

Identifying miRNAs in RNA viruses

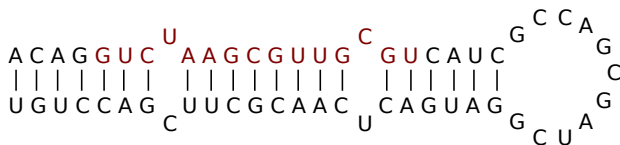
Kevin Lamkiewicz

Friedrich Schiller Universität Jena

16.02.2017

32nd TBI Winterseminar Bled

miRNAs and their function



- ▶ hairpin structure (precursor structure)
- ▶ mature miRNA: ~ 18 - 21nt
- ▶ regulatory function on post-transcriptional level

miRNAs in Viruses

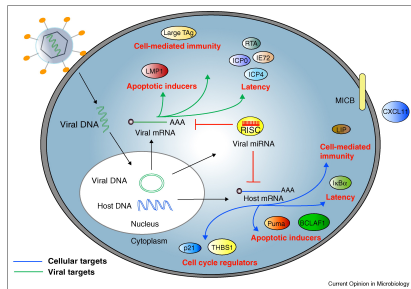
Identification of Virus-Encoded MicroRNAs

Sébastien Pfeffer,¹ Mihaela Zavolan,² Friedrich A. Grässer,³
Minchen Chien,⁴ James J. Russo,⁴ Jingyue Ju,⁴ Bino John,⁵
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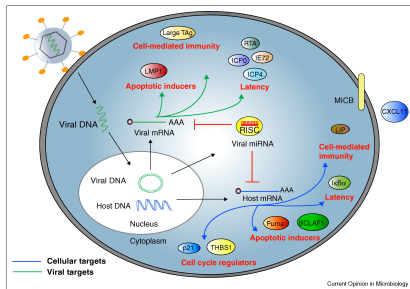


Isaac W Boss, Rolf Renne
 Viral miRNAs: tools for immune evasion; Current Opinion
 in Microbiology (2010)

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Browse miRBase by species

Click taxa to expand and collapse the tree. Click species names to list microRNAs.
 Jump to: [human](#), [mouse](#), [fly](#), [worm](#), [Arabidopsis](#).

Key: species name (miRNA count) [assembly version]

- Chromalveolata
- Metazoa
- Mycetozoa
- Viridiplantae
- Viruses
 - [Rovine foamy virus](#) (2 precursors, 4 mature)
 - [Bovine herpesvirus 1](#) (10 precursors, 12 mature)
 - [Bovine herpesvirus 5](#) (5 precursors, 5 mature)
 - [Bix polyomavirus](#) (1 precursor, 2 mature)
 - [Bovine leukemia virus](#) (5 precursors, 10 mature) [K02120.1]
 - [Bandicoot papillomatosis carcinomatosis virus type 1](#) (1 precursor, 1 mature)
 - [Bandicoot papillomatosis carcinomatosis virus type 2](#) (1 precursor, 1 mature)
 - [Duck enteritis virus](#) (24 precursors, 33 mature)
 - [Epstein Barr virus](#) (25 precursors, 44 mature) [EMBL:AJ507799.2]
 - [Herpes B virus](#) (12 precursors, 15 mature) [RefSeq:NC_004812]
 - [Human cytomegalovirus](#) (15 precursors, 26 mature) [EMBL:K17403.1]
 - [Human herpesvirus 6B](#) (4 precursors, 8 mature)
 - [Human immunodeficiency virus 1](#) (1 precursor, 4 mature)
 - [Herpes Simplex Virus 1](#) (18 precursors, 27 mature)
 - [Herpes Simplex Virus 2](#) (18 precursors, 24 mature)
 - [Herpesvirus saimiri strain A11](#) (3 precursors, 6 mature)
 - [Herpesvirus of turkeys](#) (17 precursors, 28 mature)
 - [Infectious laryngotracheitis virus](#) (7 precursors, 10 mature)
 - [JC polyomavirus](#) (1 precursor, 2 mature)
 - [Kaposi sarcoma-associated herpesvirus](#) (13 precursors, 25 mature) [EMBL:U75698.1]
 - [Mouse cytomegalovirus](#) (18 precursors, 29 mature)
 - [Merkel cell polyomavirus](#) (1 precursor, 2 mature)
 - [Marek's disease virus type 1](#) (14 precursors, 26 mature) [EMBL:AF243438.1]
 - [Marek's disease virus type 2](#) (18 precursors, 36 mature)
 - [Mouse gammaherpesvirus 68](#) (15 precursors, 28 mature) [EMBL:U97553.1]
 - [Pseudorabies virus](#) (13 precursors, 13 mature)
 - [Rhesus lymphocryptovirus](#) (36 precursors, 68 mature)
 - [Rhesus monkey rhadinovirus](#) (7 precursors, 11 mature) [EMBL:AF210726.1]
 - [Simian virus 40](#) (1 precursor, 2 mature)

Goals

Short-Term

- ▶ use existing tools to identify known miRNAs
- ▶ analyze novel miRNAs

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Long-Term

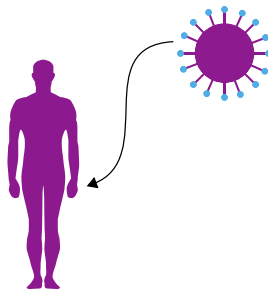
- ▶ *de-novo* viral (pre-)miRNA prediction
- ▶ systematic overview of miRNAs encoded by RNA viruses

