Interaction Between Nutrition and Reproduction in Dairy Cows

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- “Homeorhesis” is orchestrated changes in metabolism of body tissue required to sustain a specific physiological status.
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BAUMAN AND CURRIE

Metabolic Changes Following Parturition

- Fat tissue metabolism changes from nutrient uptake to lipid mobilization.
- Glucose utilization shifts to the mammary gland from the reproductive tract.
- Up to 1/4 of the total body protein can be mobilized for the benefit of the mammary gland.
- **Basically, in high producing cows the mammary gland takes priority over the reproductive system**

(Swanson, 1989)

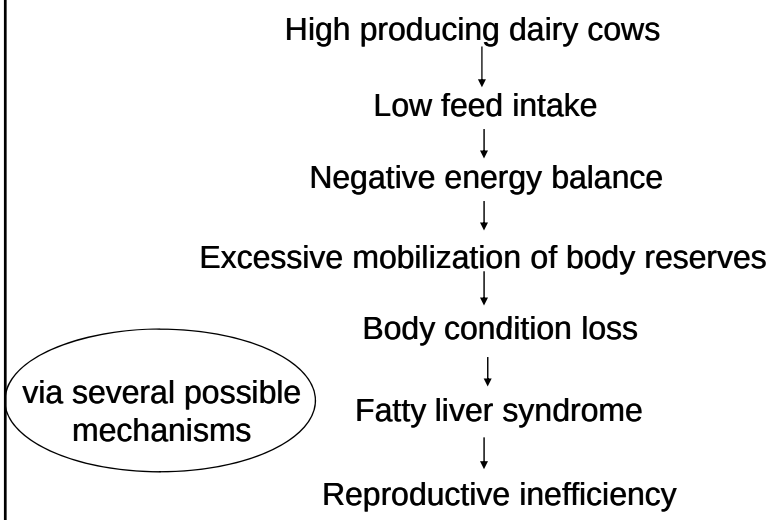
Role of Energy Balance on Reproduction

- In high producing cows, increased nutrient needs required to satisfy milk production cannot be adequately met by the postpartum diet mainly due to low feed intake.
- When feed intake does not meet the nutrient requirements of increased milk production, negative energy balance occurs.

Hypothalamic-pituitary-ovarian Axis Recovery Following Parturition

- 1) Recovery from the exposure to high placental hormones
- 2) Overcoming lactation-induced inhibitor of gonadotropins
- 3) Initiation of luteal development
- 4) Occurrence of estrus and pregnancy

What Is Happening ?



Postpartum Body Condition Loss and Reproductive Performance

- **Dairy cows in negative energy balance lose body weight because body reserves are mobilized as energy sources to support lactation**
- **The severity of postpartum negative energy balance and the delay in the initiation of reproductive cyclicity is associated with body weight and body condition loss**

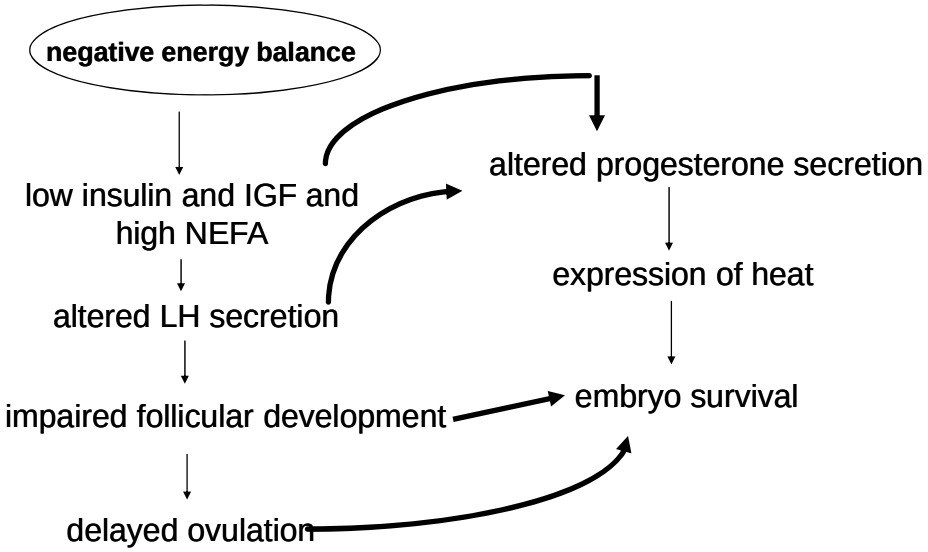
Table 3.Relationship between body condition changes during the first 5 weeks postpartum and reproductive performance.

