Research Notes

Plasma Concentrations of 13,14-dihydro-15-keto PGF$_{2\alpha}$ and Progesterone During the Oviposition Cycle of the Domestic Goose (Anser anser domesticus)$^1$

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ABSTRACT Plasma 13,14-dihydro-15-keto prostaglandin F$_{2\alpha}$ (PGFM) and progesterone levels were determined in actively ovulating, 1- to 2-yr-old female geese (Anser anser domesticus) at hourly intervals during the oviposition cycle, using the enzyme immunoassay (EIA) technique. The plasma PGFM concentration showed a peak at the time of oviposition and decreased to a basal level after oviposition. Progesterone levels began to surge approximately 12 to 13 h before ovulation and reached a peak 2 to 3 h before ovulation. The plasma progesterone concentrations returned to basal level at the time of ovulation. The present method of EIA was found to have practical application in analyses of progesterone and PGFM in plasma of birds.

(Key words: prostaglandin F$_{2\alpha}$, progesterone, goose, oviposition, ovulation)

INTRODUCTION

Oviposition in the hen is the result of a coordinated series of precisely timed physiological events culminating in uterine muscle contraction and vaginal relaxation to expel the egg (Saito et al., 1987). During the past decade, evidence has been provided in support of a functional role for the primary prostaglandins (PG) in the physiological control of oviposition in birds (Toth et al., 1983). Prostaglandin injections can induce premature oviposition in the domestic hen (Hertelendy, 1974; Hertelendy et al., 1975; Hertelendy and Biellier, 1978) and Japanese quail (Hertelendy, 1972, 1974), can elicit definitive pressure changes in different segments of the oviduct (Wechsung and Houvenaghel 1975a, 1977), and may cause contraction of uterine strips in vitro (Wechsung and Houvenaghel 1975b, 1976). Plasma concentrations of PG significantly increase immediately before and during oviposition with a decrease following the expulsion of the egg (Wechsung et al., 1978; Hammond et al., 1980). Morever, serum concentrations of PGF in males and females have shown diurnal variation, and, in laying hens, changes have been associated with oviposition (Takahashi et al., 1991). Changes in plasma levels of PGFM correlate well with PGF$_{2\alpha}$, and at oviposition, plasma levels of PGFM peak (Olson and Hertelendy, 1981).

An increase in plasma progesterone precedes mid-sequence ovipositions, which are accompanied by ovulation (Etches, 1979). The highest concentrations of plasma progesterone were found 6 to 4 h before ovulation in hens (Johnson and van Tienhoven, 1980). The granulosa cells of the largest preovulatory follicle are the major intra-ovarian source of PG, and the production of PGF$_{2\alpha}$ is associated with preovulatory surges of gonadotropins and steroid hormones preceding oviposition (Etches et al., 1990). The levels that blood PGFM and progesterone change during an oviposition period have not been reported in geese, which show seasonal oviposition. This study was undertaken to determine how plasma PGFM and progesterone levels in domestic geese fluctuate according to an oviposition period. In addition, the measurements obtained in this current study are the first in geese. Furthermore, the enzyme immunoassay (EIA) techniques that were employed for hormone analyses in this study are also the first for geese.

MATERIALS AND METHODS

Ten 1- to 2-yr-old goose (5 to 6 kg in weight) were caged individually and kept on a lighting schedule of 10 h per d (lights on 0600 to 1600 h) during the egg laying season between January and March. Feed and water were

Abbreviation Key: PG = prostaglandin; PGFM = 13,14-dihydro-15-keto PGF$_{2\alpha}$; EIA = Enzyme immunoassay.
supplied for consumption ad libitum. The times of the oviposition were recorded to the nearest minute using a video camera to monitor all cages. The probable ovulation times were calculated, using the times of oviposition as reported previously (Duplaix et al., 1981; Gulati et al., 1981) and by adding 0.5 to 1 h to the time of oviposition (Etches, 1979). In the present study, the ovulation time of geese was determined by adding 1 h to the time of oviposition. The oviposition time was considered to be the zero time for blood collection. Blood samples were obtained only once for each test goose during a given oviposition cycle. Samples (1.5 mL) were collected from geese by catheter into heparinized tubes from the axillary (wing) vein at 1-h intervals during an oviposition period (46 to 48 h). After centrifugation, the plasma was stored frozen at −20 C until assayed. Each blood sample was analyzed for PGFM and progesterone.

Plasma progesterone concentrations were determined using the double antibody EIA procedure described by Prakash et al. (1987). Antiprogestrone-7α carboxyethylthioether-bovine thyro globulin (carboxyethylthioether-BTG), produced in rabbits, was kindly supplied by D.F.M. Van de Wiel.4 For the preparation of enzyme-labeled progesterone, 6β-OH-progesterone hemisuccinate6 was labeled with horse-radish peroxidase6 by the mixed anhydride method (Meyer et al., 1986). The conjugate was purified by the column chromotography (Sephadex G-25).7 The affinity-purified goat IgG-anti rabbit IgG was produced in our laboratory with a method described by Meyer and Güven (1986). The microtitration plates8 were first coated with 1 µg/well affinity-purified goat IgG produced against rabbit IgG. The immune reaction was performed by incubating a mixture of 10 µL of plasma, 100 µL of enzyme label, and 100 µL of antiserum. After the plates were washed, 150 µL of the substrate solution (0.01% 3,3′,5,5′ tetramethylbenzidine;7 0.004% H2O2 in 100 mM sodium acetate, pH 5.5, with citric acid) was added. The plate was incubated in the dark for 40 min, and the substrate reaction was stopped by adding 50 µL of 4N H2SO4. The optical density was measured at 450 nm with a microtitration plate reader. The results were determined with the Easy WIN fitting program E 5.0a.10 The standard curve was sensitive at 0.25 to 16 ng/mL (2.5 to 160 pg/well). The intra- and interassay coefficients of variation were less than 14%.

Plasma PGFM concentrations were determined using the EIA procedure described by Güven and Özsar (1993).

The levels of progesterone in the plasma began to surge approximately 12 to 13 h before ovulation (Figure 1), increasing from 1.6 ng/mL to maximum of 5.61 ± 0.30 ng/mL 2 to 3 h before oviposition. Baseline concentrations were reattained at the time of ovulation (Figure 1). The progesterone levels were reported to begin increasing 9 h before oviposition in Japanese quail (Gulati et al., 1981), 6 to 7 h before oviposition in hens (Duplaix et al., 1981; Etches and Cheng, 1981) or 7 h before oviposition in hens

![Figure 1](https://academic.oup.com/ps/article-abstract/80/2/225/1602915/1982/1982016/1982016)
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