Poultry as reservoir hosts for fishborne zoonotic trematodes in Vietnamese fish farms
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1. Introduction

Fishborne zoonotic trematodes (FZT) including liver and intestinal trematodes are increasingly being recognized as significant public health problem (Chai et al., 2005). The parasites are especially of concern to the fast growing aquaculture industries of Southeast Asia. Studies on freshwater fish were conducted in Vietnam and found that in the Mekong Delta, 1.2–29.7% of cultured fish were infected with FZT metacercariae (Thu et al., 2007; Thien et al., 2009) whereas in the North, prevalence of FZT was 44.6% in Nghe An province (Chi et al., 2008) and was >50% in Nam Dinh province (Van et al., in press).

The role of reservoir hosts for FZT in aquaculture systems has recently been demonstrated, including the importance of treatment of infected domestic animals for sustainable prevention and control of FZT in fish farms (Anh et al., 2009a,b). There are a wide range of potential definitive hosts in the life cycle of FZT, apart from humans, particularly domestic and wild animals and fish-eating birds (Chai et al., 2005; Schuster et al., 2007; Anh et al., 2009a). In Vietnam, chicken and duck are common poultry in Vietnamese fish farms. Ducks are often maintained in so-called VAC ponds (integration of vegetable, pond and...
animal husbandry farming) and chickens allowed to roam freely around ponds. Their role, however, in maintaining the life cycle of FZT in aquaculture systems is not understood. The aim of the study reported here was therefore to determine the prevalence of FZT in chickens and ducks in two northern Vietnam communes endemic for FZT. Greater knowledge on the role of poultry as reservoir hosts is needed to develop an effective integrated control program for FZT in fish aquaculture.

2. Materials and methods

2.1. Sampling method

From April to May 2009, a cross-sectional survey was conducted for FZT in ducks and chickens in Nghia Lac and Nghia Phu communes in Nam Dinh province which is located in northern Vietnam. A total of 33 and 27 fish-farming households from Nghia Phu and Nghia Lac communes, respectively, were randomly selected from a list of households and ducks and chickens purchased from them. A total of 6 of the selected households in Nghia Phu and 9 in Nghia Lac was included in a study on FZT infections in fish in 2006 (Van et al., in press). A total of 50 ducks and 50 chickens were surveyed, 5 ducks and 5 chickens per selected household if possible. If chickens and/or ducks were not reared in a selected household, the household was replaced by other randomly selected households. During sampling, farmers were asked questions about certain practices relating to poultry husbandry: where the poultry are fed, the types of commercial feeds fed, and whether snails and fish remain are used to feed the fish.

2.2. Parasite recovery and identification

The chickens and ducks were killed by exsanguinations from the neck vein and their intestines and livers removed to separate dishes containing saline. The livers were opened following the main tributaries of the biliary duct, and any visible trematodes picked out and, placed in a bucket with warm saline for 1 h and the fluid then was poured into conical flasks. The sediment was subsequently allowed to settle for 30 min, and then examined in Petri-dishes under a stereomicroscope. All isolated trematodes from an individual chicken or duck were combined in one flask and fixed in hot 5% formalin. After counting the number of trematodes recovered, all the trematodes were stained in Semichon’s acetocarmine and identified with published keys (Yamaguti, 1971; Pearson and Ow-Yang, 1982; Jones et al., 2005).

2.3. Statistical analysis

Prevalence estimates for total trematode infections and for individual trematode species, by commune and animal species (chicken or duck) were compared using logistic regression adjusting for clustering within households. Similarly, intensity of infection for all trematode infections and for individual trematode species, were compared between communes and animal species after adjusting for clustering within households using negative binomial regression (Hilbe, 2006). The ancillary parameter was estimated using a full maximum likelihood estimation and this was then specified in a generalized linear model as described in Hilbe (2006). Factors that were not significant were removed from the final model. Potential risk factors were then tested for significance by adding them one by one to these models. A P-value less than 0.05 were taken to indicate a significant difference.

3. Results

Prevalence of trematode species in chicken and duck in the two communes is presented in Table 1. Chickens were collected from 41 farms and ducks from 24 farms. Among them, 24% and 63% of the farms had infected chickens and ducks, respectively. Overall the prevalence of trematode infections (all species combined) was 12% and 30% in chickens and ducks, respectively. Two species were identified as fishborne zoonotic trematodes in chickens, Centrocestus formosanus and Echinostoma cinetorchis.

Table 1

<table>
<thead>
<tr>
<th>Identified trematode species</th>
<th>Nghia Lac commune</th>
<th>Nghia Phu commune</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Chicken n = 50</td>
<td>Duck n = 50</td>
</tr>
<tr>
<td><strong>Centrocestus formosanus</strong></td>
<td>2.0 (1)</td>
<td>0.0</td>
</tr>
<tr>
<td><strong>Echinostoma cinetorchis</strong></td>
<td>2.0 (1)</td>
<td>4.0 (1)</td>
</tr>
<tr>
<td><strong>Hypoderaeum conoideum</strong></td>
<td>4.0 (2)</td>
<td>14.0 (2)</td>
</tr>
<tr>
<td><strong>Nigeria hardoiensis</strong></td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td><strong>Notoctylys spp.</strong></td>
<td>0.0</td>
<td>2.0 (1)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>8.0 (2)</td>
<td>18.0 (2)</td>
</tr>
</tbody>
</table>

Numbers in parentheses are the maximum number of trematodes recovered in one animal.
The 4 species of intestinal trematodes recovered from chickens and ducks in this study are new records for these hosts in Vietnam. The FZT species *C. formosanus* and *E. cinetorchis* have been reported previously in dogs and cats in Vietnam by Anh et al. (2009b), although infections in humans have not been reported from Vietnam. *C. formosanus* metacercariae are relatively common in fish (Thien et al., 2007; Chi et al., 2008; Van et al., in press) and requires fish as second intermediate hosts. In contrast, *E. cinetorchis* and *H. conoideum* use either fish or snails as second intermediate hosts, a factor that might explain the higher prevalence of the latter species especially in ducks. Echinostome cercariae are commonly found in snails in these communes (Dung, 2007). To supply more calcium and nutrition for chickens and ducks (in all farms, ducks were raised for egg production), the feeding of snails is common practice by their owners. The higher prevalence of *E. cinetorchis* and *H. conoideum* in ducks may also be due to the practice of penning ducks in fish ponds and adjoining canals where access to infected snails is increased. In general, the access of chickens and ducks to fish or fish waste (e.g., intestine, scale, fins and gills) is an important risk factor since fish in these communes are commonly infected with FZT metacercariae (Van et al., in press).

Contamination of fish ponds by poultry with trematode eggs is facilitated by the belief on the part of owner’s that poultry faeces is a good fish food. Further, the free-roaming practice for chickens may increase the transport of trematode eggs to water bodies containing snail intermediate hosts during rain and feces are washed into the ponds by surface water runoff.

The low prevalence of FZT species in the chickens and ducks suggests their role as reservoir hosts is not significant. The penning up of chickens and locating their houses as far as possible away from water bodies would be beneficial to preventing fish infections; this is probably not feasible for duck production in these farming communities, however. Instead, the potential for treatment of ducks with an appropriate anthelmithic should be investigated. In addition, fish farmers must be educated on the risks associated with feeding snails or raw fish
waste to poultry and livestock as a component of any integrated FZT prevention and control program.

Acknowledgements

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