



Hit the methionine target

A good nutritional start is critical for reproductive success in herds.

by Phil Cardoso

IN THE last 30 years, cows have improved milk yield from approximately 15,000 pounds to more than 25,000 pounds per lactation. Feeding strategies must meet the challenge of greater nutritional requirements caused by this dramatic change. Nutrient demands for milk synthesis are higher in early lactation, and if no



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compensatory intake of nutrients is achieved to cope with milk production requirements, reproductive functions (such as synthesis and secretion of hormones, follicle ovulation, and embryo development) may be depressed.

Why does methionine matter?

Studies from our group and others clearly established the link between nutrition and fertility in dairy cows during the last two decades. Additionally, the incidence of diseases and disorders can be high around the calving period and have a negative impact on reproductive performance. Researchers from Cornell and the University of Florida have shown that the risk of pregnancy was reduced if cows lost more than one body condition score (BCS) unit in early lactation.

Methionine is the most limiting amino acid (AA) in lactating cows. In contrast, supplementing rumen-protected methionine (RPM)

has shown to have a positive effect on milk protein synthesis in dairy cows. Although the role of methionine in bovine embryonic development is unknown, there is evidence that methionine availability alters bovine embryos in the cow but also in the lab (in vitro). For instance, feeding female mice a low-protein diet during the preimplantation period of pregnancy resulted in a reduction in AA concentration in uterine fluid, serum, and AA profile of the embryo at blastocyst stage (Day 7 to 8).

One interesting study, reported in 1989, used serum from lactating dairy cows to grow head-fold stage rat embryos (Day 9.5 after breeding). Complete development of these embryos requires serum, and development proceeds normally when done in rat serum. When embryos are grown in serum from dairy cows, embryonic development is abnormal when measuring total embryo protein, somite pairs, and percentage of the embryos that are abnormal (no neural tube closure, abnormal shape, no development of eyes and branchial arches).

Meanwhile, supplementation of bovine serum with AA and vitamins produced normal development of the rat embryos. Amino acid supplementation alone, but not vitamin supplementation, produced normal development as well. Use of serum from cows that were supplemented with methionine also produced normal embryo development. Thus, bovine serum alone has such low methionine concentrations that normal development of rat embryos is slowed.

The bovine methionine target

The requirements for complete development of bovine embryos have not yet been deter-

mined. Current culture conditions allow development of bovine embryos to the blastocyst stage and even allow hatching of a percentage of embryos (Day 9); however, conditions have not been developed in vitro that allow elongation of embryos. The methionine requirements for cultured preimplantation bovine embryos (Day 7 to 8) was determined in studies from University of Florida.

There was a surprisingly low methionine requirement (7 μ M) for development of embryos to the blastocyst stage by Day 7; however, development to the advanced blastocyst stage by Day 7 appeared to be optimized at around 21 μ M. Thus, the results of these studies indicated that development of morphologically normal bovine embryos required methionine concentrations of approximately 21 μ M, at least during the first week after fertilization.

Our group performed an experiment where cows supplemented with RPM easily achieved serum concentrations of methionine greater than 21 μ M whereas cows receiving a typical Midwest TMR diet (based on corn silage and alfalfa hay and haylage) did not (see figure).

The objective of our experiment was to determine the effect of supplementing RPM on lipid accumulation in embryos of dairy cows. Holstein cows entering their second or greater lactation received a control diet (CON; fed a basal diet with a 3.4:1 Lys:Met) and a methionine supplemented diet (MET; fed the basal diet plus 0.08 percent dietary dry matter RPM for a 2.9:1 Lys:Met) from 28 days precalving to 73 days postcalving. A total of 37 embryos were harvested from cows (MET = 16 and CON = 21).

Cows receiving MET had greater lipid accumulation (7.3 arbitrary units) when compared with cows receiving CON (3.7 arbitrary units). There was no treatment effects on the number of cells or stage of development. Cows that were supplemented with methionine produced embryos with higher lipid concentration when compared with CON which could potentially serve as an important source of energy reserves for the early developing embryo.

Researchers from the University of Wisconsin conducted a trial with a total of 309 cows (138 primiparous and 171 multiparous) that were assigned to two treatments; 1) CON: Cows fed a ration formulated to deliver 2,500 grams of MP with 6.9 percent Lys (percent MP) and 1.9 percent Met (percent MP) and 2) MET: Cows fed a ration formulated to deliver 2,500 grams of MP with 6.9 percent Lys (percent MP) and 2.3 percent Met (percent MP). From 28 to 128 days in milk, after the morning milking, cows were individually topdressed with 50 grams of dried distilled grains (DDG) or 50 grams of a mix of DDG (29 grams) and MET (21 grams; Smartamine M), respectively.

Cows were inseminated and pregnancy checked at 28 days with a blood test and at 32, 47, and 61 days with ultrasound. Pregnancy losses between Days 28 and 61 after artificial insemination were not different in primiparous cows (12.8 percent CON and 14.6 percent MET); however, pregnancy losses between treatments were significantly different for the multiparous cows (19.6 percent CON versus 6.1 percent MET).

What we have learned?

RPM added to the diet of Holstein cows:

- Improved the serum concentration of methionine during the dry and lactation periods.
- Expanded lipid droplet numbers in the preimplantation embryo, which could be used as energy by the embryos for improved establishment of pregnancy.
- Reduced pregnancy losses measured from 28 to 61 days after insemination in multiparous cows. 🐮

