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

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**Supplementary** **Table S1**

The set of 15 differential equations1 of the mathematical model2.

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| Eq. nr. | Equation |
| 1.  | $\frac{d}{dt}GnRH\_{Hypo}\left(t\right)=Syn\_{GnRH}\left(t\right)-Rel\_{GnRH}(t)$  |
| 1a. | $Syn\_{GnRH}\left(t\right)=c\_{GnRH,1}∙(1-\frac{GnRH\_{Hypo}\left(t\right)}{GnRH\_{Hypo}^{max}})$  |
| 1b. | $Rel\_{GnRH}\left(t\right)=(H\_{1}^{-}\left(P4\&E2\right)+H\_{2}^{-}\left(P4\right))∙GnRH\_{Hypo}(t)$  |
| 2. | $\frac{d}{dt}GnRH\_{Pit}\left(t\right)=Rel\_{GnRH}\left(t\right)∙H\_{3}^{+}\left(E2\right)-c\_{GnRH,2}∙GnRH\_{Pit}(t)$  |
| 3. | $\frac{d}{dt}FSH\_{Pit}\left(t\right)=Syn\_{FSH}\left(t\right)-Rel\_{FSH}(t)$  |
| 3a. | $Syn\_{FSH}\left(t\right)=H\_{4}^{-}(Inh)$  |
| 3b. | $Rel\_{FSH}\left(t\right)=(b\_{FSH}+H\_{5}^{+}\left(P4\right)+H\_{6}^{-}\left(E2\right)+H\_{7}^{+}\left(GnRH\_{Pit}\right))∙FSH\_{Pit}(t)$  |
| 4. | $\frac{d}{dt}FSH\_{Blood}\left(t\right)=Rel\_{FSH}\left(t\right)-c\_{FSH}∙FSH\_{Blood}(t)$  |
| 5. | $\frac{d}{dt}LH\_{Pit}\left(t\right)=Syn\_{LH}\left(t\right)-Rel\_{LH}(t)$  |
| 5a. | $Syn\_{LH}\left(t\right)=H\_{8}^{+}\left(E2\right)+H\_{9}^{-}(P4)$  |
| 5b. | $Rel\_{LH}\left(t\right)=(b\_{LH}+H\_{10}^{+}\left(GnRH\_{Pit}\right))∙LH\_{Pit}(t)$  |
| 6. | $\frac{d}{dt}LH\_{Blood}\left(t\right)=Rel\_{LH}\left(t\right)-c\_{LH}∙LH\_{Blood}(t)$  |
| 7. | $\frac{d}{dt}Foll\left(t\right)=H\_{11}^{+}\left(FSH\_{blood}\right)-(H\_{12}^{+}\left(P4\right)+H\_{13}^{+}(LH\_{blood}))∙Foll(t)$  |
| 8. | $\frac{d}{dt}CL\left(t\right)=SF∙H\_{13}^{+}\left(LH\_{blood}\right)∙Foll\left(t\right)+H\_{14}^{+}\left(CL\right)-H\_{15}^{+}(IOF)∙CL(t)$  |
| 9. | $\frac{d}{dt}P4\left(t\right)=c\_{CL}^{P4}∙CL\left(t\right)^{2}-c\_{P4}∙P4(t)$  |
| 10. | $\frac{d}{dt}E2\left(t\right)=c\_{Foll}^{E2}∙Foll\left(t\right)^{2}-c\_{E2}∙E2(t)$  |
| 11. | $\frac{d}{dt}Inh\left(t\right)=c\_{Foll}^{Inh}∙Foll\left(t\right)^{2}-c\_{Inh}∙Inh(t)$  |
| 12. | $\frac{d}{dt}OTR\left(t\right)=H\_{16}^{+}\left(P4\right)-c\_{OTR}∙OTR(t)$  |
| 13. | $\frac{d}{dt}OT\left(t\right)=H\_{17}^{+}\left(E2\right)∙CL\left(t\right)^{2}-c\_{OT}∙OT(t)$  |
| 14. | $\frac{d}{dt}IOF\left(t\right)=H\_{18}^{+}\left(PGF2α\&CL\right)-c\_{IOF}∙IOF(t)$  |
| 15. | $\frac{d}{dt}PGF2α\left(t\right)=H\_{19}^{+}\left(OTR\&OT\right)-c\_{PGF2α}∙PGF2α(t)$  |

1 Notation of Hill functions in the above equations is abbreviated as *H(substrate)*. For full description of the Hill equations see Table S2. 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, CL = corpus luteum size. Foll = follicle size, Ovul Foll = ovulated follicle,  *Syn* = synthesis, *Rel* = release, *Pit* =pituitary, *Hypo* = hypothalamus, *c* = rate constant, *t* = time.

2 Reference: Boer HMT, Apri M, Molenaar J, Stötzel C, Veerkamp RF, and Woelders H 2012. *Candidate mechanisms underlying atypical progresterone profiles as deduced from parameter perturbations in a mathematical model of the bovine estrous cycle. Journal of Dairy Science 95, 3837-3851.*