

ASSESSMENT OF THE RISKS OF RATS (*RATTUS NORVEGICUS*) AND OPOSSUMS (*DIDELPHIS ALBIVENTRIS*) IN DIFFERENT POULTRY-REARING AREAS IN ARGENTINA

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ABSTRACT

We have studied the prevalence of *Trichinella spiralis*, *Leptospira* spp. and *Salmonella* spp. in rats and opossums that inhabit poultry farms of Exaltación de la Cruz, Buenos Aires, Argentina, to determine the potential sanitary risk for humans that are in contact with these animals. The study was carried out on 48 poultry farms between spring 1999 and winter 2001. The study of opossums began in winter 2000. During the study period we captured 152 *Rattus norvegicus*, 3 *Rattus rattus*, 16 *Didelphis albiventris* and 1 *Lutreolina crassicaudata*. We have registered the presence of rats and opossums in 70% and 27% of the studied farms, respectively. The percentage of farms with rats was independent of the presence or absence of pigs. We did not detect the presence of *Leptospira* spp. and *Trichinella spiralis* in any individual. We detected the presence of *Salmonella* Enteritidis in one *Rattus norvegicus* and one *Didelphis albiventris*. According to our results, the rats and opossums of poultry farms may not report a risk factor in the transmission of *Trichinella* and *Leptospira* under the present conditions; but the detection of *Salmonella* Enteritidis in rats as well as in opossums suggests the idea of applying prophylactics measurements on poultry farms.

Key words: zoonosis, *Salmonella*, poultry farms, rats, opossum

INTRODUCTION

Rodents are potential zoonoses transmitters, such as Argentine Hemorrhagic Fever, Hantavirus (pulmonary and renal syndrome), leptospirosis, salmonellosis, trichinosis and lymphocytic choriomeningitis (1,24,27,32). Commensal rodents, such as rats, are in intimate contact with human beings and domestic animals, so they can disseminate disease to them throughout feces, urine and hair remnants.

Opossums are also potential zoonoses transmitters such as "Doença de Chagas" (29), leptospirosis and salmonellosis and they are an important link between the wild and domestic habitat.

The etiologic agent of trichinosis is the nematode *Trichinella spiralis*. The main hosts are pigs, rats and mice in domestic habitats. The sylvan reservoirs are omnivorous and carnivorous animals with cannibalistic and scavenging behavior. The domestic cycle is usually confined to small farms where the pigs are bred without microbiological barriers or veterinary controls (26). The role of rats in the maintenance and transmission of *T. spiralis* is a matter of controversy. According to Leiby *et al.* (19), *Rattus norvegicus* is the most important animal in the transmission and maintenance chain of trichinosis, whereas Madsen (21) said that rodents are accidental hosts in areas where the parasites have been previously present in pigs.

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There are no reports of rats infected with *Trichinella* in areas where the parasite has not been detected in wildlife or in domestic pigs. In Europe, *Trichinella* was detected in 73% of rats coming from food storage areas and in 6% of rats coming from pigpen. Rats coming from granaries, sheds and areas far from animal breeder places and slaughterhouses did not carry parasites (13). Human beings are accidental hosts that acquire trichinosis through the consumption of undercooked infected pork meat. During the last century (1900-1998), human cases of trichinosis in Buenos Aires Province reached 2731, resulting in 303.5 mean cases per year (7). Few studies about trichinosis in wild animals were made in Argentina, but the agent was detected in rodents, foxes, armadillos, wild boars and large hairy armadillos (*Chaetophractus villosus*) (1,15,33).

Leptospirosis is a worldwide disease with approximately 1% lethality. Rats are the main carriers of leptospires and they are important transmitters of infections to human beings and domestic animals. In poultry farms the rodents attracted to foodstuffs may infect chickens, especially in bad hygiene conditions, posing a danger to poultry processors (8). Furthermore, the critical number of rats for maintenance of leptospirosis in an area is estimated to be about two individuals per hectare, because in this way at least two rats would overlap their home range about half the time of its active life (14). According to studies carried out in Peru, Brazil and Argentina, *Didelphis* is the second main reservoir of leptospires (6,20,28). Leptospires were isolated from other animals, such as pampa's cavys, otters, hares and sigmodontine rodents (3,30). Human beings may become infected when they have contact with moist soil that contains infected urine. To create a leptospires focus, the presence of infected animals as well as particular habitat conditions (wet conditions, neutral or neutral-alkaline pH, temperate temperature) are needed. The prevalence in rodents that inhabit Buenos Aires downtown and its suburbs varied between 12.5% and 43% depending on the zone, environmental conditions and season (2,30,31).

