Finding RNA-DNA Hybrid Viruses

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Until recently it was thought that recombination between DNA and RNA viruses was practically nonexistent. The discovery of the RNA-DNA Hybrid Virus (RDHV) genome in a metavirome from a high-temperature acidic lake changed this view (Demer and Stedman, 2012). We and others, have discovered multiple examples of this recombination hiding in plain sight in multiple published and unpublished metagenomes from many different environments and recent publications (Rosario et al., 2012; Tao Woon Whan et al., 2012; Misuhiro Yoshida et al., 2013, and others through personal communication. Comparing the proteins with these hybrid virus proteins against each other will reveal conserved regions. This will also reveal insight into the evolutionary relationships between the various viruses. Locating conserved sequences will allow for the creation of detection tools such as degenerate primers which can be employed on environmental samples to detect the presence of similar viruses. Finding more Hybrid RNA-DNA Viruses may eventually help further the understanding of viral evolution.

**Methods**

Sequences of capsid proteins with homology to BSL RDHV capsid proteins were collected from metagenomes and other research groups. The bioinformatics software program Geneious was used to compare and investigate phylogenic relationships of the replication initiation (rep) protein and the capsid protein. The newly discovered reclaimed water virus capsid protein is homologous to BSL RDHV. Tampa Bay virus, and DMCLaHV but its replication initiation protein is very different. The rep protein from BSL RDHV is homologous to the Circoviridae family of animal ssDNA viruses but the rep protein from the reclaimed water virus is homologous to the plant Geminiviridae ssDNA viruses. The inverse is true when comparing BSL RDHV with DfcyV. Here the rep protein is homologous but the capsid proteins are very different. It is also interesting that geography appears to play little role in the phylogeny of RNA-DNA hybrid viruses. The capsid protein from BSL RDHV, from Boiling Springs Lake in California, is most similar to capsid proteins from Lac Pavin in France. As for the reclaimed water virus, from Florida, the other virus which shared the most homology within the capsid protein came from an air around Seoul, South Korea. Much more can be learned about this new group of viruses as more metagenomes are collected and more genomes are sequenced. It is also still unclear how exactly these hybrid viruses came to be and answering that may help further our understanding of viral evolution.

**Results**

RNA-DNA hybrid viruses are extremely diverse in both the replication initiation (rep) protein and the capsid proteins. The newly discovered reclaimed water virus capsid protein is homologous to BSL RDHV, Tampa Bay virus, and DMCLaHV but its replication initiation protein is very different. The rep protein from BSL RDHV is homologous to the Circoviridae family of animal ssDNA viruses but the rep protein from the reclaimed water virus is homologous to the plant Geminiviridae ssDNA viruses. The inverse is true when comparing BSL RDHV with DfcyV. Here the rep protein is homologous but the capsid proteins are very different. It is also interesting that geography appears to play little role in the phylogeny of RNA-DNA hybrid viruses. The capsid protein from BSL RDHV, from Boiling Springs Lake in California, is most similar to capsid proteins from Lac Pavin in France. As for the reclaimed water virus, from Florida, the other virus which shared the most homology within the capsid protein came from an air around Seoul, South Korea. Much more can be learned about this new group of viruses as more metagenomes are collected and more genomes are sequenced. It is also still unclear how exactly these hybrid viruses came to be and answering that may help further our understanding of viral evolution.

**Discussion**

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**References**


Karyna Rosario, Ian Hewson for DMCLaHV genome.


Stedman, Demer 2012 “novel virus detection in an extreme environment suggests recombination between unrelated viruses of DNA and RNA viruses.” Biology Direct. 7:12

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