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Review on Effect of Stress on Production and Reproduction of Dairy Cattle

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Abstract

A man can create stress as the result of confinement and an ambitious vision and carelessness.Many people create stress to fulfill their interest of improving production and reproduction, which carries out unconsciously through manipulating animal which is even impossible to adapt to our environment. Reduction in synthesis of milk and susceptibility of dairy cows more to illness is the result of stress, which can affects further directly and/or indirectly metabolic and physiological acclimation. Therefore, this review aims to review effect of stress on production and reproduction of dairy cattle. Stress affects the reproductive performance of both male and females. In male's quantity and quality of the sperm and females fertility percentage, fertility and embryo quality declines. Moreover, the productive performance of cattle like milk production and growth of cattle is also affected by stress factors.Hence, managing effect of stress factors is aimed at alleviating rather than eliminating the challenges on animals production and providing shelters, insulation in the form of bedding, proper feeding, and reduction of dry matter daily intake, reduction of rumen fermentation activity, reduction of physical activity and direct cooling of animal are needed to alter stress. Furthermore, creating awareness on animal handling techniques, continuing research and development endeavors are needed.

Keywords: Stress, Dairy cattle, Production, Reproduction, Performance.

INTRODUCTION

Lack of attention and ruthless production goals which are carried by producers leads to confinement and ultimately create stress. Many people create stress to fulfill their production goals through improper handling techniques which make then even difficult to survive. This directly related with infection of disease causing agents. The contribution of humans with this regard is crucial and that's way its effect is easily managed by them. Furthermore, humans could identify stress in milk animals through use of thyroid hormone and its metabolites [1].

Heat stress is caused when the body temperature of an animal is beyond its normal range which creates a problem in heat dissipation and finally reduces physiological as well as behavioral responses [2]. It has negative impact on farm animal productivity and health [3]. In high producing animals the effects of heat stress are particularly negative due to high metabolic rates. Hence, reducing productive performance avoid hyperthermia [4]. Furthermore, in today's world, there is negative relationship of milk yield and heat stress [5].

Animal, which are not protected against cold are more susceptible to cold stress or hypothermia and there are two possible conditions for formation of cold stress which are natural and artificial. Serious illnesses, injuries, everlasting tissue problems as well as deaths are due to difficulty in regulating body temperature's [6]. More energy is required as animals exposed to cold weather to maintain their body reserves and body temperatures. Increasing feed intake of cattle is one way to compensate for colder weather. However, how much they can consume can be limited by physical of cattle. Once that physical limit was reached, to compensate for the increased energy requirement cattle need higher quality feeds and supplements [7]. Therefore, this review is aimed to review the several effects of strees in productive and reproductive performance of dairy cattle.

STRESS AND DAIRY CATTLE PERFORMANCE

Productive performance

Milk

Even though high milk production is connected with high heat production of cattle, the body a cow is able to maintain and avoid hypothermia. The heat loss is avoided by animals through production of more hair coats. Lower fertility and production performances are commonly seen in cold stress seasons and along with increased nutrient demand [8]. Cattle breeders who keep their cattle on pastures and free stall barns mainly faced problem of cold stress. Cold stress was associated with factors like barn microclimate: temperature, relative humidity and air velocity. Solar radiation in un-shaded areas of the barn can mitigates operative temperature sensations during frost. Due to increased feed intake and decreased heat stress in cattle, rumen volatile fatty acid production increased in cold stress season. The thermo neutral zone (comfort level) of cow is between -2 - 20°C. Depending on other factors such as humidity, housing, ventilation, *etc* temperatures above or below thermo neutral zone may affect dairy animals [9].

In animals of high genetic merit, milk production and its composition in dairy animals adversely affected by heat stress [10]. In lactating dairy cows, more than 35°C of body temperature stimulates stress [11] and this reduces milk yield through reduction of feed intake and metabolic problems [12]. Due to reduce in feed intake in dairy animals, drop in milk production up to 50% was resulted [13]. A decrease in milk yield following lactation is the result of heat stress during the dry period which reduced mammary cell proliferation [14]. Due to this, heat stress reduces milk production by 14% and 35% in early lactation and mid-lactation respectively.Milk quality can be also affected by hot and humid environment. In the summer season, there is lower milk fat and milk protein [15]. However, heat stress has not effect on the content of lactose in milk but significantly reduces milk production, percentage of milk fat and percentage of proteins [16].

Growth

The main objective in animal production is maximum growth through effective use of feed and other resources. An increase in size can be termed as animal growth, in simplest terms. Animal's skeletal dimensions and its composition changes when animal grow from conception to maturity [17]. The major factors that affect average daily gain is availability of nutrients, hormones, enzymes and environmental factors like increase in ambient temperature [18]. Even though voluntary food intake of animal increases the digestibility of the feed, this frequently reduced in cold-stress. Cold exposure may restrict the growth of the animal when insufficient nutrient availability combined with an increased maintenance cost. In calves, growth, health and future performance is influenced by heat stress [19]. Moreover, there is no difference in growth rate of calves born to heat-stressed dry cows and calves born to cooled dry cows from birth to weaning except for mean daily gain of pre-weaning weight which is lower in heat-stressed cows than those from cooled cows is observed [20].

Health

Hypothermia in cattle is the result of extreme cold stress. During cold stress, shrinkage of blood vessels to increase heat production so as to maintain body temperature lowers when the body temperature goes beyond 35ºC (95ºF). The absence to keep body temperature is the most critical aspect of hypothermia. There are several stages of hypothermia like mild (shivering when core temperature reaches 35ºC (95ºF)), moderate (mental disorientation), Severe (causes death) [6].

