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Implications of Stress on Livestock Growth and Productivity

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Abstract
An individual's biological reaction to physical, emotional, or mental stimuli that upset their homeostasis is stress. Chemical stresses such as poor water quality, low dissolved oxygen, imbalanced pH levels, chemical introduction, or pesticide contamination can be the cause. Stress can also be caused by the makeup of the diet, which includes the amount of protein and amino acids as well as metabolic waste products like nitrite or ammonia. Pathogenic and nonpathogenic microbes, parasites, species mixing, territoriality, space requirements, and population density are examples of biological stresses. Temperature, dissolved gases, light, and sound are examples of physical stresses. The body's homeostasis may be upset by these stressors, leading to a coordinated physiological response aimed at stabilising the system. Prolonged stress can cause disease, suffering, and in extreme situations, even death.Overall, stress is a complex and multifaceted issue that can impact an individual's overall health and well-being.

Keywords: Stress, Livestock, Productivity, Stressors, Heat, Temperature, Animals.

Introduction
Stress is an all-encompassing term that is usually used negatively. It describes the detrimental effects that multiple factors have combined to have on an animal's health and ability to perform. It occurs when an animal's ability to maintain a regular physiological condition is compromised by several factors that are detrimental to its general state of health. In biology, the word "stress" is frequently used to refer to a group of physiological and behavioural changes brought on by unpleasant stimuli. (Agarwal and Prabhakaran, 2005). Stress is the culmination of changes in a creature's physiology and behaviour brought on by external factors, whether they be mental, emotional, or physical. It usually has a negative connotation and is defined by the negative effects of different factors on the efficiency and welfare of animals. The normal physiology or homeostasis of the animal is disturbed by this situation. (Ghosh *et al*., 2019).

In their thermoneutral zone, homoeothermic animals maintain a normal body temperature with little energy use. The effective temperature of the environment is raised above the livestock's thermoneutral zone by high ambient temperature, solar radiation, and wind speed. As a result, the animal's body temperature is higher than the range designated for its thermoneutral zone, and its overall heat load is higher than its ability to dissipate heat. (Bernabucci *et al*., 2010). This situation is called heat stress. When heat stress is accompanied by high ambient humidity, the effect of high temperature is more pronounced because of the reduced heat dissipation by evapotranspiration (Lin *et al*., 2000; Marai *et al*., 2007).

If livestock producers are unable to identify the environmental factors and management practices that stress farm animals, it could result in a shortage of animals and animal products. Farm animals may also perform poorer and have reduced reproductive potential. Understanding the stressors that affect domestic farm animal productivity and management strategies that can lower environmental stress are necessary to improve animal comfort and maintain a safe, efficient, and reasonably priced food supply. Studying the effects and consequences of stress on animal productivity is crucial for accurately evaluating and identifying the stressors that affect animal productivity. Furthermore, it's critical to comprehend how these stressors affect animals.. The ultimate objective is to devise approaches for mitigating stress in farm animals, thereby promoting improved productivity.

Stressors in livestock

The different stressors that enhance stress in animals can be chemical stressors: poor water quality low dissolved oxygen, improper pH, Pollution intentional pollution: chemical treatments, accidental pollution: insect spray, Diet composition - type of protein, amino acids, Nitrogenous and other metabolic wastes accumulation of ammonia or nitrite. Biological stressors encompass factors like population density (such as crowding and mixing different animal species, leading to aggression and territorial behavior) as well as the presence of microorganisms (both pathogenic and nonpathogenic) and microorganisms like internal and external parasites. On the other hand, physical stressors include elements like light, sounds, dissolved gases, and temperature. Temperature is one of the most important influences on the immune system of animals and Procedural stressors are handling, shipping, and disease treatments (Altan *et al*., 2003; Asres and Amha, 2014).

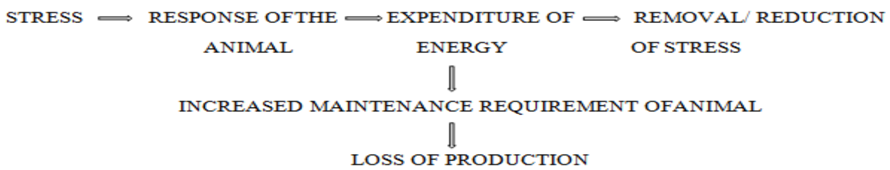
The different types of stressors and their effect on the physiological system are presented below-(Ghosh *et al*., 2019)

Stressor	Symptom	Physiological system inhibited
Heat	Elevated body temperature	Increased heat loss and decreased phasic drive
Cold	Reduced body temperature	Food intake has increased, and the heat gain and loss mechanisms have been improved.
Poor housing	Increased lameness	HPA axis activated
Poor nutrition	Insufficiency signs	Mobilization of the nutrient reserve, altered behavior
Social	Altered behavior	Food intake reduced, HPA axis activated

Adverse effect of stress on animal health

Growth and production: Different stressors have a negative impact on an animal's growth and productivity. For example, increased levels of glucocorticoids in response to stress stimulate the hypothalamic secretion of somatostatin, which inhibits the anterior pituitary's growth hormone (GH) secretion. It is evident that these stress hormones have an impact on an animal's growth. Another stressor that has been shown to have an impact on an animal's body weight reduction is transportation stress. (Aich *et al*.,2012).

