

Novel Sensor Technology for Progesterone and Estradiol Detection in Milk Samples

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Poor reproductive efficiency is a well-documented challenge facing the dairy industry. Undetected estrus is the main contributor to poor reproductive efficiency in dairy herds in Alberta. By monitoring milk hormones, such as progesterone and estradiol, it is possible to predict when a cow will be in estrus. However, current commercially available technologies to detect these targets, especially "cow-side" detection methods, are either expensive, lack sensitivity, and/or are time consuming. Therefore, more sensitive, affordable, timely, and easy to use sensing technologies are needed. This abstract describes a biosensor composed of poly (N-isopropylacrylamide) (pNIPAm) microgels, which can be used to make optical devices (etalons) for progesterone and estradiol determination in water and milk. We have designed two separate etalon-based sensing approaches that yield optical responses that depend on the concentration of progesterone or estradiol in the solution. The overall mean concentration of serum progesterone and estradiol in cattle during estrous cycle range from 0 (estrus) to 5 (middle cycle) ng/mL and 2 (diestrus) to 12 (middle cycle) pg/mL, respectively. The biosensor technology presented here can detect progesterone and estradiol in water and milk with high sensitivity and specificity (1.78 and 0.13 nm/ng-mL⁻¹ for progesterone; 1.18 and 0.01 nm/pg-mL⁻¹ for estradiol). The linear detection range is 0 to 30 ng/mL progesterone with a calculated detection limit of 0.17 ng/mL. The linear detection range is 0-200 pg/mL estradiol with a calculated detection limit of 0.86 pg/mL. Therefore, the sensor performance allows physiologically relevant concentrations to be quantified.

Take Home Message: Cost effective, simple, and easy to use biosensors have been developed to determine progesterone and estradiol concentration in water and milk with high sensitivity and specificity. These findings make feasible the development of "cow-side" test devices for reproductive monitoring in dairy cows.

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