

STRESS AND DAIRY CALVES

**Field Day, June 24, 1997
Carolyn L. Stull, Ph.D.
Veterinary Medicine Extension
University of California, Davis**

What is Stress?

Everyone knows what stress is, however, it is not easily defined. One definition defines stress as adverse effects in the environment or management system which force changes in an animal's physiology or behavior to avoid physiological malfunctioning and assists the animal in coping with its environment. Animals respond to challenges in their immediate environment by several interacting mechanisms including physiological, biochemical, immunological, anatomical and behavioral. Identifying and minimizing stressful situations allows for greater well-being, growth, reproductive efficiency of the animal as well as economic benefits for the producer and consumer.

COMMON TYPES OF STRESSORS

A satisfactory environment for a calf provides for thermal comfort, physical comfort, minimal disease or maximum health, and behavioral needs. Each of these four areas can be a potential source of stress for the dairy calf.

Thermal stress

Cold or heat stress can affect younger or sick animals much more severely than mature, healthy cattle. Thermal comfort may be quantified as the thermal neutral zone. In the calf, the range is 50° to 85°F in still air. This optimal thermal environment promotes maximum performance and provides the least stress for the calf. Within this thermal neutral zone, the calf can maintain body temperature, or homeothermy, by constriction or dilation of the blood vessels, changing postures or behavior, changes in hair, or by sweating and panting. As air temperature falls below 50°F, known as the lower critical temperature, the calf must divert food energy from production or growth to produce additional metabolic heat and maintain body temperature. This ultimately leads to a reduced feed efficiency. Cold stress has also been shown to decrease the rate of absorption of colostrum in newborn calves.

The upper critical temperature, approximately 85°F, is reached when the calf cannot dissipate enough metabolic heat to the environment to maintain homeothermy. Thus food **intake** is reduced, thereby lowering heat production generated by digestion and absorption of nutrients. This decreases the growth rate in calves. Other environmental factors such as humidity, wind-chill factors, and moisture due to rain or mud, affect the upper and lower critical temperature of the environment.

Environmental

The physical component of the calf's environment includes the space available and the surfaces with which the animal comes into contact with. Flooring materials and space allocation in confinement systems have been studied in calf systems. Slippery surfaces should be avoided to prevent injury, both in individual stalls and group pens. Calves placed in group pens should be provided with enough feeder space to allow all calves access. Water availability should also provide easy access, especially to the small, young calf.

Another environmental stressor of the calf's environment which may have a greater impact on health and well-being is the waste management system. Toxic gases, especially elevated ammonia levels, can cause damage to the lung epithelium and precipitate respiratory disease. The calf may be continually exposed to these gases with the accumulation of manure and urine.

Disease

This stressor is that which results in the onset and spread of disease. The susceptibility of the calf depends on many factors including its immunity levels, pathogen challenge and preventative health program. The newborn calf is dependent on colostrum for the first 30 days of immunity. Greater mortality, increased morbidity, and lesser weight gains have been correlated to the ingestion of colostrum. The calf must receive the colostrum within 24 hours, and preferably within 6 hours to maximize the transfer of passive immunity. Colostrum not only contains necessary immunoglobulins, but also contains higher concentrations of protein, fat, vitamins and minerals than compared to milk of later lactation. Thus, colostrum assists the newborn calf both in immunity and enhanced nutrition.

Cleanliness and stocking density can affect the pathogen challenge to the calf. Dry, sanitized, and clean housing is important in minimizing disease. The umbilical cord should be dipped in 7% tincture iodine solution to help prevent access to pathogenic bacteria. Vaccination and parasite programs are important components in effectively managing disease and parasitic infections. Herd history and age of calves will assist in planning an effective preventative health program.

Other Stressors

There are numerous other examples of common stressors in the management of dairy calves. These include management techniques such as ear tagging, dehorning, or transportation. These management techniques should be planned to minimize the total additive effect of all stressors on the calf. Social stress can occur when calves are isolated from herd mates or through interaction of an individual herd mates. Calves recently introduced to a herd, and sick or injured calves may experience social stress. One stressor which is easily eliminated is the improper handling of calves by caretakers which can cause both behavioral and physiological stress effects.

EFFECTS OF STRESS

The reaction of the animal to stressors depends on the duration and intensity of the stressors, the animal's previous experience to the stressors, its physiological status, and the immediate environmental restraints. An animal may react either by a behavioral or a physiological response, but most often a combination of both. The duration and intensity of stress can impact the animal's capacity to grow, reproduce and maintain health.

