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MicroRNA Profiling Reveals an Abundant miR-200a-3p Promotes Skeletal Muscle Satellite Cell Development by Targeting TGF-β2 and Regulating the TGF-β2/SMAD Signaling Pathway

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Abstract: MicroRNAs (miRNAs) are evolutionarily conserved, small noncoding RNAs that play critical post-transcriptional regulatory roles in skeletal muscle development. Chicken is an optimal model to study skeletal muscle formation because its developmental anatomy is similar to that of mammals. In this study, we identified potential miRNAs in the breast muscle of broilers and layers at embryonic day 10 (E10), E13, E16, and E19. We detected 1836 miRNAs, 233 of which were differentially expressed between broilers and layers. In particular, miRNA-200a-3p was significantly more highly expressed in broilers than layers at three time points. In vitro experiments showed that miR-200a-3p accelerated differentiation and proliferation of chicken skeletal muscle satellite cells (SMSCs) and inhibited SMSCs apoptosis. The transforming growth factor 2 (*TGF-β2*) was identified as a target gene of miR-200a-3p, and which turned out to inhibit differentiation and proliferation, and promote apoptosis of SMSCs. Exogenous TGF-β2 increased the abundances of phosphorylated SMAD2 and SMAD3 proteins, and a miR-200a-3p mimic weakened this effect. The TGF-β2 inhibitor treatment reduced the promotional and inhibitory effects of miR-200a-3p on SMSC differentiation and apoptosis, respectively. Our results indicate that miRNAs are abundantly expressed during embryonic skeletal muscle development, and that miR-200a-3p promotes SMSC development by targeting TGF-β2 and regulating the TGF-β2/SMAD signaling pathway.

Keywords: RNA-seq; skeletal muscle satellite cells; miR-200a-3p; TGF-β2/SMAD pathway; differentiation; proliferation; apoptosis

1. Introduction

Muscle is an important component of animal bodies, including human bodies. Skeletal muscle accounts for about 40–60% of the body weight of adult animals. Muscle fibers are the functional units of muscle and their numbers are mostly fixed in the embryonic stage, and postnatal muscle growth is mainly due to hypertrophy and hyperplasia of the muscle fibers, which is accompanied by the proliferation and differentiation of activated skeletal muscle satellite cells (SMSCs) [1]. In chicken, the primary muscle fibers were shown to appear on day 6 of the incubation period, the secondary