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Summer stress management in poultry

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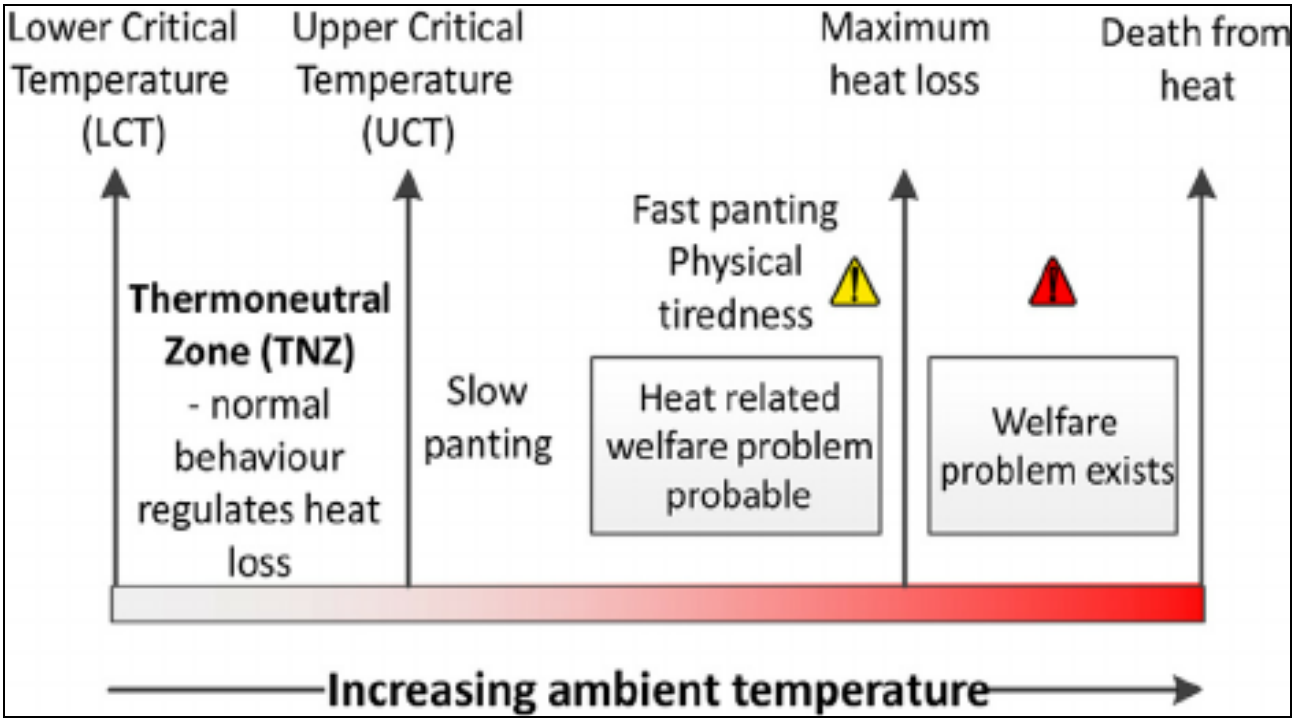
Abstract
The two primary environmental factors in terms of THI that determining the summer stress level in livestock are Air temperature and Relative humidity. The effect of Summer Stress include decrease in egg production, egg quality of laying hen and reduced growth rate in broiler production which results in huge economic losses to poor farmers. Due to absence of sweat gland in bird's thermoregulation becomes challenging in hot weather. Provision of ventilation, density of bird, nutritional manipulation, supplementation of minerals and electrolyte are some of the managemental approaches to alleviate the summer stress. Therefore, the main objective of this review is to give some scientific reports on summer stress in poultry including its preventive measures.

Keywords: summer stress, poultry, managemental

Introduction
Animals are divided into two groups: cold-blooded (heterothermic) and warm-blooded (homeothermic) (Nagy, 2004) [32]. Birds are homeothermic, as they have the facility to require care of their body temperature throughout the year (Pickering, 2000; Donald and William, 2002) [35, 11]. One of the important stressors in poultry production is a hot environment. Summer stress results from a negative balance between internet amount of energy flowing from the animal's body to its surrounding environment and thus the quantity of heat energy produced by the animal. Stress response is particularly associated with the activation of hypothalamo-pituitary-adrenal (HPA) axis and orthosympathetic nervous system, which aggravates the detrimental effect of high body temperature. High mortality, decreased feed consumption, poor weight gain and meat quality in broiler chickens, and poor laying rate and egg weight and shell quality in laying hens are adverse effect of summer stress. (Howlider and Rose, 1987; Marsden and Morris, 1987; Shane, 1988; Yahav, 2000) [22, 29, 40, 51].

