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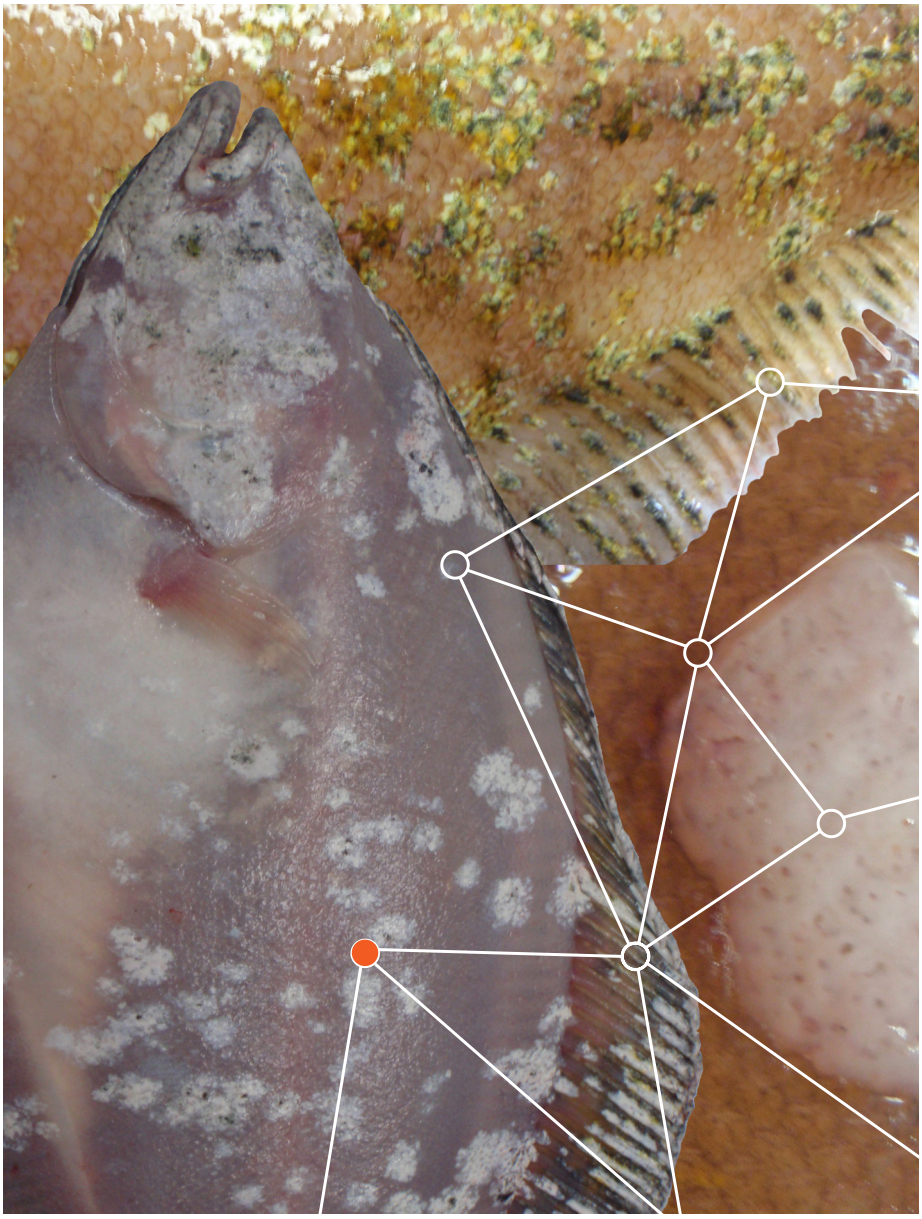

ICES INTERNATIONAL COUNCIL FOR THE EXPLORATION OF THE SEA
CIEM CONSEIL INTERNATIONAL POUR L'EXPLORATION DE LA MER

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Tenacibaculum maritimum, causal agent of tenacibaculosis in marine fish

Original by Y. Santos, F. Pazos and J. L. Barja (No. 55)
Revised by Simon R. M. Jones and Lone Madsen

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Conseil International pour l'Exploration de la Mer

H. C. Andersens Boulevard 44–46
DK-1553 Copenhagen V
Denmark
Telephone (+45) 33 38 67 00
Telefax (+45) 33 93 42 15
www.ices.dk
info@ices.dk

Recommended format for purposes of citation:

ICES 2019. *Tenacibaculum maritimum*, causal agent of tenacibaculosis in marine fish. Original by Santos Y., F. Pazos and J. L. Barja (No. 55), Revised by Simon R. M. Jones and Lone Madsen. ICES Identification Leaflets for Diseases and Parasites of Fish and Shellfish. No. 70. 5 pp. http://doi.org/10.17895/ices.pub.4681

Series Editor: Neil Ruane.

