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Identification of instances of horizontal gene transfer between *Drosophila ananassae* and its endosymbiont bacteria *Wolbachia*

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Abstract

Horizontal gene transfer (HGT) is the transmission of genetic material among organisms, other than by vertical transmission from parent to offspring. HGT is thought to be an important factor driving evolution. While extensively studied among prokaryotes, there is growing evidence that HGT is also prevalent in eukaryotes. In this study, we focused on the endosymbiont bacteria *Wolbachia*, and the Drosophila species that it infects. Based on a literature review we identified certain proteins in *Wolbachia* that have shown evidence of HGT and tested them using the Community Science Project pipeline. We found a particular Wolbachia protein, functionally annotated as DDE-type integrase/transposase/recombinase, which was also present in *Drosophila ananassae.* This protein in *Drosophila ananassae* was defined as a putative gag-pol protein based on functional annotation in the UniProt database. Using phylogenetic analysis, we were able to observe the evolutionary relationship between these two organisms and confirm the instance of HGT. Using synteny analysis we were able to observe the arrangement of the gene in several *Wolbachia* and *Drosophila* species. Further investigations in this system will focus on understanding the mechanism of HGT and expanding our study to other genes, to discover the extent of horizontal gene exchange.

Introduction

- Horizontal gene transfer is the transmission of genetic material among organisms, other than by vertical transmission from parent to offspring (Burmeister, 2015)
- One of the driving factors of evolution (Burmeister, 2015)
- Wolbachia is one of the most common endosymbiotic bacterias (Choi et al., 2015)
- present in numerous arthropods and nematodes
- Wolbachia pipientis normally functions in the fertility and lethality (Choi et al., 2015)
- Typically harmful in arthropods such as *Drosophila*
- *Wolbachia* is transmitted by way of the *wAna* genome
- *W. pipientis* has an extensive relationship with germline cells (Choi et al., 2015)
- Allows horizontal gene transfer to take place between eukaryotic genomes and bacterial genomes
- *D. ananassae* showed most extreme case of *W. pipientis* infecting its whole genome

Methods

After a substantial literature review, we picked out candidate proteins in *Wolbachia* that could potentially be in HGT with *Drosophila*. MegaX was used to identify the evolutionary relationship between the two. The relationship was further assessed using a Synteny analysis consisting of the *Wolbachia* gene, *Drosophila annasse*, and three top BLAST based on similarity.

Conclusions

Through the analysis, it was determined there is evidence of horizontal gene transfer between *Drosophila ananassae* and its endosymbiont bacteria *Wolbachia.* This was established through the phylogenetic tree clade relationship, as well as the Synteny results which observed the preserved genomes between the two, as well as other similar Drosophila species. Future studies will be directed to explore horizontal gene transfer between Wolbachia and other related Drosophila species.

Results

BLAST Results of Wolbachia	Column1	Column2	Column3	Column4	Column5	Column6
	Accession #	Perc. Identity	E value	Query Cover	Description	
Forward Blast	ABP48078.1	98.20%	0	98%	putative gag-pol protein	
Reverse Blast	WP_007549182.1	98.20%	0	63%	DDE-type integrase/transposase/recombinase	

Figure 1: This represents the forward blast of *Wolbachia* against drosophila, and the reverse blast which is the drosophila against *Wolbachia.*

