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EDUCATION

Ph.D. Nutritional Sciences, University of Florida, FL, USA, 2011

Dissertation: Identification of Biomarker Responses in Humans under Experimentally Induced Zinc Depletion

Advisor: Dr. Robert J. Cousins

M.S. Food Science and Human Nutrition, University of Florida, USA, 2007

Thesis: Zinc Transporter Expression in Mature Red Blood Cells and Differentiating Erythroid Progenitor Cells

Advisor: Dr. Robert J. Cousins

B.S. Biotechnology, Yonsei University, Seoul, Korea, 2001

PROFESSIONAL EXPERIENCES

Academic Employment:

Associate Professor, Department of Food and Nutrition, Yonsei University, Seoul, Korea	2021-Present
Assistant Professor, Department of Food Science and Nutrition, University of Minnesota, Twin Cities, MN, USA	2017-2021

Fellowship and Training:

Visiting Fellow, National Institute of Diabetes and Digestive and Kidney Diseases, National Institutes of Health, MD, USA	2013-2017
Postdoctoral Research Scientist, Columbia University Medical Center, NY, USA	2012
Mirzayan Science and Technology Policy Fellow, Food and Nutrition Board, National Academies, Washington, DC, USA	2012
Postdoctoral Associate, Center for Nutritional Sciences, University of Florida, FL, USA	2011

Other Professional Positions:

Assistant Manager, Overseas Business Team, Lotte Chilsung Beverage Company, Ltd., Seoul, Korea	2004-2005
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RESEARCH INTEREST

- Zinc Transporters in Cellular and Systemic Zinc Homeostasis and Distribution
- Ferritin Iron Regulation via NCOA4-Mediated Ferritinophagy
- Nutrient-Gene Interactions during Development and Cell Differentiation
- Nutritional Immunity via Host-Pathogen Interactions and Inflammation
- Functional Implications of Genetic Variants in Metal Homeostasis

PROFESSIONAL SOCIETY MEMBERSHIPS

The Korean Nutrition Society	2021-Present
International Society of Zinc Biology-Asia/Oceania	2021-Present
American Chemical Society	2019-Present
American Society for Nutrition	2017-Present
East-to-West Iron Club	2015-Present
American Association for the Advancement of Science	2017-2021

HONORS, AWARDS AND SCHOLARSHIP

Certificate of Outstanding Teaching, Center of Educational Innovation, University of Minnesota	2019,2020,2021
Research Advisory Committee Service Award, College of Food, Agricultural and Natural Resource Sciences, University of Minnesota	2019
Excellence in Research Award, Korean Scientists Association of the NIH	2016
Office of Dietary Supplements Research Scholarship, Office of Dietary Supplements, NIH	2016
Best Poster Presentation Travel Award, 10th Annual NIDDK Fellow Scientific Conference, National Institute of Diabetes and Digestive and Kidney Diseases, NIH	2015
Best Dissertations in College of Agricultural and Life Sciences Majors, University of Florida	2012

Runner-Up of the Nutrition and Toxicology Section Poster Competition, Journey Through Science Day, New York Academy of Sciences & PepsiCo	2011
Checker's Scholarship, University of Florida	2010
College of Agricultural and Life Sciences Alumni Graduate Award, University of Florida	2007

RESEARCH SUPPORT

NIH (R21HD106043) <i>NCOA4-Mediated Ferritinophagy in Iron-Dependent Brain Development</i> Overall Goals: To generate a novel neuron-specific <i>Ncoa4</i> knockout model, and determine the significance of ferritinophagy during iron-dependent brain development. Role: Principal Investigator (Multi-PI)	2021-2023
Minnesota Pork Board <i>Timing of Dietary Zinc Additions during Gestation for Improved Piglet Survival: A Practical Approach</i> Overall Goals: To determine the molecular profiles of maternal zinc supply in newborn piglets. Role: Co-Investigator	2019-2021
Allen Foundation Inc. <i>ZIP10 and Its Genetic Variants in Erythroid Zinc Metabolism</i> Overall Goals: To characterize the roles and regulation of ZIP10 in erythroid zinc homeostasis, and to determine the functional consequences of its mutations with the highest allele frequencies in humans. Role: Principal Investigator	2019-2021
College of Food, Agricultural and Natural Resource Sciences, University of Minnesota <i>Start-Up Funds</i> Overall Goals: To set up a new laboratory for molecular, cell biology, and nutrition research, and to identify and characterize new molecular mechanisms for cellular iron and zinc regulation in neurons and blood cells. Role: Principal Investigator	2017-2021

