COMPARATIVE GONADOTROPHIC POTENCY OF ANTERIOR PITUITARIES FROM COCKS, LAYING HENS AND NON-LAYING HENS IN MOLT

YUICHI SAEKI, KENTARO HIMENO, YUICHI TANABE AND TOSHIMATSU KATSURAGI

Division of Genetics, Livestock Section, National Institute of Agricultural Sciences, Chiba

A bulk of studies on the assay of gonadotrophic hormone content of the anterior pituitary from the animals in various reproductive conditions has been done. Riley and Fraps (1942b) assayed pituitary glands from chickens in various reproductive stages, judging the gonadotrophic potency by the increment of uterine weights of immature mice, and concluded that glands from non-laying hens produced a greater gonad stimulating effect than did those from laying hens. A similar result was obtained by Phillips (1942) in the gonadotrophic assay of the chicken pituitary using the histological changes of the vaginal epithelium of immature rats as an index of the gonadotrophic potency.

On the other hand, it was reported that, in immature female chickens, the gametogenic components of the ovary were almost refractory to gonadotrophins of mammalian origin, but were capable of being stimulated by the avian gonadotrophin (Nalbandov and Card, 1946; Das and Nalbandov, 1955), and that hypophysectomized male chickens were capable of responding to mammalian gonadotrophins for a very limited time, whereas sustained testicular growth and androgen secretion could be obtained by the injection of chicken pituitary (Nalbandov, Meyer and McShan, 1951). These results showed that there was a qualitative difference in the gonadotrophic complex of mammals and birds.

Therefore, the present investigation was undertaken to compare the gonadotrophic potency of anterior pituitary glands taken from cocks, laying hens and non-laying hens, in annual molting, using the increment of testes weights of one-day-old cockerels as an index of gonadotrophin.

MATERIALS AND METHODS

Anterior pituitaries were obtained from cocks, laying hens and non-laying hens in annual molting, mostly of the Single Comb White Leghorns which have been bred at National Institute of Agricultural Sciences, and partly from those of the crossbreds. They ranged in age from 1 to 2 years. The experimental period was from September, 1955 to January, 1956.

The anterior pituitaries, dissected from the heads a few minutes after the birds were killed, were acetone-dried and pulverized.

Received for publication May 12, 1956.
One-day-old Single Comb White Leghorn cockerels weighing between 30 and 40g were used as assay animals. They were kept in an electric brooder and maintained only on water.

Each assay sample of pituitary powder was suspended to a volume of 0.4ml in distilled water and taken up in a 1 ml tuberculin syringe. Each volume contained one chicken pituitary or two pituitaries. Each assay chick was assigned a specific syringe at the beginning of the injection period to avoid any possibility of interchanging samples. Each injection in a 0.1ml volume was made into the breast muscle every 24hrs. for a 4-day period, and on alternate sides of the breast. The control chicks were injected with 0.4 ml of isotonic saline. The chicks were sacrificed 24 hrs. following the final injection. The testes were dissected out and weighed with a torsion balance.

RESULTS

Average weights of anterior pituitaries, ovaries, oviducts and testes of birds used in this experiment are given in Table 1. The anterior pituitaries from cocks, laying hens and non-laying hens weighed 11.4, 8.5 and 8.3 mg, respectively.

**Table 1. The weights of pituitary, ovary, oviduct and testes of the bird at autopsy**

<table>
<thead>
<tr>
<th>Group</th>
<th>Number of birds</th>
<th>Average pituitary weight mg</th>
<th>Average ovarian weight g</th>
<th>Average oviduct weight g</th>
<th>Average testes weight g</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laying Hen</td>
<td>31</td>
<td>8.5</td>
<td>39.1</td>
<td>46.3</td>
<td>—</td>
</tr>
<tr>
<td>Non-laying Hen</td>
<td>26</td>
<td>8.3</td>
<td>3.2</td>
<td>6.9</td>
<td>—</td>
</tr>
<tr>
<td>Cock</td>
<td>17</td>
<td>11.4</td>
<td>—</td>
<td>—</td>
<td>7.6</td>
</tr>
</tbody>
</table>

Experiment 1. Response of the chick testes to one or \(\frac{1}{2}\) pituitary injection

The testicular weights of chicks injected with pituitaries obtained from cocks, laying hens and non-laying hens at the one pituitary dosage level per chick averaged 13.1, 5.8 and 6.0 mg, respectively, as compared with 5.1 mg for the control. The pituitary glands from the cock group were extremely more potent than those of all other groups.

The testes of chicks injected with \(\frac{1}{2}\) cock pituitary per chick weighed 14.2 mg. No significant difference appeared between injections of one or \(\frac{1}{2}\) cock pituitary per chick, suggesting that an upper limit response to gonadotrophins had been reached with injections of \(\frac{1}{2}\) pituitary.