Trait	High body condition	Low body condition
No cows	46	30
Body condition score change[1] (week 1-5)	+.06	-.58
Days postpartum to ovulation		
First	17.2	23.3*
Second	35.8	44.3*
Conception rate, %		
First service	62	25*
All services	61	42*

[1] body score changes from the average for the entire group

Britt, 1992

Mechanisms of Action
(Summery)



Feeding Strategies in Early Postpartum to Minimize Negative Energy Balance and Loss of Body Condition

- Maximizing energy density of the diet
  - increasing nonstructural carbohydrate (e.g. high moisture corn) in the diet
  - supplementing fat (e.g. whole cotton seed or by pass fat)

Feeding strategies cont.

- Fat supplementation to increase density of dietary energy
  - **Advantage:** may improve fertility by increasing plasma concentration of cholesterol and thus progesterone synthesis
  - **Disadvantage:** cannot be fed in high amount and rumen inert fat is relatively expensive

Other Things We Can Do

- Adjustment of the diet of dry cows during the late dry period so that dry cows do not lose too much body condition
- Body condition score of 3.25-3.75 at calving seems to perform better in terms of metabolic and reproductive health
- Feeding high quality and fresh feed several times a day stimulates feed intake and improves energy status

Common Practice

- Dairy producers try to maximize feed intake during early postpartum for higher milk peak.
- High protein rations are generally more palatable and stimulate intake.
- Dairy producers may feed crude protein in excess of requirement.

Role of Protein on Reproduction

- Increasing dietary crude protein, may lower fertility by increasing days to first postpartum ovulation, service per conception, and (or) days open.
- **Does excess dietary crude protein influence reproduction?**

Table 1. Impact of feeding 18% versus 20 % crude protein (dry matter basis) on estimated reproductive efficiency of dairy cows.

Crude Protein dry matter, %	18	20
Rumen degradable protein/CP, %	60	70
Rumen undegradable protein/CP, %	40	30
Predicted probability of pregnancy		
Lactation 1 to 3	60%	61%
4th lactation and older	60%	43%
Impact on fertility		
Increased services	0	.65
Relative risk of problem breeding	1.0	2.5
Increased days open	0	10-15
Cost, $		
Days open, $2/day	0	20-30
Protein, extra amount for 120 days of lactation	0	25

Mechanisms of Action

- **Feeding excess RDP can lead to elevated ammonia and blood urea.**
- **High ammonia may delay clearance of uterine contaminants by reducing the immune system function.**

Mechanisms of Action cont.

- High blood urea concentration may **alter uterine pH**, prostaglandin and/or progesterone production resulting in an undesirable uterine environment for embryo survival.
- Ammonia and urea may impair sperm, egg, or early embryo survival.
- Imbalance in protein:energy ratio may negatively affect metabolism
- Nitrogen byproducts and (or) efficiency of energy utilization may alter gonadotropin and progesterone secretion