A normal behavioral response to an immediate and acute type of stress is easily observed. The calf usually will exhibit a fleeing response, if the environment allows it, or the calf is not restrained. An example of this type of stressor is a loud noise or a short term, painful procedure, such as administering injections.

Some abnormal behavioral responses have been categorized as "stereotypies." Stereotypies are sequences of movements which are repeated over and over without any apparent function. Examples of stereotypical activities in calves are tongue rolling, head butting, and repetitive licking and/or scraping of objects. Stressors which induce stereotypic behaviors can be situations in which calves are isolated from herd mates for extended periods of time or deficiencies in feeding programs.

Physiological responses to stress have been investigated more than behavioral profiles. However, no one physiological parameter has been identified to quantify a stress response. In both humans and animals, parameters which have been utilized in studying the stress response include measuring levels of hormones released from the brain and other organs, fluctuations in white blood cell parameters, and changes in the heart rate. A short term stressor, such as a loud noise, increases the heart rates and may cause constriction of the blood vessels. A stressor which lasts several seconds to a minute may increase heart rate, respiration rate, and cause digestive upset or decrease feed intake.

A long term, chronic stress, usually 24 to 48 hours, can occur in calves which are shipped or experience thermal discomfort. This longer term stress influences a number of systems in the animal including the immune, digestive, and reproductive systems. Long term stress can influence hormones essential in reproduction, growth, energy metabolism, and response to disease or infection. These deficiencies can continue after the stimulus from stressor has been diminished or eliminated.

MEASURING STRESS

The quantification of a stress response by scientists often has been designed to examine only the behavioral or the physiological responses. However, recent data has been collected utilizing a multidisciplinary approach which combines both the behavioral and physiological responses. Behavioral responses to chronic or long term stress can be very difficult to observe. This may be seen in a calf by a decrease in the amount of time spent in a recumbent position, less interaction between herd mates, or less time spent eating or drinking. All of these behavioral responses can manifest a physiological effect by a decreased growth rate and possibly a compromised immune system. Utilization of video recordings has assisted scientists in collecting behavioral data without disturbing the calves by the presence of the researcher. The very basic postures and activities can then be recorded and analyzed for duration and frequency. Thus, calves in different environments are compared and a behavioral profile established for that specific environment.

Physiological measurements of stress are dependent on the interaction of many systems. Some stress responses can be measured by the functionality of the primary system involved. Examples include a high environmental temperature which would increase respiration rate, induce sweating and raise body temperature. Lack of colostrum would compromise the immune system in the calf less than a month old. Changes in hormones such as cortisol, or the reproductive hormones are utilized in quantifying the response to stress. One indicator of the impact of stress on the immune system is characterized by the ratio of neutrophils to lymphocytes, which are types of white blood cells. Heart rates can be recorded by telemetric systems to monitor the stress response of the cardiovascular system. Stress is important to the dairy producer, since the longer term effects influences the ability of the calf to mature and reproduce.

MINIMIZING STRESS

The first step to minimizing stress on the production facility is to be able to identify the signs and symptoms of stress in both the individual animal and as a herd. This will include observations on appropriate or abnormal behavior,

indicators of sickness, and decreased weight gains and subsequent growth. Once a stressor is identified, its rapid elimination will assist in termination of the stress response. Proper management of the calf including housing, waste management, sanitation, preventative health programs, nutrition are essential in minimizing stress. The proper handling of calves, prevention of accidents, and suitable facility design which incorporates the calf's well-being may have a continual effect on behavior as the calf matures to a lactating cow.

REFERENCES

- Friend, T. 1980. Stress: What is it and how can it be quantified? *Int. J. Study Animal Problems*. 1(6):366-374.
- Roy, J.H.B. 1990. *The calf. Volume 1. Management of Health*. London: Butterworths.
- Stull, C. L. and McMartin, D.A. 1992. Welfare parameters in veal calf production facilities. Davis: University of California, Davis.
- Webster, A.J. 1983. Environmental stress and the physiology, performance and health of ruminants. *Journal of Animal Science*. 57:1584-1593.
- Yousef, M.K. 1985. *Stress physiology in livestock, Volume 1, Basic principles*. Boca Raton: CRC Press.