Minsu Kim, Ph.D.

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EDUACTION

Mar. 2019 ~ Feb. 2025	**Konkuk University** Department of Bioscience & Biotechnology *Integrated M.S. and Ph.D.* Course (Advisor: Dr. Yoon Kyung Choi)	Seoul, Korea
Mar. 2013 ~ Feb. 2019	**Konkuk University** Department of Biomedical Science & Engineering	Seoul, Korea

RESEARCH EXPERIENCES

1. Postdoctoral associate (Mar. 2025 ~ Apr. 2025)
2. Graduate student (Mar. 2019 – Feb. 2025)
   - Investigating **inflammatory changes after traumatic brain injury caused by infiltrated immune cells** (with a focus on mechanisms that may be influenced by spaceflight conditions).
   - Examining **astrocyte mitochondrial function in TBI models and its role in neuronal differentiation** (providing insights into neuroprotection strategies that could be relevant for long-duration space missions).
3. Undergraduate student (Jan. 2018 ~ Feb. 2019)

RESEARCH INTEREST [Space Biology – Microgravity – Cosmic Radiation – Brain]

- My primary research objective is to identify **the molecular mechanisms by which space environments—particularly microgravity and cosmic radiation—affect the blood-brain barrier (BBB)**. By investigating how these space-related stressors impact the integrity of the neurovascular unit and promote neuroinflammation, I aim to identify predictive markers and modifiable pathways relevant to long-duration space travel. Specifically, I am interested in the interplay between BBB component cell damage and immune cell activation, with the final objective of advancing our understanding of space-induced neurological disorders and contributing to foundational knowledge for the upcoming space era.

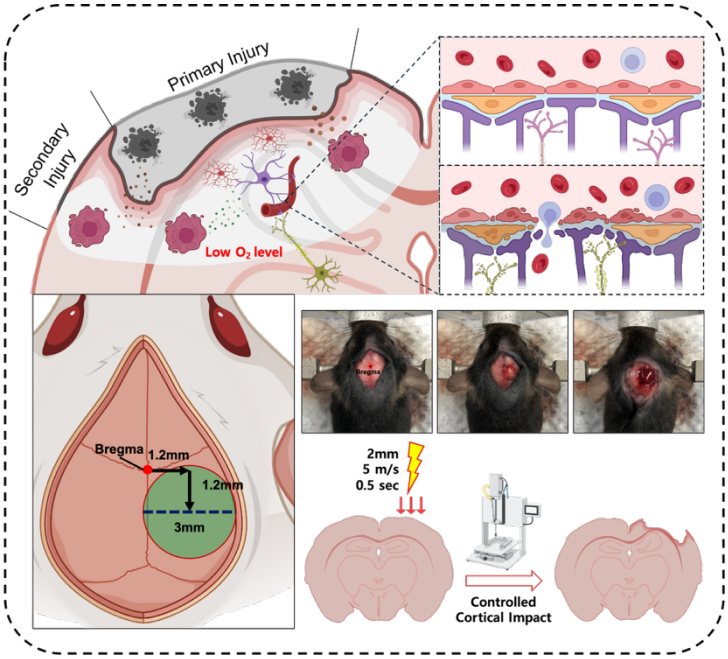
TECHNICAL SKILLS

- **Controlled Cortical Impact**

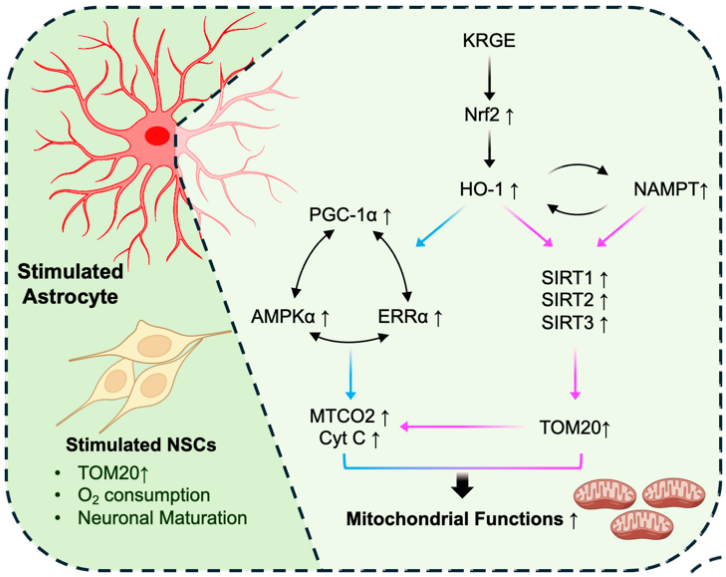
  (Traumatic Brain Injury modeling)
- **Western Blot**
- **Immunohistochemistry**
- **Cell Culture**
- **Retro-Orbital Sinus Injection**
- **Rodents Handling**
- **Python (**basic; statistical analysis, data visualization)
- **ImageJ** (for immunohistochemistry and fluorescence quantification)

