Transcriptome Signature of Circulating PBMCs to Understand Mechanism of High Altitude Adaptation in Native Cattle Adapted to Trans Himalayan Region of Ladakh

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Abstract

Ladakh "land of high passes" is located between the Kunlun mountain range in the north and the main Great Himalayas to the south in state of Jammu and Kashmir. This cold-arid desert located at over 3000 meter above mean sea level is characterized by a very harsh climate with extreme temperature (-40^{o}C in winter and 35^{o}C in summer); low humidity, precipitation, and reduced oxygen level (nearly 60-70% of the oxygen concentration at sea level). The local cattle from Ladakh region, known as "Ladakhi cattle" is a unique germplasm having excellent adaptation potential to high altitude hypobaric stress. In the present study, an effort was made to evaluate the transcriptional signature of circulating PBMCs in local Ladakhi cattle from Ladakh region and Sahiwal cattle from tropical condition using Agilent 44K microarray chip. The top up-regulated genes in Ladakhi cows were *INHBC, ITPRI, HECA, ABI3, GPR171*, and *HIF-1α* involved in hypoxia and stress response. In Sahiwal cows, the top up-regulated genes *eEF1A1, GRO1, CXCL2, DEFB3* and *BOLA-DQA3* were associated with immune function and inflammatory response indicating their strong immune potential to combat the pathogens prevalent in the tropical conditions. The molecular pathways highly impacted were MAPK signaling, ETC, apoptosis, TLR signaling and NF- kB signaling pathway indicating signatures of adaptive evolution of these two cattle types in response to diverse environments. Further, qPCR analysis revealed increased expression of some high altitude related genes *viz., HIF-1, EPAS-1, VEGFA, NOS2, ECE-1* and *GLUT-1* in PBMCs of high altitude cattle signifying their importance as an essential component of high altitude adaptation. These genes are supposed to be crucial in maintaining cellular homeostasis in Ladakhi cattle. Based on data generated in the present study, native cattle of Ladakh region was found to be genetically distinct from native cattle adapted to tropical region of India.

Keywords—*Gene expression, High altitude, Ladakhi cattle, Microarray, Sahiwal cattle*

Abbreviations
PBMC: Peripheral blood mononuclear cells
HIF-1: hypoxia inducing factor-1
GLUT1: glucose transporter 1
VEGFA: vascular endothelial growth factor A
NOS2: nitric oxide synthase 2
ECE-1: endothelial converting enzyme
qPCR: quantitative PCR

Professional Biography (100-150 words)

Dr.Preeti Verma has completed her PhD at the age of 29 years from Singhania University, INDIA and is currently perusing her postdoctoral studies from Animal Biotechnology Centre, National Dairy Research Institute, INDIA.

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