Archival copy: for current recommendations see http://edis.ifas.ufl.edu or your local extension office.

UF IFAS Extension UNIVERSITY of FLORIDA

FSHN0519

Preventing Foodborne Illness: *Cyclospora cayetanensis*[1]

Keith R. Schneider, Rachael Silverberg, Susie Richardson, and Renée Goodrich Schneider[2]

This is one in a series of fact sheets discussing common foodborne pathogens of interest to food handlers, processors, and retailers.

What is *Cyclospora cayetanensis*?

First reported in 1979, *Cyclospora cayetanensis* is a microscopic, spore-forming, intestinal protozoan parasite (Ortega and Sanchez 2010). It was not until 1993 that it was officially classified as *Cyclospora cayetanensis* (Ortega and Sanchez 2010). The parasite is a known cause of the gastrointestinal infection cyclosporiasis, often referred to as "traveler's diarrhea" for its prevalence among visitors to regions where the species is endemic. The incidence of cyclosporiasis has been increasing worldwide, with several documented cases in the United States and Canada (Chacín-Bonilla 2012). These organisms have a protective covering that makes them resistant to disinfectants and that gives *Cyclospora* the ability to survive outside of hosts for extended periods (Mansfield and Gajadhar 2004; Ortega and Sanchez 2010).

How does *Cyclospora cayetanensis* spread?

The full host range of *C. cayetanensis* is currently unknown. At this time, humans are the only known host, with chimpanzees and other primates thought to be potential reservoirs (Ortega and Sanchez 2010). Infection with *C. cayetanensis* begins when ingested particles invade the epithelial cells of the small intestine. *Cyclospora cayetanensis* then replicates and continues to spread to nearby cells. It is this self-limiting (short-lived) stage that causes most of the symptoms associated with this parasite (Ortega and Sanchez 2010).

During infection, some of the parasitic cells undergo a sexual reproductive stage where survival structures called "oocysts" are produced. These are the structures that eventually pass in the host's fecal matter and spread infection to other new hosts (Ortega and Sanchez 2010). After one to two weeks, shed oocysts become "activated" (i.e., infectious), and if consumed through contaminated food or water, the disease will spread to the new host. Due to this lag time in infectivity, direct person-to-person contamination is unlikely (Ortega and Sanchez 2010).

Environmental factors have an effect on the time required for shed oocysts to become pathogenic, and these conditions can vary regionally and seasonally (Chacín-Bonilla 2010). In many countries, outbreaks of cyclosporiasis occur most prevalently during warm and rainy seasons. However, exceptions can be found in countries such as Haiti (Eberhard, Nace, and Freeman 1999), Peru (Bern et al. 2002), and Turkey (Turgay et al. 2007), where frequencies of cyclosporiasis incidence peak during seasons with less rainfall. Many times the facilitative conditions that aid in *Cyclospora* propagation are also conducive for fruit and

1. This document is FSHN05-19, one of a series of the Food Science and Human Nutrition Department, UF/IFAS Extension. Original publication date September 2005. Reviewed September 2008. Revised March 2015. Visit the EDIS website at http://edis.ifas.ufl.edu

2. Keith R. Schneider, professor; Rachael Silverberg, laboratory technician; Susie Richardson, laboratory technician; and Renée M. Goodrich Schneider, professor; Food Science and Human Nutrition Department, UF/IFAS, Gainesville, FL 32611.

The Institute of Food and Agricultural Sciences (IFAS) is an Equal Opportunity Institution authorized to provide research, educational information and other services only to individuals and institutions that function with non-discrimination with respect to race, creed, color, religion, age, disability, sex, sexual orientation, marital status, national origin, political opinions or affiliations. For more information on obtaining other UF/IFAS Extension publications, contact your county's UF/IFAS Extension office. U.S. Department of Agriculture, UF/IFAS Extension Service, University of Florida, IFAS, Florida A & M University Cooperative Extension Program, and Boards of County Commissioners Cooperating. Nick T. Place, dean for UF/IFAS Extension.

Archival copy: for current recommendations see http://edis.ifas.ufl.edu or your local extension office.

vegetable production. These conditions tend to occur at varying times in different regions of the world. When fruit and vegetable production is out of season in the US, it is often in season in another country. The US imports produce to fill domestic consumer demand during off-seasons. If a producing country does not adhere to adequate sanitary practices—for example, if crops are irrigated with untreated water, or if employees are not required to adhere to hygienic and sanitary practices—the risk of infestation with *C. cayetanensis* oocysts increases. This has lead to multiple domestic outbreaks of gastroenteritis linked to imported goods contaminated with *Cyclospora* (Hall, Jones, and Herwaldt 2011).

