PC12 Cells as A Model for Studying Parkinson's Disease and Treatment

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INTRODUCTION

Parkinson's Disease (PD)is a neurodegenerative disorder associated with degeneration of dopaminergic neurons. The symptoms arising from such a loss include the presence of both motor and non-motor dysfunction[1]. More specifically, it is the the progressive motor impairment that preludes the diagnosis of PD. Since such neurodegenerative disorder occurs primarily in the brain, an appropriate *in vitro* study model is crucial in understanding and developing treatment options for PD. Various studies have used rat pheochromocytoma PC12 cell lines to conduct PD research and there are several advantages making this cell line an ideal candidate to study PD. For instance, upon stimulation of PC12 cells with neural growth factor (NGF), cells differentiate into dopaminergic neurons that are of great value in PD research[2]. Such a differentiation would enable one to conduct experiments mimicking dopaminergic neuron degeneration and explore treatment options in *in vitro* settings.

Since this is the first time in our lab using PC12 cells line, certain optimizations and troubleshooting are necessary to establish an appropriate experimental condition to further our study of PD.

References

1. Aryal, S., Skinner, T., Bridges, B., & Weber, J. T. (2020). The Pathology of Parkinson's Disease and Potential Benefit of Dietary Polyphenols. *Molecules (Basel, Switzerland)*, *25*(19), 4382. https://doi.org/10.3390/molecules25194382
2. Wiatrak, B., Kubis-Kubiak, A., Piwowar, A., & Barg, E. (2020). PC12 Cell Line: Cell Types, Coating of Culture Vessels, Differentiation and Other Culture Conditions. *Cells*, *9*(4), 958. https://doi.org/10.3390/cells9040958

OBJECTIVES

- To establish conditions promoting PC12 cells to differentiate into dopaminergic neuronal phenotype
- To investigate the toxic effects of glutamate and 6-hydroxydopamine on PC12 cells

MATERIAL AND METHODS

Rat Pheochromocytoma PC12 cells were incubated in cell culture media DMEM containing fetal bovine serum (FBS) and horse serum (HS) at 37℃ and 5.0% CO_2 for cell growth and proliferation. $2x10^5$ cells/well were plated in 24-well cell culture plate for experiments.

a. PC12 Cell Differentiation (Fig. 1)
b. Starvation Experiment for Neurite Growth (Fig. 2)

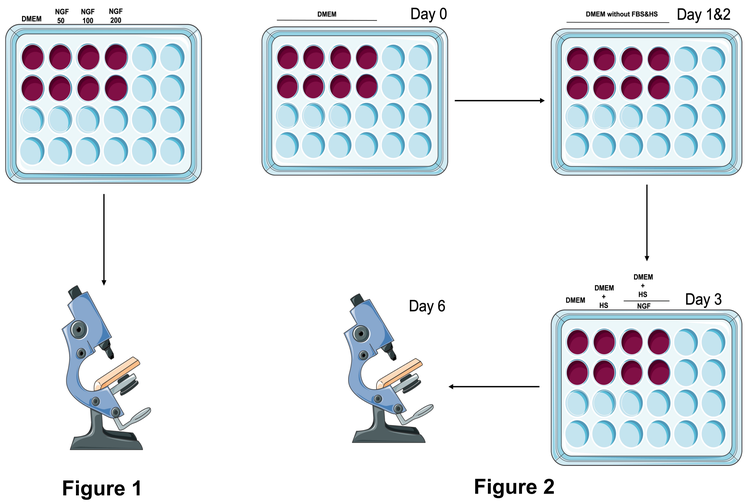


Figure 1 **Figure 2**

c. Glutamate Experiment

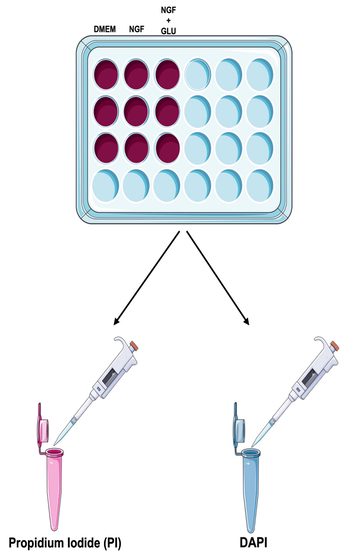


Figure 3

d. 6-Hydroxydopamine Experiment

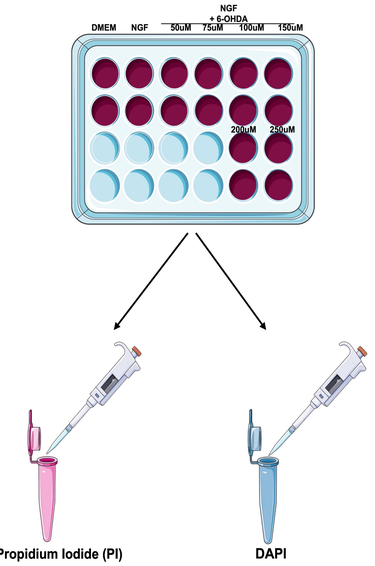
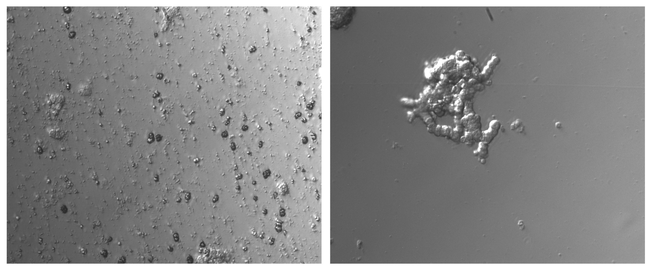


