CXLI. THE PREPARATION OF TAURINE IN CONSIDERABLE QUANTITY.

BY WILLIAM OGILVY KERMACK AND ROBERT HENRY SLATER.

From the Research Laboratory of the Royal College of Physicians, Edinburgh.

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IN order to carry out certain experiments to investigate the action of taurine in its physiological aspects it became necessary to prepare this compound on a considerable scale. Various possibilities of synthesising it were explored but it appeared that in all probability the cheapest and most expeditious method of obtaining the necessary quantity would be to prepare it from some animal product¹, and ox-bile was, under the circumstances, chosen as being most suitable.

Preliminary experiments with fresh ox-bile obtained from the slaughter house, in which the bile was boiled up for eight hours with one-third of its weight of concentrated hydrochloric acid and the product separated from glycine by treatment with alcohol according to the method of Hammarsten [1901] gave yields of 5 g. of taurine per litre of bile. Difficulties were, however, encountered when it was attempted to apply this method on a large scale. For instance it was difficult to obtain three hundred litres of bile from an ordinary slaughter house even over a considerable time, and it was therefore very useful to find that the commercial preparation of sodium tauroglycocholate which can be purchased in large quantities may be used instead of the fresh ox-bile, over which it has many advantages as a source of taurine². It seems, therefore, desirable to put on record the results which have been obtained by the use of this material. Preliminary experiments showed that on a small scale yields of 3-4 g. taurine were obtained from 100 g. sodium tauroglycocholate. On the large scale it was found that 5 kg. of the sodium salt yielded 173 g. taurine. The details of the large scale process follow.

EXPERIMENTAL.

Sodium tauroglycocholate (5 kg.) is dissolved in water (20 l.) and concentrated hydrochloric acid (10 l. $d = 1.18$) is added. The mixture is efficiently stirred and boiled under reflux for ten hours. On cooling, the aqueous solution is decanted from the solid hard mass of dyslysin and the latter washed well

¹ Since the work described in this paper was carried out a synthetic method has been described by Marvel, Bailey and Sparberg [1927] which appears capable of giving good yields of taurine from comparatively cheap materials.

² It may be noted that in a paper by Rose and Huddleston [1926] in which the effect of taurine on the growth of animals deprived of cystine was investigated references are made to the use of desiccated bile as a source of taurine.

with water. The aqueous solution and washings are evaporated *in vacuo* to about 2 l., and whilst still hot filtered from the sodium chloride (A) which has separated. The filtrate is further concentrated to 300 cc. on the water-bath and again filtered whilst hot (B). The filtrate is diluted with 0.5*N* HCl to 500 cc., poured into absolute alcohol (5 l.), and after standing overnight, the taurine which separates along with some sodium chloride is filtered off, whilst the glycine remains in solution. Recrystallisation of this material from an equal weight of boiling water yields almost pure taurine containing a barely detectable amount of sodium chloride. The compound is washed with absolute alcohol and the alcoholic washings mixed with the filtrate: this precipitates taurine and sodium chloride contained in the mother-liquors. The sodium chloride obtained at the stages A and B (mentioned above) is extracted with a small quantity (about 200 cc.) of boiling water and the solution is filtered hot, the process being repeated if necessary. These filtrates containing taurine, sodium chloride and possibly some glycine are diluted to twice their volume with 0.5*N* hydrochloric acid and the solution is added to ten volumes of absolute alcohol so as to effect separation from the glycine. The precipitated taurine obtained is crystallised from hot water. The mother-liquors from all these crystallisations are evaporated down to a small volume, filtered hot from the sodium chloride which has separated and allowed to cool. The taurine is filtered off and if necessary again crystallised. The combined sodium chloride residues are extracted with boiling alcohol containing potassium hydroxide (2 %) and the hot alkaline extract is neutralised with acetic acid [cf. Abderhalden, 1909]. The comparatively small amount of taurine which separates on cooling is filtered off and purified by recrystallisation from an equal weight of hot water. The total yield of taurine from 5 kg. sodium tauroglycocholate amounts to 173 g.

The alcohol used in the above purification is distilled off and the resulting aqueous solution is evaporated to dryness on the water-bath. The residue is extracted with boiling absolute alcohol, filtered hot, and the filtrate saturated with dry hydrogen chloride. On standing in the ice-chest overnight crystals of glycine ester hydrochloride separate. These are filtered off, washed with a little alcohol, and dried. The yield is 104 g.

The hard mass of dyslysin, which remains after hydrolysing the sodium tauroglycocholate with hydrochloric acid, is not easily attacked by aqueous sodium hydroxide solution but it is soluble in boiling alcoholic potassium hydroxide solution. When the alcohol is removed by distillation in steam an aqueous solution remains from which the bile acids may be precipitated by means of mineral acid. It may be here noted that attempts were made to obtain taurine by alkaline hydrolysis of sodium tauroglycocholate as described by Abderhalden [1909], but on a large scale the considerable quantities of alkali and acid, which must be used, result in the formation of a very large amount of salt and the difficulty of isolating taurine in good yield and in pure condition becomes very great.

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