ABSTRACT

Objective. Identify the natural infection of freshwater snails as an intermediate host of Fasciola hepatica in Guatemala. Materials and methods. Freshwater snails were collected in a high-altitude village (3,000 m asl) from Huehuetenango department, where fascioliasis is endemic. The identification of the snail species was based on the morphological characteristics observed under the stereoscope using an identification key. The trematode phases were searched externally by visual inspection using a light source, and internally by dissection and visual inspection of the tissues under a stereoscope and microscope. Results. 260 snails were found and identified as Pseudosuccinea columella. Two of them were found naturally infected with larval phases of F. hepatica. Conclusions. This is the first report of P. columella carrying phases of F. hepatica in the highlands of Guatemala. It is necessary to increase the research of the ecology of this parasite in other understudied areas in Guatemala and Central America, due to the latent risk of infection for populations of herbivorous animals and humans.

Keywords: Trematode infections; snails; zoonosis (Source: National Library of Agriculture).

RESUMEN

Objetivo. Identificar la infección natural de caracoles de agua dulce con Fasciola hepatica en una localidad del altiplano de Guatemala. Materiales y métodos. Se colectaron caracoles de agua dulce en una aldea endémica de fascioliasis, en la localidad de Paquix, en el departamento de Huehuetenango, ubicada a ~3,300 msnm. La identificación de la especie de caracol se basó en las características morfológicas observadas por estereoscopio usando una clave de identificación. La búsqueda de fases del trematodo se realizó mediante la inspección visual externa con fuente de luz y la disección e inspección visual dentro del molusco bajo estereoscopio y microscopio. Resultados. 260 caracoles fueron encontrados e identificados como Pseudosuccinea columella. Se examinaron
los especímenes colectados y se encontraron dos caracoles infectados de forma natural con fases larvarias de F. hepatica. **Conclusiones.** Este es el primer reporte de este hospedero intermediario portando formas de F. hepatica en Guatemala. Es necesario aumentar los reportes de este parásito y de sus interacciones ecológicas en otras áreas no estudiadas de Guatemala y Centro América, debido al riesgo latente de infección para poblaciones de animales herbívoros y humanos.

**Palabras clave:** Infecciones por trematodos; caracoles; zoonosis (*Fuente: Biblioteca nacional de agricultura*).

**INTRODUCTION**

Fascioliasis is a parasitic disease affecting humans and animals. It is associated with the cattle and sheep production in endemic tropical areas (1). *Fasciola hepatica* (Linnaeus, 1761) is the species of liver fluke present in America. A fundamental part of the life cycle of this trematode is carried out in a freshwater snail intermediate host (2). After the hatching of the eggs, the miracidium seeks and penetrates a snail, developing various parasitic phases (sporocyst, redia and cercaria). The cercariae abandon the snail and become infective metacercariae encysted in the aquatic vegetation, being then consumed by herbivorous animals or humans. In Latin America, fascioliasis is frequently reported in Bolivia, Paraguay and Argentina (3,4). However, the notification of the clinical cases is scarce in poor countries, where this illness is classified as a Neglected Tropical Disease (NTD) (5).

*Pseudosuccinea (Lymnaea) columella* (Say, 1817) was first reported in Guatemala in 1982 by Paraense. The specimen was collected at ~1,500 mamsl in Purulhá locality at Baja Verapaz department (Figure 1). Nevertheless, this species of snail has never been looked for in other locations, in the highlands of Guatemala, were human fascioliasis cases have been reported (6). The main purpose of this communication is to report for the first time the natural infection of *Pseudosuccinea columella* with *F. hepatica* in the highlands of Guatemala.

**MATERIALS AND METHODS**

Sampling was carried out during the dry season of 2008 in Paquix locality, at Huehuetenango department in Guatemala (Figure 1, dot 1). This area belongs to the Sierra de los Cuchumatanes mountainous system, at 3,300 mamsl, were sheep breeding and watercress cultivation (*Nasturtium officinale*, W.T. Aiton 1812) are the livelihood for native persons.

We collected 260 snails (Figure 1) in a water creek (15°26’03.4”N, 91°26’50.2”W). Two individuals were positive to trematode phases by visual inspection using a stereoscope and a light source for transillumination. Furthermore, dissection and visual internal inspection under stereoscope and microscope was made to confirm the presence of parasites phases.

**RESULT**

We collected 260 snails (Figure 1) in a water creek (15°26’03.4”N, 91°26’50.2”W). Two individuals were positive to trematode phases by visual inspection. Shell morphology of the collected snails was consistent with the characteristics of
**DISCUSSION**

This is the first report of *P. columella* with natural infection of *F. hepatica* in the highlands of Guatemala. We assume that the dispersion of this snail species covers different altitudes of the country, allowing the trematode transmission to animals and humans in different areas of the nation. On our collection site, in the Huehuetenango department, the average temperature is 11.89 °C (minimum of 3.37°C and maximum of 19.49°C). At the collection site carried out by Paraense in 1982, in the department of Baja Verapaz, the average temperature is 18.31°C (minimum of 11.40°C and maximum of 24.82°C). The different average temperatures in both collection sites support the idea postulated by other authors, about the invasive capacity of *P. columella* in different environmental conditions. It has been hypothesized that *P. columella* was introduced from North America to other regions of the planet in the mid-twentieth century. In Africa, the introduction of this intermediate host has caused the increase in the prevalence of *Fasciola gigantica* in Egypt (9).

In terms of NTD it is important to recognize the need to establish a specific monitoring program for zoonotic fascioliasis in Guatemala. For human onchocerciasis, another parasitic NTD in Huehuetenango caused by *Onchocerca volvulus* (Leuckart, 1894), a surveillance program of World Health Organization and the local health system, confirmed the prevalence, and made possible the interruption the transmission using mass treatment (10). Until now, some unofficial reports at the same locality of our snail collection, refer fascioliasis cases in children and adults (11).

