Can Rumen Protected Methionine Improve Reproduction in Dairy Cows? Part 2: Transition Period – Follicular Growth and Oocyte Development

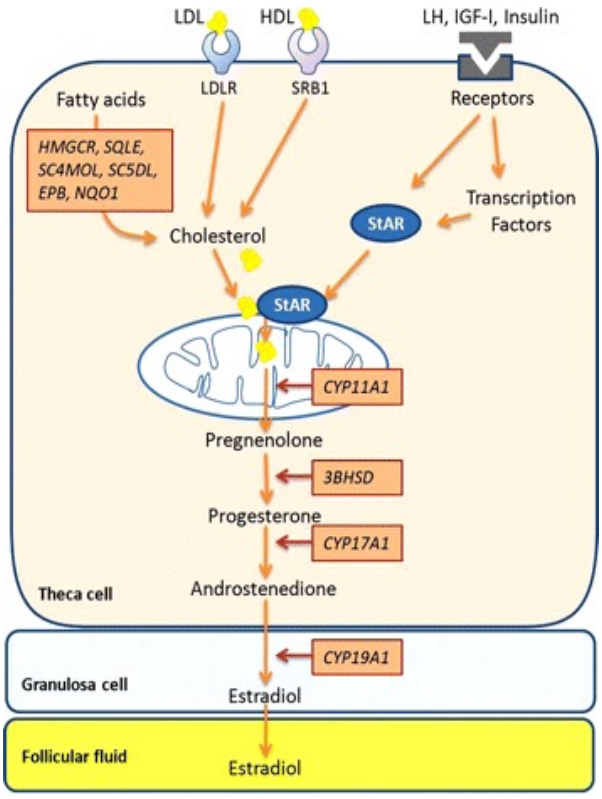
OVULATION & FERTILIZATION OF A HIGH-QUALITY OOCYTE

A review from Santos et al. (2004) showed that early embryonic loss in the first 50 days of pregnancy typically varies between 10 to 20% in an average U.S. dairy herd. The cost associated with pregnancy loss during the first month of pregnancy ranges from $152 to $361/pregnancy (DeVries et al., 2006). Embryonic loss prior to the first pregnancy detection is difficult to measure, therefore pregnancy losses after the first ultrasound are normally detected through a return to estrous for a cow that was previously diagnosed as pregnant.

Follicles are always present on the bovine ovary. The follicle is stimulated through hormonal interaction between the hypothalamus secreting gonadotropin releasing hormone (GnRH) to the anterior pituitary stimulating production and release of FSH (follicle stimulating hormone). The hormonal cascade is initiated postpartum through nutritional status via blood metabolites.

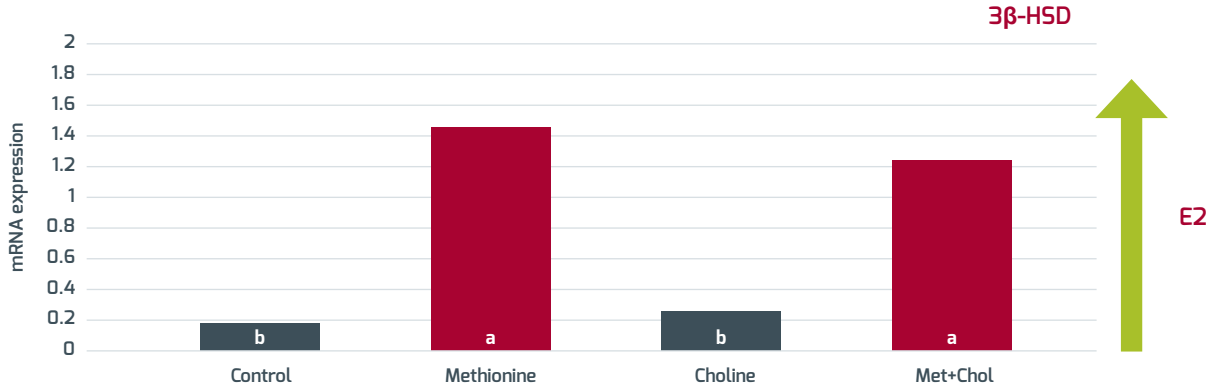
A study by Hansen (2013) showed that the dominant follicle for the first breeding postpartum began prior to calving. Therefore, at the time of expected insemination (~60 to 70 DIM), the follicle may have 90 to 100 days of growth. Highlighting the impact that nutritional strategies prepartum have on follicular growth post-partum. The size of the follicle and the amount of estradiol produced are highly correlated. Estradiol is the hormone that causes the cow to demonstrate estrus. The continued growth of the follicle and increased production of estradiol causes a surge in LH luteinizing hormone (LH) which causes ovulation. Without this estradiol surge, ovulation is not possible, and the cow cannot become pregnant.

Figure 1. Metabolic pathway of steroidogenesis in the bovine follicle



Acosta et al. (2017) studied the effect of RPMet supplementation (-21 to 73 DIM) on the first dominant follicle and embryo. Diets were balanced to reach a Lys:Met ratio of 2.9:1. Follicles were aspirated at 16-mm (normal size for Holstein cows; n=40) and embryos were harvested 7 d after insemination (n=37). Follicles from cows on RPMet supplementation showed a higher expression of 3β-hydroxysteroid dehydrogenase (3β-HSD), an enzyme which is involved in ovarian steroidogenesis over control. This enzyme plays an important role in the process of converting cholesterol to estradiol to provide positive feedback to the hypothalamus.

Figure 2. Effect of Smartamine® on mRNA expression for 3ß-HSD and estradiol (E2) production



The positive feedback (of 3β-HSD) increases the secretion of FSH which stimulates the ovary to produce more estradiol. **Increased estradiol production drives the outward display of estrus and an LH surge which leads to ovulation.** The follicular fluid from cows on RPMet also showed a high concentration of methionine compared to the follicular fluid of control cows (18.2 vs. 11.1 µM, P =0.001).

CONCLUSION

Adequate methionine levels can positively impact the follicular health of the first dominant follicle postpartum which can result in higher first insemination pregnancy rates.

Methionine & Follicle =
Increased follicle size =
increased estradiol production =
increased display of estrous =
fertile oocyte ovulation

Contact your Adisseo representative to learn more!

MILK PAY.COM by ADISSEO

https://milkpay.com/contact/

ADISSEO A Bluestar Company