for by either a modification of potassium permeability by the sugar, or a less specific effect of the high potassium concentration on cellular function.

Experiments which involved the modification of the serosal fluid were carried out using the everted segment preparation. When the sodium concentration was lowered to 20 m.equiv./l. by replacement of the sodium chloride with mannitol the potential difference increased by 12·1 ± 0·8 and 12·2 ± 1·2 mV in the absence and presence of galactose, respectively. These potential changes are of opposite polarity but smaller in magnitude than those produced by similar changes in composition of the mucosal fluid (Fig. 1). This contrasts with the findings of Baillien and Schoffeniels[4] that the changes in potential difference across the isolated intestinal mucosa of the tortoise were similar in magnitude when the composition of either the mucosal or serosal fluids was varied. The difference may be explained by the presence of the muscle layers in these everted sac preparations.

These diffusion potentials across the intestine can be described by the Hodgkin–Katz[5] modification of the Goldman equation[6], that is, at 37° C

$$E = 61{\cdot}5 \log \left[\frac{P_{Na}\,\gamma_{Na}\,[Na]_m + P_K\,\gamma_K\,[K]_m + P_{Cl}\,\gamma_{Cl}\,[Cl]_s \cdots}{P_{Na}\,\gamma_{Na}\,[Na]_s + P_K\,\gamma_K\,[K]_s + P_{Cl}\,\gamma_{Cl}\,[Cl]_m \cdots}\right]$$

In this equation the value of the potential difference, E, is related to the ionic composition of the mucosal, m, and the serosal, s, fluids; the ionic activity coefficients γ, and the relative ionic permeability coefficients, P. Using the equation and the diffusion potentials, obtained when the composition of the mucosal fluid was varied, the relative permeability coefficients may be calculated. If it is assumed that $P_{Na} = 1{\cdot}0$, the relative permeability coefficients in the absence of sugar are $P_{Na} : P_K : P_{Cl} = 1{\cdot}0 : 1{\cdot}2 : 0{\cdot}1$; and in the presence of galactose there was the apparent decrease in the relative permeability of potassium so that $P_{Na} : P_K : P_{Cl} = 1{\cdot}0 : 0{\cdot}6 : 0{\cdot}1$.

In conclusion, it can be stated that diffusion potentials can be produced across the mammalian small intestine and that the tissue is more permeable to cations than anions. Galactose did not alter the relative permeability of the intestine to sodium or chlorine, but there was an apparent decrease in the permeability to potassium. The potential difference dependent on galactose could be related to such a change in the potassium ion permeability coefficient, but other less specific effects cannot be discounted.

This work was supported by grants to Prof. D. H. Smyth from the Medical Research Council and John Wyeth and Brother, Ltd.

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[1] Barry, R. J. C., Dikstein, S., Matthews, J., Smyth, D. H., and Wright, E. M., *J. Physiol.*, **171**, 316 (1964).
[2] Baillien, M., and Schoffeniels, E., *Arch. Internat. Physiol. Biochim.*, **70**, 140 (1962).
[3] Robinson, J. R., *Biochem. J.*, **45**, 68 (1949).
[4] Baillien, M., and Schoffeniels, E., *Biochim. Biophys. Acta*, **53**, 537 (1961).
[5] Hodgkin, A. L., and Katz, B., *J. Physiol.*, **108**, 37 (1949).
[6] Goldman, D. E., *J. Gen. Physiol.*, **27**, 37 (1943).

RADIOBIOLOGY

Influence of Neutron and Gamma Whole-body Irradiation of Lactating Cows on the Chloride Content of the Milk

THE lactation and radionuclide metabolism of dairy cattle after lethal doses of gamma and neutron radiation have recently been investigated by Cragle *et al.*[1]. One of the effects of radiation is a general body infection, and the composition of milk might be expected to be similar to that produced by cows with mastitis, that is, to show an increase in chloride concentration. This has been shown to influence palatability of the milk. Chloride determinations were made by titration against silver nitrate of milk samples produced by the cows used in the work of Cragle *et al.* Some of the samples contained added or induced radioactivity, and no organoleptic analyses were made in these cases.

Whole body gamma irradiation of 650 r. was given to four cows with a cobalt-60 source at the rate of 29·8 rads/h surface dose. Three cows were exposed to fast neutrons for 26 min for a total neutron dose of 649, 671 or 446 rads.

The chloride concentration of the milk from cows receiving gamma irradiation was relatively constant until the twelfth or thirteenth day after irradiation. At this time a marked increase was noted. This coincided with a rise in the body temperature of the cows. Milk flow continued until 1 or 2 days before death, which occurred 15, 16 or 19 days after irradiation.

The cows receiving 446 rads of neutron radiation produced milk with only minor day to day variations in chloride content and survived the radiation treatment. The milk from the other two cows showed a steady increase in chloride concentration during the period after irradiation until the milk flow ceased at 9 and 13 days after irradiation for cows receiving 671 and 649 rads of neutrons, respectively. The elevations of body temperature on these two latter cows were noted 3 days and 1 day after milk flow ceased.

Neutron irradiation of lactating dairy cows had an immediate effect on milk composition, but the effect of gamma irradiation was delayed until just before the death of the animal. However, the dose rate for the two radiation exposures was different, which may be a contributing factor. The data thus indicate that if cows are exposed to lethal doses of gamma radiation in the order of 650 rads, as can occur if the animals are exposed to severe fall-out conditions, the milk will probably be palatable and nearly normal in composition until the animal approaches death. If the animals were in the vicinity of a nuclear detonation and received neutron radiation, however, the abnormal composition and decreased quantity of the milk would be noticeable within 1 or 2 days although the animal might live for several weeks.

We thank Dr. R. G. Cragle for supplying the samples used in these investigations.

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[1] Cragle, R. G., Miller, J. K., Swanson, E. W., and Brown, D. G., *J. Dairy Sci.*, **48**, 942 (1965).

PHARMACOLOGY

Pharmacologically Active Peptides produced in the Tissues of the Host during Chronic Trypanosome Infections

IN recent years evidence has been accumulating which suggests that pharmacologically active peptides are of importance in the pathology of some acute parasitic infections[1–4]. The present work has been to extend these studies to chronic infections, and in all experiments so far trypanosomes have been used as test organisms.

Rabbits were infected with 5×10^5 *Trypanosoma brucei* intravenously and placed in metabolism cages. The urine was collected daily and extracted for kinins[1]. Samples of blood were taken daily from an ear vein and the plasma extracted for kinins[5] and for kininogen[6]. Assays were performed on guinea-pig ileum, rat duodenum[7] and rat uterus.