



Identifying the heat resistant genes by multi-tissue transcriptome sequencing analysis in Turpan Black sheep

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ABSTRACT

Heat stress not only affects the physical condition but also affects reproductive performance in sheep. A thorough understanding of the molecular and physiological mechanisms underlying heat stress would certainly improve livestock productivity and provide genetic evaluation ways for heat resistant breeds selection. In this study, 85 Turpan Black sheep, a breed exhibited excellent heat resistance from long-term artificial selection, and 85 heat sensitive Kazakh sheep in Turpan basin were tested for physiological and reproductive performance from July to August in summer. The results showed that the estrus rate was significantly higher in Turpan Black sheep ($P < 0.05$), while the heart rate and respiratory rate of Turpan Black sheep are significantly lower than that of Kazakh sheep ($P < 0.05$). Furthermore, to clarify genes participated in heat stress response, the pituitary, ovarian and hepatic tissues from three Turpan Black sheep and three Kazakh sheep were subjected to RNA-seq. The results indicated that 32, 49 and 69 genes were up-regulated, and 39, 60 and 145 genes were down-regulated in pituitary, ovarian and hepatic tissues in Turpan Black sheep compared with that of the Kazakh sheep, respectively. KEGG and gene set enrichment analysis showed that the differentially expressed genes were mainly involved in signal transduction pathways. In particular, the differentially expressed genes in hepar were enriched in the energy metabolism pathway, while the differentially expressed genes in ovarian tissue were enriched in the ovarium steroidogenesis pathway. In conclusion, our results implied that the pituitary-ovary axis might include hepar as downstream targeted organism in heat resistant regulation. Under heat stress, the signals released from pituitary would impact steroidogenesis in ovary, and further alter energy metabolism in hepar. As we know, this is the first comparative study to investigate the gene expression in multi-tissue in sheep under heat stress.

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1. Introduction

The ancestors of sheep were initially domesticated from the Free Asian Mouflon sheep in the Fertile Crescent [1]. From a genetic perspective, different sheep populations show obvious differences

in growth and production traits in order to adapt to different geographic regions [2]. Turpan Black sheep, also called Toksun big-tailed Black sheep, is a hybrid of Bayanbulak sheep, Kazakh sheep and Karakul sheep through long-term cultivation and natural selection in Toksun County of Xinjiang Uygur Autonomous Region in

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