Prepared under the auspices of the ICES Working Group on Pathology and Diseases of Marine Organisms.

DOI: http://doi.org/10.17895/ices.pub.4681

ISBN 978-87-7482-227-1
ISSN 0109–2510

Contents

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Susceptible species

The bacterium displays a lack of strict host specificity and has been reported from wild, cultured, and ornamental fish species in seawater. These include Dover sole *Solea solea*, Senegalese sole *Solea senegalensis*, wedge sole *Dicologlossa cuneata*, turbot *Scophthalmus maximus*, Japanese flounder *Paralichthys olivaceus*, greenback flounder *Rhombosolea tapirina*, yellow-eye mullet *Aldrichetta forsteri*, yellowtail *Seriola quinqueradiata*, red sea bream *Pagrus major*, black sea bream *Acanthopagrus schlegelii*, rock bream *Oplegnathus fasciatus*, gilthead sea bream *Sparus aurata*, black bream *Acanthopagrus butcheri*, European sea bass *Dicentrarchus labrax*, white sea bass *Atractoscion nobilis*, tub gurnard *Chelidonichthys lucerna*, striped trumpeter *Latris lineata*, Atlantic salmon *Salmo salar*, rainbow trout *Oncorhynchus mykiss*, Chinook salmon *O. tshawytscha*, puffer fish *Takifugu rubripes*, Pacific sardine *Sardinops sagax*, northern anchovy *Engraulis mordax*, lumpsucker *Cyclopterus lumpus*, and sand tiger shark *Carcharias taurus* (Avendaño-Herrera *et al.*, 2006; Småge *et al.*, 2016; Pérez-Pascual *et al.*, 2017). Ornamental fish reported as hosts include the Picasso trigger fish *Rhinecanthus assasi* and black damsel fish (*Neoglyphieodon meles*). The true host range is likely much larger.

Disease name

Tenacibaculosis, bacterial stomatitis (mouthrot), erosive dermatitis.

Aetiological agent

Tenacibaculum maritimum (syn. *Flexibacter maritimus* (Suzuki *et al.*, 2001)) is a gliding, Gram-negative, aerobic bacterium with a long slender rod-shaped morphology (Figure 1) which, depending on agar type, produces colonies with uneven edges and a pale yellow pigment. The diversity of sequence types identified in disease lesions suggests the occurrence of multiple *Tenacibaculum* spp. (Habib *et al.*, 2014). However, a causative role in disease development has not been confirmed for most non-*T. maritimum* sequence types (Olsen *et al.*, 2017).

Geographical distribution

The bacterium has a global distribution with identifications from Asia (Japan, Korea, and Singapore), Europe (France, Greece, Ireland, Italy, Malta, Netherlands, Norway, Portugal, Spain, Turkey, and UK), Australasia (Australia, New Zealand), North America (Canada, USA), South America (Chile), Africa (Egypt), and French Polynesia.

Associated environmental conditions

Disease in cultured fish associated with *T. maritimum* infection can be triggered by recent stressors including smoltification, handling or exposure to harmful algae. Temperatures above 15°C and salinities above 30‰ are associated with increased prevalence and severity of tenacibaculosis.

Significance

The economic impacts of tenacibaculosis caused by infection with *T. maritimum* in marine farmed finfish are related to increased mortality, reduced growth, and costs associated with antibiotic treatment.

Gross clinical signs

The most prominent clinical signs are skin ulcers on all areas of the body surface, mouth erosion, tail rot, and frayed fins. Affected fish might be moribund and lethargic. Different clinical manifestation may also occur, such as mouthrot in Atlantic salmon, with characteristic yellow plaques in the mouth (Figure 2).