PUBLICATIONS

Asterisk(*) - indicates student author

Peer-Reviewed Journal Article:

- Kim, J. Y.*, Lee, J. K., & **Ryu, M.-S.** Zinc transporter ZIP10 supports erythroid development and heme synthesis during cellular zinc restriction. *Manuscript in preparation.*
- Guggisberg, C. A.*, Lee, J. K., & **Ryu, M.-S.** NCOA4 regulates ferritin after erythrophagocytosis and responds to inflammatory cues in J774 macrophages. *Manuscript in preparation.*
- Bengson, E. F.*, Guggisberg, C. A.*, Bastian, T. W., Tran, P. V., Georgieff, M. K., & **Ryu, M.-S.** NCOA4 mediates adaptive responses to iron restriction in HT-22 mouse hippocampal neuronal cells: Implications for neurodegeneration. *Manuscript in preparation.*
- Zhou, J., Liu, C., Sun, Y., Francis, M., **Ryu, M.-S.**, Grider, A., Ye, K. (2021). Genetically predicted circulating levels of copper and zinc are associated with osteoarthritis but not with rheumatoid arthritis. *Osteoarthritis Cartilage*, 29(7), 1029-1035..
- Zhou, J., Liu, C., Francis, M., Sun, Y., **Ryu, M.-S.**, Grider, A., Ye, K. (2020). The causal effects of blood iron and copper on lipid metabolism diseases: Evidence from phenome-wide Mendelian randomization study. *Nutrients*, 12(10), 3174.
- Philpott, C. C., **Ryu, M.-S.**, Frey, A., & Patel, S. (2017). Cytosolic iron chaperones: Proteins delivering iron cofactors in the cytosol of mammalian cells. *The Journal of Biological Chemistry*, 292(31), 12764-12771.
- Ryu, M.-S.**, Duck, K. A., & Philpott, C. C. (2018). Ferritin iron regulators, PCBP1 and NCOA4, respond to cellular iron status in developing red cells. *Blood Cells, Molecules & Diseases*, 69, 75-81.
- Ryu, M.-S.**, Zhang, D., Protchenko, O., Shakoury-Elizeh, M., & Philpott, C. C. (2017). PCBP1 and NCOA4 regulate erythroid iron storage and heme biosynthesis. *The Journal of Clinical Investigation*, 127(5), 1786-1797.
- Philpott, C. C., & **Ryu, M.-S.** (2014). Special delivery: distributing iron in the cytosol of mammalian cells. *Frontiers in Pharmacology*, 5, 173.
- Frey, A. G., Nandal, A., Park, J. H., Smith, P. M., Yabe, T., **Ryu, M.-S.**,.... Philpott, C. C. (2014). Iron chaperones PCBP1 and PCBP2 mediate the metallation of the dinuclear iron enzyme deoxyhypusine hydroxylase. *Proceedings of the National Academy of Sciences of the United States of America*, 111(22), 8031-6.
- Ryu, M.-S.**, Guthrie, G. J., Maki, A. B., Aydemir, T. B., & Cousins, R. J. (2012). Proteomic analysis shows the upregulation of erythrocyte dematin in zinc-restricted human subjects. *The American Journal of Clinical Nutrition*, 95(5), 1096-102.
- Aydemir, T. B., Chang, S. M., Guthrie, G. J., Maki, A. B., **Ryu, M.-S.**, Karabiyik, A., & Cousins, R. J. (2012). Zinc transporter ZIP14 functions in hepatic zinc, iron and glucose homeostasis during the innate immune response (endotoxemia). *PLoS One*, 7(10), e48679.

