

MDMA Exposure Upregulates BDNF Gene Expression in the Amygdala and Dorsal Hippocampus

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Introduction

- **Post-Traumatic Stress Disorder (PTSD)** is a mental health condition characterized by continued and heightened feelings of stress and fear after a traumatic event that affects roughly 5% of the U.S. population each year.¹
 - Recent studies supported the use of **3,4-methylenedioxymethamphetamine (MDMA)** as a psychotherapeutic intervention for PTSD symptoms, including intrusive memories, flashbacks, and nightmares.²
 - **Brain-derived neurotrophic factor (BDNF)** is a protein that plays an essential role in neuronal growth, memory extinction, and recovery from PTSD.³
 - **MDMA facilitates BDNF expression** in the frontal cortex and amygdala.⁴
 - The amygdala (COA) and dorsal hippocampus (DH) are regions of particular interest for their roles in learning and memory, which are implicated in PTSD and other anxiety disorders.^{5,6}
- We hypothesized that BDNF expression would increase in the amygdala and dorsal hippocampus after acute MDMA administration in male rats.**

Methods & Regions of Interest

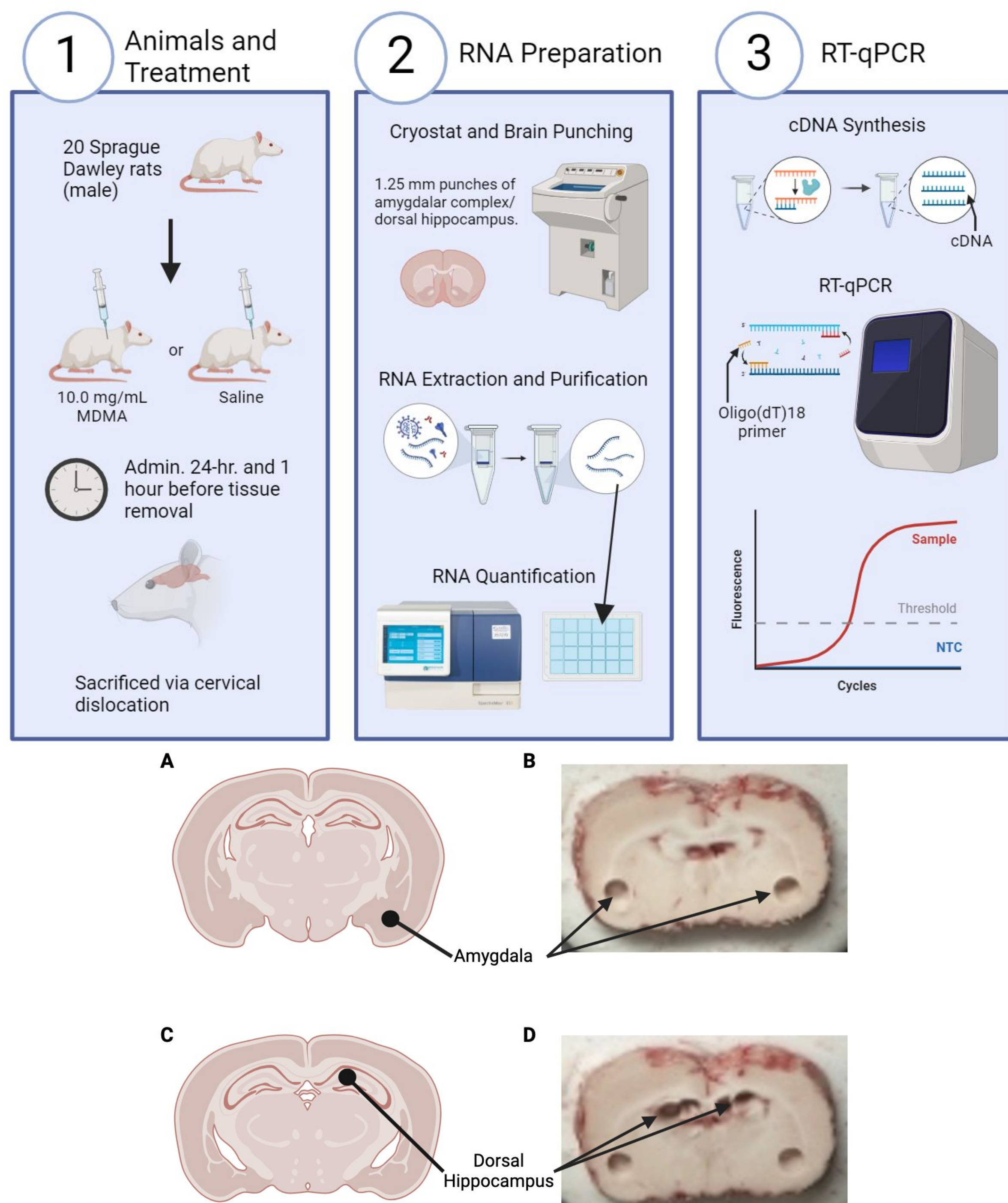


Figure 2. Brain Regions. Anatomical diagrams from the Allen Mouse Brain Atlas (A and C). Tissue punches of selected regions (B and D).

Results

BDNF Expression in the Amygdala

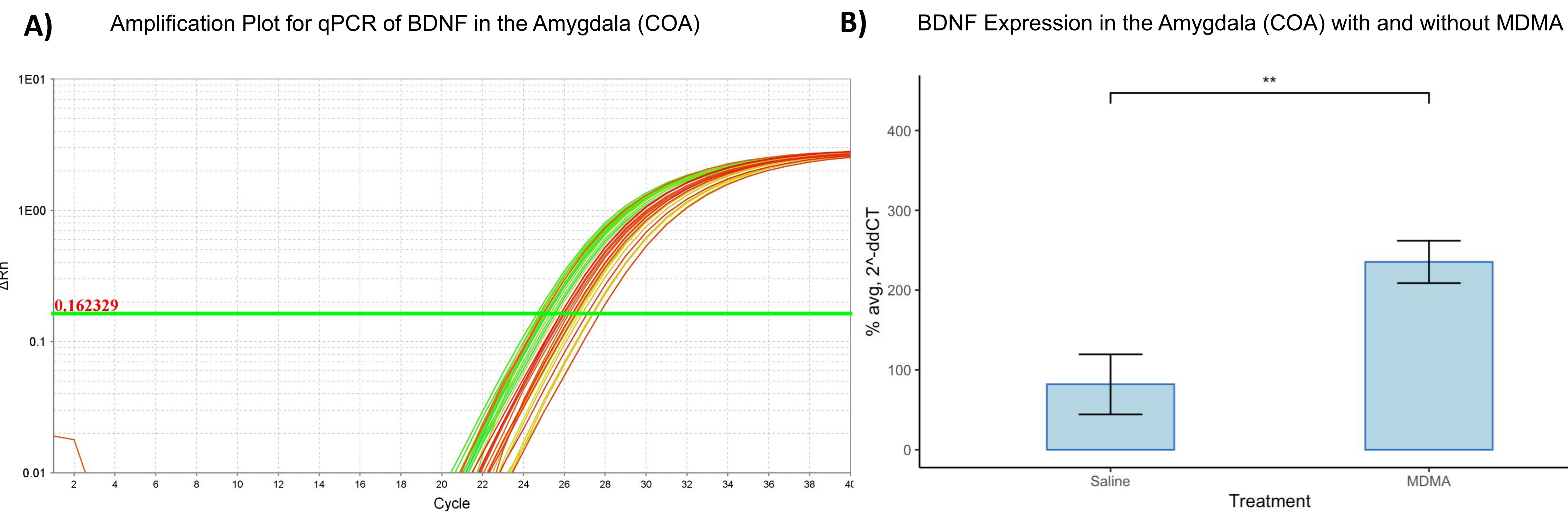


Figure 3. Increased BDNF Expression in the Amygdala (COA) with MDMA. Overall BDNF qPCR amplification plot, with samples in triplicate (Saline: n = 10, MDMA: n = 10) showing the change in fluorescence as a function of each cycle of the PCR. Individual curves represent an amplification curve that corresponds to a specific sample in the experiment. The threshold, where amplified DNA is notably detected, is represented by the horizontal green line (Green Line, 0.162329) (A). Bar graph for relative BDNF mRNA expression to GAPDH expression in the amygdala. BDNF expression calculated from raised $\Delta\Delta Ct$ values. ($t=3.33$, $P=0.0042$) Error bars represent standard error of the mean (** $p<0.01$) (B).

