**Validation of a mathematical model of the bovine estrous cycle for cows with different estrous cycle characteristics**

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**Supplementary** **Table S3**

List of parameters and initial parameter values1 (resulting in a 3-wave cycle).

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| --- | --- | --- | --- | --- |
| No. | Parameter | Value | Dimension | Description |
| 1 | $$c\_{GnRH,1}$$ | 2.75 | $$\frac{[GnRH\_{Hypo}]}{[t]}$$ | Rate constant for the synthesis of GnRH in the hypothalamus |
| 2 | $$GnRH\_{Hypo}^{max}$$ | 16.00 | $$[GnRH\_{Hypo}]$$ | Maximum concentration of GnRH in the hypothalamus |
| 3 | $$m\_{P4\&E2}^{GnRH,1}$$ | 2.05 | 1/[t] | Maximum rate constant for (P4&E2)-dependent GnRH release. |
| 4 | $$T\_{E2}^{GnRH,1}$$ | 0.10 | [E2] | Threshold for E2 to suppress GnRH release |
| 5 | $$T\_{P4}^{GnRH,1}$$ | 0.35 | [P4] | Threshold for P4 to enable E2 to suppress GnRH release |
| 6 | $$m\_{P4}^{GnRH,2}$$ | 1.91 | 1/[t] | Maximum rate constant for P4-dependent GnRH release |
| 7 | $$T\_{P4}^{GnRH,2}$$ | 0.25 | [P4] | Threshold for P4 to inhibit GnRH release directly |
| 8 | $$m\_{E2}^{GnRH,2}$$ | 0.99 | $$\frac{[GnRH\_{Pit}]}{[GnRH\_{Hypo}]}$$ | Maximum ability of the pituitary to sense GnRH |
| 9 | $$T\_{E2}^{GnRH,2}$$ | 0.65 | [E2] | Threshold for E2 to increase the ability of the pituitary to sense GnRH |
| 10 | $$c\_{GnRH,2}$$ | 1.63 | 1/[t] | Rate constant for the clearance of GnRH from the pituitary |
| 11 | $$m\_{Inh}^{FFSH}$$ | 4.21 | [FSH]/[t] | Maximum FSH synthesis rate in the pituitary |
| 12 | $$T\_{Inh}^{FSH}$$ | 0.12 | [Inh] | Threshold for Inhibin to inhibit FSH synthesis |
| 13 | $$m\_{P4}^{FSH}$$ | 0.29 | 1/[t] | Maximum rate constant for P4-stimulated FSH release |
| 14 | $$T\_{P4}^{FSH}$$ | 0.15 | [P4] | Threshold for P4 to stimulate FSH release |
| 15 | $$m\_{E2}^{FSH}$$ | 0.40 | 1/[t] | Maximum rate constant for E2-inhibited FSH release |
| 16 | $$T\_{E2}^{FSH}$$ | 0.31 | [E2] | Threshold for E2 to inhibit FSH release |
| 17 | $$m\_{GnRH}^{FSH}$$ | 1.23 | 1/[t] | Maximum rate constant for GnRH-stimulated FSH release |
| 18 | $$T\_{GnRH}^{FSH}$$ | 0.07 | $$[GnRH\_{Pit}]$$ | Threshold for GnRH to stimulate FSH release |
| 19 | $$c\_{FSH}$$ | 2.73 | 1/[t] | Rate constant for the clearance of FSH from peripheral blood |
| 20 | $$b\_{FSH}$$ | 0.95 | 1/[t] | Rate constant for basal FSH release from the pituitary |
| 21 | $$m\_{E2}^{LH}$$ | 0.38 | [LH]/[t] | Maximum rate of E2-stimulated LH synthesis |
| 22 | $$T\_{E2}^{LH}$$ | 0.24 | [E2] | Threshold for E2 to stimulate LH synthesis |
| 23 | $$m\_{P4}^{LH}$$ | 2.71 | [LH]/[t] | Maximum rate of P4-inhibited LH synthesis |
| 24 | $$T\_{P4}^{LH}$$ | 0.03 | [P4] | Threshold for P4 to inhibit LH synthesis |
| 25 | $$m\_{GnRH}^{LH}$$ | 2.22 | 1/[t] | Maximum rate constant for GnRH-stimulated LH release |
| 26 | $$T\_{GnRH}^{LH}$$ | 0.69 | $$[GnRH\_{Pit}]$$ | Threshold for GnRH to stimulate LH release |
| 27 | $$b\_{LH}$$ | 0.01 | 1/[t] | Rate constant for basal LH release from the pituitary |
| 28 | $$c\_{LH}$$ | 12.0 | 1/[t] | Rate constant for the clearance of LH from peripheral blood |
| 29 | $$m\_{FSH}^{Foll}$$ | 0.56 | [Foll]/[t] | Maximum rate of the FSH-dependent increase of Follicle size |
| 30 | $$T\_{FSH}^{Foll}$$ | 0.57 | [FSH] | Maximum threshold for FSH to stimulate increase of Follicle size. |
| 31 | $$T\_{Foll}^{FSH}$$ | 0.22 | [Foll] | Threshold for Follicle size to reduce the FSH threshold |
