fizikalna kemija makromolekula

makromolekule

sintetski polimeri

biološki (prirodni) polimeri

fizikalna kemija proteina

Edwin J. Cohn

Topljivost i kiselo-bazna svojstva proteina

Cohn, E. J., Hendry, J. L., and Prentiss, A. M., "Studies in the Physical Chemistry of the Proteins. V. Molecular Weights of the Proteins", *J. Biol. Chem.* 63 (1925) 721-766.

Cohn, E. J., "The Properties and Functions of Plasma Proteins with consideration of the Methods for their Separation and Purification", *Chem. Rev.* 28 (1941) 395.

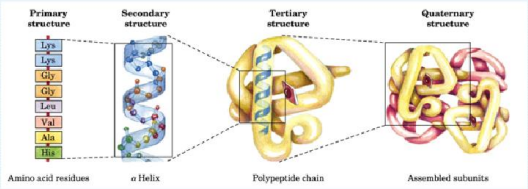
Simoni R D et al. J. Biol. Chem. 2002;277

jbc

Klasični način opisa proteina:

- Primarna struktura - redoslijed (sekvencija) aminokiselina
- Sekundarna struktura – konformacija peptidnih lanaca
- Tercijarna struktura
- Kvaterna struktura

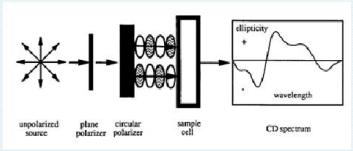
Razine strukture proteina



Spektroskopsko istraživanje sekundarne strukture proteina

- Cirkularni dikroizam (*Circular dichroism*, CD)
- Infracrvena (IR) i Raman spektroskopija
- Nuklearna magnetska rezonancija (NMR)

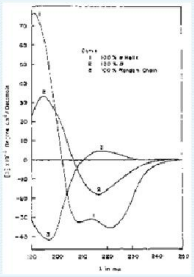
Fizikalni principi CD-a



- Kiralne ili asimetrične molekule daju CD spektar zato jer različito apsorbiraju lijevo i desno polariziranu svjetlost i zato se smatraju "optički aktivnim"

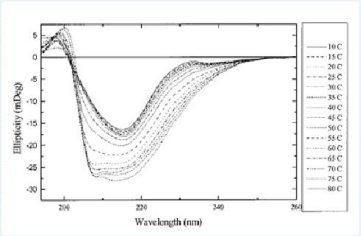
Sekundarna struktura proteina iz CD spektara

- različita vrsta proteina daje različite CD spektre



Sekundarna struktura proteina iz CD spektara

- CD spektri su posebno korisni za određivanje temperaturne ovisnosti sekundarne strukture proteina.



Sekundarna struktura proteina iz CD spektara

ostale informacije:

- (1) interakcije protein - ligand;
- (2) termodinamika smatanja (*folding*) proteina;
- (3) promjene konformacije i agregacija proteina;
- (4) međuprodukti smatanja;
- (5) kinetika smatanja proteina.

N. J. Greenfeld, Applications of circular dichroism in protein and peptide analysis, *Trends in analytical chemistry*, vol. 18, no. 4, 1999

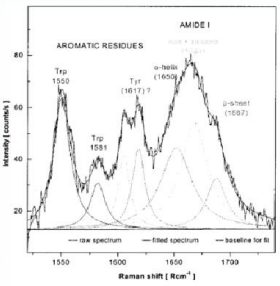
Sekundarna struktura proteina iz IR i Ramanskih spektara (vibracije!)

- amidne vrpce se najčešće koriste za istraživanje strukture proteina

Principal Amide I Frequencies Characteristic of Protein Secondary Structures

Conformation	H_2O	D_2O
α-helix	1650–1657	1647–1654
Antiparallel β-sheet	1612–1640; 1670–1690 (weak)	1628–1635
Parallel β-sheet	1626–1640	
Turn	1655–1675 1680–1696	
Unordered	1640–1651	1643

Sekundarna struktura proteina iz IR i Ramanskih spektara (vibracije!)



- Ramanski spektri daju informacije o aromatskim ostacima u području oko 1620 cm^{-1}

Sekundarna struktura proteina pomoću NMR spektroskopije

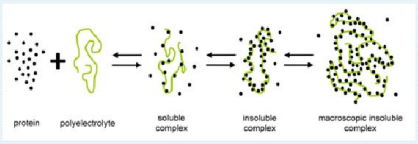
- Određivanje sekundarne strukture pomoću NMR spektroskopije ne zahtijeva potpunu trodimenzijsku strukturnu analizu kao što zahtijeva rendgenska kristalografija.
- Poznavanje kemijskih pomaka amida i protona su u principu sve što je potrebno.
- Spektroskopija NMR je najsnažnija i najtočnije metoda određivanja sekundarne strukture proteina bez trodimenzijske strukture.

