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ELECTRICAL RESISTANCE AND CAPACITANCE IN TOAD SKIN DURING CHANGES IN POTENTIAL DIFFERENCE INDUCED BY THE ADMINISRATION OF NORADRENALIN

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Experiments carried out previously in this laboratory (1, 2, 3) on the toad *(Bufo spinulosus arunco)* showed that noradrenalin (3 ug/ml) induced changes in potential difference in the toad belly skin when applied to the vascular surface of the skin, but it had no effect when placed on the epidermal surface.

Noradrenalin was found to act only on certain areas of the isolated toad skin. Examination of the skin by transparency established the existence of corium glands at all the sites which responded to noradrenalin (Fig. 1).

The primary object of the present experiments was the measurement of the electrical properties of toad skin as part of an investigation of the changes induced by noradrenalin on these active areas of the skin.

The blocks of skin were mounted in lucite chambers and measurements of potential difference and capacitance were carried out. Electrical resistivity was recorded by means of a Grass 5P1 pre-

amplifier using lead PGR. Electrical capacitance was measured by means of a Heathkit impedance bridge whose output was fed into the 5P1 preamplifier. The potential difference was also recorded after amplification through a 5P1 preamplifier.

As may be seen in Fig. 2, the changes in electrical resistance of the skin reflect the changes in potential difference after administration of noradrenalin. Fig. 2 shows that the capacitance across the skin was not modified by noradrenalin. The total resistivity measured in each of the blocks of skin ranged from 600 to 800 ohms over a surface of 1.33 cm^2. The total capacitance over 1.33 cm^2 surface was about 1 uf in the various blocks of skin. The short-circuit current measured by means of the classical technique (4) exhibited variations which were very similar to the changes in potential difference and electrical resistivity.

Since the changes in the electrical properties were confined to the areas of skin which contained large corium glands, it may be postulated that the activity of these glands is responsible for the effects described. The variations in potential difference are undoubtedly due to active transport of sodium. When external sodium was replaced by choline the effect of noradrenalin decreased markedly and in some cases disappeared completely (Fig. 3). When sodium was replaced by lithium, the effect of noradrenalin disappeared entirely in every experiment.

These results would seem to indicate that the decrease in resistance across the skin or the increase in conductance, is due to the movement of sodium from the epidermal side to the vascular surface through the corium glands. This implies that the glands participate actively in the process of sodium transfer and reabsortion.

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RESUMEN

Se estudia la acción de la noradrenalina (3 ugr/ml) sobre la resistencia y capacidad eléctricas en la piel aislada del sapo, Bufo spinulosus arunco. Se comparan los cambios registrados con las variaciones de potencial y corriente de corto-circuito producidas con iguales dosis de noradrenalina. Se encuentra que la acción de la noradrenalina se manifiesta en las zonas de la piel que contienen glándulas mucosas gigantes. Las variaciones de potencial y corriente de cortocircuito parecen ser producidas por el paso activo de sodio. El reemplazo de este catión en el medio que baña la cara externa de la piel por colina o por litio reduce la respuesta o la hace desaparecer. Los cambios de resistencia se deberían a las variaciones en el transporte activo de sodio que altera la conductancia de la piel.

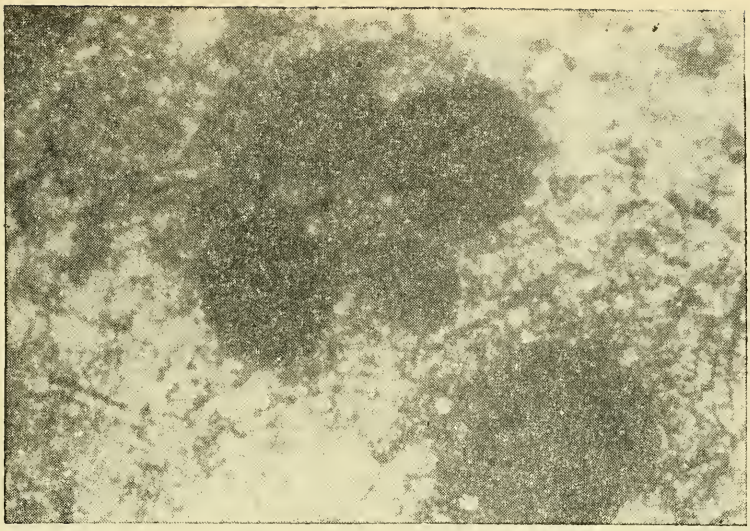

Fig. 1.— Photograph of a block of skin as viewed by transparency. The dark spherical bodies are corium glands and are 150 to 800 u in diameter. The opening of stoma measures 25 to 30 u. This piece of skin responds to stimulation with noradrenalin (3 ug/ml).

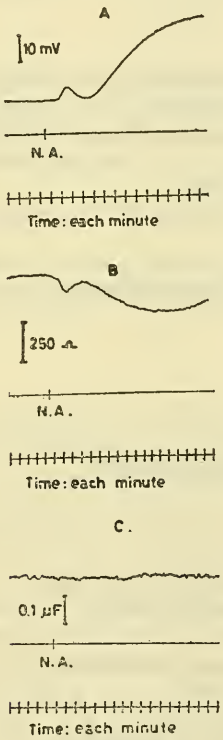

Fig. 2.— Records of potential, resistance and capacitance in isolated toad skin after addition of noradrenalin (3 ug/ml) to the vascular surface of the skin.
A.— Potential difference.
B.— Electrical resistivity.
C.— Capacitance.

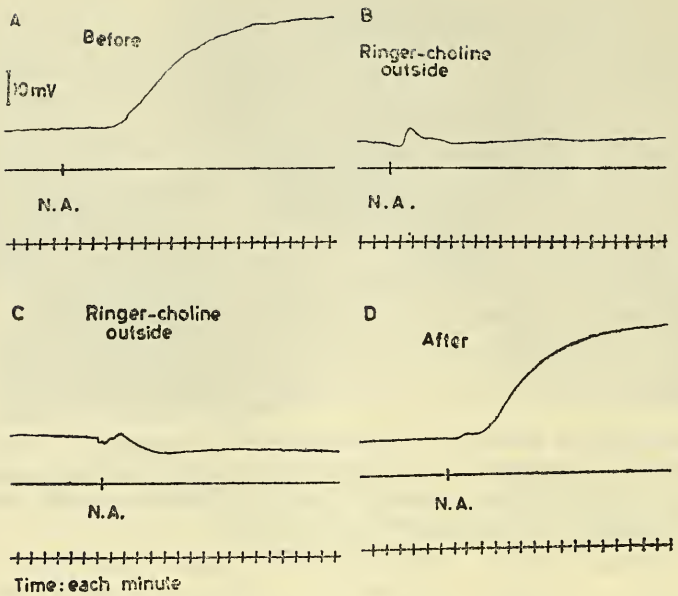

Fig. 3.— Effects on the potential difference of the isolated toad skin induced by noradrenalin 3 ug/ml applied to the vascular surface before and after replacement of the epidermal Ringer solution by choline chloride.
A.— Effect of noradrenalin on the potential difference before replacement with choline chloride.
B and C.— Effect of noradrenalin on the potential difference during replacement.
D.— Effect of noradrenalin on the potential difference after washing and replacement by sodium chloride on the epidermal surface.

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