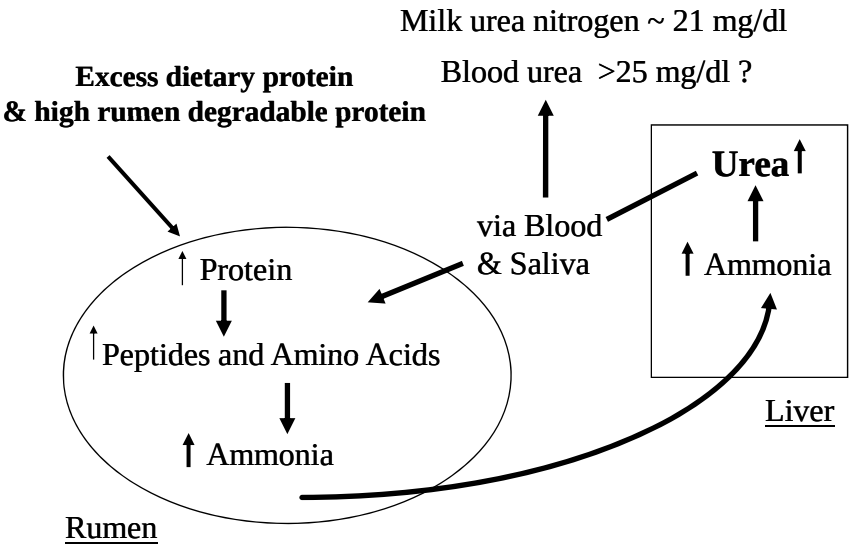


Table 2. Relationship between crude protein (CP) level, conception rate and blood urea nitrogen (BUN) .

	15-16 % CP		**19-21 % CP**	
Reference	Conception %	BUN (mg/dl)	Conception %	BUN (mg/dl)
Jordan & Swanson	53	NR	40	NR
Folman et al.	56	8.8	44	15.4
Kaim et al.	57	9.0	43	17.0
Howard et al.	87	15.0	85	26.0
Carrol et al.	64	11.0	56	24.0
Bruckental et al.	65	25.0	52	32.0
Canfield et al.	48	12.0	31	19.0
Elrod and Butler	83	<16.0	62	>16.0
Avg.	**62**	**13.8**	**48**	**21.3**

- 24 Holstein herds in Ohio:
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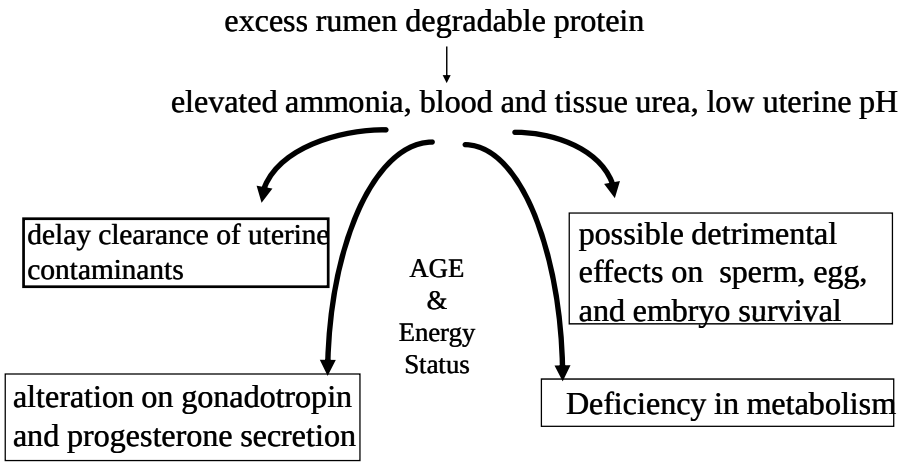
  - cows with MUN values above 15.4 mg/dl were 1.4 times less likely to be confirmed pregnant than cows with lower MUN levels (12.7 mg/dL)

Impact of Excess Protein on Reproduction (Summary)



Management Aspects

- **MUN concentration between 10-16 mg/dL is an acceptable range.**
- **Samples for MUN testing should be taken from group of cows that are in same plane of diet and are in a similar stage of lactation.**
- **Bulk tank MUN is not informative:**
  - **By only taking a bulk tank sample we would not be able to detect a problem within a group of cows that experience deficiency or excess of dietary protein.**

Management Aspects

- **How many cows should we test?**
  - **if samples are collected only for milk urea, it is possible to sample a minimum of 8-10 cows in a group.**
  - **reasonable number of cattle to test is 15 to 20% of the group.**
- **Reduce variation and confounding effects**
  - **initial and subsequent samples should be taken at the same time of the day.**
  - **Consider feeding and milking time**

Suggestions

- Rations should be formulated to provide proper amount of rumen degradable and rumen undegradable protein
  - Balance for 18% crude protein DM for high producing cows
  - rumen degradable / rumen undegradable
    about 63% to 33%
- After critical evaluation of other aspects of reproductive management adding bypass protein may be considered