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EDITORIAL
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Editorial: Minimally Invasive Monitoring of Stress in Farm Animals (Volume 1)

Edward Narayan[1,2*] *and Surinder Singh Chauhan*[3]

[1] School of Agriculture and Food Sciences, Faculty of Science, The University of Queensland, St Lucia, QLD, Australia, [2] Centre for Animal Science, Queensland Alliance for Agriculture & Food Innovation, The University of Queensland, St Lucia, QLD, Australia, [3] Faculty of Veterinary and Agricultural Sciences, The University of Melbourne, Parkville, Australia

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Editorial on the Research Topic

Minimally Invasive Monitoring of Stress in Farm Animals, Volume I

Stress is the biological reaction when the animal is facing a potential threat to its welfare, which in farm animals can reduce productivity. Productivity may be defined as a level of improved performance or fitness or a quantified production trait of an animal, which can be measured by terms of meat, milk, wool, and egg quality and quantity in most production farm animals.

In Edition 1 of this Research Topic, we show a collection of 6 peer reviewed articles and 2 reviews, which highlight the different minimally invasive methods and techniques that are already in use or currently in development in order to monitor different types of stress in livestock animals and methods of reducing it.

For example, research conducted on broiler chickens by Livingston et al. showed that point-of-care devices, which are rapid blood detection devices, can be used to monitor heat stress by checking specific biomarkers that were found to be of importance for the survival and better performance of male chicks. The researchers also showed that nutritional manipulation of some factors, such as vitamins C and E, could greatly reduce the mortality rate and altered the body score of young chicks under heat stress conditions.

Similarly, to the chicks in the article mentioned above, Dado-Senn et al. found that *in utero* heat stress during late gestation reduced the growth size, organ development and immunity of dairy calves post birth, with the authors pointing out that this may lead to reduced milk productivity in the future. The heat stress of the pregnant dam was measured by calculating the temperature-humidity index (THI) of the different pens, by recording the dam's flank movement per minute to calculate the respiration rate, and skin temperature using an infrared thermometer. Another similar method that can be to measure stress is the heart rate interval, which was used by Kitajima et al. to measure stress due to Vitamin A restriction in fattening steers. In the literature review conducted by Islam et al. those methods are only some of the currently available techniques for monitoring heat stress and some other types of stress in cattle using minimally invasive technologies, and the authors came to the conclusion that more automated smart technologies will have to be put in the future in order to monitor and mitigate the effects of heat stress in cattle.

Three of the papers focus on stress in young calves and lambs, with Freitas-de-Melo et al. discussing how less invasive weaning methods may improve the welfare and reduce the stress of the lambs' post weaning. Two of the publications focus on using a non-invasive technique, hair cortisol concentration, to determine stress in calves (Tamminen et al.) and lambs (Hantzopoulou et al.), which is a non-invasive technique, and currently the only technique that can monitor chronic stress.

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Geoffrey E. Dahl, University of Florida, United States

***Correspondence:**
Edward Narayan
e.narayan@uq.edu.au

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Finally, the paper by Henniger et al. investigates how growth promoting implants, which are used to enhance growth, may affect the microbial community in the rumen of steers. Orogastric tubing was used to collect samples from the rumen of the animals under the different implant treatments.

Overall, this Research Topic highlights the array of already existing minimally invasive techniques for monitoring stress in livestock animals, and the need for further research in this sector. The use of a combination of physiology, behaviour, and emerging technologies could be a powerful tool in reducing the stress in production animals and increasing productivity as a result.

AUTHOR CONTRIBUTIONS

EN conceptualized this Research Topic and collaborated with SC for the co-editorship. All authors contributed to the article and approved the submitted version.

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