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The crystal structure of an orthomyxovirus matrix protein reveals mechanisms for self-polymerization and membrane association

Many enveloped viruses encode a matrix protein. In the influenza A virus, the matrix protein M1 polymerizes into a rigid protein layer underneath the viral envelope to help enforce the shape and structural integrity of intact viruses. The influenza virus M1 is also known to mediate virus budding as well as the nuclear export of the viral nucleocapsids and their subsequent packaging into nascent viral particles. Despite extensive studies on the influenza virus M1 (FLUA-M1), only crystal structures of its N-terminal domain are available. Here we report the crystal structure of the full-length M1 from another orthomyxovirus infecting fish, the infectious salmon anemia virus (ISAV). The structure of ISAV-M1 assumes the shape of an elbow, with its N-domain closely resembling to that of the FluA-M1. The C-domain, which is connected to the N-domain through a flexible linker, is made of four α-helices packed as a tight bundle. In the crystal, ISAV-M1 monomers form infinite two-dimensional (2-D) arrays with a network of interactions involving both the N- and C-domains. Results from liposome flotation assays indicated that ISAV-M1 binds membrane via electrostatic interactions that are primarily mediated by a positively charged surface loop from the N-domain. Cryo-electron tomography reconstruction of intact ISA virions identified a matrix protein layer adjacent to the inner leaflet of the viral membrane. The physical dimensions of the virion-associated matrix layer are consistent with the 2-D ISAV-M1 crystal lattice, suggesting that the crystal lattice is a valid model for studying M1-M1, M1-membrane, and M1-RNP interactions in the virion.

Biography

Yizhi Jane Tao is a Chinese Biochemist, Structural Biologist and Professor of Biochemistry and Cell Biology at Rice University in Houston, Texas. She led a team of researchers to be the first to map the structure of the influenza A virus nucleoprotein to an atomic level, a feat which circulated widely. She was named among the top ten most influential Chinese of 2006 by a consortium of China's leading media outlets including Phoenix Satellite Television, China News Service, Asia Newsweek, and World Journal.

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