Traumatic Brain Injury (TBI)

TBI is caused by an external mechanical force applied to the head. In the brain, a group of cells known as the neurovascular unit (NVU)—comprising astrocytes, pericytes, endothelial cells, and neurons—plays a key role in regulating the permeability of the blood-brain barrier (BBB). TBI is known to increase BBB permeability by causing primary injury that leads to the death of NVU components. The death of these cells triggers the release of damage-associated molecular patterns (DAMPs) from necrotic cells, which subsequently induces secondary injuries such as oxidative stress, hypoxia, and inflammation. The hypoxic environment exerts its effects throughout the peri-injured area and impairs mitochondrial function in the affected cells. As a result, the increased permeability of the BBB allows infiltration of immune cells, including neutrophils and macrophages. These activated immune cells then release inflammatory cytokines, further amplifying the inflammatory response.



J Ginseng Res. 2021, 10.1016/j.jgr.2021.02.003.



Two HO-1–Dependent Pathways That Enhance Mitochondrial Function in Damaged Astrocytes

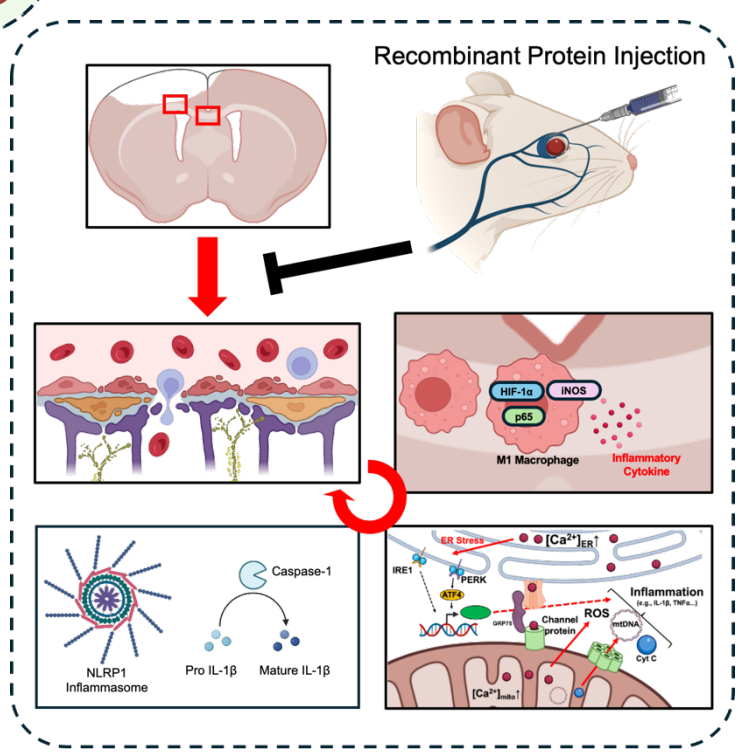
Intake of Korean Red Ginseng Extract increases the expression of Heme Oxygenase 1 of astrocytes in the brain of TBI mouse model. HO-1 then increases the circuit of three proteins (AMPKα-PGC-1α-ERRα) or increases SIRT protein levels by interacting with NAMPT. Increased TOM20 expression by SIRTs and the circuit induces mitochondrial protein (MTCO2, Cytochrome C). These two independent pathways are dependent on HO-1 activity, as demonstrated by treatment with SnPP (HO-1 activity inhibitor).

Int J Mol Sci. 2021, 10.3390/ijms222313081.
Cells. 2022, 10.3390/cells11050892.

Protecting Blood-Brain Barrier Integrity Limits Immune Cell Infiltration and Inflammation After Traumatic Brain Injury.

