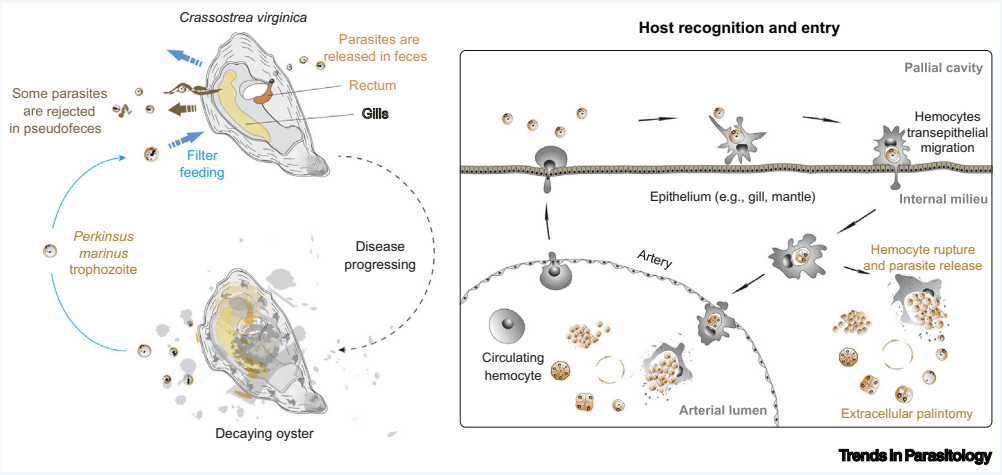
Trends in Parasitology | Parasite of the Month

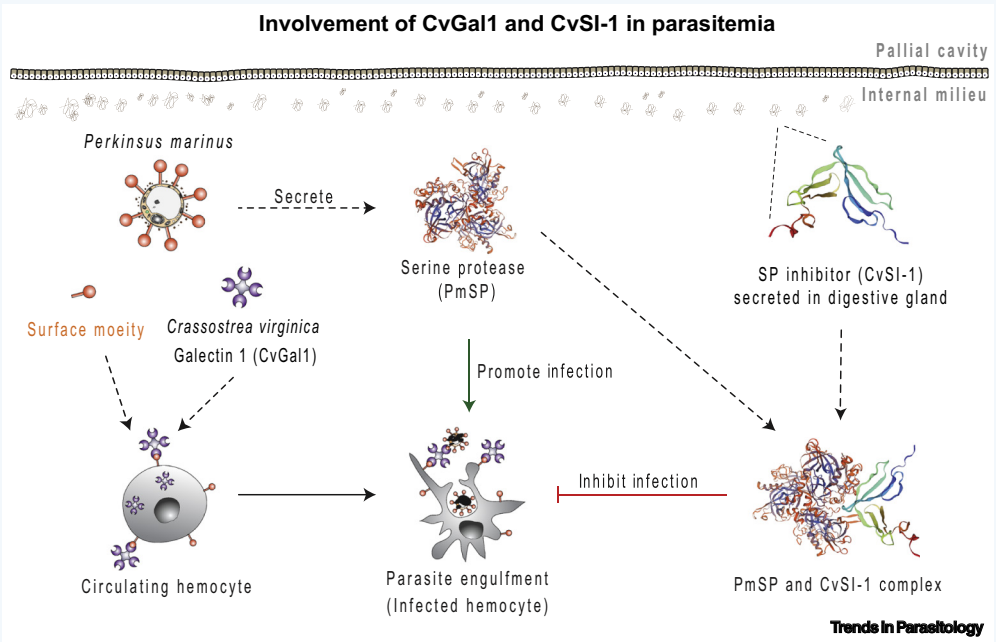
Perkinsus marinus

Raghavendra Yadavalli,[1] Kousuke Umeda,[1,2] and José A. Fernández Robledo[1,*]

[1]Bigelow Laboratory for Ocean Sciences, Boothbay, ME, USA
[2]National Research Center for Protozoan Diseases, Obihiro University of Agriculture and Veterinary Medicine, Hokkaido, Japan



Perkinsus marinus is a facultative intracellular marine protozoan parasite responsible for the Dermo disease in *Crassostrea virginica* oysters. Associated with mass mortalities in the Gulf Coast and Chesapeake Bay (USA), it remains one of the main hurdles for oyster reef restoration and aquaculture. Oysters take up the parasite by filter-feeding; in the pallial cavity it can be phagocytosed by the hemocytes via CvGal1, gaining access to the internal milieu. Inside the parasitophorous vacuole, the parasite resists oxidative stress and acquires nutrients. Propagation strategies include binary fission, budding, palintomy, and schizogony. Although the effect on humans upon consumption of raw infected oysters has not been studied, humanized HLA-DR4 mice fed with *P. marinus* do not develop noticeable pathology but elicit systemic immunity. Parasite culture in host-free media, and the use of genetic tools, make it a tractable genetic model and a heterologous expression and vaccine-delivery system.



