

Low or Marginal Selenium Status Has a Negative Effect on the Success of Bovine Embryo Transfer

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Introduction

Deficiencies in the trace elements selenium and copper have been shown to negatively affect reproductive performance in cattle. Selenium has also been shown to play a role in inflammatory regulation. Selenium impacts both the production of prostaglandins and the anti-inflammatory response, particularly through the activity of glutathione peroxidase. There is some evidence that selenium deficiency reduces embryo survival during implantation, which takes place in the fourth week after estrus. Primary copper deficiency results from insufficient levels of copper in the diet, while secondary deficiencies are attributed to the reduction in copper absorption or utilization by the antagonistic effects of molybdenum, sulfur or iron. Secondary copper deficiency caused by molybdenum interference retards embryo development and leads to early embryonic death. This field study was undertaken in an attempt to demonstrate the correlation between levels of selenium and copper in cows and the success of embryo transfer.

Materials and Methods

Forty-three cows were synchronized using Ovsynch plus CIDR® (controlled internal drug release [progesterone]). Seven days after synchronized heats on day 9 of the protocol, quality 1 and 2 embryos from five different donor cows were transferred to the uterine horn ipsilateral to the corpus luteum in each recipient cow on day 16. All transfers were performed by the same clinician. During pregnancy diagnosis, by transrectal ultrasonography, four weeks after transfer of embryos, plasma and serum samples were collected and analyzed for selenium and copper concentrations. Selenium and copper were measured using a Perkin-Elmer Analyst 600 Graphite Furnace Atomic Absorption Spectrophotometer at the Tifton Clinical Veterinary Laboratory. Statistical analyses were performed using SAS V 9.1 (Cary, NC, USA). Chi-square analysis was used to compare the pregnancy rates between embryo quality groups (1 and 2) and among donor cows. The effect of selenium and copper on pregnancy rate was tested using a logistic

model with selenium and copper levels assigned a scalar value (0 = low; 1 = marginal or 2 = adequate) and used as a continuous factor.

Results

There was no significant difference between embryos of quality 1 or 2 on the observed pregnancy rates. The selenium level (low < 0.05 ppm, marginal 0.05 - 0.07 ppm and adequate > 0.07 ppm) significantly influenced the frequency of successful pregnancy when analyzed in the whole population of recipients ($P = 0.0244$, odds ratio = 3.5), but no significant effect of copper level (low < 0.5 ug/ml, marginal 0.5 - 0.7 ug/ml and adequate > 0.7 ug/ml) on the frequency of successful pregnancy was observed. Successful pregnancy rates associated with each of the selenium levels was: low (0%, 0/5), marginal (36.8%, 7/19), adequate (57.9%, 11/19), and associated with each of the copper levels was: low (20%, 1/5), marginal (54.6%, 12/22), adequate (31.3%, 5/16). However, embryos from different collections demonstrated a significant effect of donor cow based on the frequency of successful pregnancy, with the range of 100% (2/2) to 10% (1/10, $P = 0.03$) for different donors. When the specific donor was included as a factor in the analysis, the effect of selenium level on odds of successful pregnancy tended toward significance ($P = 0.08$). There was no effect of copper level on odds of successful pregnancy.

Significance

When embryos of quality 1 or 2 were transferred to recipients in this study, the rate of successful pregnancy decreased in recipient cows with low or marginal blood selenium concentration. This negative effect was not observed in recipients with marginal or low serum copper levels. In Georgia, secondary copper deficiency is generally caused by the antagonistic effect of sulfur. Although there was no difference in the rate of successful pregnancy observed when embryo quality of 1 or 2 was utilized, the source of the embryos had a significant influence on the establishment of pregnancy in recipient animals.