Possible Secretion of the Oviposition-Inducing Factor after Oviposition of the Terminal Egg of a Clutch Sequence in the Domestic Fowl

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Abstract To estimate whether the oviposition-inducing factor (OIF) is released other than at the time of oviposition, spontaneous oviposition of the terminal (Ct) egg of a clutch sequence was prevented by ligation of the vagina for a short period. Of 51 hens, 17 laid their retained Ct eggs on the day of operation, 25 laid about 1 hr before C1 ovulation the next day after the operation, and 9 laid on the third day in association with ovulation. When the oviposition of the midsequence (Cs) egg and the acceptance of the ovum destined to ovulate next were prevented simultaneously, five out of 20 hens laid their eggs immediately or soon after the removal of the vaginal ligature. All of the remaining 15 hens held their Cs eggs for a night and laid the next day in coincidence with ovulation. From the present experimental results, it is suggested that an increased secretion of OIF may occur in the afternoon of Ct oviposition but may not occur after Cs oviposition.

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Key words : oviposition factor, prevention of oviposition, ovulation

In the poultry industry, it is well known that economical loss as a result of soft-shelled (SS) eggs laid prematurely is a significant problem. Recent studies based on the observation of 81 million commercial layers have shown that the stimulate of total eggs cracked or lost prior to reaching their destination ranged from 13 to 20%¹⁾. HUGHES and PARKER²⁾ reported that a majority of SS eggs was laid between 5p.m. and 9p.m.. HEWITT³⁾ and POLIN and STURKIE⁴⁾ suggested that the cause of SS eggs might be attributed to the premature laying of eggs, although SS eggs were reported to be caused by a lack of calcium utilization within the uterus rather than premature oviposition⁵⁾.

At present, it has been well documented that arginine vasotocin (AVT)⁶⁻¹⁰⁾ and prostaglandins¹¹⁻¹³⁾ are closely related to cause oviposition in the domestic fowl. These active substances are arbitrarily symbolized as OIF (Oviposition-inducing factor). However, little information is available as to whether any increase in the plasma OIF takes place elsewhere other than at the time of the OIF surge occurring just before spontaneous oviposition or shortly before ovulation of the first (C1) egg of a clutch^{9,14,15,17)}.

The present study was conducted to estimate whether such OIF is released during the laying cycle.

Materials and Methods

Birds from a commercial hybrid egg-laying stock were used. They were maintained in individual laying cages fitted with automatic oviposition recorders and were exposed to a 14-hr photoperiod (0500 to 1900). All hens selected for the present study exhibited clutches of more than 4 eggs, with a pause of only a single day for at least 3 weeks.

Experiment I

The following procedure was employed in the surgical prevention of oviposition. The vagina was loosely ligated through an incision made in the left abdominal wall just before the expected time of oviposition of the terminal (Ct) egg of a clutch, followed by closing of the incision. Within 3 hrs after the ligation, the thread placed around the vagina was removed.

Experiment II

Shortly before the expected time of oviposition of an intrasequential (Cs) egg (C2 or C3),

the vagina and the infundibulum were ligated simultaneously through a left abdominal incision. The thread placed around the vagina was removed within 3 hrs after the operation while the ligature of the infundibulum was left to prevent the reception of the ovum destined to ovulate next. By this treatment, the uterine egg was retained in the uterus following removal of the vaginal ligature with some exception.

The oviposition time of the retained egg was recorded and arranged every 1 hr-interval. All hens were autopsied within a few hours after laying of the retained egg.

The significance for the percentage of the hens laid retained eggs were determined by the χ^2 test.

Results

Experiment I

A total of 51 hens were operated on and the incidence of the retained Ct eggs laid at various

Fig. 1. Oviposition time and number of hens laid retained Ct egg. The arrow indicates the time of removal of the vaginal ligature. Figures inside columns indicate the number of hens laid retained egg. L: light period. D: dark period.

Fig. 2. Oviposition time and number of hens laid retained Cs egg. The arrow indicates the time of removal of the vaginal ligature. Figures inside columns indicate the number of hens laid retained egg. L: Light period. D: dark period.

times is shown in Fig. 1. Of the total hens, 17(33.3%) laid their retained eggs between 1700–2200 on the operation day in which the percentage of hens which laid between 1900–2000 was higher than the others. No ovulation was found in any of these hens.

On the other hand, 25 hens laid their retained Ct egg between 0200–0800 the next day after the operation in which majority of hens (16), significant at 5% level, laid between 0300–0600. At autopsy, C1 ovulation had occurred in all hens except in one which laid the retained egg at 0200. The average interval between the oviposition of the retained Ct egg and C1 ovulation was about 1 hr, which was estimated from the position of the C1 ovum present in the oviduct.

The remaining 9 hens held their Ct eggs for more than 35 hrs and laid between 0300–1200 (see Fig. 1). The postmortem examination of these hens revealed that ovulation had occurred

in association with the oviposition of the retained Ct egg in all cases.

Experiment II

Of the total 20 hens, 5 laid their uterine eggs immediately or soon after removal of the vaginal ligation (Fig. 2). The remaining 15 hens held their eggs (C2 or C3) until the next day after the operation. At autopsy, two internally ovulated ova, one within the period of vaginal ligation and another on the day of the oviposition of the retained egg, were found in the abdominal cavity in all hens except in one which laid the retained egg at 0200 and contained an ovum probably ovulated the preceding day (on the day of operation).