Salmonellosis is an important disease both for human health and for the economic losses that causes to the poultry activity (16,17). The global increase of human infections due to serovar Enteritidis observed between 1980-1990 was almost entirely attributable to the presence of this organism in the poultry production industry worldwide (4). According to the Hungarian enteric surveillance data, human salmonellosis is mostly due to *S. Enteritidis* infection, caused by ingestion of food of poultry origin (meat and egg products) (23). The etiologic agent (*Salmonella* spp.) can be transmitted by chickens through vertical way, which can result in the contamination of a flock, or in the case of embryonic mortality, resulting in contaminated eggs (16). Therefore, different countries state that infected flocks of breeding birds should be destroyed, and that prophylaxis measurements should be implemented (16). The infection rate has been estimated to be between 1-3% in domestic animals

and around 3.4% in wild animals (opossums mainly) (1). Generally, rodents are infected with particular serotypes of the resident area.

The broiler industry is an activity that has increased worldwide; so, the goal of this study was to detect the prevalence of *Trichinella spiralis*, *Leptospira* spp and *Salmonella* spp in rats and opossums that inhabit poultry farms in the study area aiming to assess the potential risk posed by these animals to the human population.

MATERIALS AND METHODS

Study area

Fieldwork took place in Exaltación de la Cruz County, Buenos Aires Province, Argentina. The area is a gently sloping plain in the pampean subregion. The climate is temperate, with a mean annual temperature of 16°C and a mean annual precipitation of 1000mm.

The area is intensely cultivated, and most of the remaining native plants are restricted to linear and less disturbed habitats including cropfield edges, fencerows and roadsides, typically known as 'borders' (5,22). Other activities include extensive cattle farming and intensive poultry farming, mainly for the broiler industry, which has increased in the area in the last 14-19 years (12).

In poultry farms, seven-day-old chickens are provided to the farmers by large integrated breeding companies. When they are in their sheds, chickens are kept on litter floors, receive a constant supply of food and water and are maintained at a comfortable temperature. The chickens are reared for about 60 days and then sold as meat to the company. Within the next 20 days the sheds are prepared for new chickens. Usually, this is the period when sheds are treated with chemical for rodent control. However, farms may remain untreated for some periods because the company does not provide the poison, or the farmer decides not to use it.

Rodent and opossum survey

The study was carried out on 48 poultry farms (six for each season) located in Exaltación de la Cruz County, NW Buenos Aires province, Argentina, between spring 1999 and winter 2001. The opossums sampling began in winter 2000.

Cage live traps (15x16x31 cm.) were placed around the chicken sheds (maximum of three sheds per farm) and other buildings every 20 meters. Traps were baited with meat and carrots and checked each morning during three consecutive days.

The relationship between presence of rats on farms and the presence of pigs for the farmers consumption was determined by means of Chi-square Test (36).

Captured rodents and opossums were identified to species level. Breeding condition, trap location and date of capture were recorded. Animals were euthanized and the age of the rodent was determined by the dry weight of eye lens (18).

The prevalence was calculated as follows

$$\frac{\text{Number of hosts infected with one or more individuals of a particular parasite}}{\text{number of hosts examined for this particular parasite}} \times 100$$

Leptospira spp. detection

Two methods were used: serology and Warthin-Starry. Due to problems of contamination of samples when working in field conditions, the second method was selected for analysing the samples. Although this method may underdiagnose the presence of *Leptospira*, Fresh *et al.* (10) and Zamora *et al.* (35) detected 83.3% of the cases and results were comparable to the ones obtained using serological methods (10,34).

At necropsy, the kidneys of each animal were removed and transversal sectioned in half. The kidneys were then fixed in 10% buffered formalin. Sections of each kidney were silver impregnated according to the Warthin-Starry methods (9) and observed at light microscopy.

