Mitochondrial calcium uptake 1 (*Micu1*) gene found to be expressed in pancreatic β-cells

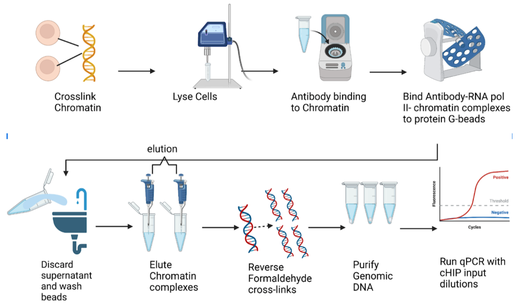
Madeline Corsetti and Layla Dreyer
California State University, Chico

Introduction

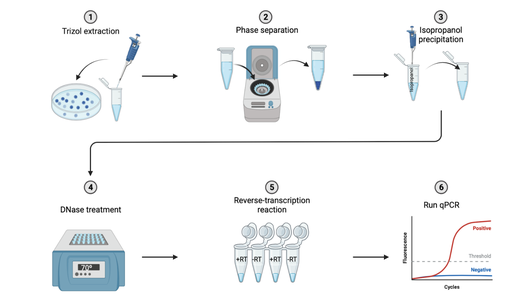
The mitochondrial calcium uptake 1 gene, or *Micu1*, is one of the main regulators of the mitochondrial calcium uniporter (mtCU),[2,3] a transmembrane protein complex that mediates mitochondrial Ca^{2+} uptake. Discovered in 2010, *Micu1* emerged as an essential component governing this process. Mitochondrial calcium assumes vital roles in various cellular processes, including ATP production and cell signaling.[1] It has also been associated with metabolic functions which could subsequently impact insulin secretion. Earlier ChIP assays have demonstrated that Pdx1 and NeuroD1, key transcription factors regulating the insulin gene in pancreatic β-cells, bind to the promoter region of *Micu1*. This finding led us to propose that *Micu1* is expressed within pancreatic β-cells.

Methods

ChIP qPCR:



RT qPCR:



Results

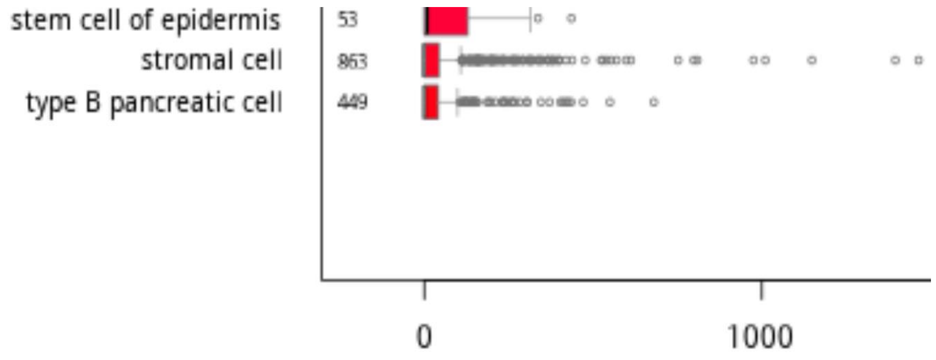
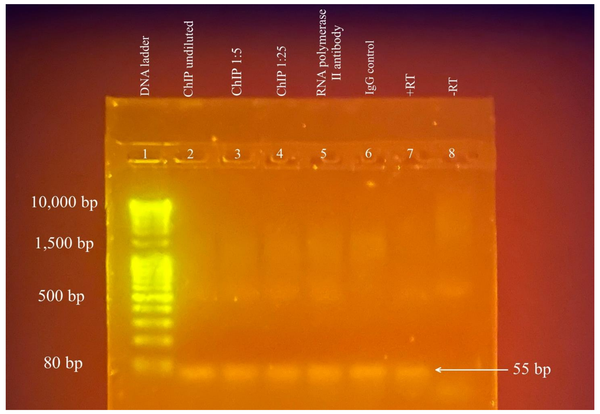


Figure 1. Tabula muris from the UCSC genome browser showing *Micu1*'s expression in rat pancreatic β-cells.

Figure 2. Gel electrophoresis analysis of ChIP samples from INS-1 cells using our custom *Micu1* primers. The gel shows the migration of undiluted, 1:5 diluted, and 1:25 diluted ChIP samples, as well as a sample with RNA polymerase II antibody, an IgG control, and +/- RT samples. The +RT and -RT samples enable the detection of RNA-associated DNA. Gel electrophoresis separates DNA fragments based on size. Here, we see a product of approximately 55 base pairs, which was the expected amplicon length.



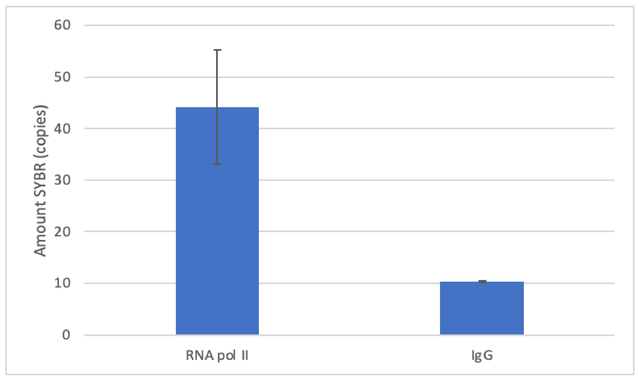


Figure 3. Results from qPCR using our custom *Micu1* primers with INS-1 cell samples under two conditions: RNA polymerase II antibody treatment and IgG control. Binding of the RNA polymerase II antibody indicates the presence of actively transcribed genes in INS-1 cells, while the IgG control sample serves as a negative control for nonspecific binding. Statistical analysis yielded a p-value of 0.07.

Conclusion

- Our research suggests that *Micu1* is expressed in pancreatic β-cells, potentially acting as a co-regulator of the insulin gene alongside Pdx1 and NeuroD1.
- While lacking statistical significance, our data still provides insight into *Micu1*'s potential role in pancreatic β-cell physiology.
- Further studies are required to confirm direct functions of *Micu1*.

Future Directions

Further knowledge of *Micu1's* expression in pancreatic β-cells could offer understanding to the developing world of diabetes research. Possible tests include the Western blot and ELISA. These tests could provide more information about *Micu1*'s associated protein expression.

Citations

1. Duchen M. R. (2000). Mitochondria and calcium: from cell signalling to cell death. *The Journal of physiology*, *529 Pt 1*(Pt 1), 57–68.
2. MICU1 mitochondrial calcium uptake 1 [homo sapiens (human)] - gene - NCBI. (n.d.).
3. Tarasova, N. V., Vishnyakova, P. A., Logashina, Y. A., & Elchaninov, A. V. (2019). Mitochondrial Calcium Uniporter Structure and Function in Different Types of Muscle Tissues in Health and Disease. *International journal of molecular sciences*, *20*(19), 4823.