| 32 | $$m\_{P4}^{Foll}$$ | 1.10 | 1/[t] | Maximum rate constant for the P4-dependent decrease of Follicle size |
| 33 | $$T\_{P4}^{Foll}$$ | 0.13 | [P4] | Threshold for P4 to stimulate decrease of follicle size. |
| 34 | $$m\_{LH}^{Ovul. Foll}$$ | 3.49 | 1/[t] | Maximum rate constant for the LH-dependent change of Follicle size |
| 35 | $$T\_{LH}^{Ovul. Foll}$$ | 0.17 | [LH] | Threshold for LH to stimulate decrease of follicle size |
| 36 | $$m\_{OTR\&OT}^{PGF2α}$$ | 53.91 | [PGF2α]/[t] | Maximum rate of PGF2α secretion |
| 37 | $$T\_{OTR}^{PGF2α}$$ | 1.43 | [OTR] | Threshold for OTR to allow OT to stimulate PGF2α secretion |
| 38 | $$T\_{OT}^{PGF2α}$$ | 1.09 | [OT] | Threshold for OT to stimulate PGF2α secretion |
| 39 | $$c\_{PGF2α}$$ | 1.23 | 1/[t] | PGF2α clearance rate constant |
| 40 | $$SF$$ | 0.20 | [CL]/[t] | Scaling factor for LH-induced rise of CL |
| 41 | $$m\_{CL}^{CL}$$ | 0.04 | [CL]/[t] | Maximum rate of increase of CL stimulated by itself |
| 42 | $$T\_{CL}^{CL}$$ | 0.10 | [CL] | Threshold volume of CL to stimulate self-growth |
| 43 | $$m\_{IOF}^{CL}$$ | 41.39 | 1/[t] | Maximum rate of decrease of CL stimulated by IOF |
| 44 | $$T\_{IOF}^{CL}$$ | 1.32 | [IOF] | Threshold for IOF to stimulate CL regression |
| 45 | $$c\_{CL}^{P4}$$ | 2.25 | $$\frac{\left[P4\right]/[CL]^{2}}{[t]}$$ | Proportionality constant for P4 secretion by the CL |
| 46 | $$c\_{P4}$$ | 1.41 | 1/[t] | Rate constant for P4 clearance in peripheral blood |
| 47 | $$c\_{Foll}^{E2}$$ | 2.19 | $$\frac{\left[E2\right]/[Foll]^{2}}{[t]}$$ | Proportionality constant for E2 secretion by the follicles |
| 48 | $$c\_{E2}$$ | 1.23 | 1/[t] | Rate constant for E2 clearance in peripheral blood |
| 49 | $$c\_{Foll}^{Inh}$$ | 1.41 | $$\frac{\left[Inh\right]/[Foll]^{2}}{[t]}$$ | Proportionality constant for Inh secretion by the follicles |
| 50 | $$c\_{Inh}$$ | 0.48 | 1/[t] | Rate constant for Inh clearance in peripheral blood |
| 51 | $$m\_{P4}^{OTR}$$ | 3.58 | [OTR]/[t] | Maximum rate of P4-dependent OTR synthesis in the endometrium |
| 52 | $$T\_{P4}^{OTR}$$ | 0.77 | [P4] | Threshold for P4 to stimulate OTR synthesis in the endometrium |
| 53 | $$c\_{OTR}$$ | 2.98 | 1/[t] | Rate constant for OTR clearance in the endometrium |
| 54 | $$m\_{E2}^{OT}$$ | 1.59 | $$\frac{\left[OT\right]/[CL]^{2}}{[t]}$$ | Maximum proportionality factor for OT secretion by the CL. |
| 55 | $$T\_{E2}^{OT}$$ | 0.14 | [E2] | Threshold for E2 to stimulate OT secretion by the CL |
| 56 | $$c\_{OT}$$ | 0.64 | 1/[t] | Rate constant for OT clearance |
| 57 | $$m\_{PGF2α\&CL}^{IOF}$$ | 39.68 | [IOF]/[t] | Maximum rate of synthesis of ‘intra-ovarian factor’ (IOF) |
| 58 | $$T\_{PGF2α}^{IOF}$$ | 1.22 | [PGF2α] | Threshold for PGF2α to stimulate synthesis of ‘intra-ovarian factor’ (IOF) |
| 59 | $$T\_{CL}^{IOF}$$ | 0.60 | [CL] | Threshold CL volume to stimulate synthesis of ‘intra-ovarian factor’ (IOF) |
| 60 | $$c\_{IOF}$$ | 0.30 | 1/[t] | Rate constant for clearance of ‘intra-ovarian factor’ (IOF) |

1 E2 = estradiol, P4 = progesterone, GnRH = gonadotropin releasing hormone, Inh = inhibin, OT = oxytocin, OTR = oxytocin receptor, FSH = follicle stimulating hormone, LH = luteinizing hormone, IOF = intra-ovarian factors, PGF2α = prostaglandin2α, CL = corpus luteum size. Foll = follicle size, Ovul. Foll. = ovulated follicle,  *Pit* =pituitary, *Hypo* = hypothalamus, *c* = rate constant, *t* = time, *T* = threshold for change of behaviorof the Hill functions, *m* = maximum value of the switched parameter.