What is Stress?
It is a method adopted by body in response to any challenge and it may define as- set of responses to any external demand or challenge which led the poultry flock to adapt to an abnormal phenomenon (Virden and Kidd, 2009) [47].

Ambient temperature zones for poultry
The temperature range within which poultry bird are ready to keep a continuing blood heat is understood as Thermo neutral zone. This range lies between 21 to 26.7 °C. When upper critical temperature i.e., 26.7 °C is exceeded, birds must lose heat actively by panting. Beyond 29.4 °C, birds reduce their feed consumption and as temperature cross 32.2 °C, the egg size and production decreases in layers beyond 35 °C, hens start losing weight. If heat production still increases beyond maximum heat losses by the bird's body, either in intensity (acute heat stress) or over long periods (chronic heat stress) birds will die. At 32 °C and 50% ratio are the benchmarks for beginning of warmth stress in hot environments.



Sources for summer stress and their effect on flock

- Body heat is the main source of heat.
- Temperature of air ventilating the house.
- Heat from roof and walls.
- Heat from working litter.

As birds lack sudoriferous gland so under high environmental temperature, they alter their behaviour and physiological homeostasis seeking thermoregulation, thereby decreasing blood heat (Lara and Rostagno, 2013) [24]. Birds show neurological symptoms like head tilts and inability to perch. Spend less time in feeding, moving or walking, but longer in drinking, panting and in resting condition. (Mack *et al*., 2013) [27]. Splash water on their combs and wattles so as to extend evaporative cooling from these surfaces (Fedde, 1998) [14]. Birds have a further mechanism to market heat exchange between their body and therefore the environment, which are the air sacs. Air sacs are very useful during panting, as they promote air circulation on surfaces contributing to extend gas exchanges with the air, and consequently, the evaporative loss of warmth (Fedde, 1998) [14]. Summer stress causes slower growth and lower weight of chickens, poor feed utilization, increases susceptibility to disease and increases mortality caused by weakness of the body's immune function (Altan *et al*., 2003; Sosnowka-Czajka *et al*., 2005) [4, 44].

Methods of Heat Loss

Conduction, Convection and Radiation are sensible heat losses while evaporative and excretions are insensible heat loss.

Conduction: Loss of heat by direct body contact with cooler surrounding surfaces, such as the floor, litter, slats, sidewalls and cage wires, inside the poultry house (Holik, 2010) [20]

Convection: Temperature loss by convection occurs when heat from the comb, wattles, face, legs, toes, neck, body and wings is lost to the surrounding air as air circulates inside the poultry house (Cengel, 2002; Yahav *et al*., 2005) [10, 52].

Radiation: When the temperature of a bird's body surface is greater than that of the surrounding environment, heat is transferred from the bird's body surface to the environment through electromagnetic radiation (Scanes, 2015) [39].

After a bird cannot maintain its body heat balance by one among these three methods, it must use "evaporative heat loss", or panting, the most pathway of warmth dissipation for birds in hot summer is respiratory (Hillman *et al*., 1985) [19], especially when ambient temperature approaches blood heat. When air temperature rises, the frequency of breathing is increased and therefore the evaporative heat loss is significantly enhanced (Wiernusz and Teeter, 1996) [50].

