Feedstuffs, November 13, 2006 **Feedstuffs** Reprint

Calf transportation is one source of stress

Bottom Line

with
AL KERTZ*

THE young calf is least capable of handling stress yet often undergoes the most stress on a dairy. These stresses include being born, the environment in which they are born, housing, how and what they are fed, magnitude and duration of sicknesses, de-horning, vaccinations, etc.

A program highlighted stress in calves (Leadley, 2006), in comments offered by Dr. David Hale to a calf raiser's group in northwestern New York. Hale indicated that the following things occur when a calf is stressed, as mediated through the adrenal gland making and releasing the steroid hormone cortisol:

- Blood pressure increases.
- Strength of heart muscle contractions increases.
- Blood is diverted from peripheral organs to vital ones (for example, from feet to heart and lungs).
- Blood sugar goes up, and sugar use by body cells goes down.
- Acute reactions of tissue cells to trauma and/or toxins are prevented or inhibited.

While the above effects are positive in that they are critical for survival in life-threatening situations, there are downsides because the body defense mechanisms are decreased as follows:

- Cortisol decreases white blood cell movement to infection sites. It also decreases destruction of foreign material by body cells (phagocytosis).
- Cortisol decreases interferon production (interferon is the body's alarm system for viral infection).
- Cortisol decreases production of two types of white blood cells (eosinophils and lymphocytes).
- Cortisol decreases antibody production.

This all adds up to the body turning off its immune system defenses in an attempt to survive. While this may increase short-term survival, the longer-term result may be overwhelming infection and death.

We know that these stresses can occur in multiple fashion around the weaning transition period (Kertz, 2002), but what about the early period, such as when calves are moved?

This is increasingly an issue with larger calf operations picking up calves in a given geographical area for transport to their facility. This was studied and reported from Wageningen, Netherlands (Arieli et al., 1995).

Twenty-four Holstein male calves averaging six days old and 97 lb. initial bodyweight were obtained from commercial dairy farms. Calves were fed colostrum during the first two days of life and only a liquid milk replacer thereafter. Calves were brought into the laboratory after traveling an average distance of 12.5 miles and for a duration of 30 minutes.

Upon arrival, calves were assigned to a 2 x 2 factorial arrangement of treatments involving high-energy (HE) or lower-energy (LE) feeding and ambient temperatures of 45.5°F or 66°F. Feeding levels corresponded to 0.7 (LE) and 1.1 times (HE) maintenance. The milk replacer used all milk byproducts and contained 23% crude protein and about 19% fat.

Calves were individually housed in one of two open circuit indirect climatic respiratory chambers for two consecutive seven-day periods. Calves were tethered and kept on a wooden slatted floor. Relative humidity was maintained at about 65%, and air velocity was less than 0.2 m per second. Lights were on from 0645 to 1845. Calves were weighed at the beginning and end of each balance period at 0900, and bodyweight were adjusted for milk intake at 0800.

Total fecal and urine collections were done, and heat production was determined daily from continuous measures of carbon dioxide and oxygen. Energy retention, energy retained as protein and energy retained as fat were calculated per balance period for each calf. Weekly differences (a positive value indicates an increase for that trait between weeks 1 and 2) in heat production, growth and energy balance at LE and HE are shown in the Table at both ambient temperatures.

Weekly differences in heat production, growth and energy balance

	LE		HE		Std. error	
	45.5°F	66°F	45.5°F	66°F	of means	P-value[1]
Heat prod, kcal/kg of bodyweight$^{0.75}$ per day	-10.1	-16.0	-11.6	-10.3	1.54	TxF[2]
Retention, kcal/kg of bodyweight$^{0.75}$ per day						
Energy	23.1	24.8	16.3	23.0	5.50	NS
Protein	-2.0	1.1	-6.0	3.3	3.34	T[3]
Fat	25.1	23.7	22.3	19.8	3.04	NS
Growth, g per day	56	36	-62	78	90.5	NS

[1]F = Main effect of feeding amount; T = main effect of temperature.
[2]P <0.05.
[3]P < 0.10.

Mean heat production decreased by 12 kcal/kg of metabolic bodyweight (bodyweight$^{0.75}$) daily from weeks 1 to 2. This was largest when LE and thermoneutral ambient temperature were combined. Normally, there is a decrease in basal metabolic rate and metabolizable energy for maintenance in the first few weeks after birth for calves.

These changes indicate an adaptation of the young calf to limited energy reserves and to a dietary energy source that may be characterized by a low-carbohydrate, high-fat diet.

This decreased efficiency from weeks 1 to 2 was paralleled by a significant increase of urinary nitrogen excretion (not shown). This may be related to an increased utilization of protein as an energy source, coinciding with an increased capacity for endogenous production of glucose by the calf. At the same time, the calf increases its ability to digest protein and dry matter weekly, as shown in a classic study by Polzin et al. (1976).

Other key findings in the Arieli et al. report were:

*Dr. Al Kertz is a board-certified, independent dairy nutrition consultant based out of St. Louis, Mo. His area of specialty is dairy calf and heifer nutrition and management. To expedite answers to questions concerning this article, please direct inquiries to *Feedstuffs*, Bottom Line of Nutrition, 12400 Whitewater Dr., Suite 160, Minnetonka, Minn. 55343, or e-mail comments@feedstuffs.com.

• There was a 5% increase in energy digestibility in week 2 compared to week 1, including a 9% increase in nitrogen digestibility. This is likely due to increased maturation of the digestive system, as just noted, but also reflects some stabilization after the initial movement from farm to laboratory.

• Young calves need at least two weeks to adapt to a combination of new environmental temperature and lower energy, according to another report cited (Tomkins and Jaster, 1991) based on a comparison of the thermal demands of calves fed restricted energy.

• There was a positive correlation between digestibility and initial immunoglobulin G (IgG) serum concentration. The authors noted that this might be due to (1) IgG preventing excessive endogenous loss of fecal material caused by intestinal damage or (2) IgG having a greater effect on energy metabolizability than on energy digestibility. This indicated that IgG affected energy balance at locations other than at the gut and was associated with a tendency for greater protein retention.

So, young calves may need at least two weeks to adapt to a combination of new environmental temperature and lower energy intake. Both nutrient availability and heat production changes indicate that for the first two weeks after arrival, calves are not yet in a steady state regarding energy metabolism and, thus, are in a precarious state.

The Bottom Line

At the 2004 Professional Dairy Heifer Growers Assn. conference, Mike Van Amburgh of Cornell University calculated from this Arieli et al. (1995) study that an additional 0.25 lb. of dry matter intake would be required to compensate for this increased stress due to transporting these calves.

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