*P. columella* has been confirmed as intermediate host of *F. hepatica* in Egypt, New Zealand, Brazil, Argentina, France and Cuba (9,12,13,14,15,16). The presence of trematode phases inside the mollusks by visual inspection is valid to report natural infection (16). It is important to replicate these efforts in different regions of Central America, exploring the possibility of strict absence given the variation of altitudes (between zero and 4000 mamsl) and the identified potential zoonotic risk areas.

**Conflict of interest**

The authors declare that there is no conflict of interests.

**Acknowledgments**

We are grateful to Manuel Rodriguez and Ludwig Figueroa for providing the laboratory of parasitology, veterinary faculty at Guatemala City.
REFERENCES

1. Mas-Coma S. Epidemiology of fascioliasis in human endemic areas. J Helminthol. 2005; 79(3):207–216. DOI: http://dx.doi.org/10.1079/JOH2005296.

2. Graczyk TK, Fried B. Development of Fasciola hepatica in the Intermediate Host. In: Dalton JP. (Editor). Fasciolosis. London: CABI Publishing; 1999. https://www.cabi.org/bookshop/book/9780851992600/

3. Marcos L, Maco V, Samalvides F, Terashima A, Espinoza JR, Gotuzzo E. Risk factors for Fasciola hepatica infection in children: a case-control study. Trans R Soc Trop Med Hyg. 2006; 100(2):158–166. DOI: http://dx.doi.org/10.1016/j.trstmh.2005.05.016

4. Parkinson M, O'Neill SM, Dalton JP. Endemic human fasciolosis in the Bolivian altiplano. Epidemiol Infect. 2007; 135(4):669–674. DOI: http://dx.doi.org/10.1017/S095026880600728X

5. Hotez P, Bottazzi M, Franco-Paredes C, Ault S, Valero M. Epidemiology of human fascioliasis: a review and proposed new classification. Bull World Health Organ. 1999; 77(4):340-346. https://www.who.int/bulletin/archives/77(4)340.pdf?ua=1

6. Mas-Coma M, Esteban J, Bargues M. Epidemiology of human fascioliasis: a review and proposed new classification. Bull World Health Organ. 1999; 77(4):340-346. https://www.who.int/bulletin/archives/77(4)340.pdf?ua=1

7. Paraense W. Lymnaea viatrix and Lymnaea columella in the neotropical region: a distributional outline. Mem Inst Oswaldo Cruz. 1982; 77(2):181-188. http://dx.doi.org/10.1590/S0040-07301982000200008

8. Burch J. North American fresh water snails: Museum of zoology and Department of Ecology and Evolution Biology. The University of Michigan; USA; 1982. URL Available in https://molluskconservation.org/PUBLICATIONS/WALKERANA/ Vol2/walkerana%20vol2%20no6%201-80.PDF

9. Grabner DS, Mohamed FA, Nachev M, Méayed EM, Sabry AHA, Sures B. Invasion biology meets parasitology: a case study of parasite spill-back with Egyptian Fasciola gigantica in the invasive snail Pseudosuccinea columella. PloS one. 2014; 9(2):e8853. DOI: https://doi.org/10.2171/journal.pone.0008537

10. Cruz-Ortiz N, Gonzalez R, Lindblade K, Richards F Jr., Sauerbrey M, Zea-Flores G, et al. Elimination of Onchocerca volvulus Transmission in the Huehuetenango Focus of Guatemala. J Parasitol Res. 2012; 638429. DOI: http://dx.doi.org/10.1155/2012/638429

11. Mas-Coma S, Bargues M, Valero M. Fascioliasis and other plant-borne trematode zoonoses. Int J Parasitol Parasites Wildl. 2005; 35(2005), 1255-1278. DOI: https://doi.org/10.1016/j.ijipara.2005.07.010

12. Pullan NB. The first report in New Zealand of Lymnaea columella Say (Mollusca: gastropoda) an intermediate host of the liver fluke Fasciola hepatica L. NZ Vet J. 1969; 17(2):255-256. DOI: http://dx.doi.org/10.1080/00401980.1969.33842

13. Abilio F, Watanabe T. Ocorrência de Lymnaea columella (Gastropoda:Lymnaeidae), hospedeiro intermediário da Fasciola hepatica, para o Estado da Paraíba, Brasil. Rev Saúde Pública. 1998; 32(2):185-186. DOI: http://dx.doi.org/10.1590/S0034-89101998000200013

14. Prepelitchi L, Kleiman F, Pietrokovsky S, Moriena R, Racipippi O, Alvarez J, Wisnivesky-Colli C. First Report of Lymnaea columella Say, 1817 (Pulmonata: Lymnaeidae) Naturally Infected with Fasciola hepatica (Linnaeus,1758) (Trematoda: Digenea) in Argentina. Mem Inst Oswaldo Cruz. 2003; 98(7):889-891. DOI: http://dx.doi.org/10.1590/S0040-073020000200005

15. Pointier J, Coustau C, Rondelaud D, Theran A. Pseudosuccinea columella (Say 1817) (Gastropoda, Lymnaeidae), snail host of Fasciola hepatica: first record for France in the wild. Parasitol Res. 2007; 101:1389–1392 DOI: http://dx.doi.org/10.1007/s00436-007-0656-y

16. Gutiérrez A, Vázquez A, Hevia Y, Sánchez L, Correa A, Hurtrez-Boussés S, Pointier L, Théron A. First report of larval stages of Fasciola hepatica in a wild population of Pseudosuccinea columella from Cuba and the Caribbean. J Helminthol. 2011; 85:109–111 DOI: http://dx.doi.org/10.1017/S0022149X10000350