The primary outcome of stress in animals, regardless of its source, is a decline in production. The animal expends energy in order to counteract the impact of stress. It results in production loss. The Mechanism is described below with a diagram (Ghosh *et al*., 2019).



In lactating dairy cows, more than 35°C of body temperature stimulates stress (Berman, 2005) and this reduces milk yield through reduction of feed intake and metabolic problems (Baumgard *et al*., 2010). Due to reduce in feed intake in dairy animals, drop in milk production up to 50% resulted (Baumgard and Rhoads, 2013). A decrease in milk yield following lactation is the result of heat stress during the dry period which reduced mammary cell proliferation (Tao and Dahl, 2013). Due to this, heat stress reduces milk production by 14% and 35% in early lactation and mid-lactation respectively.

Impact on reproduction

Fertility: Seasons affect breastfeeding cows' fertility. Falls by around 50% in the winter, 20% in the summer, and less in the autumn than in the winter. A few years earlier, Brown-Brandl *et al*., 2005) reported that conception rates fell from 52% in winter to 24% in the summer. In summer, 80% of estrus may be undetectable. Brown-Brandl *et al*., 2005) Pregnancy rates can drop by up to 50%, and when indicated, the animals' rectal temperatures rose from 38.5˚C to 40˚C in just 72 hours following the insemination procedure. In stress-exposed male animals, gamete maturation or formation disrupted spermatogenesis and reduced sperm fertility parameters; however, in female animals, it disrupted folliculogenesis and may also prevent gonadotropic response in granulosa cells due to the presence of glucocorticoid receptors. (Fernandes *et al*., 1997).

Seasonal influences affect the variation in nursing cow fertility. Heat stress can have a detrimental effect on the development and maturation of oocytes, or egg cells, which can result in decreased oocyte development. Furthermore, these cows' increased infertility has been connected to heat stress. Furthermore, as 80% of estrus is undetectable in the summer, poor fertility is caused by inconspicuous estrus during this time of year. An elevated temperature triggers an increase in endometrial PGF-2α release, endangering the maintenance of pregnancy and perhaps leading to infertility. (Girma F and Gebremariam B, 2019).

Semen Quality: Regarding the Man Low sperm quality is directly linked to low female fertility and can be brought on by environmental stress. This is likely because low fertilisation rates and increased embryonic mortality work together to induce low fertility in females. (Yousef *et al*., 1968).

Male fertility is just as crucial as female fertility for the fertilisation of eggs to create a viable embryo. Bull testicles need to be 2–6°C colder than body temperature in order to produce viable sperm. Bulls that have infertility may experience alterations in seminal and biochemical parameters as a result of heat stress-induced elevation in testicular temperature. Seasonal variations in sperm and hormone levels can have an impact on male reproduction. Heat stress lowers factors related to semen quality in the summer. (Girma F and Gebremariam B, 2019).

Estrous period and follicular growth: The female sexual behavior and fertility rate are the main indicators of mammalian female reproduction that are negatively affected by environmental stress. A temperature increase of 0.5˚C uterine during hot days caused a decrease in the rate of fertilization (Asres and Amha, 2014). Maternal behavior; Stress during gestation alters postpartum maternal care decrease and related to offspring prenatal stress induces developmental and behavioral disorders (Webster, 2001).

Embryonic development: Thermal stress affects the development and survival of embryos in dairy cows. lowers the chance of embryonic mortality under heat stress by interfering with the synthesis of interferon tau, cellular degeneration, and protein buildup. Embryo development and endometrial activity are both restricted by insufficient progesterone production. The heat stress that dairy cows endure can also slow down the development of embryos. Furthermore, heat stress can result in foetal malnourishment and, eventually, retarded foetal growth. (Girma F and Gebremariam B, 2019).

Several studies (Bhatia and Tandon, 2005) have indicated that in cattle, embryonic development is highly sensitive to high temperatures, in the top three to 11 days after service; acquiring more heat tolerance as the gestation period progresses. Reduced uterine and umbilical blood flows result in decreased foetal oxygen, nutrition, and growth; also, greater uterine resistance with high anxiety ratings and low birth weight are associated with early embryonic death in cattle and an increased risk of spontaneous abortion and premature delivery. (Fox and Tylutki, 1998).

