

Electrolytic Desalting of Amino Acid Solutions with Electronegative and Electropositive Membranes, and the Conversion of Arginine into Ornithine

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Arginine was found by Stein and Moore¹ to undergo conversion into ornithine during desalting in the apparatus of Consden, Gordon and Martin². We have confirmed this observation with an improved apparatus³.

Experiments performed to disclose the reason for this conversion pointed to the formation of ornithine at the mercury electrode used as a cathode. In the said apparatus³ dilute H_2SO_4 streams over the surface of the dialysing membrane at the anode and removes the ions passing through the membrane, while the mercury cathode comes into direct contact with the solution undergoing desalting. It was therefore tried to replace this mercury electrode with an electrode similar to the anode, but with dilute NaOH streaming over the surface. In this manner any interference of the mercury electrode with the amino acid solution during the electrolysis could be avoided. The complete apparatus therefore consisted of two electrodes of the construction mentioned above placed in a small beaker containing the amino acid solution, and separated by a glass plate placed loosely between the electrodes in order to produce an even distribution of the electric current through the solution. Through one of the electrodes (the anode) 0.1 N H_2SO_4 was passed and through the second (the cathode) 0.1 N NaOH .

Solutions of amino acids containing about 0.5 mg N per ml were prepared in physiol. NaCl . Nitrogen was determined by micro-Kjeldahl before and after de-

salting. During the electrolysis a great loss of water from the solution occurred. This was compensated by adding suitable amounts of H_2O when needed. Complete desalting (of 10 ml solution) was accomplished in about 35 mins. during which time the current decreased from 0.7 amps. to 0.1 amps. The solutions were then removed, filled up to an appropriate volume and the amount of N estimated in an aliquot.

Pieces of cellophane (from Visking Nojax casings, size 36/32) were used as membrane for the anode. In experiments where this material was used also at the cathode a great loss of amino acids resulted. This was true especially in the case of neutral and basic amino acids, which disappeared almost completely, while the acidic amino acids were retained to some extent.

In the conventional construction of the desalting apparatus, where an electronegative membrane is used solely at the anode, no losses of amino acids are encountered, excepting probably a slight loss in the case of the strong acid taurine³. We have therefore prepared an electropositive membrane for use at the cathode by impregnating cellophane with a phenylenediamine resin as described by Gilbert and Swallow⁴.

Experiments with these membranes showed a considerable improvement in recovery of the amino acids, and in the case of acidic amino acids complete recovery was approached. Typical results are presented in Table 1. The percentage of recovery of the amino acids varied with the quality of the membrane prepared and could be increased to 50 per cent or more in the case of arginine as representing a basic amino acid. In experiments where the content of arginine was estimated after Albanese and Frankston⁵ and ornithine after Chinard^{6,1,3} it was found that no conversion of arginine into ornithine had occurred. This result greatly supports the idea that the conversion observed in the con-

Table 1. Desalting of amino acids with either an electronegative (−) or an electropositive (+) membrane at the cathode. Results presented as mg N per 2 ml of solution before and after desalting.

	Before desalting:	After desalting: (−) (+)	
Glycine	1.06 mg N	0.03 mg N	0.26 mg N
Glutamic acid	1.01 mg N	0.75 mg N	0.97 mg N
Arginine	0.98 mg N	0.05 mg N	0.20 mg N

ventional apparatus is caused by a process taking place at the surface of the mercury cathode.

The results here obtained lead to the conclusion that complete recovery of arginine and any other amino acid might

probably be obtained in an apparatus of the proposed construction provided a suitable electropositive membrane could be developed. It might be possible by using such a membrane at the cathode to obtain just as satisfactory results as those produced at the anode by the electronegative cellophane.

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