Control measures and legislation

Tenacibaculosis can be treated with antibiotics, although varying results are seen. Surface-acting disinfectants administered by immersion may be efficacious as preventive or prophylactic measures. Manipulation of temperature and/or salinity may assist in disease mitigation. Tenacibaculosis is not reportable to the OIE.

Diagnostic methods

The presence of *Tenacibaculum maritimum* in affected tissue or culture can be confirmed by quantitative real-time PCR (e.g. Fringuelli *et al.*, 2012; Frisch *et al.*, 2018) or other molecular methods. The bacterium can be isolated on non-selective oligotrophic media containing at least 30% seawater, e.g. marine agar. Isolation of pure cultures is challenged by slow growth of the organism, which increases the potential for overgrowth with mixed flora from the external lesions. The bacterium grows between 10 and 34°C, with optimal growth at 30°C (Wakabayashi *et al.*, 1986; Avendaño-Herrera *et al.*, 2006). Yellow colonies on agar plates (Figure 1) are characterized by biochemical reactions (e.g. APIZYM) and PCR.

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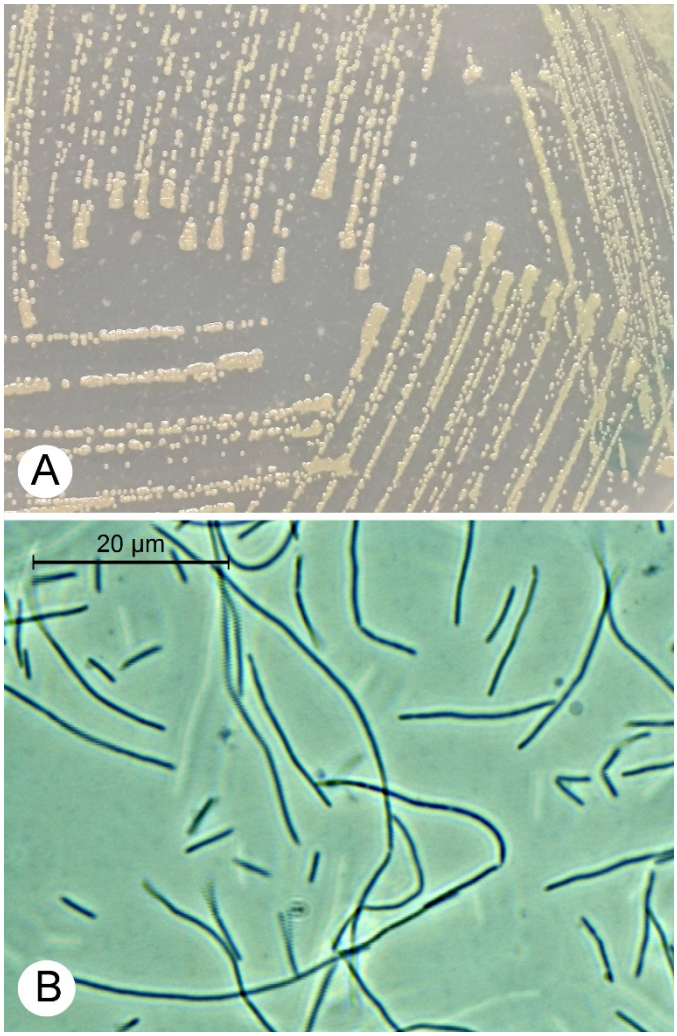

Figure 1. *Tenacibaculum maritimum* **(type strain NCIMB 2153): (A) colonies on marine agar (7 d culture) and (B) bacterial cells in marine broth (2 d culture) (L. Madsen, DTU Aqua).**

Figure 2. Stomatitis (mouthrot) caused by infection with *Tenacibaculum maritimum* **in post-smolted Atlantic salmon (***Salmo salar***), showing characteristic yellow pigmented lesions (B. Milligan, Cermaq Canada, Ltd.).**

Author contact details

Simon R. M. Jones

Pacific Biological Station

3190 Hammond Bay Road

Nanaimo, British Columbia V9T 6N7

Canada

Lone Madsen

DTU Aqua

Kemitorvet, Building 202

DK-2800 Kgs. Lyngby

Denmark