What are the symptoms associated with *Cyclospora cayetanensis*?

Usually, symptoms begin about one week after ingestion of contaminated food or water. Such symptoms may include:

- Frequent watery diarrhea (~6 stools/day, possibly explosive)
- Substantial weight loss
- Fatigue
- Abdominal pain
- Vomiting
- Nausea
- Low-grade fever

Some cases are asymptomatic (without symptoms). The disease usually is self-limiting (symptoms go away after a few days) and typically is not fatal, although there can be a relapse (symptoms return). In severe cases, symptoms can last more than a month if left untreated (Chacín-Bonilla 2010; Ortega and Sanchez 2010).

What are the risk groups of *Cyclospora cayetanensis*?

As with many foodborne pathogens, certain populations are at higher risk of becoming sick. Typically in developed countries, the very young and very old are more susceptible (Chacín-Bonilla 2010). Recent tourists and former residents of less developed countries where the disease is established are also at higher risk (Torres-Slimming et al. 2006). Young children are most likely to develop symptoms, while older children and adults tend to be more resistant to infection or be asymptomatic (Chacín-Bonilla 2010).

Foods associated with cyclosporiasis

Several types of fresh produce have been implicated as vehicles of transmission. Most recently, fresh cilantro grown in Mexico resulted in 304 confirmed cases of *Cyclospora* infection in the US in 2014; of these, 133 cases were reported in Texas (CDC 2014). In 2013, 631 cases were reported across 25 states in the US. Investigations performed by local public health officials, the US Food and Drug Administration (FDA), and the Centers for Disease Control and Prevention (CDC) implicated two separate vehicles of infection: salad mix produced by Taylors Farms de Mexico and fresh cilantro from Pueblo, Mexico (CDC 2013). Additionally, fresh raspberries, snow peas, and mesclun lettuce imported from Guatemala have all been implicated in US outbreaks (Chacín-Bonilla 2010). The implication of multiple vehicles of infection in the US since the mid-2000s highlights the need for prevention and control measures to ensure the safety of produce that is eaten raw and the need for an improved understanding of the epidemiology of *Cyclospora*. Table 1 outlines recent foodborne *Cyclospora* outbreaks in the US.

Sources of contamination

Little information is available regarding animal hosts and the environmental survival time of *Cyclospora*. Oocysts, however, tend to be resistant to adverse conditions and have been known to survive for long periods if kept moist. Oocysts must be consumed in order for cyclosporiasis to develop, and are only shed in the fecal matter of an infected host. Thus fecal contamination of food or water is the only method of contamination (Chacín-Bonilla 2010).

Prevention of cyclosporiasis

The best way to avoid exposure to *Cyclospora* is to avoid food and water from unsafe sources. Any foods to be eaten raw, such as produce, should be thoroughly washed with potable water before use or consumption, which will decrease ***but will not eliminate*** the risk of *Cyclospora* transmission. Travelers to resource-poor countries or other areas with sub-standard effluent treatment facilities should be advised to follow precautions specified by the CDC's "Yellow Book," *Health Information for International Travel* (http://wwwnc.cdc.gov/travel/yellowbook/2014/table-of-contents).

Individuals should be aware that the only way to prevent cyclosporiasis is to avoid ingesting contaminated products, as there is no vaccination for this disease. Most people

Archival copy: for current recommendations see http://edis.ifas.ufl.edu or your local extension office.

who contract cyclosporiasis are treated with a regimen of tri-methoprim-sulfamethoxaole (TMP-SMX) (Ortega and Sanchez 2010). However, those with sensitivities to sulfa drugs and immunocompromised individuals will need to consult with their medical professionals about alternative methods of treatment (Ortega and Sanchez 2010).

Other ways to minimize risk

- Use and drink purified water (municipal water, bottled water, etc.), especially when visiting developing countries or where water supplies are under less rigorous sanitary programs. Water can be made safe by boiling, if necessary.
- Peel, cook, or wash fruits and vegetables before serving or processing.
- Do not use untreated manure as a fertilizer for fruits and vegetables. The USDA National Organic Program specifies regulations regarding the time associated with composted manure under section 205, subsection 203 http://www.ams.usda.gov/AMSv1.0/getfile?dDocName=STELPRDC5087165.

