frontiers | Frontiers in Veterinary Science

TYPE Editorial
PUBLISHED 14 December 2022
DOI 10.3389/fvets.2022.1098796



OPEN ACCESS

EDITED AND REVIEWED BY
Domenico Bergero,
University of Turin, Italy

*CORRESPONDENCE
Lei Liu
leiliu@sdau.edu.cn;
liusanshi1985@126.com

†These authors have contributed equally to this work

SPECIALTY SECTION
This article was submitted to Animal Nutrition and Metabolism, a section of the journal Frontiers in Veterinary Science

RECEIVED 15 November 2022
ACCEPTED 28 November 2022
PUBLISHED 14 December 2022

CITATION
Wang X, Hu J and Liu L (2022) Editorial: Relieving stress response in animals. *Front. Vet. Sci.* 9:1098796. doi: 10.3389/fvets.2022.1098796



# Editorial: Relieving stress response in animals

Xiaojuan Wang†, Jiaqing Hu† and Lei Liu*

Key Laboratory of Efficient Utilization of Non-grain Feed Resources (Co-construction by Ministry and Province), Ministry of Agriculture and Rural Affairs, Shandong Provincial Key Laboratory of Animal Biotechnology and Disease Control and Prevention, Department of Animal Science, Shandong Agricultural University, Taian, Shandong, China

KEYWORDS

**plant extracts, heat stress, feed additives, mitigative effect, response mechanism**

Editorial on the Research Topic
Relieving stress response in animals

As global warming continues unabated, the prevalence of heat stress in animals is projected to increase in terms of frequency, duration, and severity. Heat stress responses are now regarded as an expensive problem in the animals around the world. Heat stress could (1) activate hypothalamic-pituitary-adrenal (HPA) axis and increase glucocorticoids secretion, which could affect food intake *via* changing appetite peptides expression in the hypothalamus or gut, (2) affect food digestion and absorption *via* changing the expression of nutrient transporters and secretion of digestive enzymes, (3) affect the intestinal barrier *via* changing the intestinal microbiome and damaging the intestinal structure, (4) cause immune responses *via* increasing the level of inflammatory factors and inhibiting the level of immune factors, (5) induce severe oxidative stress *via* changing oxidative biomarkers levels, (6) affect the skeletal muscle development *via* changing the protein synthesis and decomposition, and (7) affect the lipid deposition *via* changing the glucolipid metabolism. The mitigation measures for heat stress affecting health are imperative.

Dihydromyricetin (a nature flavonoid compound extracted from *Ampelopsis grossedentata*) could protect dairy cow mammary epithelial cells against heat stress-induced injury through preventing oxidative stress, the imbalance of mitochondrial fission and fusion, which provides useful evidence that dihydromyricetin can be a promising therapeutic drug for protecting heat stress-induced mammary glands injury and mastitis (1). Astragalus polysaccharides have an effect on the serum hormones of heat-stressed dairy cows, and regulate the metabolism of heat-stressed dairy cows through glucose metabolism and amino acid metabolism pathways (2). Ginsenosides (ginseng extract) was found to be a suitable feed additive in animal nutrition to reduce the negative physiological effects caused by heat stress in intestinal barrier (3). Curcumin supplementation reversed the endoplasmic reticulum heat stress-mediated apoptosis in mice, indicating that curcumin supplementation alleviates physiological stress and cardiac damage caused by heat stress (4). Dietary addition of clove (*Syzygium aromaticum L.*) essential oil could significantly improve body weight gain and feed, and contribute to

normalization of oxidative/nitrosative biomarkers in heat stressed broilers (5). Chlorogenic acid can ameliorate acute heat stress damage through suppressing inflammation and improved antioxidant capacity and cecal microbiota composition in mice (6).

