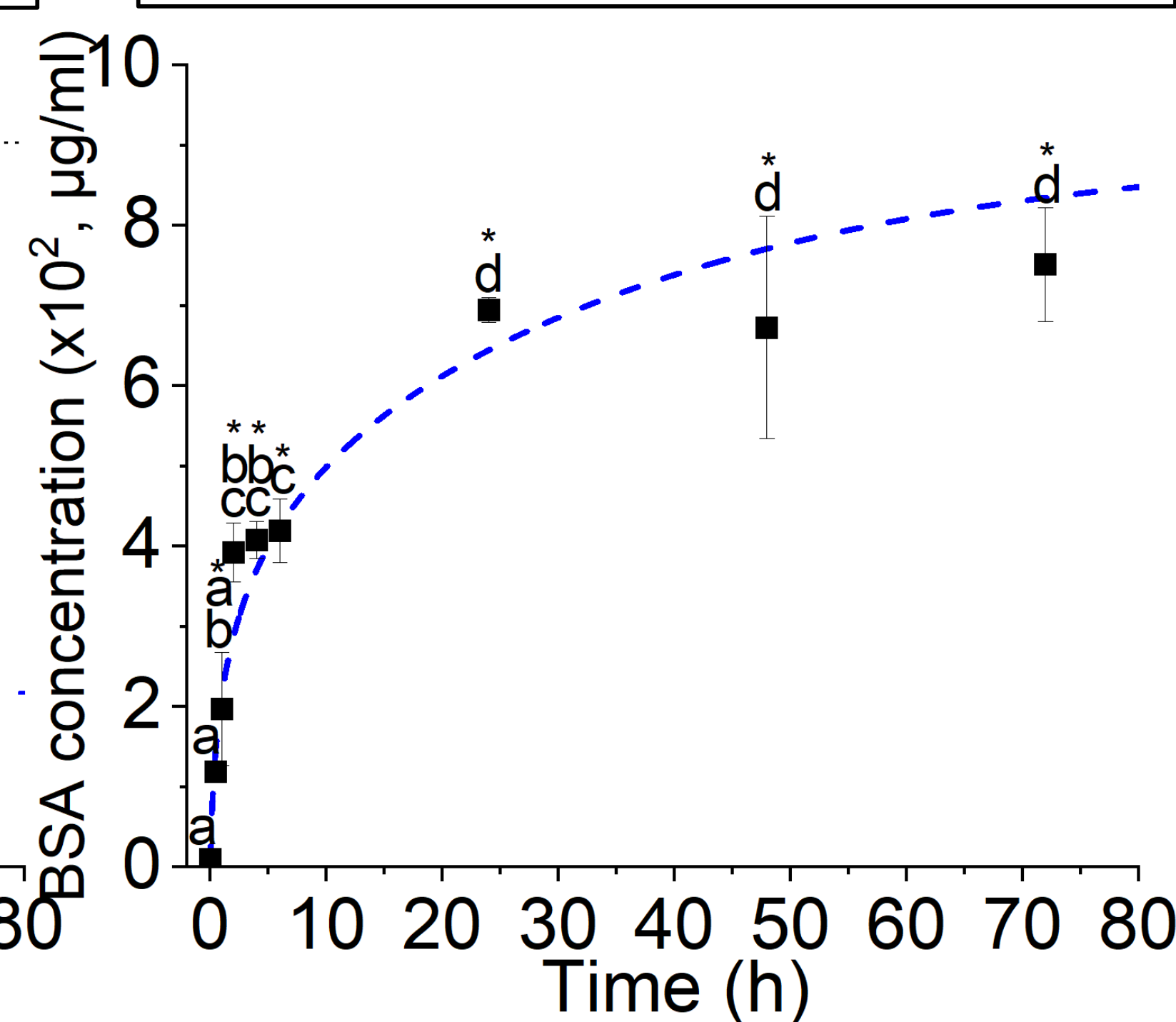
 c_s^m and c_m^{OB} = Maximal BSA and cell concentration on HA surface. K_a and K_a^{OB} = BSA and cell adsorption coefficient. K_d and K_d^{OB} = BSA and cell desorption coefficient.

