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Climatic stressors induced molecular responses of crossbred dairy cows in tropical Savannah region

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Abstract

Climate change has a deleterious impact on livestock production system which adversely affects both the livelihoods of farmers as well as the supply chain of animal origin food. A study was conducted to assess the impact of climatic stressors (seasonal transition and temperature humidity index (THI)) on the molecular response of 40 lactating crossbred dairy cows reared by small-scale farmers in Bengaluru, India. The research period comprised the transitioning season of hot summer to wet monsoon, wherein the gene expression in bovine peripheral blood mononuclear cells (PBMCs) was assessed at two points, late summer (June) and early monsoon (July). Selective genes were considered; these were reported to be associated with (a) heat stress and adaptation: heat shock factor-1 (HSF1), heat shock protein 70 (HSP70) and HSP90; (b) production: growth hormone (GH), growth hormone receptor (GHR), insulin-like growth factor-1 (IGF-1) and leptin (LEP); and (c) inflammatory/immune response: interleukin 18 (IL18), interferon gamma (IFN), IFNβ and tumor necrosis factor alpha (TNFα). The mRNA isolated from the bovine PBMCs were subjected to quantitative Real Time PCR using Glyceraldehyde-3-phosphate dehydrogenase and Hypoxanthine phosphoribosyl transferase 1 as reference genes. Seasonal transition and/or higher THI significantly upregulated the relative PBMC mRNA expression of HSP70, IL18, IFNβ, IFNγ, TNFα, GH and IGF-1 genes during late summer as compared to early monsoon. The significant upregulation of the molecular chaperone HSP70 could indicate the activation of a "second window of protection" against cellular stress. Further, all of the selected inflammatory/immune response genes were significantly upregulated at higher THI and/or in late summer. The results revealed the significant influence of climatic stressors in activating both adaptation and immune response related transcripts in dairy cows. Thus, the study reveals the compromised immune system during exposure to climatic stressors in dairy cows. Further, the study points towards the fact that these targeted genes could serve as biomarkers for quantifying climatic stressors in dairy cattle in tropical Savannah regions.

Keywords: Adaptive responses, climatic challenges, dairy cattle, gene expressions, immunity

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