And also, there was no significant difference in the non-laying hen group when it was compared with the laying hen group and the control group. It was unfortunate that the amount of sample was not sufficient to a significantly positive response.

The above data show that to elicit a significant gonadotrophic response a dosage of at least two hen pituitaries per chick must be administered. From this reason, the experiment injected with two hen pituitaries per chick was undertaken. Experiment 2. Response of the chick testes to two hen pituitaries injections

The testicular weights of chicks injected with pituitaries obtained from laying hens and non-laying hens at the two pituitary dosage level per chick averaged 7.0 and 10.5 mg, respectively, as compared with 4.1 mg for the control (Table 2). There was a significant difference in the non-laying hen group when it was
pared with the laying hen group and the control group; moreover, a highly significant difference between the laying hen group and the control group was observed.

The results of this study showed that pituitaries from cocks were the richest in gonadotrophin and pituitaries from non-laying hens had a greater potency than those obtained from laying hens.

**DISCUSSION**

Riley and Fraps (1942 a, b) reported that on the basis of mg equivalent to 1 M. U. U, pituitaries from sexually mature males (7-15 months old) had a gonadotrophic potency approximately 11 times that of glands from laying hens and 7 times that of pituitaries from hens with quiescent follicles, judging the gonadotrophic potency by the increment of uterine weights of immature mice. Phillips (1942) found that the pituitaries from non-laying hens were more potent than those from laying hens, using the histological changes of vaginal epithelium as an index of the gonadotrophic potency.

In our results using the testicular weight changes of chicks as a criterion of the gonadotrophic potency, the cock pituitary was the richest in gonadotrophin and the pituitary from the non-laying hen was more potent than that of the laying hen. Accordingly, even in avian recipients, our findings come very close to those of Riley and Fraps (1942 a, b), and Phillips (1942).

In assaying gonadotrophin, it is an important problem whether we measure the actual rate of secretion of the hormone, or measure the amount of hormone which happens to be stored in the gland at the time when it is obtained for assay and which has not been released. Since the potency of the anterior pituitary from the non-laying hen is higher than that of the anterior pituitary from the laying hen according to our results, the question is naturally raised whether the same relationship holds true in its release into blood; as to this problem, there is a report in which the gonadotrophic potency of specific amounts of serum from non-laying hens is more potent than that obtained from laying hens (Bailey and Phillips, 1952).

So, it is highly presumable that there exists a close relationship between the
gonadotrophin content in the anterior pituitary and its secretion rate into the blood stream.

With mammals, determinations were made of FSH and LH activity of anterior pituitaries from the female rats which had lost their estrus cycles by feeding the pyridoxine (B6) deficient diet (Wooten et al. 1955), and from the postmenopausal women (Bahn et al. 1953); according to their findings, the pituitary from the animal with a resting ovary showed a significantly higher FSH activity than that from the animal with an active ovary while LH activity was equal, or slightly more potent in the pituitary from the animal with a resting ovary; consequently, the anterior pituitary from the animal with a resting ovary showed the disproportional increase of FSH as compared with LH. Kammlade et al. (1952) reported that sheep pituitaries contained extremely more gonadotrophic hormone during the anestrus season than they did during the estrus cycle; this fact led them to the postulation that the anestrus period might be caused by a rise in FSH and a fall in LH.

However, it was found in aves that the LH potency of the pituitary from the non-laying hen was considerably greater than that of the pituitary from the laying hen, in forcing C1 ovulation (Fraps, 1943; Fraps, Fevold and Neher, 1947), and in producing the increment of mouse uterine weight (Riley and Fraps, 1942b); furthermore, our study suggested that the FSH content of the pituitary from the non-laying hen might not so much exceed that of the pituitary from the laying hen as to cause the extreme disproportion between the ratio of FSH and LH in the non-laying hen and the ratio in the laying hen, although the fractionation and characterization of the type of hormones the glands contained were not performed.

So, the question still remains whether the same phenomenon of the unbalance between FSH and LH of pituitary in mammals with a resting ovary is found in aves with a resting ovary. Recently, Nakajo and Imai (unpublished) assayed gonadotrophin dividing the pituitary into the caudal and the cephalic lobes, and obtained a similar result to ours.

SUMMARY

Assay was made of the gonadotrophic potency of the anterior pituitaries obtained from cocks, laying hens and non-laying hens in annual molting, of the Single Comb White Leghorns and partly those of the crossbreds. The degree of response was measured by the increment of the testicular weight of one-day-old cockerels.

Pituitaries from cocks were the richest in gonadotrophin content and pituitaries from non-laying hens showed a greater potency than those obtained from laying hens.
REFERENCES

Bahn, R. C., N. Lorenz, W. A. Bennett and A. Albert (1953). Endocrinol. 53, 455.