Protein fractionation by ammonium sulphate and dialysis

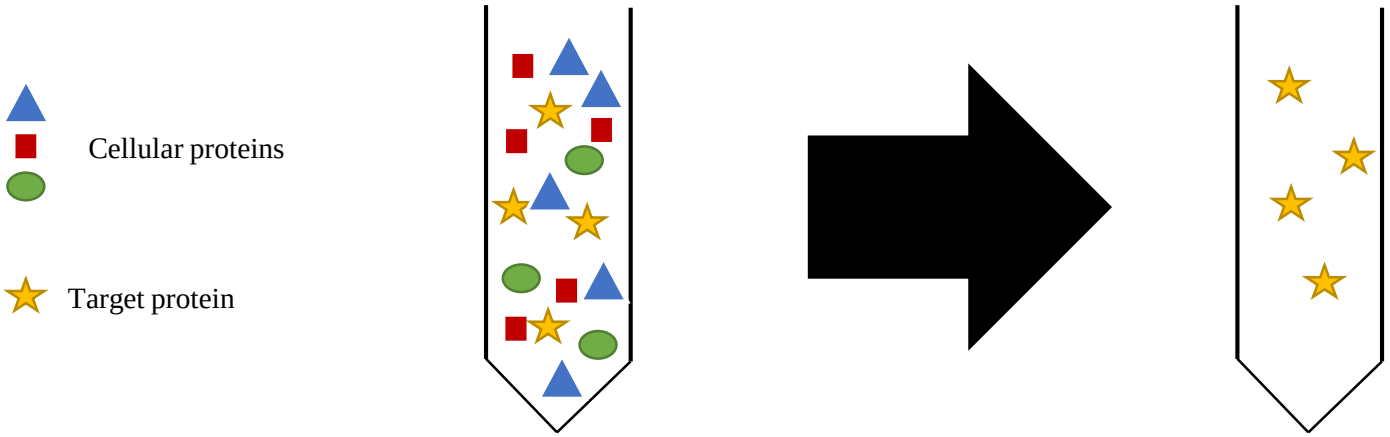
BCH303 [Practical]

Protein purification:

- Purification should yield a sample of protein containing only one type of molecule, the protein in which the biochemist is interested ➔**This protein sample may be only a fraction of 1% of the starting material.**

- <u>How is the biochemist able to isolate a particular protein from a complex mixture of proteins?</u>

- Isolation techniques utilize different properties of proteins.



Purification based on solubility:

- Salting out.
- The salt concentration at which a protein precipitates **differs from one protein to another.**
- Concentrating.
- Initial purification.

The type of salt used in precipitation :

- Ammonium sulphate.
- **Causes ?**

- **……. How to remove the salt ?**

Dialysis:

- Proteins separated from small molecules (salts).
- Semi-permeable membrane.
- Osmosis.
- Pores.

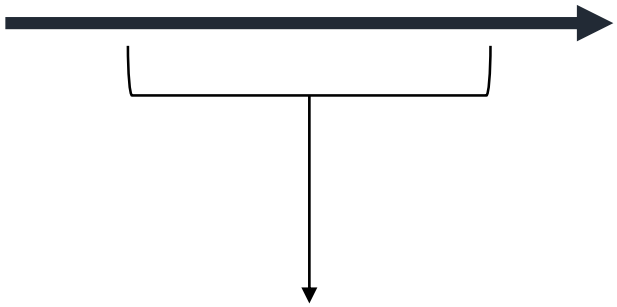
Practical part

Protein fractionation by ammonium sulphate and dialysis:

Objective:

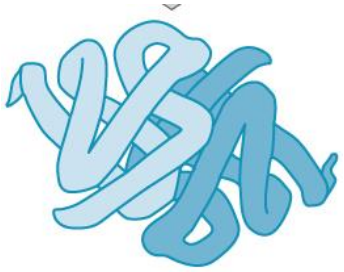
- Fractionation of animal crude extract by ammonium sulphate.
- Removing of salts ions using dialysis.

Whole tissue



a series of processes to remove other unwanted proteins and components

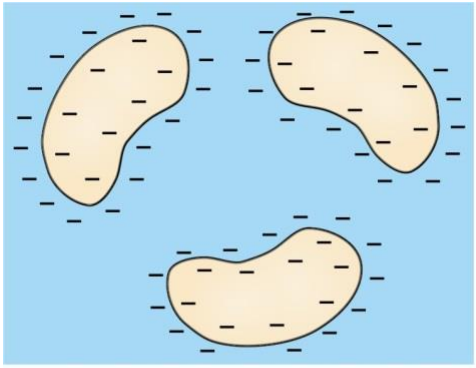
(Protein can not be isolated by only one step)



