determine the average molar proportions of the carbohydrates attached to all the glycopeptides. The existence of a D-mannose-containing glycopeptide is in agreement with previous observations that small amounts of D-mannose were attached to the glycopeptides released by rennin action on whole milk (Sinkinson & Wheelock, 1970a).

We are grateful to the Agricultural Research Council for a grant to purchase the gas-liquid chromatograph. G.S. holds a University of Bradford Research Studentship.

- Alais, C. & Jollès, P. (1961). *Biochim. biophys. Acta*, **51**, 315.
 Jollès, P., Alais, C., Adam, A., Delfour, A. & Jollès, J. (1964). *Chimia*, **18**, 357.
 Kuwata, T., Niki, R. & Arima, S. (1969). *J. agric. chem. Soc. Japan*, **43**, 183.
 Mackinlay, A. G. & Wake, R. G. (1967). *Biochim. biophys. Acta*, **140**, 123.
 Sinkinson, G. & Wheelock, J. V. (1970a). *Biochim. biophys. Acta*, (in the Press).
 Sinkinson, G. & Wheelock, J. V. (1970b). *J. Dairy Res.* **37**, 113.
 Wheelock, J. V. & Sinkinson, G. (1969). *Biochim. biophys. Acta*, **194**, 597.

Carbohydrates of Bovine α -Lactalbumin Preparations

By E. J. HINDLE and J. V. WHEELOCK. (*School of Biological Sciences, University of Bradford, Yorks. BD7 1DP, U.K.*)

Recently there has been renewed interest in the protein α -lactalbumin, because of the discovery of its role as a component of lactose synthetase (Brodbeck, Denton, Tanahashi & Ebner, 1967).

Crystalline α -lactalbumin prepared by conventional methods has been found to consist of the major protein, present in the greater proportion, and a smaller amount of a second component. This secondary protein has the same amino acid composition as the major protein and has been reported to contain 1% of hexosamine (Gordon, Aschaffenburg, Sen & Ghosh, 1968). Apart from this there have been no reports of carbohydrates being present in α -lactalbumin (Ebner & Brodbeck, 1968).

α -Lactalbumin was prepared by ammonium sulphate fractionation of the 3%-(w/v)-trichloroacetic acid precipitate of whole milk (Aschaffenburg, 1968) and by ammonium sulphate fractionation of whole milk followed by separation on Sephadex G-100. Crystalline preparations were also purchased from Koch-Light Laboratories Ltd. (Colnbrook, Bucks., U.K.) and from Nutritional Biochemicals Corp. (Cleveland, Ohio, U.S.A.).

Polyacrylamide-gel disc electrophoresis of these preparations showed only the main protein band

and a faster-moving band due to the minor component.

G.l.c. of the trimethylsilyl derivatives of the methyl glycosides released on methanolysis (Clamp, Dawson & Hough, 1967; Sinkinson & Wheelock, 1970) showed that all these preparations contained D-mannose, D-galactose, 2-acetamido-2-deoxy-D-galactose and 2-acetamido-2-deoxy-D-glucose. The total concentration of carbohydrates varied from 0.25 to 1.5%. Assuming that the carbohydrates are attached to the α -lactalbumin, then there is considerably less than 1 mol of each carbohydrate/mol of protein. If all the carbohydrates are associated together in one moiety then this moiety must be present in only a proportion of α -lactalbumin molecules. As hexosamine has already been detected in the minor component it is possible that all the carbohydrates are attached to it. This would provide an explanation for the difference in properties between the major protein and the minor component.

The presence of carbohydrates in α -lactalbumin may have an effect on its role in lactose synthesis.

We thank the Agricultural Research Council for a grant to purchase the gas-liquid chromatograph and Dr K. Brew of the University of Leeds for a gift of α -lactalbumin. E.J.H. holds a University of Bradford Research Studentship.

- Aschaffenburg, R. (1968). *J. Dairy Sci.* **51**, 8.
 Brodbeck, U., Denton, W. L., Tanahashi, N. & Ebner, K. E. (1967). *J. biol. Chem.* **242**, 1391.
 Clamp, J. R., Dawson, G. & Hough, L. (1967). *Biochim. biophys. Acta*, **148**, 342.
 Ebner, K. E. & Brodbeck, U. (1968). *J. Dairy Sci.* **51**, 317.
 Gordon, W. G., Aschaffenburg, R., Sen, A. & Ghosh, S. K. (1968). *J. Dairy Sci.* **51**, 947.
 Sinkinson, G. & Wheelock, J. V. (1970). *J. Dairy Res.* **37**, 113.

The Aggregation Properties of C-Phycocyanin

By D. S. BERNs, R. MACCOLL and JUNG JA LEE (introduced by C. Ó HÉICHA). (*Division of Laboratories and Research, New York State Department of Health, and the Department of Biochemistry, Albany Medical College, Albany, N.Y. 12201, U.S.A.*)

Phycocyanin from several algal sources has been examined over a wide range of concentrations (0.005–4.0 mg/ml). Osmotic-pressure, sedimentation-velocity, gel-filtration, disc-electrophoresis and immunodiffusion measurements all indicate that phycocyanin is a highly aggregated protein (Scott & Berns, 1965; Berns, 1967, 1970; Kao & Berns, 1968). Large aggregates exist at both extremely low and high concentrations (Lee & Berns, 1968a,b). Measurements with an analytical ultracentrifuge, equipped with a monochromator and photoelectric