there was a second rise of tension[4]. The effect on dP/dt was absent when the current was switched on later than about 150 msec after the beginning of the action potential (Figure 2, C). As in the experiments by MORAD and TRAUTWEIN[1], the period which is sensitive to voltage changes was shorter than the time to peak of the initial twitch.

*Discussion.* It has been demonstrated by the present results that the rate of dP/dt and the amplitude of the initial twitch depend on the membrane voltage during the early part of electrical activity.

Since it is usually assumed that the intracellular free Ca determines the contractile force, it seems reasonable to postulate that either the liberation of Ca from intracellular stores, or the transmembrane flux of Ca, is potential-sensitive. On the assumption that Ca conductance of the surface membrane increases upon depolarization[5], thus allowing Ca ions to cross the membrane down their electrochemical gradient, a decrease of inward driving force (larger amplitude of action potential) would result in a lower intracellular concentration.

An alternative way to account for the initial twitch is to make it depend entirely on the release of Ca from intracellular stores, no Ca flux through the surface membrane being involed at this stage. The mechanism by which membrane excitation releases intracellular stores is largely unknown. It seems impossible, therefore, to speculate on a possible way in which the amount of internally released Ca might depend on membrane voltage.

*Zusammenfassung.* Das Aktionspotential von Trabekeln aus der rechten Herzkammer von Kälbern und Schafen wird durch Gleichstrom verändert. Bei kleinerer Amplitude des Aktionspotentials wird die Kontraktion verstärkt, bei grösserer Amplitude abgeschwächt.

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## Electrical Activity Across the Developing Rabbit Ileum in vitro

The major factor governing the magnitude and polarity of the transmural potential difference (PD) measured across the small intestine is the activity of an electrogenic sodium pump, operating in the direction lumen to plasma[1]. Sodium movement also appears to be involved in the active transport of hexoses and amino acids[2,3]. When an actively transported hexose crosses the brush border via the appropriate carrier system, it does so in the company of sodium ions, possibly on a 1:1 basis[4]. This sodium movement and the additional presentation of sodium ions to the electrogenic pump located at the lateral and basal borders of the mucosal epithelial cell probably accounts for the increase in transmural PD observed when glucose is added to the mucosal bathing medium[2]. Both this glucose transfer PD and the endogenous PD appear to increase during development in mammals[5,6]. In birds, on the other hand, both potentials decrease sharply after hatching[7].

*Materials and methods.* Everted sacs of rabbit distal ileum, prepared according to the method of WILSON and WISEMAN[8], were immersed in and partially filled with KREBS-HENSELEIT solution[9] at 37 °C aerated with either 95% $O_2$–5% $CO_2$ or 95% $N_2$–5% $CO_2$. The transmural PD was measured for 20 min using a high input impedence electrometer with matched calomel half cells and agar-KCl bridges. Adjacent segments of ileum were everted and randomly placed in solutions containing 0 m*M*, 2 m*M*, 5 m*M* or 10 m*M* D-glucose. The data were corrected for electrode asymmetry but not for osmotically induced potential differences.

When sucrase activity was to be measured the mucosa was scraped from the duodenum and from the remainder of the small intestine which was divided into 3 equal lengths. The procedure of CARNIE and PORTEOUS[10] was used in assaying for sucrase, with glucose being measured with a peroxidase-glucose oxidase method (Sigma Chemical Co., St. Louis, Mo., USA).

*Results and discussion.* Figure 1 illustrates the 5 min average transmural PD plotted as a function of medium glucose concentration. Both the endogenous PD and the glucose transfer PD increased between the second and fourth week, to reach maximum values at the sixth week. At all glucose concentrations tested the PD was lower in young adult ilea than in 6-week ilea. At all ages studied the transmural PD was significantly enhanced by the addition of glucose to the bathing medium although the magnitude of this transfer PD was significantly lower in the 1-day–2-week groups than in the 4-week-adult groups. In every age group the transmural PD-glucose dose response curve exhibited saturation.