Dietary addition of Radix bupleuri extract could maximum mitigate the negative effects of heat stress on body temperature and milk production in dairy cows. The improvement in milk production was probably not only due to the increased feed intake, but also to the direct mitigating effect of heat stress responses (decreased body temperature), which provides more energy for production rather than for homeothermy (7). Havlin et al. (8) reported that inclusion of citrus extracts in diet led to a higher proportion of Holstein cows lying down rather than standing, suggesting an improvement in comfort level. In addition, citrus extracts supplementation improved mammary health, as indicated by lower somatic cell count. Dietary supplementation of *B. vulgaris* root extract to quails reduced the detrimental effects of oxidative stress and lipid peroxidation resulting from Heat stress *via* activating the host defense system at the cellular level (9). The administration of *Rosa canina* extract attenuated reactive oxygen species levels and enhanced antioxidant defense in the hippocampus. Extract of *Rosa canina* attenuated the deleterious effect of Heat stress on cognition through its antioxidant properties and by enhancing synaptic function and plasticity (10). Supplementation with *Gingko biloba* extract before heat-stress exposure protected chicken myocardium from damage by increasing serum heat shock protein 70 (HSP70) from myocardial cells and cardiac microvascular endothelial cells and protected the microvascular system from adverse injury (Zhang et al.). Grape seed extract, a rich source of polyphenols, can attenuate the responses of jejunum epithelial cells induced by heat stress decreased protein concentrations of inflammatory factors and HSP70 (11). *Macleaya cordata* extract could alleviate heat stress-induced decline in growth performance by modulating blood biochemical markers and cecal flora composition in broilers (12). Turmeric or garlic extract supplementation could be an effective dietary supplementation to eliminate heat stress and improve health, oxidative capacity, and testicular functions of rabbit males (13). *Coptidis Rhizoma* could protect the brain against heat stress-mediated brain damage *via* amelioration of hyperthermia and neuroinflammation in mice, suggesting that fever-reducing *Coptidis Rhizoma* can attenuate thermal stress-induced neuropathology (14). Korean ginseng (*Panax ginseng Meyer*) suppressed the immune response upon heat stress and decreased the production of inflammatory cytokines in muscle and spleen and maintaining immune homeostasis (15).

In conclusion, Plant extracts have no residue, no resistance and no rest period, are considered as a green and safe feed additive, and will be continuously developed and applied in animal feeds to relieve heat stress.

## Author contributions

Writing: XW. Original draft preparation: JH. Funding acquisition, writing—review, and editing: LL. All authors have read and agreed to the published version.

## Funding

This work was supported by the National Key Research and Development Program of China (2018YFE0128200), the earmarked fund for CARS (CARS-43-B-1), Natural Science Foundation of Shandong Province (ZR2021MC043 and ZR2021QC108), Special Economic Animal Industry Technology System of Shandong Province (SDAIT-21-16), Agricultural Seed Improvement Project of Shandong Province (2021LZGC002), Taishan Industry Leadership Project (TSCY20190107), and Natural Science Foundation of China (31972594 and 32172787).

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Publisher's note

## References


1. Wang HL, Xing GD, Qian Y, Sun XF, Zhong JF, Chen KL. Dihydromyricetin attenuates heat stress-induced apoptosis in dairy cow mammary epithelial cells through suppressing mitochondrial dysfunction. *Ecotoxicol Environ Saf.* (2021) 214:112078. doi: 10.1016/j.ecoenv.2021.112078

2. Zeng HF, Xi Y, Li Y, Wang Z, Zhang L, Han Z. Analysis of astragalus polysaccharide intervention in heat-stressed dairy cows' serum metabolomics. *Animals*. (2020) 10:574. doi: 10.3390/ani10040574

3. Sandner G, Mueller AS, Zhou X, Stadlbauer V, Schwarzinger B, Schwarzinger C, et al. Ginseng extract ameliorates the negative physiological effects of heat stress by supporting heat shock response and improving intestinal barrier integrity: evidence from studies with heat-stressed caco-2 cells, C. elegans and growing broilers. *Molecules*. (2020) 25:835. doi: 10.3390/molecules25040835

