BIOMARKERS OF THERMAL ADAPTATION: NEW TOOLS IN SUSTAINABLE LIVESTOCK PRODUCTION UNDER CLIMATE CHANGE

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ABSTRACT

Climate changes have been identified as one of the greatest environmental, social and economic threats to the planet and humanity. The increase of extreme weather events, such as prolonged droughts, extreme ambient temperatures or periods with high and intensive precipitation has effects on animal production systems. Crops, and consequently forage productivity and availability are compromised, the risk of new diseases increase, and animal production is impaired (growth, reproductive performance, metabolic and health status, and immune response can be affected).

In this way the development of resilient and robust animal production systems, together with an improvement in the knowledge of the environmental impact in animal production and welfare are crucial to enhance innovation, sustainability and productivity in the animal sector.

Ambient temperature and its abrupt extreme events have a major impact on the energy metabolism of livestock. This implies that animals presenting more physiological versatility can be best adapted, and therefore less susceptible to thermal stress and more productive.

To achieve a production system where the detrimental effects of the climate change can be the minimum is necessary to improve the ability of the animal to cope with environmental stress by management and selection. The existence of biomarkers that allow to identify the levels of thermal stress and/or acclimation are valuable in the process of selecting the best well suited animals for each environmental condition, to propose selection programs based on that and for the herds management.

Ideally biomarkers should be obtained from readily accessible samples, preferably non-invasively or minimally invasive, such as saliva, sweat and milk, hair and feces. Nowadays, the most commonly fluid used in biomarkers studies is the blood/plasma, but with growing tendency for being replaced.

Blood cortisol has been one of the parameters more frequently used for assessing stressful conditions such as thermal stress. Nevertheless, it does not allow a full understanding of heat stress, due to its circadian cycle and because the confounding with other types of stress. Moreover, and taking the advantage of saliva as a non-invasive source of this corticosteroid, salivary cortisol has been also referred as potentially interesting. However, some of the limitations in taking conclusions from salivary cortisol results are the same reported for blood cortisol. Consequently, new and better non-invasive methods, than allow assessing stress, are necessary.

The aim of this chapter is to present the state of the art on stress responses (climate, housing) and the principal effects of great temperature amplitudes in livestock production and the existing means to evaluate heat stress and acclimation capacity. Focus will be put on the importance of new reliable biomarkers. Saliva, hair, milk and feces will be discussed as potential sources of such non-invasive biomarkers.

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