Feed

Feed intake is directly influence by temperature [21]. In milking cows, as the atmospheric temperature is 25-26°C and above 30°C, feed intake starts to reduce slowly and rapidly respectively [21]. Metabolic and health problems are commonly seen in increased atmospheric temperature which changes the physiology of ruminant animals [22]. Heat stress reduce acetate production but increases propionate and butyrate ones [23]. Furthermore, it changes the pH, rumen microbial, motility, rumination [24] and reduces metabolic heat productions [25].

Acid and base

Level of respiration and sweating increase with increased heat stress. Respiratory alkalosis is resulted from decreases in blood carbonic acid concentration [26]. Therefore, to maintain the carbonic acid, animals need to avoid bicarbonate through urine [27]. Carbonic acid to bicarbonate ratio balance in the blood, results in urinary bicarbonate loss [25]. Thereby, resulting into subclinical and acute rumen acidosis is due to chronic hyperthermia causes severe or prolonged in appetence [9].

Immunity

The vital requirement for the animal to remain devoid of stress is by having immunity.In situations where the environmental temperature is varied, the immunity reaction which includes white and red blood cells varies accordingly [28, 29]. Moreover, when the climatic conditions are changed, disease prevalence and outbreak increase simultaneously. However, both rainfall and temperature may affect the disease prevalence and its outbreak [30, 31].

Reproductive performances

Fertility

Female reproduction like sexual behavior and fertility rate are the critical factors that are negatively influenced by environmental stress [32]. There is variation in fertility of lactating cow due to season. Since heat stress affects the growth and maturation of oocyte, it reduces oocyte development. Heat stress also increases infertility [15]. Moreover, during summer season lower fertility is due to unnoticeable estrus since 80% is unnoticeable during this season. The increment of secretion of endometrial PGF-2α is resulted from a period of high-temperature and then thereby threatening pregnancy maintenance leads to infertility [33]. Depending on the severity of the thermal stress, conception rates drop in cooler months and drop even lower during summer [34, 35].

Estrous period and follicular growth

Heat stress increases incidence of anestrous and silent heat besides it reduces the length and intensity of estrus in farm animals [15]. Moreover, there is a problem with fertility when the body temperature exceeds 40°C, through suppressing of follicular development [36]. There are also indications for low fertilization because of low estradiol secretion [37].

Embryonic growth and development

Thermal stress affects embryonic growth and survival in dairy animals. Disturbs buildup of proteins [38], cellular destruction [37], lowering interferontau production which causes embryonic death in heat stress [39]. Endometrial function and embryo development is limited by low secretion of progesterone [37]. When milking cows are exposed to heat stress, there is retardation in embryo developments [40]. Thermal stress can also cause fetal malnutrition and eventually fetal growth retardation [14].

Semen quality

For fertilization of egg so as to produce viable embryo, male's fertility is important as female fertilities. For fertile sperm production, bull testes must be cooler (2-6°C) than body temperature. Infertility problems in bulls may result from changes in seminal and biochemical parameters because of increase in testicular temperature as results of thermal stress. Moreover, poor semen quality, low fertilization capacity and embryo mortality are also associated with environmental stress [41]. There are also seasonal effects in sperm and hormone which ultimately affect male reproduction [42]. During summer season, heat stress decline semen quality parameters [43, 44].

Alleviate stress effects

There is a possibility to avoid cold stress by providing insulation in the form of bedding in fattening animals. To overcome problem of cold conditions, protection from the effects of wind is very important.During cold conditions, pen design and layout should be considered in order to prevent hypothermia. To lower the effects of cold stress in fattening animals, feeding management and delivery schedules are another strategy used [45]. Moreover, nutritional strategies like increasing energy and protein density of the diet to maintain a high efficiency of the rumen activity is one of the main rule to prevent negative effect of heat stress. Supplementation of rumen-protected fat may be considered in order to increase energy value of the feed. To overcome this problem, protein content of the diet, dietary source of by-pass protein should be preferred and a supplementation with rumen protected essential amino acid should be included in the diet.

Since managing effect of stress strategies are vital to decrease constraints of animals production, reduction of dry matter daily intake;reduction of rumen fermentation activity; reduction of physical activity; reduction of milk yieldand synthesis of milk component(protein, fat, lactose);reductionofsomehormonesinvolvedintheenergymetabolism; reduction of metabolic activity of peripheral tissues are somemechanisms of self-adaptation adopted by the dairy cow. On the other hand, increasing the amount of body water transpiration and panting activity in dairy cow is used to increase the heat dissipation. Cooling the barn and the environment of the herd and directly cooling of animals are two management strategies may be applied in ordertomitigatetheheatstress. East-west orientation is preference orientation in order to reduce stress. Moreover, the slope of the roof, the height ofthebarnandtheoverallspacedevotedtotheanimal should be optimized. One way to combat an obstacle of stress in natural air circulation is by optimizing natural ventilation and avoiding the entire structural situation [45].

CONCLUSIONS AND RECOMMENDATIONS

Generally, reducing chances of acidosis, lameness and improving animal well-being helps to maintain higher milk production, better reproduction and improve animal health is possible by preventing stress. Besides, stress affects both productive and reproductive performance in both male and female cattle. With regard to females, stress reduces percentage of fertility, quantity and quality of embryo. Moreover, there is also negative effect of stress on quality and quantity of sperm in males. Stress does not only affect reproductive performance but also productive performance like reducing milk production and growth of cattle through disordering of metabolism. Considering the relationship of metabolic heat and production level, the effects of heat stress are particularly negative in high productive animals. Therefore, there is a need of further research and development endeavors to understand and improve dairy cattle performances.

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