Figure 4

RESULTS

Figure 5. Morphologic Changes upon NGF Treatment



DMEM (Day 3) NGF (Day 3)

Figure 6. Neurite Growth Was Observed in NGF Treated Group

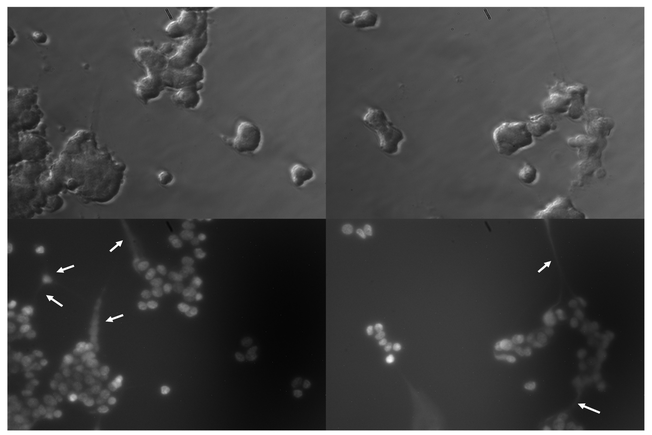


Figure 7. Cytotoxic Effect Induced by Glutamate

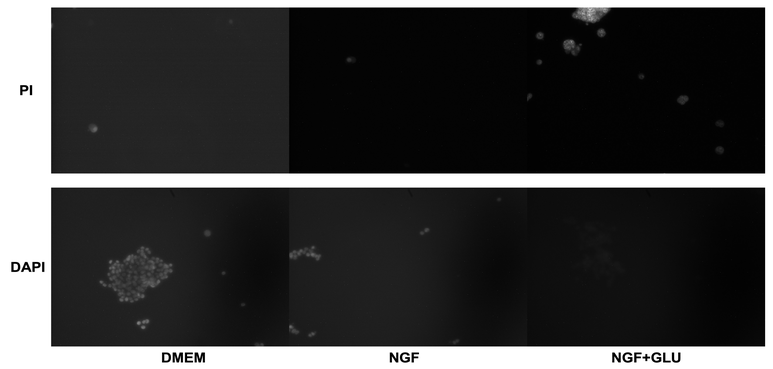
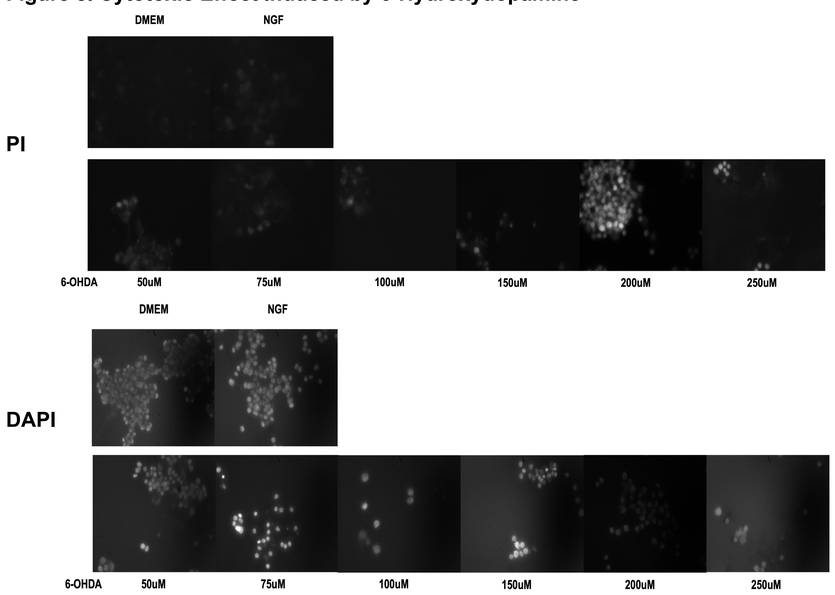


Figure 8. Cytotoxic Effect Induced by 6-Hydroxydopamine



Conclusion and Future Directions

Although only some PC12 cells showed morphological changes upon NGF incubation, this does not affect how they respond to glutamate or 6-OHDA challenges. The cytotoxic effect of glutamate and 6-OHDA on the PC12 cell line certainly make it an ideal model to study potential treatments for Parkinson's Disease *in vitro*.

In the future, potential neuroprotective compounds (e.g. sea cucumber extracts and blueberry extracts) can be incorporated into PC12 cells challenged by glutamate or 6-OHDA to study their effects on dopaminergic neurons.

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