1.2.5 Enteric Redmouth Disease

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A. Name of Disease and Etiological Agent

Enteric redmouth disease (ERM) is caused by *Yersinia ruckeri*.

B. Known Geographical Range and Host Species of the Disease

1. **Geographical Range**
   ERM occurs throughout the world primarily in areas where salmonids are intensively cultured.

2. **Host Species**
   ERM is most prevalent in salmonid species that are cultured under intensive conditions. Isolation of *Y. ruckeri* has been reported from rainbow trout and steelhead *Oncorhynchus mykiss,* Atlantic salmon *Salmo salar,* brown trout *Salmo trutta*, cutthroat trout *Oncorhynchus clarkii*, brook trout *Salvelinus fontinalis*, lake trout *Salvelinus namaycush*, Chinook salmon *Oncorhynchus tshawytscha*, coho salmon *Oncorhynchus kisutch*, and sockeye salmon *Oncorhynchus nerka*. In addition, isolations have been made in non-salmonid fish including goldfish *Carassius auratus,* cisco *Coregonus* sp., emerald shiners *Notropis atherinoides,* Siberian sturgeon *Acipenser baeri,* fathead minnows *Pimephales promelas,* channel catfish *Ictalurus punctatus,* as well as others. Certain aquatic invertebrates such as crayfish and even mammals, notably muskrats, have been found to harbor *Y. ruckeri*.

C. Epizootiology

Yersinia ruckeri causes a severe bacteremia predominantly in salmonid fish species. The disease is typically acute in small fish and causes chronic disease in larger fish. Fish that survive infection can become asymptomatic carriers which subsequently shed large numbers of cells thus facilitating pathogen transfer within a population. The severity of an outbreak is dramatically increased under unfavorable rearing conditions such as low dissolved oxygen, high temperature, or if animals are stressed by crowding or handling. *Y. ruckeri* strains comprise several O-serotypes; however, the majority of outbreaks are caused by serotype O1 isolates. Vaccines for ERM were successfully developed and commercialized in the 1970s and typically consist of immersion-applied killed whole-cell preparations of serotype O1 *Y. ruckeri* strains. Recently, outbreaks of *Y. ruckeri* in vaccinated fish have occurred at fish farms in the United States and throughout Europe and the *Y. ruckeri* isolates associated with these outbreaks form a new emerging biogroup (biotype 2) that is defined by their

lack of both motility and secreted lipase activity. The emergence and potential spread of biotype 2 *Y. ruckeri* poses a threat to salmonid culture and thus monitoring of these strains has become increasingly important.

D. Disease Signs

The clinical signs of acute disease are very similar to those seen in other bacterial septicemias; however, the frequent presence of a reddening (hemorrhage) in the mouth, hemorrhages in the lower intestine, a hypertrophied spleen, and a yellow discharge from the vent may be of some diagnostic value. In chronic infections, the fish are dark, lethargic, and commonly show bilateral exophthalmia, which may progress to rupture of the eye (Figure 1). There may be cutaneous petechiation but the skin is intact. Petechial hemorrhages occur diffusely on (and in) the viscera and musculature**.**

Figure 1. Rainbow trout *(Oncorhynchus mykiss)* displaying bilateral exophthalmia and dark coloration common in fish infected with *Y. ruckeri*. Note that these signs are not distinctive of ERM. Photo by Jeff Hinshaw.

E. Disease Diagnostic Procedures

Diagnosis is based on observation of characteristic clinical signs and isolation and identification of the causative organism. Primary isolation should be made from the kidney on tryptic soy agar (TSA) or brain heart infusion agar (BHIA) incubated at 20 to 25°C for 24 to 48 hours.

1. **Presumptive Diagnosis**
   The organism should be a gram-negative, cytochrome oxidase-negative rod that ferments glucose anaerogenically. It does not produce indole in tryptone broth and produces an alkaline slant and an acid (only) butt in TSI agar. The isolate should also be negative in salicin and esculin tests to separate it from certain *Serratia* spp. Note: If ERM is strongly suspected, kidney tissue may, in addition, be inoculated onto Shotts-Waltman (SW; Waltman and Shotts 1984) medium, which should then be incubated at 20 to 25°C. The SW medium facilitates the rapid identification of *Y. ruckeri*, which will appear as very small, slightly green colonies with an opaque halo (2% of *Aeromonas hydrophila* strains tested will grow on SW, but they will produce large, yellow colonies). Note that motility and lipase production are both variable traits in *Y. ruckeri* and strains that are negative for these two phenotypes have recently been implicated in disease outbreaks in vaccinated fish.

2. **Confirmatory Diagnosis**
   a. Confirmatory testing of the sorbitol-negative Hagerman strain (Type I and serotype O1) is best accomplished serologically using serotype O1 antisera. The sorbitol positive, Type II strains are more serologically diverse encompassing up to five different serotypes however only the Serotype O2 antiserum is commercially available for serodiagnostic confirmation. PCR detection methods have also been developed which may be useful for both confirmation and detection directly from infected tissues (Altinok et al. 2001). Identification of sorbitol-positive *Y. ruckeri* can also be achieved by more detailed biochemical analysis.

   b. If anti-*Y. ruckeri* serum is not available, the isolate must be morphologically, culturally, and biochemically identical to *Y. ruckeri*.

F. Procedures for Detecting Subclinical Infections

The chances of detecting covert infections are considerably enhanced if material from the lower intestine is cultured; tissues from other organs do not appear to harbor the pathogen as regularly.

G. Procedures for Detecting Prior Exposure

Prior exposure to *Y. ruckeri* may be ascertained by examination of historical records of a facility, culture of fecal material on selective or differential media, or by serological analysis.

H. Procedures for Transportation and Storage of Samples

See Section 1, 1.1.1 General Procedures for Bacteriology.

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