CASE STUDY

How the Open Science Data Repository Helped Unravel Insights from Space-Reared Flies and Wasps

NASA's Open Science Data Repository (OSDR) serves as a central hub for spaceflight omics datasets, along with datasets related to phenotype, behavior, and other areas of research. Furthermore, the OSDR features a dedicated sample processing laboratory, supported by a skilled data processing team and streamlined analysis pipelines designed for space biology experiments.

In the publication "*Drosophila parasitoids go to space: Unexpected effects of spaceflight on hosts and their parasitoids*," (*Chou et al, 2024)* the authors investigated how spaceflight impacts the immune systems of fruit flies and their interactions with natural parasites like parasitoid wasps. Data showed that spaceflight increased inflammation-related genes and tumor burden in tumor-prone flies, while parasitoid wasps showed resilience, with unique mutants discovered post-flight for future research, offering new opportunities for host-parasite research on Earth.

Host-Parasite Interactions in Space

As humans transition to becoming a spacefaring species, understanding how microgravity and radiation impact host-pathogen interactions is crucial for long-term exploration. While spaceflight's effects on host immune systems, including humans, are well-studied, little is known about how it influences the pathogens and parasites accompanying them. This study used fruit flies (*Drosophila*) and their natural parasitoid wasps to explore these interactions in space, revealing that while wasp parasites developed normally and retained their virulence, host flies experienced significant changes. Tumor-free flies were more sensitive to space conditions, with essential gene suppression, while tumor-prone flies showed increased tumor burdens. Spaceflight also affected genes related to extracellular matrix and inflammation, many of which have human disease relevance. Additionally, mutant wasps with unique traits emerged, presenting new opportunities for research. These findings emphasize the need for further studies on host-pathogen dynamics in space to safeguard astronaut health and understand long-term biological effects.

Insights from Flies and Parasitoid Wasps

Through analyses of RNA-seq data, generated by OSDR's Sample Processing Lab and Data Processing Team, researchers found that spaceflight enhances immune gene expression and tumor development in flies, while Drosophila parasitoid wasps can develop successfully without losing their virulence. While some genetic mutations influenced immune responses and reproduction, these effects were independent of space conditions. Parasitic wasps retained their ability to interact with host flies and inject venom particles effectively, showing no significant differences in functionality. Gene expression changes in space-reared wasps were minor, with small shifts observed in certain venom-related genes. Additionally, the structural integrity and activity of venom particles remained consistent between space- and Earth-reared wasps. Notably, two novel mutations were identified in space-exposed wasps, affecting wing appearance and oviposition, with one mutation resulting in female sterility.

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> **"Such research is vital for protecting astronaut health and developing strategies for sustainable space exploration and colonization."**

OSDR's Impact on Space Health Research

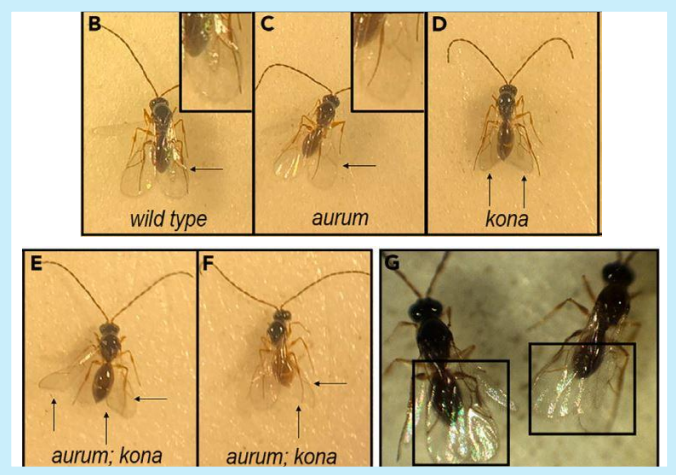
OSDR's Sample Processing Laboratory (SPL) plays a pivotal role in advancing space health research at NASA by enabling precise preparation and analysis of biological samples from spaceflight experiments. By ensuring samples are handled under controlled conditions, the SPL preserves their integrity and provides high-quality data for studies on the effects of microgravity and space radiation.

Coupled with the expertise of OSDR's data processing team and standardized analysis pipelines—which can be found on the GeneLab Data Processing GitHub page—the facility ensures consistent, accurate, and reproducible research findings, accelerating advancements in understanding countermeasures to safeguard astronaut health during extended space missions.

Researchers can request the SPL's sample sequencing services by submitting a detailed request via Sequencing and Data Processing Quote Request. Once approved, the SPL team offers guidance on sample shipping, enabling seamless collaboration and delivering robust scientific results that support NASA's mission to optimize astronaut health and performance.

Implications for Space Exploration

Fruit flies, the first organisms sent to space in 1947, have provided valuable insights into the effects of space on biology, with critical implications for human space exploration. Studies reveal that while flies face genetic and survival challenges in space, parasitic wasps show resilience, maintaining their development and virulence. These findings highlight the complexity of host-parasite interactions and the unexpected effects of spaceflight on different organisms. Such research is vital for protecting astronaut health and developing strategies for sustainable space exploration and colonization.



Mutant strains of *L heterotoma* (parasitic wasp).

Want to know more? Access these links below!

Drosophila parasitoids go to space: Unexpected effects of spaceflight on hosts and their parasitoids

Sequencing and Data Processing Quote Request

Datasets: OSD-588; OSD-609; OSD-610

GeneLab Data Processing GitHub