4. Chen Y, Jiang W, Liu X, Du Y, Liu LL, Ordovas JM, et al. Curcumin supplementation improves heat-stress-induced cardiac injury of mice: physiological and molecular mechanisms. *J Nutr Biochem*. (2020) 78:108331. doi: 10.1016/j.jnutbio.2019.108331

5. Mohammadi F. Effect of different levels of clove (*Syzygium aromaticum L.*) essential oil on growth performance and oxidative/nitrosative stress biomarkers in broilers under heat stress. *Trop Anim Health Prod*. (2021) 53:84. doi: 10.1007/s11250-020-02517-x

6. Chen F, Zhang H, Zhao N, Yang X, Du E, Huang S, et al. Effect of chlorogenic acid on intestinal inflammation, antioxidant status, and microbial community of young hens challenged with acute heat stress. *Anim Sci J*. (2021) 92:e13619. doi: 10.1111/asj.13619

7. Pan L, Bu DP, Wang JQ, Cheng JB, Sun XZ. Effects of Radix Bupleuri extract supplementation on lactation performance and rumen fermentation in heat-stressed lactating holstein cows. *Anim Feed Sci Tech*. (2014) 187:1–8. doi: 10.1016/j.anifeedsci.2013.09.008

8. Havlin JM, Robinson PH, Karges K. Impacts of dietary fat level and saturation when feeding distillers grains to high producing dairy cows. *J Anim Physiol Anim Nutr (Berl)*. (2015) 15:577–90. doi: 10.1111/jpn.12219

9. Sahin K, Orhan C, Tuzcu M, Borawska MH, Jabłonski J, Guler O, et al. Berberis vulgaris root extract alleviates the adverse effects of heat stress via modulating hepatic nuclear transcription factors in quails. *Br J Nutr*. (2013) 110:609–16. doi: 10.1017/S0007114512005648

10. Erfani M, Tabatabaei ZG, Sadigh-Eteghad S, Farokhi-Sisakht F, Farajdokht F, Mahmoudi J, et al. Rosa canina L. methanolic extract prevents heat stress-induced memory dysfunction in rats. *Exp Physiol*. (2019) 104:1544–54. doi: 10.1113/EP087535

11. Li X, Yang Y, Liu S, Yang J, Chen C, Sun Z. Grape seed extract supplementation attenuates the heat stress-induced responses of jejunum epithelial cells in Simmental × Qinchuan steers. *Br J Nutr*. (2014) 112:347–57. doi: 10.1017/S0007114514001032

12. Wang M, Zhang J, Huang X, Liu Y, Zeng J. Effects of dietary macleaya cordata extract on growth performance, biochemical indices, and intestinal microbiota of yellow-feathered broilers subjected to chronic heat stress. *Animals (Basel)*. (2022) 12:2197. doi: 10.3390/ani12172197

13. El-Kholy KH, Wafa WM, El-Nagar HA, Aboelmagd AM, El-Ratel I. Physiological response, testicular function, and health indices of rabbit males fed diets containing phytochemicals extract under heat stress conditions. *J Adv Vet Anim Res*. (2021) 8:256–65. doi: 10.5455/javar.2021.h510

14. Moon M, Huh E, Lee W, Song EJ, Hwang DS, Lee TH, et al. Coptidis rhizoma prevents heat stress-induced brain damage and cognitive impairment in mice. *Nutrients*. (2017) 9:1057. doi: 10.3390/nu9101057

15. Song JH, Kim KJ, Choi SY, Koh EJ, Park JD, Lee BY. Korean ginseng extract ameliorates abnormal immune response through the regulation of inflammatory constituents in Sprague Dawley rat subjected to environmental heat stress. *J Ginseng Res*. (2019) 43:252–60. doi: 10.1016/j.jgr.2018.02.003