BDNF Expression in the Dorsal Hippocampus

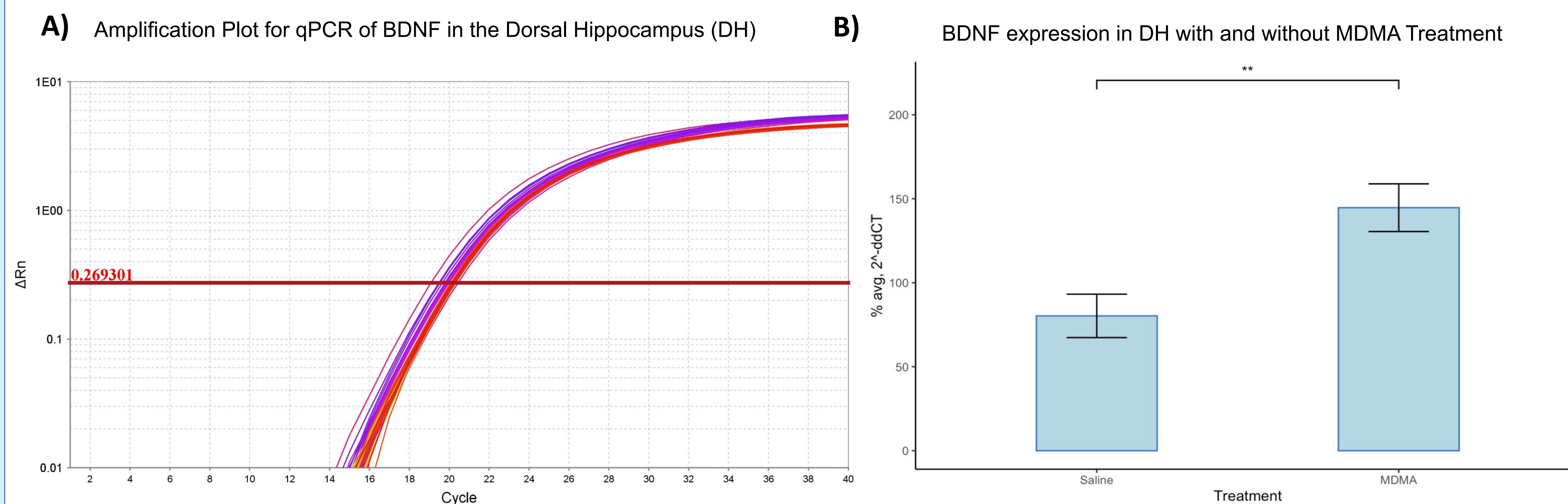


Figure 4. Increased BDNF Expression in the Dorsal Hippocampus (DH) with MDMA. Overall BDNF qPCR amplification plot, with samples in triplicate (Saline: n = 10, MDMA: n = 10) showing the change in fluorescence as a function of each cycle of the PCR. Individual curves represent an amplification curve that corresponds to a specific sample in the experiment. The threshold, where amplified DNA is notably detected, is represented by the horizontal red line (Red Line, 0.269301) (A). Bar graph for relative BDNF mRNA expression to GAPDH expression in the DH. BDNF expression calculated from raised $\Delta\Delta Ct$ values. ($t=3.36$, $P=0.0036$) Error bars represent standard error of the mean (** $p<0.01$) (B).

Conclusions

- The present study supported the increase in BDNF in the amygdala and dorsal hippocampus following acute MDMA exposure.

Future Directions

- Since MDMA acts on BDNF, which interacts with the serotonergic system, future research should consider this system as a potential mechanism through which this increase is occurring.⁷
- Future research should extend this design to consider the implications of these brain regions, the amygdala and dorsal hippocampus, and genes in learning and memory in the fear-extinction learning paradigm.⁸
- This study also only considered male rats, so future research should be conducted to include female rats and consider the potential role of the estrous cycle.⁹

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References