BSA adsorption & desorption on HA

Adsorption of BSA on HA

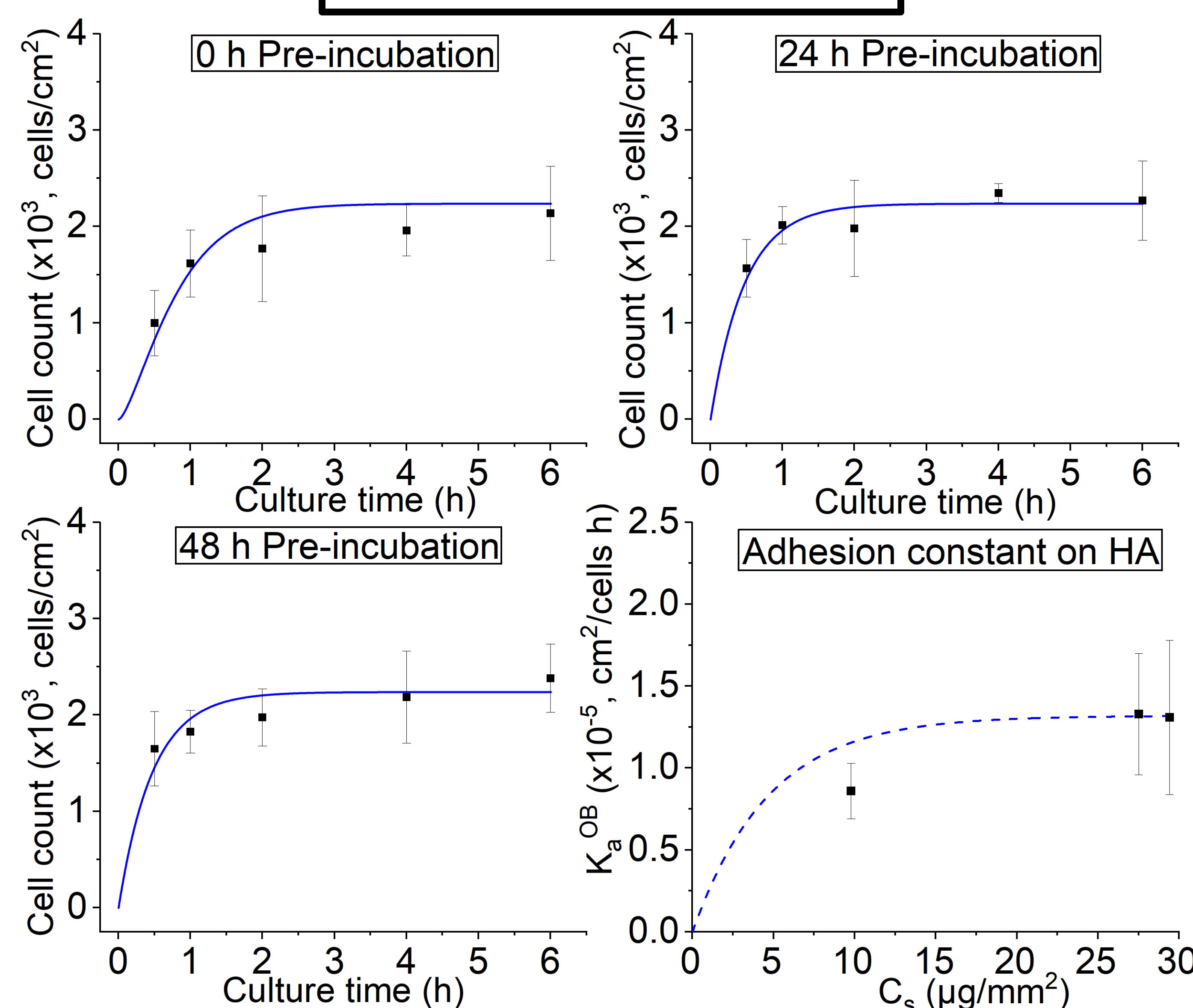


Desorption of BSA on HA



- 50% of the BSA adsorbed to the HA surface after 72 h.
- After 72 h in BSA-free medium, 18% of the adsorbed-BSA desorbed.
- Model satisfactorily captured trend in both cases.

Cell Adhesion on HA



- Stronger cell adhesion to pre-incubated HA.
- K_a^{OB} approached steady value as C_s was increased.
- Model displayed good agreement with experimental trend.

Conclusions

- Pre-incubation in supplemented media improved cell adhesion to surface.
- Model and experimental data displayed good agreement.
- Positive indication towards facilitation of early biomaterial development and evaluation via *in silico* modelling

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