Sign of Summer stress in poultry

When birds are in summer stress condition, they pant with opened mouth, spreading their wings and squatting on the brink of the bottom (Gasping, panting, spreading of wings, pale cones and wattles, closed eyes, lying down, drop by egg production, increased cannibalism and decreased appetite (Safdar and Maghami, 2014) [37]. Attempt to move faraway from other birds or move against cooler surfaces, like the block walls or into moving air streams. Water consumption increases and feed intake decreases. Lift their wings far away from their bodies to scale back insulation

Effect of Summer Stress on poultry production System

Inhibition of growth and production in birds is mediated via the stress hormones, especially the cortisol. Feed consumption is reduced by 5% for each 1 ºC rise in temperature between 32-38ºC. during a recent study (Sohail *et al*., 2012) [43], broilers subjected to chronic heat stress had significantly reduced feed intake (16.4%), lower weight (32.6%) and better feed conversion ratio (+25.6%) at 42 days aged. Reduced dietary digestibility and decreased protein and calcium levels (Bonnet *et al*., 1997; Zhou *et al*., 1998) [9, 55]. Reduction of egg weight (3.24%), egg shell thickness (1.2%), egg shell weight (9.93%), egg shell percent (0.66%) (Ebeid et.al., 2012) [12]. Affect all phases of semen production. Yalcin and Siegel (2003) [53] showed that overheating fertile eggs during

incubation resulted in differential tissue growth at different stages of incubation. Direct effect on organ and muscle metabolism which may persist after slaughter. Ex- PSE meat in turkey, heat shortening in broilers, and dehydration. Change in meat quality during transport cause more variable breast meat pH. Chronic heat stress decreased proportion of breast muscle increasing proportion of thigh muscle in broiler (Zhang *et al*., 2014) [54]. Lower relative weight of thymus and spleen (Ghazi *et al*., 2012) [16]. Reduced lymphoid organ weight (Bartlett and Smith, 2003, Niu *et al*., 2009) [7, 33]. Lower levels of total circulating antibodies when broiler subjected to summer stress, also as lower specific IgM and IgG levels (Bartlett and Smith, 2003) [7]. Rise in heterophil: lymphocyte ratio during summer stress. (Felver-Gant *et al*., 2012) [15].

Measures to Alleviate Summer Stress

Various measures can be adopted to alleviate the summer stress such as Housing management, Feeding management, Water management, Litter management and Breeding management.

Housing Management

Poultry houses should be designed to avoid the penetration of warmth from the surface environment (Donald and William, 2002) [11]. The direction of the poultry sheds should be from east to west long and north to south in breadth in hot areas. The poultry shed roof should be steep and high. Furthermore, the reflectivity of the roof is often increased by installing an aluminium roof or by painting the surface with metallic zinc paint. Recommended design spacing D = 0.4 x H x (L) 0.5 where, H and L are height and length of obstructing building or not but 10-12 meters. Wall should be water proof and poor conductor of warmth. Insulation-should be placed below the roof because it will prevent influx of warmth. Increasing the quantity of air movement increases convective heat loss from the birds during a house thereby lowering the effective air temperature. As air speed increases, the quantity of warmth removal increases and therefore the bird cooling is enhanced. The encompassing environment is controlled by using various things like fans, fogger with fan, cooling pads, curtain, static pressure controllers and thermostats. Use of sprinkler and fogger with fan reduces the temperature inside the house on hot climatic condition (Sinha *et al*., 2018) [41]. Good ventilation is important for warmth stress management. Removes the moisture loaded air from the poultry house and enter equal amount of fresh air from outside. The ventilation duct connects the moving air flow from the entrances to the exhaust fans, providing maximum air flow speed. Wind speed of tunnel ventilation is about 350 meters / minute. Evaporative cooling pads works on an equivalent cooling principle as foggers, air is cooled inside the house when it passes through the cooling pads. Circulation fans are recommended for correct ventilation during a good ventilated house for maximizes air movement over the birds to extend convective cooling.

Feeding Management

Intermittent feeding programs have been investigated in other broiler operations. These methods may have potential uses in high-temperature regions where birds are less active during dark times, thereby reducing heat production. Feeding should be conducted during the cool hours of the day, i.e., during the early hours in the morning and during late hours in the evening (Farghly *et al*., 2018a) [13]. Feed intake will be reduced by 1.2% for every 1 °C rise in the temperature range of 22-32 °C and 5% for 1 °C rise in the temperature range of 32-38 °C. To improve the laying rate and egg shell quality the laying hens should be feed during the evening period.