- Ryu, M.-S.**, Langkamp-Henken, B., Chang, S. M., Shankar, M. N., & Cousins, R. J. (2011). Genomic analysis, cytokine expression, and microRNA profiling reveal biomarkers of human dietary zinc depletion and homeostasis. *Proceedings of the National Academy of Sciences of the United States of America*, 108(52), 20970-5.
- Lichten, L. A., **Ryu, M.-S.**, Guo, L., Embury, J., & Cousins, R. J. (2011). MTF-1-mediated repression of the zinc transporter Zip10 is alleviated by zinc restriction. *PLoS one*, 6(6), e21526.
- Guo, L., Lichten, L. A., **Ryu, M.-S.**, Liuzzi, J. P., Wang, F., & Cousins, R. J. (2010). STAT5-glucocorticoid receptor interaction and MTF-1 regulate the expression of ZnT2 (Slc30a2) in pancreatic acinar cells. *Proceedings of the National Academy of Sciences of the United States of America*, 107(7), 2818-23.
- Ryu, M.-S.**, Lichten, L. A., Liuzzi, J. P., & Cousins, R. J. (2008). Zinc transporters ZnT1 (Slc30a1), Zip8 (Slc39a8), and Zip10 (Slc39a10) in mouse red blood cells are differentially regulated during erythroid development and by dietary zinc deficiency. *The Journal of nutrition*, 138(11), 2076-83.

Book Chapter:

- Ryu, M.-S.**, & Aydemir, T. B. (2020). Zinc. In B. Marriott, D. F. Birt, V. Stalling, & A. Yates (Eds.), *Present Knowledge in Nutrition* (11th ed., vol. 1, pp. 393-408). Cambridge, MA: Academic Press.

Published Abstract:

- Kim, J.*, Lee, J., & **Ryu, M.-S.** (2021). *Zinc and the zinc Transporter SLC39A10/ZIP10 are required for heme synthesis in developing erythroid progenitors*. (Supplement_2 ed., vol. 5, pp. 1320). Current Developments in Nutrition. https://doi.org/10.1093/cdn/nzab059_021
- Zhou, J., Liu, C., Francis, M., Sun, Y., **Ryu, M.-S.**, Grider, A., & Ye, K. (2021). *Shared and unique clinical effects of five circulating minerals: A comparative phenome-wide Mendelian-randomization study*. (Supplement_2 ed., vol. 5, pp. 1112). Current Developments in Nutrition. https://doi.org/10.1093/cdn/nzab053_105
- Ryu, M.-S.**, Guggisberg, C. A.*, & Bengson, E. F.* (2019). *NCOA4-mediated ferritinophagy: Linking cellular iron storage with systemic iron homeostasis and inflammation* (pp. 258). Abstracts of Papers of the American Chemical Society. (American Chemical Society (ACS) National Meeting, 2019, San Diego, CA)
- Guggisberg, C.*, & **Ryu, M.-S.** (2019). *NCOA4 mediates ferritin responses to iron, erythrophagocytosis, and hepcidin in macrophages (P24-056-19)* (Supplement_1 ed., vol. 3, pp. nzz044.P24-056-19). Current Developments in Nutrition. <https://doi.org/10.1093/cdn/nzz044.P24-056-19>
- Bengson, E.*, & **Ryu, M.-S.** (2019). *NCOA4-mediated ferritinophagy is essential for HT22 neuronal cell survival during iron deficiency (OR15-07-19)* (Supplement_1 ed., vol. 3, pp. nzz044.OR15-07-19). Current Developments in Nutrition. <https://doi.org/10.1093/cdn/nzz044.OR15-07-19>
- Philpott, C., & **Ryu, M.-S.** (2018). *Emerging mechanisms of cellular iron transport and trafficking*. (Suppl 1 ed., vol. 132, pp. SCI-2). *Blood*. doi: <https://doi.org/10.1182/blood-2018-99-109519>
- Philpott, C., **Ryu, M.-S.**, Li, F., Frey, A., Protchenko, O., & Shakoury-Elizeh, M. (2017). *Intracellular systems of iron cofactor delivery: Analysis of murine models of iron chaperone deficiency*. (8th ed., vol. 92, pp. E413-E413). *American Journal of Hematology*. <https://onlinelibrary.wiley.com/doi/epdf/10.1002/ajh.24812>
- Ryu, M.-S.**, Wohlschlegel, J., & Philpott, C. C. (2015). *Pcbp1 and Ncoa4 Regulate the Flux of iron through ferritin in developing erythroid cells*. (23rd ed., vol. 126, pp. 404). *Blood*. <http://www.bloodjournal.org/content/126/23/404>
- Philpott, C. C., Frey, A. G., **Ryu, M.-S.**, Palenchar, D., Wildemann, J., Vashisht, A. A., . . . Bullough, K. (2015). *Special delivery: The role of iron chaperones in the distribution of iron in developing red cells*. (23rd ed., vol. 126, pp. SCI-45). *Blood*. <http://www.bloodjournal.org/content/126/23/SCI-45>
- Ryu, M.-S.**, Langkamp-Henken, B., & Cousins, R. J. (2011). *Acute dietary zinc depletion in humans produces biomarker changes*. (1_supplement ed., vol. 25, pp. 228.6). *The FASEB Journal*. https://www.fasebj.org/doi/abs/10.1096/fasebj.25.1_supplement.228.6
- Ryu, M.-S.**, Lichten, L. A., & Cousins, R. J. (2008). *Regulation of the erythroid zinc transporters Zip10, Zip8 and ZnT1 during zinc deficiency*. (2_supplement ed., vol. 22, pp. 676). *The FASEB Journal*. https://www.fasebj.org/doi/abs/10.1096/fasebj.22.2_supplement.676
- Ryu, M.-S.**, & Cousins, R. J. (2007). *Expression of zinc transporters during the differentiation of erythroblasts from phenylhydrazine (PHZ)-treated mice*. (5th ed., vol. 21, pp. A720). *The FASEB Journal*. <https://www.fasebj.org/doi/abs/10.1096/fasebj.21.5.A720-b>