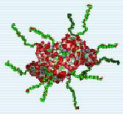
Interakcija proteina sa...

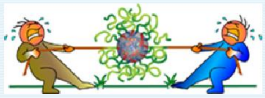
- ... polielektrolitima
- ... polisaharidima
- ... DNA
- ... itd

- Primjena!!

Kompleksi protein-polielektrolit

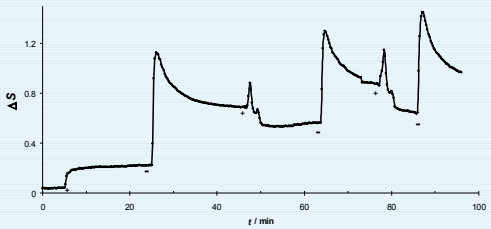




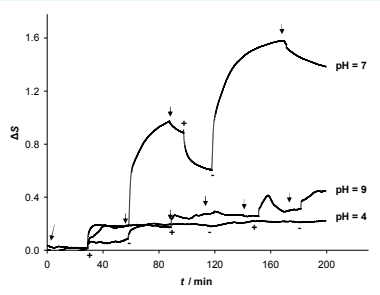


Karakterizacija polielektrolitno-proteinskih višeslojeva pomoću optičke reflektometrije

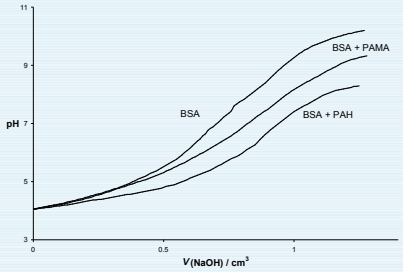
PVP^{+}/BSA



PAMA/BSA

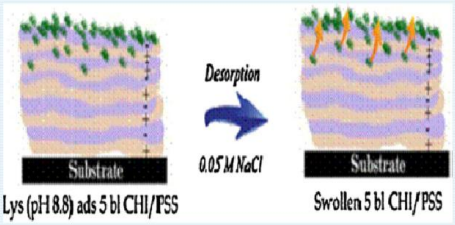


potenciometrijska titracija

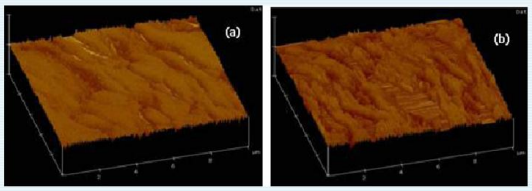


J. Mathew et al., *Fabrication of switchable protein resistant and adhesive multilayer membranes*, Colloids and Surfaces B: Biointerfaces 94 (2012) 118– 124

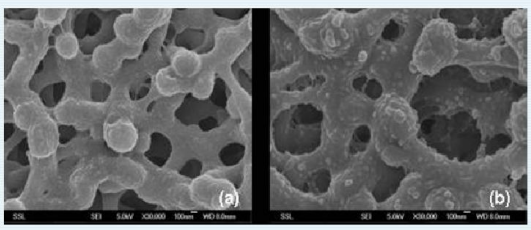
- Fabrication of protein adhesive and resistant surfaces based on chitosan/polystyrene sulfonate (CHI/PSS) multilayer membranes is presented. Adsorption behavior of bovine serum albumin (BSA) and lysozyme to CHI/PSS multilayer was studied.



Shematski prikaz adsorpcije lizozima
(a) pri pH = 8,8 (b) desorpcija, reverzna migracija na površinu.

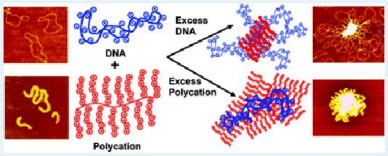


AFM prikazi adsorpcije lizozima na CHI/PSS višesloj (10 slojeva)
(a) pH = 8,8 (b) pH = 10,6



SEM prikazi adsorpcije BSA (pH 4.8)
(a) 6 CHI/PSS slojeva (b) 14 CHI/PSS slojeva.

Polyelectrolyte – DNA complexes



D. Störkle, S. Duschner, N. Heimann, M. Maskos, and M. Schmidt, Complex Formation of DNA with Oppositely Charged Polyelectrolytes of Different Chain Topology: Cylindrical Brushes and Dendrimers, *Macromolecules*, 2007, 40 (22), pp 7998–8006.