Discussion

It is noteworthy that the pattern of oviposition times of the retained Ct eggs on the operation day (Fig. 1) was fundamentally similar to the observations by several workers^{2,16)}

based on the study of prematurely laid SS eggs. From the present results, it is suggested that some amount of OIF may be released in the afternoon of the spontaneous Ct oviposition but may not take place after Cs oviposition. It is also suggested that such increased OIF, if any, may act as a safety mechanism which forces out the Ct egg when its oviposition is accidentally affected by physiological disorder. In addition, it is reasonable that the oviposition of the retained Cs egg did not occur in the afternoon, suggesting that no OIF is released during egg formation in intact hens.

On the other hand, the hens with one exception laid their retained Ct eggs in association with Cl ovulation the next day after ovulation (Fig. 1), assuming that OIF was released prior to Cl ovulation. In this connection, there is evidence that a significant increase of plasma AVT occurs shortly before Cl ovulation^{9,17)}.

In Experiment II, one fourth of the Cs eggs were laid soon after the removal of the vaginal ligature. This prompt reaction was unexpected because no such event was observed in the case of the hens with Ct egg as mentioned above. The cause of this phenomenon is unknown at present.

Collectively, it is suggested that a considerable amount of OIF may be secreted after spontaneous Ct oviposition but are not secreted during egg formation. However, measurement of plasma OIF should be necessary before

making a definitive conclusion about the secretion of OIF following Ct oviposition.

References

- 1) ROLAND, D.A., *Poult. Sci.*, **67** : 1801-1803. 1988.
- 2) HUGHES, B.L. and J.E. PARKER, *Poult. Sci.*, **50** : 1509-1511. 1971.
- 3) HEWITT, E.A., *J. Am. Vet. Med. Assoc.*, **95** : 201-210. 1939.
- 4) POLIN, D. and P.D. STURKIE, *Poult. Sci.*, **34** : 1169-1170. 1955.
- 5) ROLAND, D.A., D.J. HOLCOMBE and R.H. HARMS, *Poult. Sci.*, **56** : 1232-1236. 1977.
- 6) TANAKA, K. and S. NAKAJO, *Endocrinology*, **70** : 453-458. 1962.
- 7) STURKIE, P.D. and Y.C. LIN, *J. Endocrinol.*, **35** : 325-326. 1966.
- 8) NIEZGODA, J., J. RZASA and Z. EWY, *J. Reprod. Fert.*, **35** : 505-509. 1973.
- 9) TANAKA, K., K. GOTO, T. YOSHIOKA, T. TERAQ and O. KOGA, *British Poult. Sci.*, **25** : 589-595. 1984.
- 10) SHIMADA, K., N. SAITO, K. ITOGAWA and T.I. KOIKE, *J. Reprod. Fert.*, **80** : 143-150. 1987.
- 11) HERTLENDY, F., D.M. OLSEN, H. TODD, R.W. HAMMOND, M. TOTH and G. ASBOTH, in *Reproductive Biology of Poultry* (CUNNINGHAM, F.J., P.E. LAKE and D. HEWITT eds) 89-British Poultry Science Ltd. 1984.
- 12) OLSEN, D.M., K. SHIMADA and R.J. ETCHES, *Biology of Reproduction*, **35** : 1140-1146. 1986.
- 13) SHIMADA, K., D.M. OLSEN and R.J. ETCHES, *Biology of Reproduction*, **35** : 1147-1153. 1986.
- 14) NAKADA, T. and K. TANAKA, *Jpn. Poult. Sci.*, Fall Supplement, **10** : 5, 1973.
- 15) TANAKA, K., T. NAKADA and O. KOGA, *Jpn. Poult. Sci.*, **19** : 124-125. 1982.
- 16) HESTER, P. Y., E.K. WILSON, F.W. PIERSON and I. FABIJANSKA, *Poult. Sci.*, **59** : 2336-2341. 1980.
- 17) SHIMADA, K., H.L. NELSON and T.I. KOIKE, *General and Comparative Endocrinology*, **64** : 362-367. 1986.

産卵鶏においてクラッチ最終卵の放卵後放卵誘起因子 (OIF) の分泌の可能性

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放卵誘起因子 (OIF) が自然の放卵時期以外においても放出されているかどうかを調べるため, クラッチ最終卵 (Ct) の放卵直前臍部を短時間結紮し自然放卵を阻止した. この結果, 51羽のうち 17 羽においては結紮処置当日, 25 羽において翌日のクラッチ第 1 卵 (C 1) の排卵の約 1 時間前, 残りの 9 羽は同処置後 3 日目に Cs 卵 (C 1 と Ct を除く連産内の卵) の排卵と同時期にそれぞれ放卵された. 一方, Cs 卵の放卵直前に臍の短時間結紮と同時に, ろ斗部を結紮し, 次の予定排卵の卵が卵管内へ取り込まれなくした場合, 5 羽は臍結紮系の除去直後又はその後間もなく放卵した. 一方残りの 15 羽においては, 処置当日に放卵は行なわれず, すべて翌日の Cs 卵の排卵と同時期に行なわれた. これらの結果から, Ct 放卵当日の午後 OIF が放出されるが, 卵形成中にはこれの放出は起こらないものと推定された.

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