Universidad de Navarra
Facultad de Ciencias

MÁSTER EN INVESTIGACIÓN BIOMÉDICA
Research Project Proposal
Academic year 2026-2027

Project Nº 8

Title: *Alterations of the brain-immune axis in chronic stress and depression*

Department/ Laboratory *: Department of Pharmaceutical Sciences, School of Pharmacy and Nutrition, University of Navarra*

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Summary

The brain tightly regulates immune function through neural and neuroendocrine pathways, with the bone marrow acting as a central hub for this communication. Signals from the sympathetic nervous system influence the activity of hematopoietic stem and progenitor cells (HSPCs), controlling their quiescence, activation, and differentiation through interactions with the bone marrow niche. Under conditions of chronic psychological stress, this regulatory axis becomes disrupted, leading to sustained HSPC activation, enhanced myeloid differentiation, and the production of pro-inflammatory immune cells.

The working hypothesis of this project is that the bone marrow niche acts as a key intermediary between brain-derived signals and HSPCs, and that stress-induced alterations in niche composition and function are responsible for the long-term reprogramming of hematopoiesis. Specifically, we propose that changes in niche-derived signals reshape HSPC differentiation trajectories, promoting a biased and inflammatory output.

To test this hypothesis, the student will investigate how chronic stress remodels the bone marrow ecosystem at single-cell resolution. The project will involve the analysis and interpretation of single-cell RNA sequencing datasets to identify stress-induced changes in cellular composition, signaling pathways, and lineage trajectories. In parallel, the student will gain hands-on experience with flow cytometry to characterize bone marrow populations and will be introduced to mouse models of chronic psychological stress.

This project offers an excellent opportunity to investigate neuro-immune interactions using complementary computational and experimental approaches, advancing our understanding of how systemic stress shapes immune function. The Department of Pharmaceutical Sciences fosters a supportive, student-centered environment dedicated to professional and academic development.

yes	X
no	

Does the project include the possibility of supervised animal manipulation to complete the training for animal manipulator?