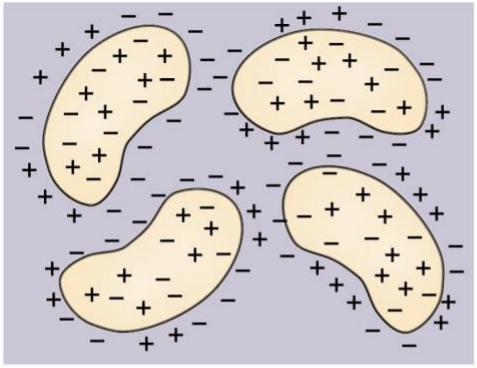
Protein of interest (Target protein)

Principle:

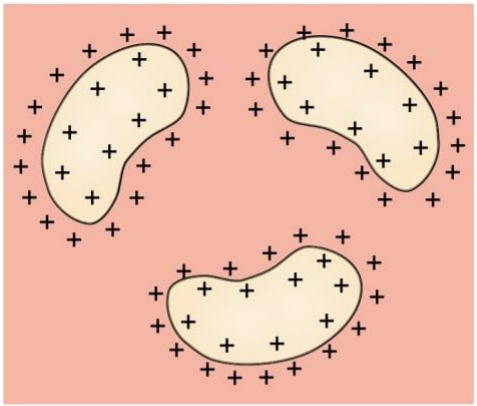
- Isoelectric point of the protein.
- Different proteins will precipitate at different salt concentration.
- Centrifugation step to collect the precipitate.
- Precipitation of proteins is conventionally carried out at 0°C to avoid possible denaturation of proteins.
- Dialysis is applied to remove salts.



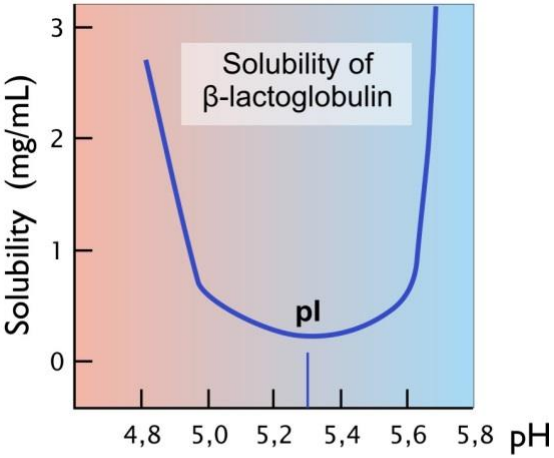
a) At pH values above the isoelectric point the protein is negatively charged



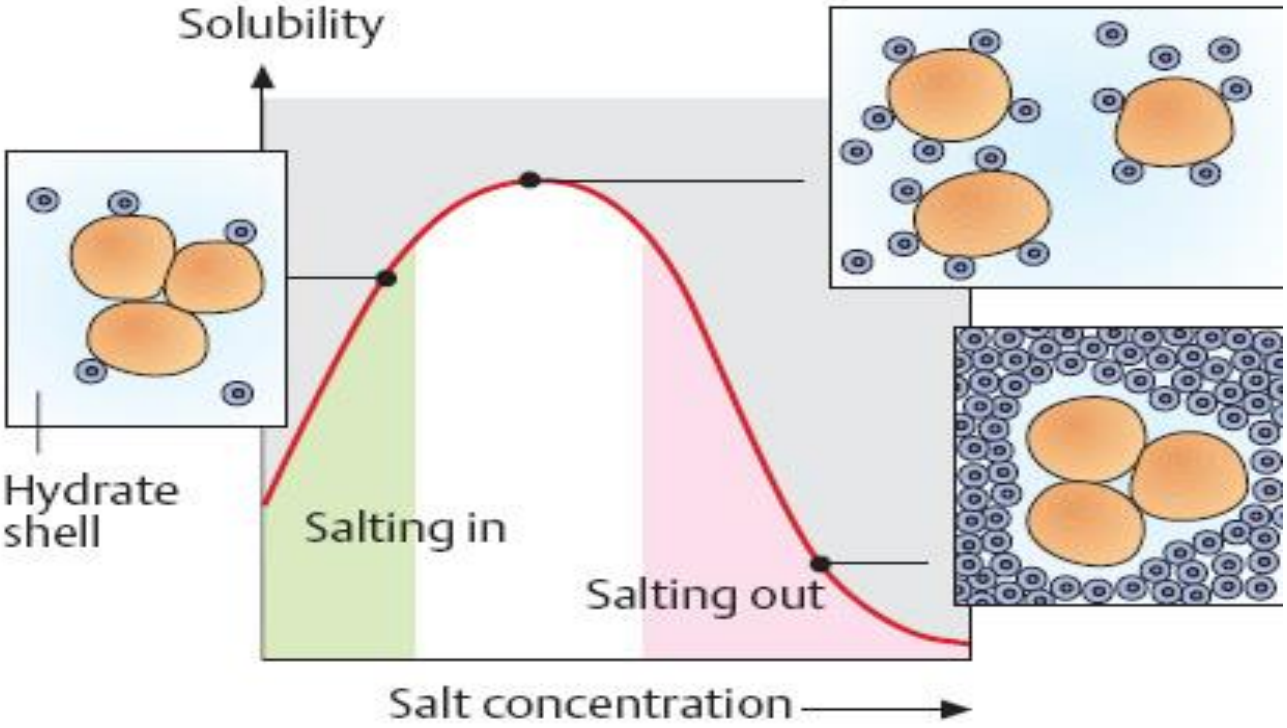
b) pH=pI, the number of negative and positive charges is equal