KEY FACTS:

P. marinus is phylogenetically close to dinoflagellates and apicomplexans.

Two genomes in the nucleus (86 Mb encoding >23 600 proteins) and mitochondrion, using mRNA *trans*-splicing with a conserved 21–22 nt spliced leader.

With a direct life cycle, trophozoites are released into the water with pseudofeces and feces, or from decaying oysters.

It remains controversial whether *P. marinus* produces zoospores as do other *Perkinsus* spp.

Continuous culture in the absence of host cells and transfection methodology enable the study of physiology, cell biology, and host–parasite interactions.

It offers a heterologous expression system for human pathogen genes (e.g., *Plasmodium falciparum*, *Toxoplasma gondii*, *Cryptosporidium parvum,* and Ebola virus).

DISEASE FACTS:

P. marinus infection is one of the World Organization of Animal Health (OIE)-listed diseases.

Once described in the Gulf of México, it is now found in both North and South America.

High water temperature is the main environmental clue associated with oyster mass mortalities.

A protease inhibitor (CvSI-1) isolated from the plasma of eastern oysters inhibits the parasite's proliferation *in vitro* and appears to be involved in the resistance to Dermo disease.

With numerous chemical inhibitors of *in vitro* propagation, treatment of diseased oysters in the natural environment remains unrealistic.

TAXONOMY AND CLASSIFICATION:
PHYLUM: Perkinsozoa
CLASS: Perkinsea
ORDER: Perkinsida
FAMILY: Perkinsidae
GENUS: *Perkinsus*
SPECIES: *P. marinus*

*Correspondence:
jfernandez-robledo@bigelow.org
(J.A. Fernández Robledo).

  https://doi.org/10.1016/j.pt.2020.05.002

Acknowledgments

National Science Foundation (NSF) 1701480 (J.A.F.R.), National Oceanic and Atmospheric Administration (NOAA) NA15NMF4270303 (J.A.F.R.), and JSPS KAKENHI – Grant-in-Aid for JSPS Fellows 19J00148 (K.U.).

Resources

www.dfo-mpo.gc.ca/science/aah-saa/diseases-maladies/pmdoy-eng.html
www.ncbi.nlm.nih.gov/genome/280
www.atcc.org
www.protocols.io

Literature

1. Mackin, J.G. *et al.* (1950) Preliminary note on the occurrence of a new protistan parasite, *Dermocystidium marinum* n. sp., in *Crassostrea virginica* (Gmelin). *Science* 111, 328–329
2. Gauthier, J.D. and Vasta, G.R. (1995) *In vitro* culture of the Eastern parasite *Perkinsus marinus*: optimization of the methodology. *J. Invertebr. Pathol.* 66, 156–168
3. Perkins, F.O. (1996) The structure of *Perkinsus marinus* (Mackin, Owen, and Collier, 1950) Levine, 1978 with comments on taxonomy and phylogeny of *Perkinsus* spp. *J. Shellfish Res.* 15, 67–87
4. Tasumi, S. and Vasta, G.R. (2007) A galectin of unique domain organization from hemocytes of the eastern oyster (*Crassostrea virginica*) is a receptor for the protistan parasite *Perkinsus marinus*. *J. Immunol.* 179, 3086–3098
5. Fernández-Robledo, J.A. *et al.* (2008) Transfection of the protozoan parasite *Perkinsus marinus*. *Mol. Biochem. Parasitol.* 157, 44–53
6. Wijayalath, W. *et al.* (2014) Humanized HLA-DR4 mice fed with the protozoan pathogen of oysters *Perkinsus marinus* (Dermo) do not develop noticeable pathology but elicit systemic immunity. *PLoS One* 9, e87435
7. Cold, E.R. *et al.* (2017) Transient expression of *Plasmodium berghei* MSP8 and HAP2 in the Marine protozoan parasite *Perkinsus marinus*. *J. Parasitol.* 103, 118–122
8. Sakamoto, H. *et al.* (2017) Investigation into the physiological significance of the phytohormone abscisic acid in *Perkinsus marinus*, an oyster parasite harboring a non-photosynthetic plastid. *J. Eukaryot. Microbiol.* 64, 440–446
9. Lau, Y. *et al.* (2018) Transepithelial migration of mucosal hemocytes in *Crassostrea virginica* and potential role in *Perkinsus marinus* pathogenesis. *J. Invertebr. Pathol.* 153, 122–129
10. Schott, E.J. *et al.* (2019) Lacking catalase, a protistan parasite draws on its photosynthetic ancestry to complete an antioxidant repertoire with ascorbate peroxidase. *BMC Evol. Biol.* 19, 146

  https://doi.org/10.1016/j.pt.2020.05.002