

Interaction between Gestation & Calf Health

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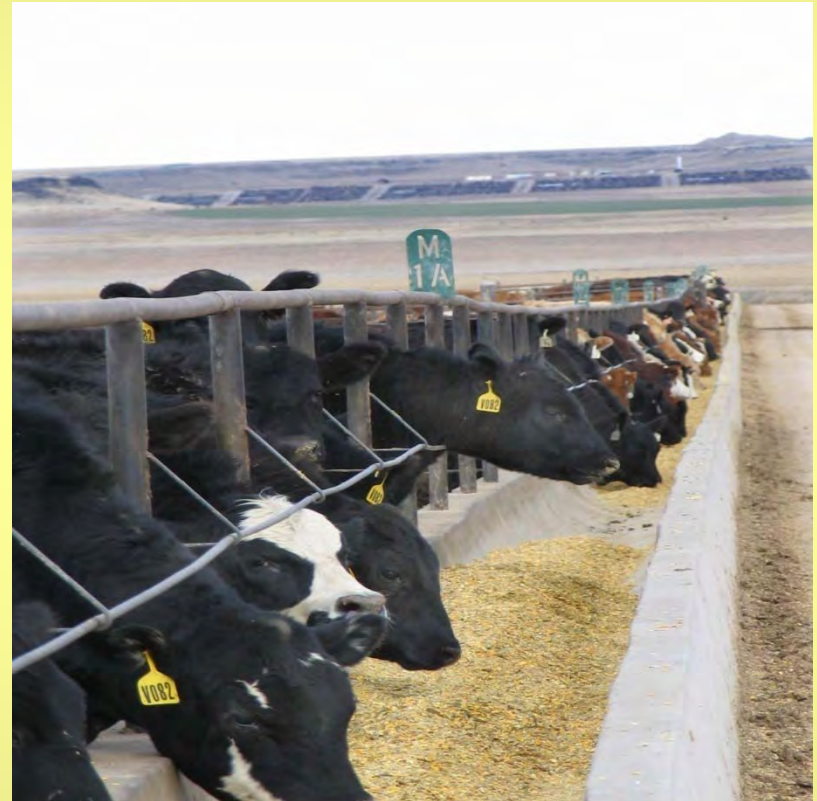
Today's talk

- Outline
 - Refresher physiology & metabolism gestation
 - Research results nutritional stress on calf health and productivity
 - Results from Corona Range & Livestock Research Center
 - Summary



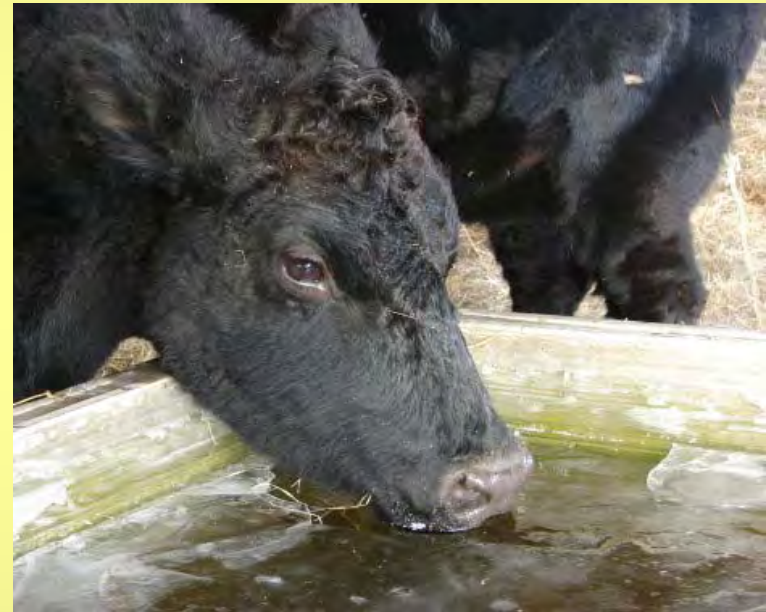
Does normal cow management on extensive range operations impact lifetime calf health?

- Can the
amount
type
length
of winter supplementation
impact calf health?



A percentage of calf value at weaning is based on predicted calf health

- New Mexico Ranch to Rail
 - Average sick calf incurs \$28 in health costs
- Are some of these costs caused by management of range cows during pregnancy?

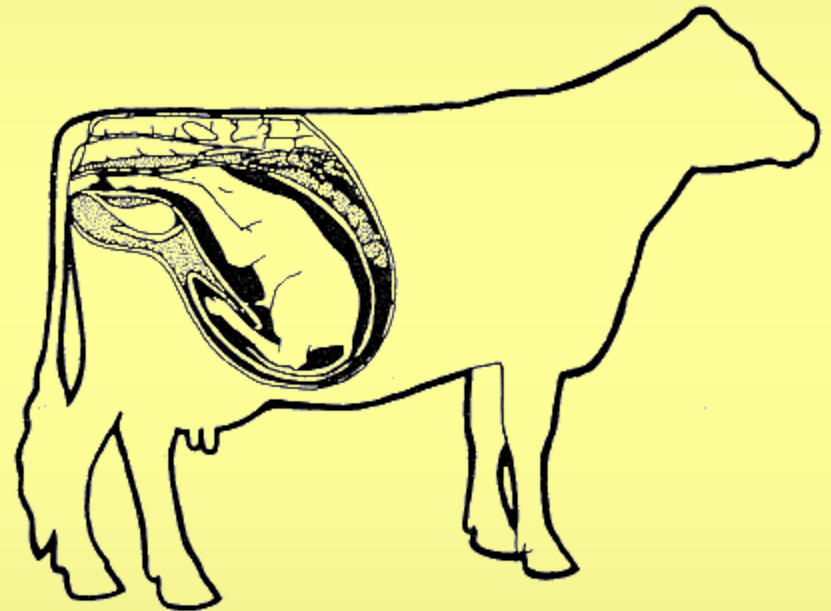


Part I PHYSIOLOGY AND METABOLISM OF GESTATION



How does a cow adapt to pregnancy?