Datasets and Tools

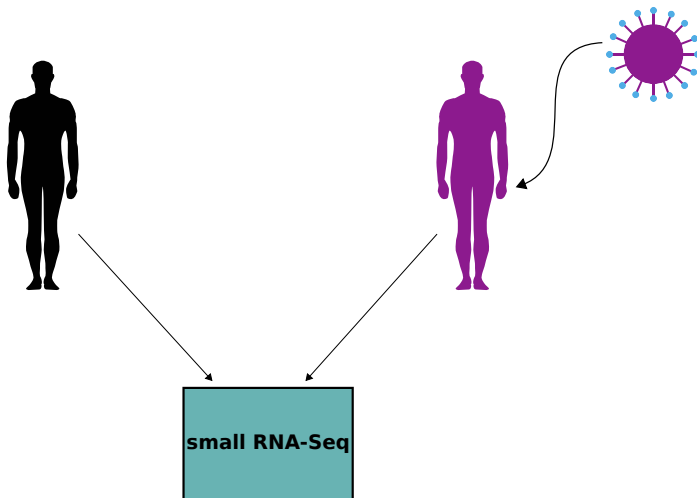
small RNA-Seqs



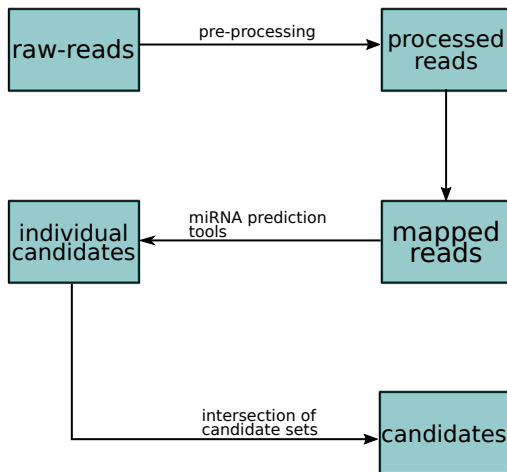
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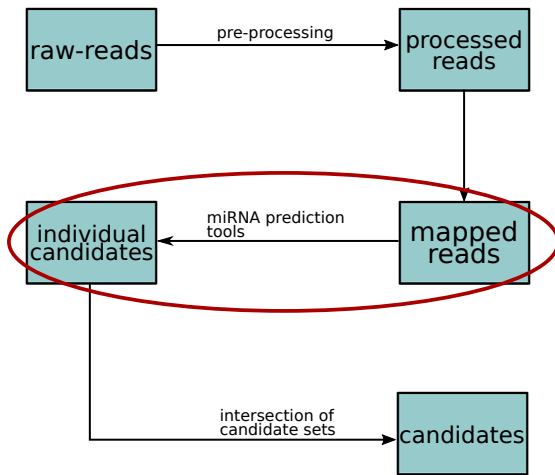


miRNA Detection Tools



Progress

First Results



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miRDeep2 and HHMMiR

- ▶ miRDeep2 **detected** annotated miRNAs of BLV
- ▶ HHMMiR **predicted** novel miRNAs in turnip crinkle virus (TCV)

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miRDeep2 and HHMMiR

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However: Tools that uses machine learning methods and classifiers are trained against a specific model (*Homo sapiens*, *Arabidopsis thaliana*, etc...)

Outlook

Next steps

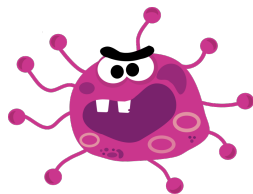
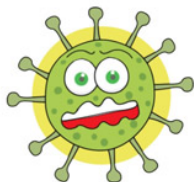
- ▶ Gather more data
- ▶ Get other tools running
Triplet-SVM, NovoMIR, ncPro-seq, CoRaL, miPred,
miReader, miRanalyzer,...

Outlook

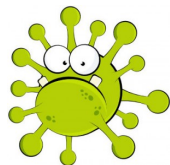
Next steps

- ▶ Gather more data
- ▶ Get other tools running
Triplet-SVM, NovoMIR, ncPro-seq, CoRaL, miPred, miReader, miRanalyzer,...
- ▶ Compare results of different tools
- ▶ Understand differences in the results
(If there are any)





Thank you for your attention!



(Images from [clipartpanda.com](https://www.clipartpanda.com) and [clipartkid.com](https://www.clipartkid.com))

Host-Virus Dataset

Host	Virus
<i>A. thaliana</i>	Turnip crinkle virus (TCV)
Sheep	Bovine leukemia virus (BLV)
Human	Enterovirus 71 (EV71)
Human	Coxsackievirus A16 (CA16)
Potato	Potato virus Y (PVY)
Soybean	Soybean mosaic virus (SMV)
Steer	Bovine foamy virus (BFV)
Mosquito	Chikungunya virus (CHIKV)
Appletree	Apple Stem Grooving Virus (ASGV)
Human	HIV1
Bat	Ebola virus
Hamster	West-Nile virus (WNV)
Mosquito	Dengue virus

Host-Virus Dataset

Host	Virus
<i>Cucumis melo</i>	Melon necrotic spot virus
<i>Nicotiana benthamiana</i>	Cymbidium ring spot virus
<i>A. thaliana</i>	Tobacco rattle virus
<i>A. thaliana</i>	Cucumber mosaic virus
<i>Nicotiana benthamiana</i>	Pepper mild mottle virus
<i>Cucumis melo</i>	Watermelon mosaic virus
<i>A. thaliana</i>	Turnip mosaic virus
<i>Nicotiana benthamiana</i>	Potato virus X
<i>Solanum lycopersicum</i>	Tomato yellow leaf curl virus