

ly ($P < .01$) lower survival rates. Embryos at 30 days postbreeding tended to be smaller but these differences were not significant.

The results of this study indicate that heat stress during early gestation is more of a factor in embryonic mortality than heat stress prior to breeding. It also appears that the embryo is more susceptible to heat stress during the first 15 days postbreeding than in the period 15-30 days postbreeding.

Summary Reports on Other Projects

Mineral Interrelationship Studies With Ruminants

Allen D. Tillman, T. E. Nelson and L. J. Bush

Procedures and Results

In work done on this project during the past year, it was found that both adult sheep and laboratory rats responded to a calcium-free diet in a similar manner: There was a linear decrease in blood plasma calcium level for three weeks, but by the end of the fourth week the levels had returned to a normal level and remained in the normal range for the five-week period the rats were on test and for 25 weeks in the case of sheep. Plasma phosphorus levels rose at the time the calcium levels returned to normal, thus the calcium x phosphorus product in blood plasma rose to high level. The data show that a calcium x phosphorus product of 70 or above indicates that the animal is receiving an insufficient amount of dietary calcium thus is drawing this element from the bones.

Sheep, which had been on the calcium-free diet for six weeks or more excreted injected phosphorus more rapidly than those maintained on an adequate dietary level of calcium. These results indicate that the parathyroid hormone activity was higher in calcium-deficient sheep. As the kidney arterial-venous blood differences were greater in calcium-deficient sheep than the controls, these results lend further support to

the idea that the activity of the parathyroid was higher in the calcium-deficient sheep.

That a calcium-deficient diet, when fed to rats, affects the metabolism and balance of other minerals was found in another series of studies.

These results indicate that a measure of parathyroid hormone activity in animals would be valuable in determining the calcium status of cattle, sheep, swine and horses. Research is underway to develop an adequate radioimmunological assay for this important hormone.

In another experiment, the interrelationship of calcium, magnesium and phosphorus was studied using the laboratory rat. High levels of magnesium affected phosphorus metabolism when dietary phosphorus levels were low. If dietary magnesium and phosphorus levels were low, high levels of calcium affected the utilization of both magnesium and phosphorus.

Publications

The following articles have been published from this project during the past year:

Nelson, T. E. and A. D. Tillman. 1967. Calcium status on adult sheep. *J. Animal Sci.* 26:977. (Abstr.).

Nelson, T. E. 1967. Mineral metabolism on a calcium deficient diet. Thesis for M.S. Degree. Oklahoma State University, Stillwater.

Nelson, T. E. 1967. Calcium status studies on adult sheep. *J. Nutrition* 93:475.

Frontera, A. R. and A. D. Tillman. 1968. Estudio Sobre Las Interrelaciones De Calcio, Fosforo, y Magnesio. La Re vista de Investigaciones Agropecuarias del INTA. (In press).

Future Work

Work continues on the developing of a method to determine pH activity. Also, the effect of varying calcium: phosphorus ratios on the utilization of calcium, phosphorus, sodium, potassium, copper, cobalt, iron, manganese, zinc and other cations is being determined in young sheep.