Physiological Reactions of Livestock

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LESSON 2 : Reactions of Animals to Thermal & other Environmental Factors

- ✓ Functions of all organs and systems ultimately depend upon **absorption of nutrition**.
- ✓ The food taken in by the animal is used in ***constructing new tissue while some is broken down that i.e., oxidized by tissue cells to produce heat and energy***.
- ✓ The heat produced by ***oxidation processes can be measured which will determine the metabolic rate*** (An indicator of their nutritive and productive status).
- ✓ It is also very much influenced by the environmental variables such as temperature, humidity, air velocity and radiation.
- ✓ The heat and moisture released through respiration are simples and his heat must be dissipated out.

1.2 Homeostasis

Homeo – like or similar,
Stasis - standing

- ✓ Preventing changes or keeping things the same.
- ✓ It refers to the "**maintenance of a fixed internal environment in animals through dynamic and self regulating processes**".
- ✓ Many internal factors are maintained constant (These include *body temperature, mature body weight, blood pressure, respiration, body fluid, hormones and movement*.)

Homeothermy:

Maintenance of appropriate internal body temperature is an excellent example of homeostasis, sometimes called homeothermy.

- ✓ The regulation of internal temperature is carried out through several sets of feedback mechanisms.
- ✓ Mammals and birds are homeotherms and they are equipped with peripheral receptors in the skin and central receptors in the brain.

- ✓ There exists for each species a range of environmental temperature that is optimal in terms of minimum action by the regulating mechanisms. This range is the thermoneutral condition.
    - ***When the environment cools below this range:*** the condition is sensed peripherally and transmitted to a specific part of the brain (the posterior hypothalamus), which activates a set of protective actions (These include *increase in appetite* and rate of heat production, *decrease in blood flow to the periphery, and change in posture of hair coat or feathers*). With continued decrease in external temperature shivering is initiated. Shivering is involuntary muscle contractions that increase the rate of heat production.
    - ***When external temperature rises above the optimal:*** another set of protection devices is activated (*The surface blood vessels dilate, appetite decreases, rate of moisture evaporation increases, respiration rate increases, in humans, profuse sweating occurs*). These actions are involuntary and are mainly controlled by the anterior hypothalamus in response to blood temperature changes. Increase in appetite increases metabolic rate, the other actions serve to increase rate of heat loss to the environment.

Thermoneutrality occurs within a range of environmental temperatures in which the body's homeothering mechanism maintain a balance between heat loss and heat production without stress.

Within this range the thermal regulation is minimal – **neither heat nor cold in felt**. In these terms, thermoneutrality defines a "**comfort" zone**.

The **overall objective** in animal housing systems design thus is to create environments in which the animals approach thermoneutrality, but with appropriate balance between the productive value of thermoneutrality and the cost of systems to maintain it.

Animal Reactions

The reactions of animals to environmental factors can be arbitrarily divided into two classes ***Productive and physiological***. The physiological reactions are body temp, pulse rate and respiration rate.

(i) Temperature:

- ✓ This is the most significant parameter Environmental temperature is the ***integrated total of all temperatures surrounding the animal*** is steradions.
- ✓ If the walls, ceiling, floor and air temperatures are identical, then the environmental temperature is simply the air temperature, but this is a rare case.
- ✓ The more usual case is that ***surfaces and air are at different temperatures*** and adjoining a THI (temperature humidity index) of 75 is a critical value for even the low producers, while the higher producers are already affected at this THI.
- ✓ Hence THI should be between 72-75 for normal cows.

Light

- ✓ The seasonal variations in physiology of farm animals are related to light, including both duration and climate. It appears that ***length of day, or rate of change of day length*** have marked *effects on hair coat of cattle and wool growth and breeding behaviors of sheep*.

Air movement:

- ✓ Animal heat loss is influenced by air velocity, which is important at both low and high temperatures. Under confinement conditions the air velocity can usually be regulated by fans.
- ✓ In the case of ***dairy cattle held at 95°F air temperature an increase in air flow rate from 0.5 to 10 mph*** (mily per hour) tended to reduce production losses normally experienced at such high temperatures.
- ✓ However, 10mph *is a rather high velocity inside a building and would be particularly annoying if conditions happened to be dusty*. The favorable effect of *increased air flow at high temperatures is due to the increase in evaporative heat loss*.

- ✓ The daily weight gains of beef cattle in summer are considerably less at 0.5 mph compared to 4mph. Increasing air velocity above the latter figure, however gives no further advantage.