ELECTRICAL RECORDING OF MOVEMENTS OF THE GIZZARD AND OVIDUCT OF BIRDS

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The presence of small stones and gravel in the muscular gizzard of birds on poultry farms makes it impossible to investigate the function of this organ by means of a balloon and chymograph. With x-rays, the period is limited to the time for which the food is in the gizzard.

Neither method is applicable to a study of oviduct movements, because the introduction into it of contrast substances, or still worse of a balloon, disturbs egg formation.

An electrical recording method in which currents are picked up from implanted electrodes enables an objective study to be made of the electrical events without disturbance of normal function, and an adequate picture is obtained of gastric [2] and intestinal [1] movements during periods of normal hunger or digestion.

In order to apply this method to birds we had to develop a method of implanting electrodes, to improve the recording of electrical potentials, and to determine whether there was an accurate correspondence between the electrical and motor activity of the organs. It is these matters which we have investigated.

Experiments were carried out on chickens of the Russian white strain under production conditions (in the Brattsevskaya Poultry Factory, and on the State Bird Farm "Rzhavski").

Electrodes were implanted at operation into the gizzard or oviducts of all the birds 6-7 days before the experiments were begun.

Before the operation the bird was fixed in the supine position, and after the operative field had been prepared, the body cavity was opened. To place the electrode on the muscular gizzard a longitudinal incision 2-2.5 cm long was made 1-1.5 cm lateral to the point at which the ventral edge of the gizzard could be felt through the abdominal wall. To place the electrode in the oviduct, an incision 3-3.5 cm long was made cranially 1.5-2 cm from the point at which the edge of the left pubis could be felt. The gizzard or oviduct was then pulled into the skin wound (and while this was done the loops of intestine were pushed back). Next, to place the electrode in the gizzard, a longitudinal incision 5 mm long in the serous-muscular layer was made starting 0.5-1 cm from the center of the saggital line of its ventral aspect; it was cut 5-6 mm deep. To place the electrode in the oviduct, an oblique incision was made at 40-45° to the surface through the serous-muscular layer in the ventral surface of the "womb"; it was 3-4 mm long and 1-1.5 mm deep. Next, by means of a No. 1 silk thread a platinum wire of 0.3 mm diameter was sewn in as a loop deep in the wound. This same thread joined the edges of the wound of the muscular wall of the gizzard or of the oviduct. Consequently, the electrode and the multistrand wire (insulated with chlorvinyl) leaving it were firmly fixed in the muscular layer of the organ. To bring out the electrode lead from the body cavity we used a tube of the fistular type prepared from black ebonite. Its internal diameter corresponded to the external diameter of the chlorvinyl insulation (when it was taut) with the result that the lead within the tube was held fixed. The lead was pulled through the tube before the operation. To place the tube near the operation wound, a puncture was made in the skin and underlying tissues. The tube was brought to the outside through this puncture and fixed in position with a collar. The outer end of the lead (length 2.5-3 cm) was left free for connection with the recording device. The wound in the abdominal wall was sewn up in layers.

Electrodes introduced in this way remained firmly in position for a long time, so that potentials could be recorded for 9-12 months.

Potentials from the gizzard and oviduct were recorded by ÉGS-1 and ÉGS-2 electrogastrographs.

To measure the gastric motility, in many experiments x-ray pictures were made at the same time as the electrical recording. To study oviduct movements, as well as electrical recordings, observations were made on the movements of this organ; for this purpose, the abdominal wall was opened during the experiment. Before the beginning of the experiment the birds were fixed to a stand.

The indifferent electrode was fixed to the right foot, which was then immersed in a vessel containing physiological saline. The implanted electrode served as the different electrode.

A study was made of the electrical activity of the muscular wall of the gizzard before and after the animals were fed. The oviduct potentials were recorded in animals bearing eggs in the duct, and in others in which the duct was empty.

EXPERIMENTAL RESULTS

Simultaneous electrical recordings and x-ray examination showed that in both birds and mammals there was a correspondence in both amplitude and frequency of the electrical potentials and the mechanical movements.

Electrogastrograms recorded for $1\frac{1}{2}$-2 h during physiological hunger showed that in birds there was no marked "hunger" period of gastric motility. However, in birds, the gizzard movements were phasic. It can be seen from the portions illustrated in Fig. 1, that in the records from one of the birds the rhythm changed from 0.8 to 3.5 contractions per minute, and that the amplitude was between 1 and 2 mV.

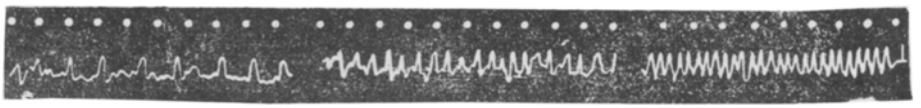

Fig. 1. Electrogastrogram of chicken No. 997. Above – time marker (1 minute).

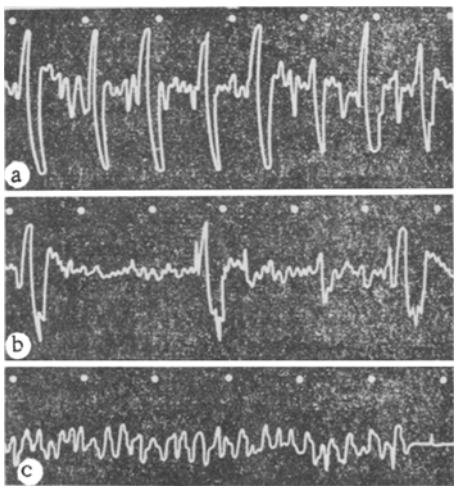

Fig. 2. Electrical recording of oviduct movements of chickens No. 3266 (a, b) and No. 3257 (c). Above – time marker ($2\frac{1}{2}$ minutes).

When food entered the gizzard, and subsequently, there was usually no great change of gastric movements. The variations in the rate remained within the previous limits of 0.8 and 3.5 contractions per minute. Some speeding or slowing of the electrical rhythm after food had been given occurred, and was related to the original rate of movements in the period of physiological hunger.

When finely powdered food was given to the birds for $2\frac{1}{2}$-3 weeks, gastric motility was reduced. In birds fed in this way, by the end of the experimental period the frequency of oscillations of the gizzard wall had fallen below the initial rate. In the control group which received more coarsely divided food, no change in the electrical oscillations was observed at this time.

Electrical recording of oviduct movements showed potentials of considerably greater amplitude (up to 28 mV) than in the gizzard. In all the birds, the voltage was rhythmic.

Electrical recording of oviduct movements combined with direct observations showed that, as in the case of the gizzard, there was a correspondence between the two.

As can be seen from the curves of the oviduct movements shown in Fig. 2a, b, two kinds of voltages were present: 1) oscillations having an amplitude from 0.5 to 4.5 mV and a frequency of 2-4 per min, representing an undulating rapidly extinguished movement; 2) oscillations having an amplitude from 9 to 28 mV, but less frequent (one per 2 min or less), corresponding to powerful tonic movements of the oviduct.

In hens which had ceased to lay eggs, the second movement was not usually present (Fig. 2c).

The results we have given indicate that our method of electrical recording of movements of the oviduct and gizzard of birds with implanted electrodes makes possible the objective study of the associated electrical events.

SUMMARY

The paper describes the technique of recording potentials from the gizzard and oviduct of birds by means of implanted electrodes. In this way we were able to make an objective study of electrical phenomena closely associated with the movements of these organs.

LITERATURE CITED

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