Use of Phytochemicals: Plant polyphenols like anthocyanins are phyto-pigments that have a positive effect on the health of poultry. Anthocyanins may act as antioxidant, anti-inflammatory, immunomodulatory, antidiabetic, anti-obesity, neuroprotective and anticancer biochemical agents; therefore, supplementation with anthocyanin diet can produce many health benefits for heat-stressed birds

Use of Vitamins: Supplementation of vitamin C under high temperature is most effective to reducing mortality rate in broiler and laying hens (Njoku, 1986; Ahmed *et al*., 2005) [34, 2, 3]. Vitamin C acts as antistressor and growth stimulant in commercial broiler production due to maintenance of normal collagen metabolism (Mahmoud *et al*., 2004; McDonald *et al*., 1992) [28, 30]. Supplementation of vitamin E during heat stress was beneficial to laying hens, maintain the biological membranes because protects cells and tissues from oxidative damage induced by free radicals (Whitehead *et al*., 1998; Sahin *et al*., 2001) [49, 38]

Use of feed additives: Including betaine in poultry diets can significantly benefit (Wang *et al*., 2004) [48] the production performance in poultry kept under summer stress conditions (Khattak *et al*., 2012; Attia *et al*., 2016; Saeed *et al*., 2017a) [23, 6, 36]. Betaine has a specific role in maintaining poultry biological processes such as osmoregulation (Honarbakhsh *et al*., 2007; Lever and Slow, 2010) [21, 26] cellular water and ion balance (Leeson and Summers, 2001) [25], methionine-sparing, fat distribution (Attia *et al*., 2005; Hassan *et al*., 2005) [5, 18] and immunity (Graham, 2002) [17] and improves the bird's capacity to resist heat stress. The combination of prebiotic and probiotic to produce the interaction effect is called synbiotic. The addition of synbiotic feeds is also suggested to help reduce the negative effects of heat stress and may improve the well-being and function of birds kept under heat stress (Mohammed *et al*., 2018) [31].

Use of Minerals: Supplementation of minerals like ammonium chloride (NH_4Cl) sodium bicarbonate ($NaHCO_3$), sodium chloride (NaCl), potassium chloride (KCl) and potassium sulphate (K_2SO4) in drinking water of poultry are beneficial effect under summer stress condition (Smith and teeter, 1988; Ubosi *et al*., 2003; Ahmad *et al*., 2005) [42, 26, 2, 5]. Teeter *et al*., (1985) [45] reported that supplementation of NH_4Cl at 3 and 10 g/kg in poultry feed under high environment temperature had improvement in weight gain up to 9.5 and 25% respectively.

Water Management

To maintain the body temperature of bird stable, clean and cool water should be advertised and frozen in water. The number of drinkers and spaces should be increased, and water supply should be ensured to prevent water loss in birds. The use of water tanks instead of nipples can increase water levels in birds. Water tanks should be kept in the shade and covered with bars. Cover water tanks with wet gunny bags to avoid

exposure to the sun. The addition of 0.25% salt in drinking water increases water consumption.

Litter Management

The litter temperature increases during hot weather. To reduce the litter temperature, litter should be kept moderately wet (Abreu and Abreu, 2004; Bessei, 2006) [1, 8]. Excessive heat and decreased humidity are due to dry litter, and wet litter during the summer is indicative of increased humidity inside the poultry house. Bad smell and ammonia inside the house are due to wet litter that can hamper the growth rate, attract flies and increase stress in birds.

Breeding Management

The naked neck type reduces the size of the feathers compared to their fully feathered counterparts. A useful effect of the naked neck gene in chicken broiler is a genetic result of high growth and meat production. A naked neck compared to a fully feathered chicken has a higher body weight and better feeding efficiency but a lower body temperature. The size of the lower feathers increases the active heat dissipation zone and increases the loss of reasonable heat loss from the neck. The gene can reduce the temperature of the feathers by wrapping the feathers and reducing their size.

Conclusion

Birds do not have sweat glands. From various studies it has been proven that heat production is influenced by body weight, type and variety, production, dietary quality, feed quality and amount of activity and exercise. Physical fatigue is one of the leading causes of death in chickens. Therefore, it is one of the most important things to learn how to recognize the various signs of a stressed bird in the summer and take different steps for the welfare of your herd. The negative impact of summer stress on poultry welfare is a particular concern for rearing farmers and commercial enterprises.

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