PRESENTATIONS

Asterisk(*) - indicates student author

Didactic Seminar:

- Ryu, M.-S.** "With the fate to become a scholar?" KS Seminar, Department of Food Science and Nutrition, University of Minnesota, St. Paul, MN, USA. (November 2018).
- Ryu, M.-S.**, Cousins, R. J. "A nurturing environment produces future legends: Development of career through successful mentor-mentee relationships." Experimental Biology, American Society for Nutrition, San Diego, CA, USA. (April 2012). *Invited*.

Poster at Professional Meetings and Conferences

- Guggisberg, C. A.*, **Ryu, M.-S.** "NCOA4 mediates ferritin responses to iron, erythrophagocytosis, and hepcidin in macrophages." Nutrition 2019, American Society for Nutrition, Baltimore, MD, USA. (June 2019).
- Ryu, M.-S.**, Philpott, C. C. "Pcbp1 and Ncoa4 regulate iron flux through ferritin and maturation of erythroid progenitor cells." 10th Annual NIDDK Fellow Scientific Conference, National Institute of Diabetes and Digestive and Kidney Diseases, NIH, Bethesda, MD, USA. (April 2016).
- Ryu, M.-S.**, Wohlschlegel, J., Philpott, C. C. "Pcbp1 and Ncoa4 regulate the cellular iron storage and utilization in developing erythroid cells." Cell Biology of Metals Conference GRC, Gordon Research Conference, West Dover, VT, USA. (July 2015).
- Ryu, M.-S.**, Frey, A. G., Li, H., Stubbe, J., Philpott, C. C. "The R2 subunit of ribonucleotide reductase, and erythroid ferritin are putative targets of the iron delivery by PCBP1." FASEB Science Research Conference on Trace Elements in Biology and Medicine, FASEB, Steamboat Springs, CO, USA. (June 2014).
- Ryu, M.-S.**, Langkamp-Henken, B., Cousins, R. J. "Dietary zinc depletion in humans produces biomarker changes." Journey through Science Day, New York Academy of Sciences and Pepsico, New York, NY, USA. (December 11, 2011). *Invited.*
- Ryu, M.-S.**, Lichten, L. A., Cousins, R. J. "Regulation of the erythroid zinc transporters Zip10, Zip8 and ZnT1 during zinc deficiency." Experimental Biology, San Diego, CA, USA. (April 2008).
- Ryu, M.-S.**, Cousins, R. J. "Expression of zinc transporters during the differentiation of erythroblasts from phenylhydrazine (PHZ)-treated mice." Experimental Biology, Washington, DC, USA. (April 2007).

