Refining of Proteins/Peptides

Whey, byproduct in the production of cheese or casein from milk, contains nutritious and water-soluble proteins in large quantity, and thus is treated by Ultra Filtration membranes or IERs to produce whey protein concentrate (or WPC) and whey protein isolate (or WPI) for foodstuff uses. Those containing proteins in over 90% conc. are used in powdered milk for babies as highly refined proteins.

[Table VIII-8-1] Composition and property of Whey proteins[102]

	Content (%)(*1	Conc. (g/L)	Isoelectric point	M.W.
ß-lactoglobulin	50	3.0	5.35	18,362 (monomer)
α-lactoglobulin	12	0.7	4.2 ~4.5	14,146
Immunoglobulin IgG_1 IgG_2 IgA IgM	10	0.6	 5.5 ~6.8 7.5 ~8.3	 161 ~163,000 150 ~154,000 385 ~417,000 1,000,000
Serum albumin	5	0.3	5.13	69,000
Proteose-peptone	0.23	1.4		

*1 Ratio to the total whey proteins

WPI is manufactured by adsorption of protein with IERs, elution from IERs and final concentration. As for IERs, those with large pores sizes polymethacrylates IERs, e.g. DIAION™ WK10S, are applied for this purpose in order to adsorb large molecular proteins.

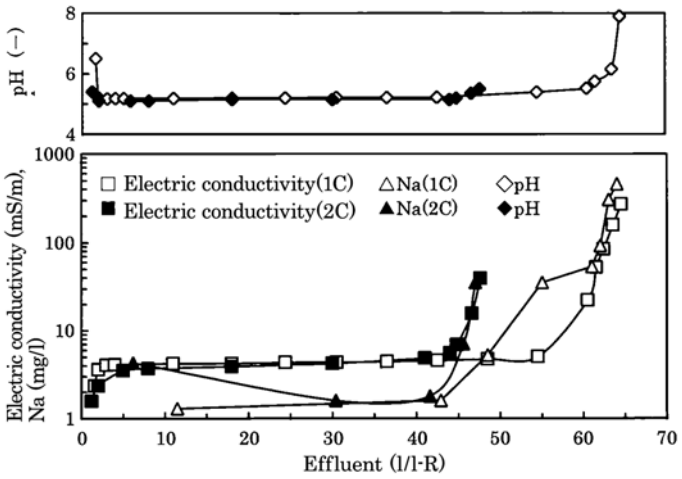
In demineralization of whey with IERs, the IERs should be gel-type because some portion of amphoteric proteins is adsorbed by IERs. The IERs with macro-pores are not recommended since they adsorb proteins within their structures.

As raw milk, used are whole milk, whey (acidic casein whey, rennet casein whey, coprecipitation whey and cheese whey), permeates from UF of whole milk, whey and butter milk, mother liquor of lactose, skim milk and butter milk. Ashes in raw milk may cause some trouble depending on their use. For baby powdered milk particularly, demineralization is necessary. Demineralization is usually done by electrodialysis. H-form CERs, e.g. SK1B and PK208, and OH-form AERs, e.g. PA418 and WA21, are used for further refining; more than 95% demineralization. Small IER towers would be satisfactory, because 90% of salts are already eliminated by electrodialysis. [103]

In treating protein with IERs, high pH in the treated liquor with AERs should be avoided not to degenerate proteins, whereas there are little problems caused by instant high pH in the treatments with SACERs. Low pH of the final treated liquor should be also avoided if they are thermally treated, e.g. concentration or spray drying.

Furthermore, since sulfate ions in foodstuffs are inhibited, the regenerants for CERs are limited to HCl solutions. Because isoelectric points of most proteins are in weakly acidic range, contamination by proteins into CERs causes little problems due to their little adsorbance of proteins by CERs. However, proteins are adsorbed irreversibly on the AERs surfaces.

Regeneration conditions, regeneration level, differ from the basicity of AERs. Na-leakage from CERs causes the increase of treated liquor pH in the treatment with SBAERs.



[Fig.VIII-8-1] Refining of gelatin

Resin:
PK216 (100mL)→ WA21 (150mL)
Flow rate: 10mL/min

Raw liquor:

Electric conductivity	0.19～0.28	mS/m
	190	mg/L
Ca	22.3	mg
Mg	276	/L
Na	53.9	mg/L
Cl	1060	mg
SO_4		/L
		mg/L

Gelatin is also a kind of proteins and its main components are thermally decomposed proteins with unfastened triple-helical structure made by thermal treatment of collagen that is extracted from animal skins, bones and tendons. Gelatin liquor is used in foodstuffs, pharmaceuticals and other industries, after concentration and refining. Fig.VIII-8-1 illustrates such deminrralization and refining of gelatin liquor.

References:

(102) Meiji Dairies Corp. and Nippon Rensui Co., Ltd., Separation and fractionation of milk whey nitrogen compounds, Report of High-Separation Research Union of Food Industries, 183

(103) Snow Brand Milk Products Co., Ltd., Manufacturing method of desalted dairy products, JPA2001275562