After traumatic brain injury (TBI), immune cells that recognize damage signals infiltrate brain tissue through the blood-brain barrier (BBB), become activated and polarized, and acquire pro-inflammatory functions. These cells spread along white matter regions and are exposed to hypoxia, releasing cytokines that amplify inflammation in neighboring cells. Stressed mitochondria contribute to this process by upregulating inflammatory proteins and mitochondrial channel proteins. This study aims to characterize how a specific recombinant protein, delivered via retro-orbital injection after TBI, preserves BBB integrity and limits immune cell infiltration by suppressing inflammation at the molecular level.

2025, Draft Manuscript in Preparation.



PUBLICATIONS (SCI ONLY)

1. Hyungsu Kim, Sunhong Moon, **Minsu Kim**, Hyungkeun Oh, Jinhong Park, Suji Kim, Taehyung Yoo, Ji-Yoon Kim, Yonghee Kim, Young-Myeong Kim, Yoon Kyung Choi. Upregulation of astrocytic mitochondrial functions via Korean red ginseng-induced CREB-BK**α**-HIF-1**α** axis through L-type Ca^{2+} channel subunits **α**1C and **β**4. *J Cereb Blood Flow Metab.* 2025 May 2:271678X251332760.

2. Sunhong Moon, Jinseo Park, Sueun Kim, **Minsu Kim**, Hui Su Jeon, Hyungsu Kim, Young-Myeong Kim, ji-yoon Kim, Yoon Kyung Choi. Korean Red Ginseng-induced astrocytic HIF-1α: A key regulator of neuroglobin derived from neural stem cell differentiation in physiologic retina and brain. *J Ginseng Res.* 2025 Mar;49(2):189-196.

3. Eunyoung Jung, Ye Eun Kim, Hui Su Jeon, Myeongjong Yoo, **Minsu Kim**, Young-Myeong Kim, Seong-Ho Koh, Yoon Kyung Choi, "Chronic hypoxia of endothelial cells boosts HIF-1α-NLRP1 circuit in Alzheimer's disease". *Free Radical Biology and Medicine*, Aug 1;204:385-393 (2023).

4. Hui Su Jeon†, Chang-Hee Kim†, **Minsu Kim**, Sunhong Moon, Yoon Kyung Choi 'Korean red ginseng mediates mitochondrial membrane potential repair via the Tom22-Tom20-SIRT2 pathway in astrocytes' *Conditioning Medicine* Oct, 5(3), 105-111 (2022)

5. Sunhong Moon, Chang-Hee Kim, Jinhong Park, **Minsu Kim**, Hui Su Jeon, Young-Myeong Kim, Yoon Kyung Choi, "Induction of BVR-A Expression by Korean Red Ginseng in Murine Hippocampal Astrocytes: Role of Bilirubin in Mitochondrial Function via the LKB1-SIRT1-ERRα Axis". *Antioxidants (Basel)*, Sep 1;11(9):1742 (2022).

6. Jinhong Park, Minjae Lee, **Minsu Kim**, Sunhong Moon, Seunghee Kim, Sueun Kim, Seong-Ho Koh, Young-Myeong Kim, and Yoon Kyung Choi, "Prophylactic role of Korean Red Ginseng in astrocytic mitochondrial biogenesis through HIF-1α". *Journal of Ginseng Research*, May;46(3):408-417 (2022).

7. **Minsu Kim**, Sunhong Moon, Hui Su Jeon, Sueun Kim, Seong-Ho Koh, Mi-Sook Chang, Young-Myeong Kim, Yoon Kyung Choi, "Dual Effects of Korean Red Ginseng on Astrocytes and Neural Stem Cells in Traumatic Brain Injury: The HO-1-Tom20 Axis as a Putative Target for Mitochondrial Function". *Cells* Mar 4;11(5):892 (2022).

8. **Minsu Kim**, Joohwan Kim, Sunhong Moon, Bo Young Choi, Sueun Kim, Hui Su Jeon, Sang Won Suh, Young-Myeong Kim, Yoon Kyung Choi, "Korean Red Ginseng Improves Astrocytic Mitochondrial Function by Upregulating HO-1-Mediated AMPKα-PGC-1α-ERRα Circuit after Traumatic Brain Injury". *International Journal of Molecular Sciences*, Dec 3;22(23):13081 (2021).

9. **Minsu Kim**, Hyejung Mok, Woon-Seok Yeo, Joong-Hoon Ahn, and Yoon Kyung Choi, "Role of ginseng in the neurovascular unit of neuroinflammatory diseases focused on the blood-brain barrier". *Journal of Ginseng Research*, Sep;45(5):599-609 (2021).