c) At pH values below the isoelectric point the protein is positively charged

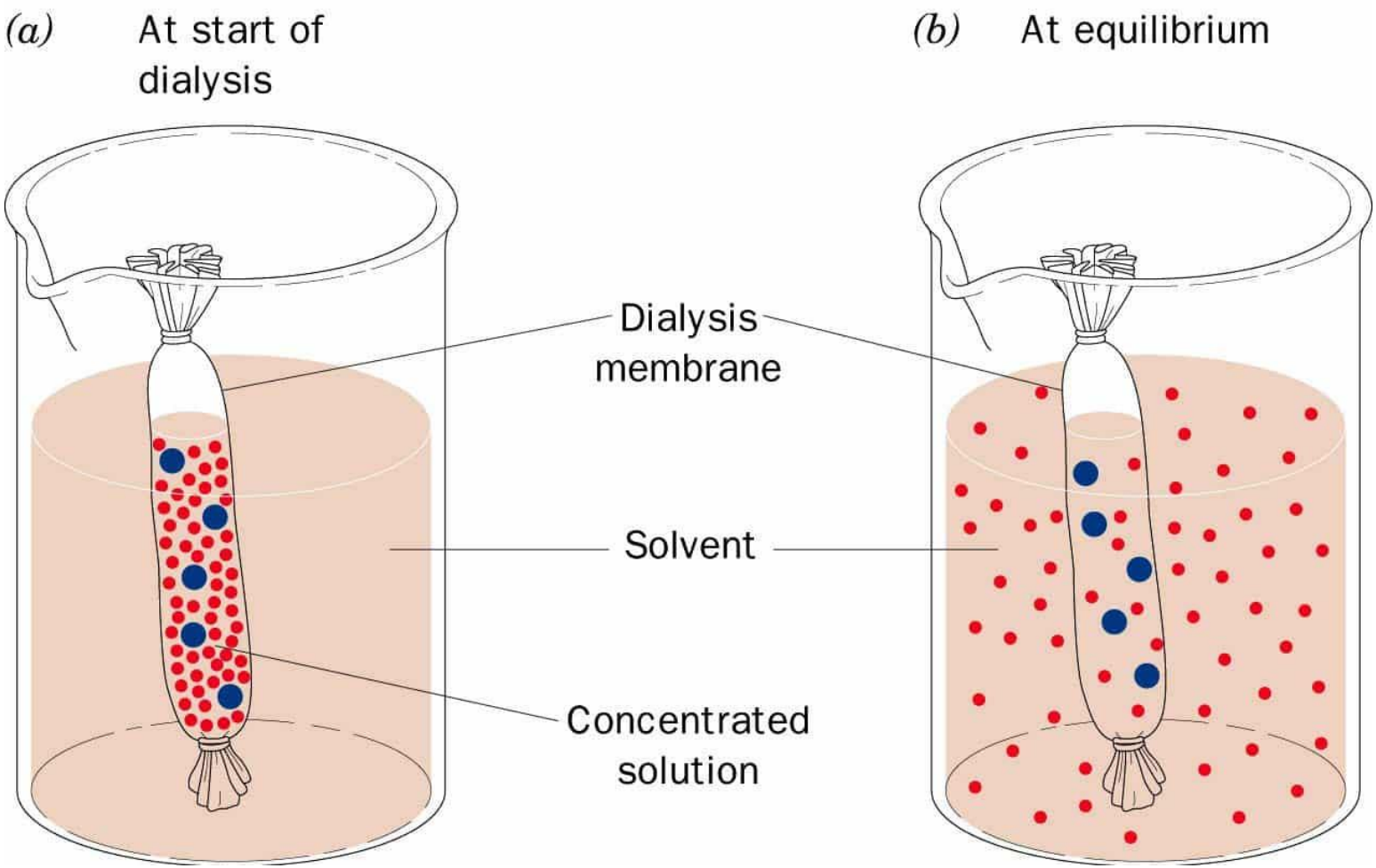


d) pH-dependence of the solubility of the β-lactoglobulin protein


Solubility
Hydrate shell
Salting in
Salting out
Salt concentration

Principle cont':

