Identifying the Molecular Link Between Endoplasmic Reticulum Morphology and Divalent Magnesium Cation Signaling Through Protein Sequence Similarity Search Tools and Phylogenetic Analysis

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The Endoplasmic Reticulum (ER) is crucial for cell health, facilitating functions like protein and lipid synthesis, calcium storage, and stress response. Previously, research has established that Mg2+ and Ca2+ play crucial roles in maintaining the structure of the ER. Failure of the ER can result in the inability to synthesize various proteins, triggering the unfolded protein response (UPR), and if the UPR fails, it leads to ER stress accumulation and cell death. The proposed science fair project aimed to uncover the molecular link between ER architecture and ion signaling, specifically focusing on Mg2+, hypothesizing that systems biology tools can predict the role of divalent cation binding proteins in controlling ER architecture. Past research has shown that three protein families (REEP, Atlastin, and Reticulon) are responsible for maintaining the structure of the ER. This led the researcher to believe that by aligning the sequences of all magnesium-binding proteins in the ER with these three proteins, the researcher would be able to identify the molecular link between ER architecture and Mg2+ signaling. Through using these tools, the researcher was able to identify several candidates for the molecular link. To further narrow down the candidate list, however, the researcher hypothesizes that laboratory research is required, including knocking down the candidate proteins in living organisms to determine their exact function. If the protein for binding Mg2+ to the ER is located, it could become a drug target, which can assist with lowering the chances of contracting apoptosis-related neurodegenerative disease.