- Who? (gets the nutrients)
- How? (organization)
- What? (is compromised during stress)



Nutrient Partitioning between Maternal & Calf

- 1947 – pregnant animals partition nutrients to fetus (Hammond)
- 1980 – competition with high metabolic tissues (Meschia)
- 1985 – coordinate regulation rather than competition (Bauman & Currie)

Nutrient Partitioning between Maternal & Calf

- **Definition – coordinate regulation**
 1. **Constraint in fetal growth**
late pregnancy to optimize neonatal survival
 2. **Minimize depletion**
of maternal energy & protein reserves

Pattern of nutrient utilization & partitioning

- Fetal nutrient requirements
 - Extensive demands for glucose & protein (as amino acids)
 - Late gestation 35 – 40% fetal energy as glucose (made in the maternal liver)
 - 55% as amino acids (from diet or maternal tissue)
 - 10% acetate (from rumen)
 - Very limited fat (prevents direct use of maternal tissue)

Metabolism of non-fetal conceptus tissues

- Gravid uterus, placenta often ignored
 - Affecting partitioning within uterus
 - Wt of placetomes, cotyledons, caruncles < 15%
 - Consume 35 - 50% oxygen
 - 60-70% glucose
 - AA uptake less than fetus (25% ?) lacks growth

Partitioning of glucose & AA

- Well fed ewes, w/singles, late gestation
 - Uterus glucose uptake 30 to 50% of maternal glucose
 - Probably equal to pregnancy induced glucose production



Partitioning of glucose & AA

- Limited studies have been conducted to address partitioning AA
 - 110 to 140 d pregnancy ewes w/ twins
 - 80% apparently digested protein partitioned- lambs
 - Remaining 20% to metabolism, developing mammary gland, visceral organs - maternal
 - In well fed ewes 10% circulating AA maternal origin

Direct effects of maternal nutrition

- Partitioning of glucose & plane nutrition
 - In previously well fed ewes;
 - Fed 60% at of maintenance for 3 weeks
 - maintained uterine glucose uptake
 - Glucose from liver declined 25%
 - Fetal growth rate unimpaired
 - Maternal wt and body condition loss

Direct effects of maternal nutrition

- Partitioning of glucose & plane nutrition
 - In previously well fed ewes;
 - Fed at 40% maintenance for 3 weeks
 - Marked decrease uterine glucose uptake
 - Proportional to glucose liver production decline

Direct effects of maternal nutrition

- Partitioning of glucose & plane nutrition
 - In ewes fasted for 5 days;
 - Umbilical uptake AA unaffected
 - Maternal blood AA declined



Direct effects of maternal nutrition

- Partitioning of glucose & plane nutrition
 - Implications
 - Severe short term nutrient deprivation is offset
 - Maternal tissue mobilization
 - Increased transport of AA placenta
 - Fetus utilizes AA for glucose



Direct effects of maternal nutrition

- Partitioning of protein & plane nutrition
 - In ewes sufficient maintenance but 50% protein;
 - Fetal protein reduced 20%
 - Reduction occurred in spite of protein tissue mobilization
 - Carcass, visceral, mammary tissue accretion
 - Maternal wt and body condition loss



Indirect effects of maternal nutrition

- Moderate undernutrition in early to mid pregnancy (placental growth rapid)
 - Interacts with body condition
 - Good BCS placenta compensates
 - In thin ewes no compensation
 - If maternal stores are available they will be mobilized

Indirect effects of maternal nutrition

- Overfed, in early to mid pregnancy
 - Causes profound reduction in fetal growth
 - Placental insufficiency



Indirect effects of maternal nutrition

- In lean ewes;
 - Fed all they can eat consumed more than fatter ewes
 - Partitioned extra nutrients to maternal



Placental nutrient transport & metabolism

- Mechanism of transport
 - Glucose accounts for 60% of net uptake, gravid uterus
 - Predominate transporters
 - not insulin dependant
 - 5 fold increase in glucose use from mid to late



Impact of placental metabolism on transfer

- Glucose metabolism
 - Entry gravid uterus determined by concentration gradient (if high in blood, flows into fetus)
 - Transport fetus is determined by transplacental concentration gradient
 - Fetal concentration gradient changes relative to mother



Placental capacity for nutrient transport

- Placental size
 - Glucose transport into fetus related to caruncle surface area
 - Heat stress reduces placentomes
 - Glucose transporters decrease
 - Reduces capacity AA



Placental capacity for nutrient transport

- Maternal nutrition
 - Placenta ameliorates under nutrition
 - Ewes w/ twins fed 60% requirements
 - 26% reduction in concentration gradient
 - Offset by 50% increase transport capacity



Placental capacity for nutrient transport

- Maternal nutrition
 - Severe
 - Profound fetal hypoglycemia
 - Helps sustain gradient (restricts reverse)
 - Placenta continues to utilize glucose
 - Lowers availability to fetus
 - Fetus compensates by lowering growth

Metabolic adaptations maternal tissues

- Pregnancy specific effects on metabolism
 - Dam need to adapt (carbohydrate & protein)
 - Lipids changes occur;
 - increased mobilization and metabolism
 - spares glucose & protein for fetus



Metabolic adaptations maternal tissues

- Pregnancy specific effects on metabolism
 - Liver glucose output increases
 - Intake does not

