betaine transport to give a concentration ratio of 1.09 ± 0.06 . These results suggest that betaine accumulation by kidney slices is linked to oxidative metabolism. Glycine and L-lysine were non-competitive inhibitors of betaine uptake, with glycine being the more potent inhibitor. Betaine uptake was also inhibited, in increasing order of inhibition, by: L-valine, L-hydroxyproline, L-proline.

It may be concluded that small intestine and kidney both exhibit the betaine-imino acid transport pathway *in vitro*.

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Hagihira, H., Wilson, T. H. & Lin, E. C. C. (1962). *Am. J. Physiol.* **203**, 637.

Robinson, J. R. (1949). *Biochem. J.* **45**, 68.

Rosenberg, L. E., Downing, S. J. & Segal, S. (1962). *Am. J. Physiol.* **202**, 800.

Transport Pathway for Glycine Betaine in Rabbit Kidney *in vivo*

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A transport pathway for betaine and the imino acids can be demonstrated in rat kidney-cortex slices *in vitro* (Evered & Nunn, 1970). This pathway could not readily be demonstrated *in vivo* in the rat as the urine flow is low in this species. However, the rabbit has a very similar endogenous renal plasma clearance rate for glycine (Evered, 1967) and was chosen for studies *in vivo*.

Under chloralose anaesthesia a male rabbit was infused intravenously at 2 ml/min with 5% (w/v) mannitol, to induce diuresis, and 0.5% (w/v) creatinine in 0.9% NaCl solution. Subsequently 0.25 M-betaine hydrochloride (neutralized) was infused in addition. Appropriate urine and blood plasma samples were collected for each test period. Creatinine was determined colorimetrically. Ninhydrin-reacting compounds were determined with an automatic analyser (Technicon Instruments Co. Ltd., Chertsey, Surrey, U.K.) with L-norvaline as an internal standard.

Infused betaine did not alter the glomerular filtration rate determined from plasma clearances rates of creatinine. The infusion did increase the plasma clearance rates for all amino acids deter-

mined except arginine. Most increases were modest and below 3.5 times the control value. The clearance for glutamate was raised 4.7-fold and for glycine 8-fold, but the value for proline was 190 times the control value. An effect on hydroxyproline was also expected, but, owing to a mixed peak in chromatography, no analytical result was available.

Our interpretation is that betaine infusion specifically inhibited the renal reabsorption of proline. The slight glycinuria was a secondary effect of the prolinuria induced by betaine infusion. This hypothesis is consistent with the effect seen in familial hyperprolinaemia (Seriver, Efron & Schafer 1964).

Betainuria has been observed in children (Schirmer, Tieckelmann & Guthrie, 1965). Betain-aemia leading to prolinuria could be confused with a renal hyperiminoaciduria instead of a metabolic lesion. This could occur if only ninhydrin-reacting compounds were assayed, as is common in screening for human inborn errors of metabolism.

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Evered, D. F. (1967). *Comp. Biochem. Physiol.* **23**, 631.

Evered, D. F. & Nunn, P. B. (1970). *Biochem. J.* **118**, 40 P.

Schirmer, J. P., Tieckelmann, H. & Guthrie, R. (1965). *Experientia*, **21**, 448.

Seriver, C. R., Efron, M. L. & Schafer, I. A. (1964). *J. clin. Invest.* **43**, 374.

The Effect of Circulating Lactose on Brain Metabolism in the Neonatal Rat

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Dietary lactose is normally hydrolysed to monosaccharides in the brush border of the small intestine, but the absorption of unhydrolysed lactose can occur in a variety of conditions in man (Arthur, 1966) and produces lactosuria. A number of findings have suggested that circulating lactose may have a deleterious effect in infants and young animals. The oral administration of lactose to young rats may cause retardation of growth with or without diarrhoea and also may lead to the development of cataracts (Koehler & Allen, 1934; Mitchell & Dodge, 1935). Infants with severe lactosuria may show aminoaciduria, proteinuria (Darling, Mortensen & Søndergaard, 1960) and a strong waxy pallor and are frequently irritable (Arthur, Clayton, Cottom, Seakins & Platt, 1966).

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