Talk at Professional Meetings and Conferences

- Kim, J. Y.*, Lee, J. K., **Ryu, M.-S.** "Zinc and the zinc transporter SLC39A10/ZIP10 are required for heme synthesis in developing erythroid progenitors." Nutrition 2021, American Society for Nutrition, Live Online. (June 7, 2021).
- Ryu, M.-S.** "Pursuit of precision: Regulatory mechanisms for erythroid metal homeostasis." Center for Neurobehavioral Development, University of Minnesota, Minneapolis, MN, USA. (May 17, 2021).
- Ryu, M.-S.** "Pursuit of precision: Regulatory mechanisms for erythroid metal homeostasis." Department of Food and Nutrition, Yonsei University, Seoul, South Korea. (March 9, 2021).
- Guggisberg, C. A.*, **Ryu, M.-S.** "NCOA4 mediates ferritin regulation after erythrophagocytosis and by hepcidin activity in J774 macrophages." East-West Iron Club Conference 2020, Virtual. (October 16, 2020).
- Ryu, M.-S.**, Guggisberg, C. A.*, Bengson, E. F.* "NCOA4-mediated ferritinophagy: Linking cellular iron storage with systemic iron homeostasis and inflammation." ACS National Meeting & Expo, American Chemical Society, San Diego, CA, USA. (August 26, 2019). *Invited.*
- Bengson, E. F.*, **Ryu, M.-S.** "NCOA4-mediated ferritinophagy is essential for HT22 neuronal cell survival during iron deficiency." Nutrition 2019, American Society for Nutrition, Baltimore, MD, USA. (June 2019).
- Ryu, M.-S.** "Ferritinophagy: A floodgate to prevent drought and flood in the iron pool." Nutrition Seminar Series, University of Wisconsin, Madison, WI, USA. (May 2, 2019). *Invited.*
- Ryu, M.-S.** "Saving matters: The fate of iron during red blood cell development." Animal Science Departmental Seminar, University of Minnesota, St. Paul, MN, USA. (February 5, 2018). *Invited.*
- Ryu, M.-S.** "Ferritin: A cytosolic reservoir preventing the drought or flood of mitochondrial iron." Center for Neurobehavioral Development, University of Minnesota, Minneapolis, MN, USA. (March 6, 2017). *Invited.*
- Ryu, M.-S.** "Pcbp1 and Ncoa4 mediate the vectorial transfer of imported iron to heme in developing red cells." Office of Dietary Supplements Scholars Symposium, Office of Dietary Supplements, NIH, Rockville, MD, USA. (November 21, 2016). *Invited.*
- Ryu, M.-S.**, Philpott, C. C. "Pcbp1 and Ncoa4 regulate erythroid iron storage and heme biosynthesis." 8th Annual Bioscience and Engineering Symposium, NIH Korean Scientists Association, Bethesda, MD, USA. (November 19, 2016). *Invited.*
- Ryu, M.-S.**, Protchenko, O., Shakoury-Elizeh, M., Philpott, C. "Ferritin iron regulators, Pcbp1 and Ncoa4, are required for the flux of exogenous iron to heme during erythroid progenitor maturation." FASEB Trace Elements in Biology and Medicine, Bozeman, MT, USA. (June 2016).
- Ryu, M.-S.**, Wohlschlegel, J., Philpott, C. C. "Pcbp1 and Ncoa4 regulate the flux of iron through ferritin in developing erythroid cells." American Society of Hematology Annual Meeting and Exposition, American Society of Hematology, Orlando, FL, USA. (December 2015).
- Ryu, M.-S.**, Langkamp-Henken, B., Cousins, R. J. "Acute dietary zinc depletion in humans produces biomarker changes." Experimental Biology, Washington, DC, USA. (April 2011).