References

Bern, C., Y. Ortega, W. Checkley, J. M. Roberts, A. G. Lescano, L. Cabrera, M. Verastegui, R. E. Black, C. Sterling, and R. H. Gilman. 2002. "Epidemiological differences between cyclosporiasis and cryptosporidiosis in Peruvian children." *Emerging Infectious Diseases* 8:581–585.

Centers for Disease Control and Prevention (CDC). 2013. "Notes from the field: Outbreaks of cyclosporiasis-United States, June–August 2013." *Morbidity and Mortality Weekly Report* 62:862–862.

Chacín-Bonilla, L. 2010. "Epidemiology of *Cyclospora cayetanensis*: A review focusing in endemic areas." *Acta Tropica* 115:181–193.

Chacín-Bonilla, L. 2012. "*Cyclospora cayetanensis* as a Global Health Problem." *Epidemiology Open Access* 2:3.

Eberhard, M.L., E. K. Nace, and A. R. Freeman. 1999. "Survey for *Cyclospora cayetanensis* in domestic animals in an endemic area in Haiti." *The Journal of Parasitology* 85:562–563.

Hall, R. L., J. L. Jones, and B. L. Herwaldt. 2011. "Surveillance for laboratory-confirmed sporadic cases of cyclosporiasis-United States, 1997–2008." *Morbidity and Mortality Weekly Report.* 60:1–13.

Mansfield, L. S. and A. A. Gajadhar. 2004." *Cyclospora cayetanensis* a food-and waterborne coccidian parasite." *Veterinary Parasitology* 126:73–90.

Ortega, Y. R. and R. Sanchez. 2010. "Update on *Cyclospora cayetanensis*, a food-borne and waterborne parasite." *Clinical Microbiology Reviews* 23:218–234.

Torres-Slimming, P. A., C. C. Mundaca, M. Moran, J. Quispe, O. Colina, D. J. Bacon, A. G. Lescano, R. H. Gilman, and D. L. Blazes. 2006. "Outbreak of cyclosporiasis at a naval base in Lima, Perú." *The American Journal of Tropical Medicine and Hygiene* 75:546–548.

Turgay, N., A. Yolasigmaz, D. D. Erodogan, F. Y. Zeyrek, and A. Uner. 2007. "Incidence of cyclosporiasis in patients with gastrointestinal symptoms in western Turkey." *Medical Science Monitor* 13:CR34–CR39.

Resources

Centers for Disease Control and Prevention [CDC], Division of Parasitic Diseases. January 2013. "Fact sheet: Parasites - *Cyclosporiasis* (*Cyclospora* Infection)." Accessed 29 July 2014. http://www.cdc.gov/parasites/cyclosporiasis/index.html.

Food Safety and Inspection Services, USDA. August 2013. Parasites and foodborne illness. Accessed 29 July 2014. http://www.fsis.usda.gov/wps/portal/fsis/topics/food-safety-education/get-answers/food-safety-fact-sheets/foodborne-illness-and-disease/parasites-and-foodborne-illness/.

Archival copy: for current recommendations see http://edis.ifas.ufl.edu or your local extension office.

Table 1. Foodborne Outbreaks of *Cyclospora* in the US since 1995.

Month/Year	Location	Number of Cases	Food/Source
June 1995	Florida	38	Raspberries
May 1995	New York	32	Food
Sept 1995	Florida	38	ND
May 1996	Boston	57	Berry dessert
Dec 1997	US/Canada	1,012	Raspberries
Dec 1997	Florida	12	Mesclun salad
June 1997	Washington, DC	341	Pasta salad
July 1997	Washington, DC	48	ND
Mar 1997	Florida (cruise ship)	220	Raspberries
Sept 1997	Virginia	21	Fruit plate
May 1998	Georgia	17	Fruit salad
May 1999	Florida	94	Fruits, berries
Aug 1999	Missouri	62	Basil
June 2000	Pennsylvania	54	Raspberries
Feb 2004	Texas; Illinois	95	ND
June 2004	Pennsylvania	96	Snow peas
Apr 2005	Florida	592	Basil
June-August 2013	25 states in US	643	Salad mix/Fresh cilantro
June-July 2014	20 states in US	304	Fresh cilantro

(Source: CDC 2013; CDC 2014; Ortega and Sanchez 2010)
ND = Not determined