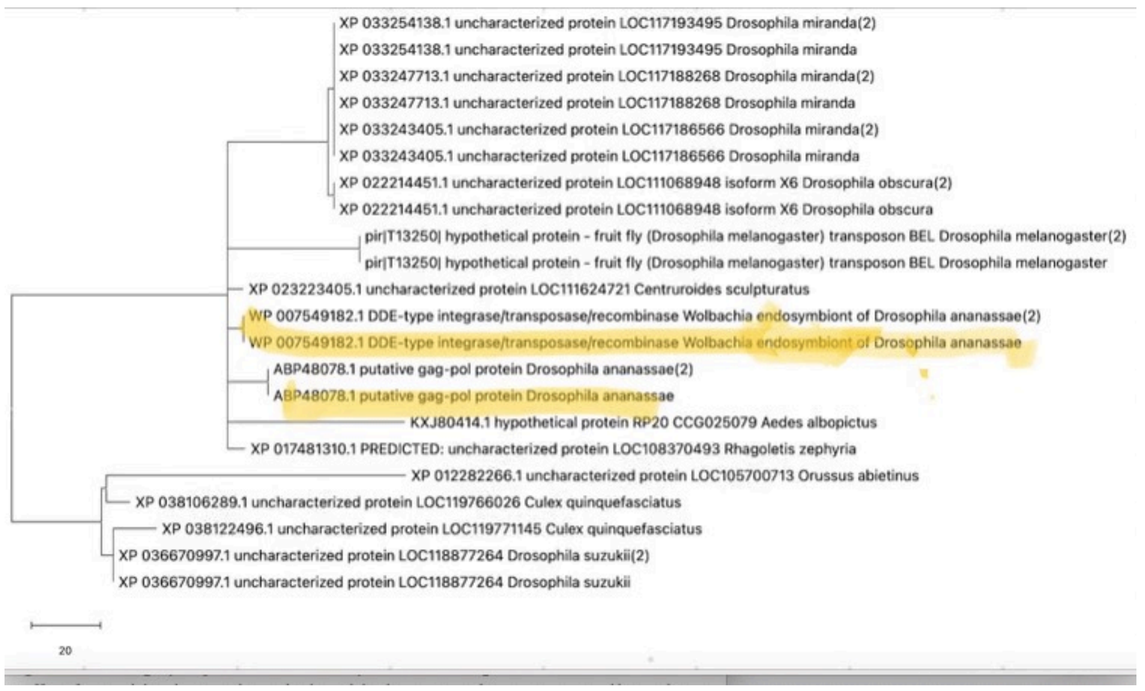

Figure 2: The phylogenetic tree analysis of *Drosophila ananassae* and its endosymbiont bacteria *Wolbachia.* This shows the relationship between the two, as well as close relatives similar in genetics.

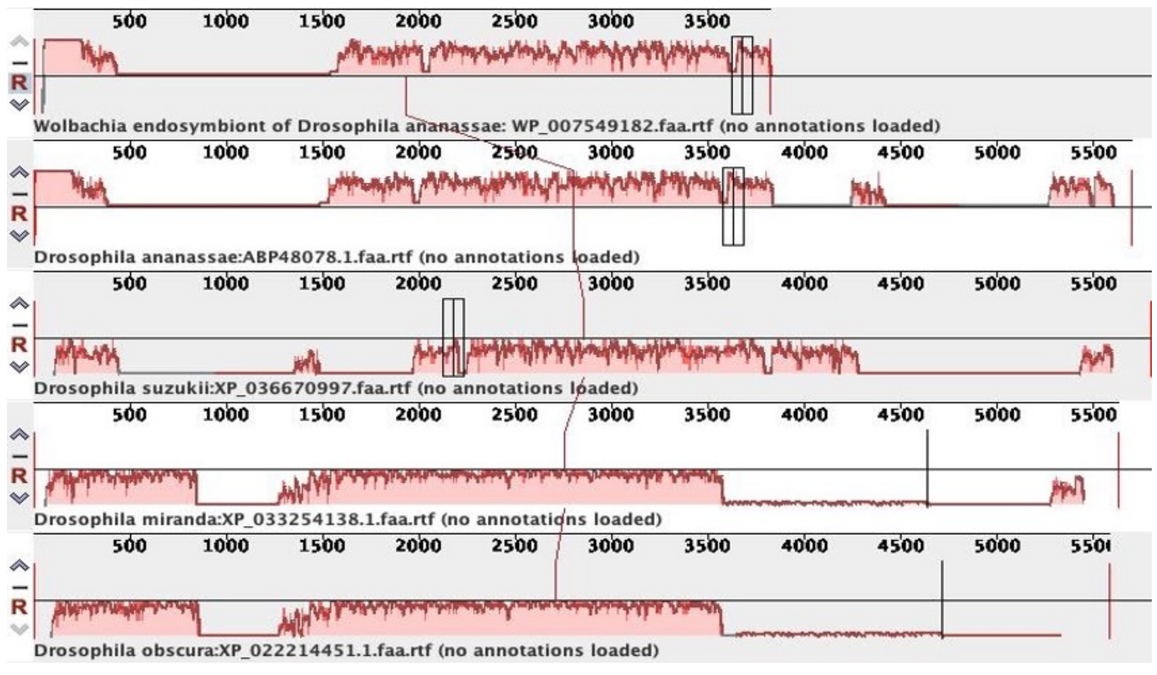

Figure 3: The synteny analysis formed from *Drosophila ananassae* and its endosymbiont bacteria *Wolbachia,* as well as the top three BLAST hits from *Drosophila ananassae*, the original Drosophila species of interest.

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