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When $N_2$ was substituted for $O_2$ and the preparation was made hypoxic there was a reduction in the transmural PD measured in the presence of glucose in the adult and 6-week-old ilea. Figure 2 illustrates the 5 min averaged PD under the hypoxic conditions. This effect was further exaggerated when the PD was averaged over 20 min. In all age groups except the adult the endogenous PD was greater in $N_2$ than in $O_2$. This enhancement of endogenous PD by hypoxia was significant at the 5% level in the 1-day group and at the 1% level in the 4-week group. This effect may have resulted from a stimulation in sodium pump activity, an increase in the permeability of the brush border to sodium, or a reduction in the conductance of the tissue. Between the fourth and sixth week a transition took place such that glycolysis could no longer support a normal PD in the presence of glucose.

As has been observed with other mammals the endogenous and glucose transfer PD increases during development. The fact that the glucose transfer PD reached a peak value at 6 weeks and then decreased to the young adult level may reflect either an altered tissue conductance or a peak in active hexose transport. A peak in intestinal sugar absorption has been observed in several young mammals[10]. At about the fourth week there was a marked increase in the glucose transfer PD and beyond this age the ileum no longer showed the resistance to hypoxia that characterizes several neonatal intestinal transport systems[11,12], and the survival of the new-born animal in general[13].

As the sucrase-isomaltase system is closely associated with, and may constitute part of, the glucose carrier system at the brush border[14], it was of interest to compare the development of sucrase activity with the development of the glucose transfer PD. Figure 3 illustrated the regional mucosal homogenate sucrase activity and shows that the major development in enzyme activity occurred in the fourth week. Although the sucrase activity did not peak at 6 weeks it seems probable that the brush border glucose digestion and transportation systems develop simultaneously, perhaps as parts of a single complex.

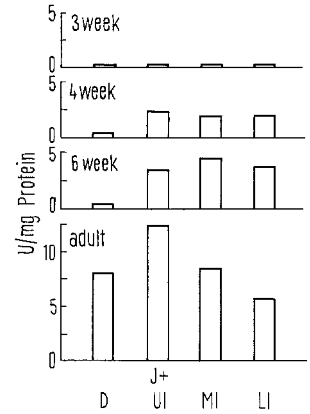


Fig. 3. The sucrase activity of mucosal homogenates from rabbit small intestine. 1 unit of activity (U) is defined as 1 $\mu M$ substrate hydrolyzed per h at 37 °C. 2 animals were used at each age group. D, duodenum; J + UI, jejunum and upper ileum; MI, mid-ileum; LI, lower ileum.

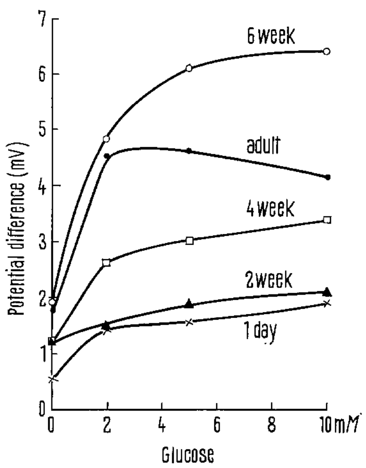


Fig. 1. The 5 min averaged ileal transmural PD measured under aerobic conditions plotted as a function of medium glucose concentration. Each point represents the mean of at least 5 everted sacs.

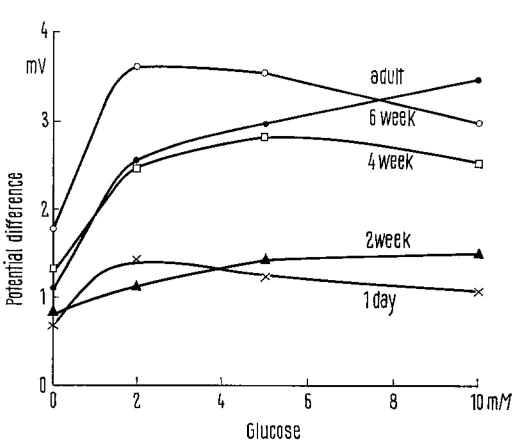


Fig. 2. The averaged 5 min ileal transmural PD measured under hypoxic conditions plotted as a function of medium glucose concentration. Each point represents the mean of at least 5 everted sacs.

*Zusammenfassung.* Im Kaninchenileum wird die Elektropotential- und Enzymentwicklung in vitro mit oder ohne Traubenzucker von der 4. Lebenswoche an gesteigert. Zwischen der 4. und 6. Woche verliert die Potentialdifferenz ihre Resistenz gegen Hypoxia in einem Traubenzuckernährboden.

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