- Selective and passive diffusion through a semi-permeable membrane.
- Sample molecules (proteins) that are larger than the membrane-pores are retained on the sample side of the membrane.
- Salt molecules move from the more concentrated solution (from inside the dialysis bag) to the less concentrated solution (e.g. buffer).
- The movement of the salt molecules will stop, when the solution reaches the equilibrium.
- At this point, the buffer is changed to drive the diffusion and salts movements

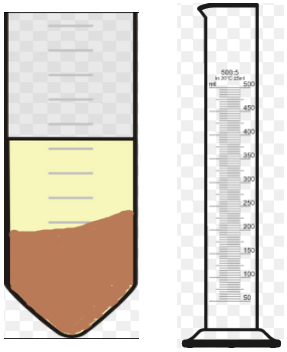

(a) At start of dialysis
(b) At equilibrium
Dialysis membrane
Solvent
Concentrated solution

Using salt fractionation table:

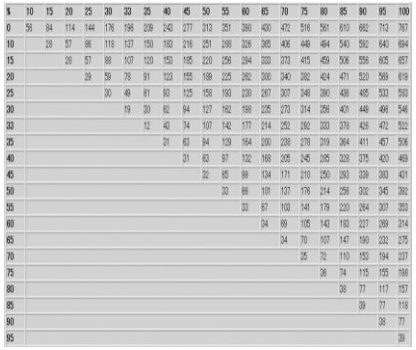
Table 1. Quantities of ammonium sulphate required in (g) to reach given degrees of saturation in one litre of solution.

%	10	15	20	25	30	33	35	40	45	50	55	60	65	70	75	80	85	90	95	100
0	56	84	114	144	176	196	209	243	277	313	351	390	430	472	516	561	610	662	713	767
10		28	57	86	118	137	150	183	216	251	288	326	365	406	449	494	540	592	640	694
15			28	57	88	107	120	153	185	220	256	294	333	373	415	459	506	556	605	657
20				29	59	78	91	123	155	189	225	262	300	340	382	424	471	520	569	619
25					30	49	61	93	125	158	193	230	267	307	348	390	436	485	533	583
30						19	30	62	94	127	162	198	235	273	314	356	401	449	496	546
33							12	43	74	107	142	177	214	252	292	333	378	426	472	522
35								31	63	94	129	164	200	238	278	319	364	411	457	506
40									31	63	97	132	168	205	245	285	328	375	420	469
45										32	65	99	134	171	210	250	293	339	383	431
50											33	66	101	137	176	214	256	302	345	392
55												33	67	103	141	179	220	264	307	353
60													34	69	105	143	183	227	269	314
65														34	70	107	147	190	232	275
70															35	72	110	153	194	237
75																36	74	115	155	198
80																	38	77	117	157
85																		39	77	118
90																			38	77
95																				39

Method:



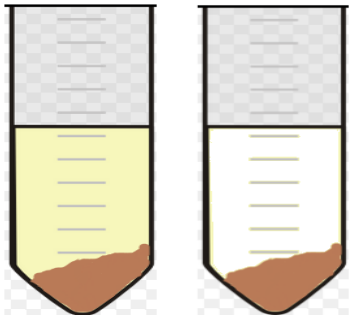
(1)
Measure the volume of the "supernatant“ (Crude extract)



(2)
Calculate the required amount of ammonium sulphate salt needed to saturate the solution 40%.

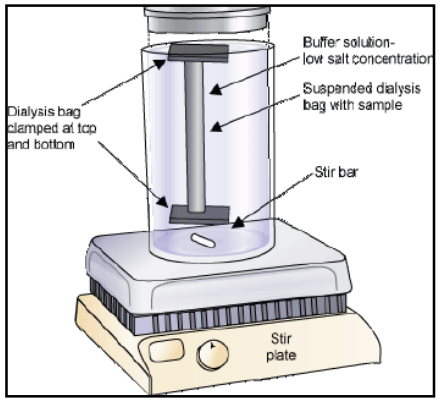
(3)
Add the required salt to the solution slowly and gradually with continuous mixing

Method cont':



(4)
Centrifuge
Discard supernatant

(5)
Dissolve the pellet



(6)
Dialysis

Home Work:

Calculate and write the procedure, how would you precipitate by 50% ammonium sulphate saturation followed by 70% saturation, if your crude extract volume was 25 ml.