Perspectives on Super-Shedding of Escherichia coli O157:H7 by Cattle

Krysty D. Munns,1,2 L. Brent Selinger,1 Kim Stanford,3 Lelu Guan,4 Todd R. Callaway,5 and Tim A. McAllister1

1Agriculture and Agri-Food Canada, Lethbridge Research Centre, Lethbridge, Alberta, Canada.
2Department of Biological Sciences, University of Lethbridge, Lethbridge, Alberta, Canada.
3Alberta Agriculture and Rural Development, Lethbridge, Alberta, Canada.
4Department of Agriculture, Food, and Nutritional Science, University of Alberta, Edmonton, Alberta, Canada.
5Food and Feed Safety Research Unit, U.S. Department of Agriculture/Agricultural Research Service, College Station, Texas.

Abstract

Escherichia coli O157:H7 is a foodborne pathogen that causes illness in humans worldwide. Cattle are the primary reservoir of this bacterium, with the concentration and frequency of E. coli O157:H7 shedding varying greatly among individuals. The term “super-shredder” has been applied to cattle that shed concentrations of E. coli O157:H7≥10^9 colony-forming units/g feces. Super-shedders have been reported to have a substantial impact on the prevalence and transmission of E. coli O157:H7 in the environment. The specific factors responsible for super-shedding are unknown, but are presumably mediated by characteristics of the bacterium, animal host, and environment. Super-shedding is sporadic and inconsistent, suggesting that biofilms of E. coli O157:H7 colonizing the intestinal epithelium in cattle are intermittently released into feces. Phenotypic and genotypic differences have been noted in E. coli O157:H7 recovered from super-shedders as compared to low-shedding cattle, including differences in phage type (PT21/28), carbon utilization, degree of clonal relatedness, tir polymorphisms, and differences in the presence of stx2a and stx2c, as well as antiterminator Q gene alleles. There is also some evidence to support that the native fecal microbiome is distinct between super-shedders and low-shedders and that low-shedders have higher levels of lytic phage within feces. Consequently, conditions within the host may determine whether E. coli O157:H7 can proliferate sufficiently for the host to obtain super-shedding status. Targeting super-shedders for mitigation of E. coli O157:H7 has been proposed as a means of reducing the incidence and spread of this pathogen to the environment. If super-shedders could be easily identified, strategies such as bacteriophage therapy, probiotics, vaccination, or dietary inclusion of plant secondary compounds could be specifically targeted at this subpopulation. Evidence that super-shredder isolates share a commonality with isolates linked to human illness makes it imperative that the etiology of this phenomenon be characterized.


The study reported here in this Research Brief was not funded by the beef checkoff, but is made available to expand the usefulness of this checkoff-funded website for those interested in beef safety.