Effect of Stress on Immune Function and Susceptibility to Disease: It is well recognised that a variety of psychological and physical stresses can change the physiological concentrations of certain hormones, chemokines, and cytokines. These changes provide signals to the central nervous system, which then sends instructions to the appropriate organs, tissues, or cells to initiate the necessary reactions. These signals have the ability to stimulate or inhibit the immune system as necessary, and if the body is unable to make up for this, it may result in major health issues. (Aich *et al*., 2009).

Events that are likely to be stressful might also make one more susceptible to other ailments. For instance, repeated fear has been linked to a higher incidence of mastitis in dairy cows, according to many studies. The exact process underlying this impact is unknown, although it has been hypothesised that stress may compromise the natural-killer cells' ability to perform their duty, which might raise the mammary gland's vulnerability to pathogenic pathogens. (Asres and Amha, 2014).

Effect on Metabolic Changes: According to Altan *et al*. (2003), heat stress increases lipid peroxidation which was associated with the production of a large number of free radicals which are capable of initiating the peroxidation of polyunsaturated fatty acids. Ralhan *et al*. (2004), also revealed that when buffaloes have reticulo-ruminal impaction, lipid peroxidation rises noticeably. Raised air temperatures can cause metabolic and health issues because they alter the physiology of ruminant animals. While heat stress increases butyrate and propionate synthesis, it decreases acetate production. Moreover, it lowers the generation of metabolic heat and modifies the pH, rumen microbiota, motility, and rumination. (Girma F and Gebremariam B, 2019).

Thermal stress raises the metabolism of water and electrolytes while decreasing the metabolism of energy (basal metabolic rate). In Bos taurus and Bos indicus, the maximum water intake during the heat period increased from 4.8 to 9.8% and 3.8 to 9.3%, respectively, over the control period. The primary cause of this is decreased plasma concentrations of corticoids, growth hormone (GH), and thyroxine, which are metabolic hormones. (Qayyum, 2010).

Effect of Stress on Feed Intake: According to certain evidence, stress may hinder rumination, which could reduce feed digestibility and performance as a result. This may also raise the risk of ruminal acidosis. It's critical to emphasise that stress is known to interfere with sleep patterns and that brain activity during rumination is comparable to that seen during sleep. Still unknown, though, is the precise mechanism via which stress affects rumination. Under nutritional stress, animals would lose weight, develop eating disorders, have altered body fat ratios, reduced appetites, and vitamin deficiencies. (Asres and Amha, 2014). Feed intake is directly influenced by temperature. In milking cows, as the atmospheric temperature is 25-26°C and above 30°C, feed intake starts to reduce slowly and rapidly respectively (Girma F and Gebremariam B, 2019).

For every degree Celsius that the temperature rises in the 22–32°C range, food intake will drop by 1.2%, and in the 32–38°C range, it will drop by 5%. feeding hens in the evening to increase calcium intake and improve laying rates and eggshell quality. Because heat stress increases the body's excretion of minerals and lowers serum and liver concentrations of vitamins and minerals, it has been shown that vitamin and mineral supplements can reduce mortality and improve the growth performance of poultry birds under heat stress. (Sahin *et al*., 2009).

Impact of Stress on Hormonal Changes: (Lay, 2010) revealed that prenatal stress generated by sows' injection of stress hormones and constraint (of the dams) resulted in offspring with higher plasma cortisol levels in response to stress and a reduced capacity for wound healing. Glucocorticoids, a class of steroid hormones that depress the immune system, includes cortisol. Moreover, cortisol might increase blood sugar and blood pressure. Stress during pregnancy has been demonstrated to raise cortisol levels in the foetus, which may subsequently compromise immunological response and raise the maximum binding capacity of glucocorticoid receptors in the central nervous system right after birth. Hierarchies are found to occur among social groupings of pigs. Piglets born to sows at the bottom of the hierarchy may have stressful pregnancies. (Durham, 2010). Phillips and Santurtun, (2013) reported that the simultaneous relationship among thermal stress, plasma aldosterone level and urine electrolyte concentration in bovines.

Conclusion

Stress is a state in which an animal's physiological homeostasis is upset by a variety of stimuli that are detrimental to its welfare. An animal's health and performance can be negatively impacted by the stress response, which involves a number of changes that can impair an animal's performance and immunity. These changes can include decreased food intake and rumination, decreased oxytocin release inhibition, decreased fertility, and effects on the quality of meat and by-products. Chemical stressors, such as poor water quality, pollution, and dietary composition; biological stressors, such as species mixing, population density, and microorganisms; and physical stressors, such as light, sound, dissolved gases, and temperature fluctuations, are some of the stressors that contribute to this state.

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