Novel Approach to Creating Hyper-Customizable Egg Models for Embryonic Analysis

El-Sherbiny, Muhammad (School: Bergen County Academies)

This research aimed to enhance the accessibility and customizability of domestic chicken eggs for embryonic analyses and model system research. Through the engineering of a novel device, a self-healing egg window can be created allowing the administration of compounds of interest, genetic manipulation, as well as the study of disease mechanisms. The self-healing window enables the placement of sensors, cameras, and probes into the embryo or its microenvironment while significantly mitigating risks of microbial ingress and water loss. Current windowing procedures decrease embryo viability due to the prevalence of these risks, primarily due to the perforation of the egg's inner membrane and inconsistent window creation. To ameliorate this, the novel device was designed and optimized to create and cover the air cell window without penetrating the inner egg membrane. The utility and effectiveness of different covering configurations were then analyzed through water loss studies and integrity testing via dye ingress, with the self-healing covering demonstrating minimal difference to an intact egg. The applications of the windowed eggs were further explored by designing and creating customizable caps that adhere and temporarily penetrate the self-healing covering for interacting, imaging, and measuring parameters of the embryo and its microenvironment. The use of the novel egg windowing device and customizable egg caps should provide a more versatile in ovo modeling, serving as a "goldilocks" model between in vitro and in vivo models. As a result, this approach offers a new and effective framework for embryonic analyses, with potential applications in biotechnology, pharmacology, and agriculture.

Awards Won:
First Award of $5,000
NC State College of Engineering: Scholarship to attend NC State Engineering Summer Camp