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Editorial

Heat Stress and Animal Welfare: Emerging Challenges for Veterinary Science in a Warming World

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Introduction

The climate change and global warming has turned into a undisputable truth, which brings new challenges in the animal welfare and veterinary medicine. Among these, heat stress in animals is rapidly gaining attention. The issue of heat stress in animals has become a major concern within a short period The high temperature is harmful to not only farm animals, laboratory animals, and even companion breeders, threatening their productivity, physiological health, but also negative effects on the nervous system and cardiovascular system. The consequences of this problem extend well beyond the scope of agriculture, as far as public health and food security are concerned, which puts the matter of shared interest as the concern of veterinary science as it is of the entire society.

Current understanding

As it was observed in reviewing the literature, heat stress significantly reduces food intake, livestock fertility and lactation levels, and truncates ruminant and swine somatic growth. The high ambient temperatures infer a low quality of the ova and increase the mortality of the avian species. Rodent models show that thermal exposure alters behavioural repertoires, neuroendocrine secretions and the electrophysiological resemblances of electroencephalography (EEG) and electrocardiography (ECG).

All this testifies to heat, not only as a physical load, but as an organismic problem, which involves several organ systems.

Despite this information, the majority of veterinary practices still initiate the treatment of symptoms instead of preventing the occurrence of heat stress in advance. Cooling systems, dietary changes, and hydration plans are excellent, although they may fall short in the case of long heat waves.

Besides that, there is an evident lack in finding early physiological biomarkers that can be used to detect the onset of heat stress before death.

Perspective

It is believed that veterinary should ensure that they move ahead of the competition and ensure that their heat-stress management is founded on sound research. With the addition of the latest devices such as electrophysiology, wearable biosensors, and even machine-learning models, it can be literally transforming the way we identify and anticipate heat-related issues in animals.

Consider such as EEG and ECG it can provide us with live data on nervous and heart stress in hot animals. By combining this data with the animals' core temperature, hormone levels such as cortisol and corticosterone, and behavioural patterns, the veterinarians would be able to identify symptoms of distress early on. The adaptable method covered in this paper can be used effectively in a variety of contexts, including zoological facilities, scientific institutes, and cattle pasturelands, and it can help animals adjust to severe weather.

Another significant advancement is the application of wearable sensor technology that can continuously monitor animal biology. When combined with cloud-based analytics, these tools can notify veterinary professionals or agronomists when they identify heat intolerance, allowing them to take prompt action.

Future Directions

The following strategic directions should be the focus of veterinary science in order to advance this field:

- Biomarker Discovery: Identifying reliable, non-invasive biomarkers (such as changes in HRV, BEG rhythms, or salivary cortisol) that indicate the onset of heat stress in different animal species.
- Precision Livestock Farming: Integrating smart sensors, environmental monitoring, and AI-based analytics to create adaptive systems that maintain animal comfort and productivity under variable climatic conditions.
- Translational Insights: Applying knowledge from laboratory animal models of hyperthermia to improve veterinary care and welfare strategies for livestock, pets, and working animals.
- Policy and Veterinary Education: Strengthening veterinary curricula and extension programs to equip professionals with the tools to recognize and mitigate heat stress, ensuring sustainable animal production systems.

Conclusion

Animal health and environmental changes are now thought to be closely related to veterinary science. It is indisputable that heat stress is not just a seasonal issue; it has grown to be a major global concern. With the aid of prediction models and moderating tools, veterinary professionals can safeguard animal welfare as temperatures rise. With the aid of modern technology, behavior analysis, and heart and brain monitoring, heat stress can be identified early and effectively treated.

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