Trichinella spiralis detection

At necropsy, the tongue, intercostal muscles and diaphragm were removed and preserved at 0-5°C. Artificial digestion methods were used for detection of L₁ *Trichinella spiralis* (11).

Salmonella sp. detection

At necropsy, a terminal intestine portion was removed and sowed in a plate containing chromogenic Chromagar Salmonella. The potential positive samples were confirmed by serological tests, using somatic (O) and flagellar (H) polyvalent sera (34).

RESULTS

During the study period 160 rats (152 *Rattus norvegicus*, 3 *Rattus rattus* and 5 unknown) and 17 opossums (16 *Didelphis albiventris* and 1 *Lutreolina crassicaudata*) were captured by means of a total trapping effort of 4382 trap-nights.

Forty-nine percent of farms had pigs for the farmer consumption. The presence of rats and opossums was registered in 70% and 27% of the studied farms, respectively. The presence of rats on farms resulted independent of the presence or absence of pigs ($X^2=0.17$; $p=0.68$).

Neither *Leptospira* spp. nor *Trichinella spiralis* was detected in any of the individuals analysed (105 rats and 17 opossums; 129 rats and 17 opossum, respectively).

The presence of *Salmonella* Enteritidis was detected in one of the 123 *Rattus norvegicus* analysed (prevalence= 0.81%) and in one of the 16 *Didelphis albiventris* analysed (prevalence= 6%). The infected rat was a reproductively active female, older than 20 months weighing 310 grams, which had recently bred and captured in autumn 2001. The infected opossum was a juvenile female weighing 110 grams, captured in summer 2001.

DISCUSSION

In the studied poultry farms, the most common rat and opossum species were *Rattus norvegicus* and *Didelphis albiventris* respectively.

The absence of *Trichinella spiralis* in rats supports the hypothesis of Madsen (21) which says that they are accidental hosts which may be infected by the consumption of infected pigs carcasses. The absence of infected rats in the study area may be related to the periodical control of pigs conducted by the Bromatology Direction of Exaltación de la Cruz, and to the high availability of food sources for rats (chicken food) which decreases the probability of eating carcasses (1,26). In agreement with this hypothesis, Caminoa (7) found infected rats in sites where pigs were also infected.

The non-detection of leptospires in rats may have been caused by the absence of this parasite in the studied habitat, but may have been also the result of the use of antibiotics to control chickens, and rodenticides to control the rats (3,7,33).

Generally, rodents are infected with particular *Salmonella* serotypes, so, the detection of *Salmonella* Enteritidis in rats suggests that the chickens were infected with the same serotype, which implies a serious risk to human health. This serotype arose as a problem for the broiler industry in Spain in 1983 and it was treated as a serious problem in 1985 and 1986 because there is a positive relationship between humans isolation of *S. Enteritidis* and the consumption of chickens, eggs and their products (25).

According to these results, the rats and opossums of poultry farms in the study area are not a risk factor in the transmission of *Trichinella* and *Leptospira*. However, the presence of *S. Enteritidis* indicates the need for application of prophylactic measures in poultry farms which must include the creation of sanitary barriers at building entrances (13), heat treatment of feed and control of wild animals entrance.

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RESUMO

Avaliação dos riscos sanitários de ratos (*Rattus norvegicus*) e gambás (*Didelphis albiventris*) em diferentes granjas avícolas na Argentina

A prevalência de *Trichinella spiralis*, *Leptospira* spp. e *Salmonella* spp. foi estudada em ratos e gambás que habitam granjas avícolas da região de Exaltación de la Cruz, Buenos

Aires, Argentina, com o objetivo de determinar o potencial risco sanitário para pessoas que ficam em contato com esses animais. O estudo foi realizado entre a primavera de 1999 e o inverno de 2001 em 48 granjas avícolas. O estudo em gambás iniciou-se no inverno de 2000. Foram capturados 152 *Rattus norvegicus*, 3 *Rattus rattus*, 16 *Didelphis albiventris* e 1 *Lutreolina crassicaudata*. Registrou-se a presença de ratos e de gambás em 70% e 27% das granjas estudadas, respectivamente. A percentagem de granjas com ratos foi independente da presença ou da ausência de suínos. Não foi detectada a presença de *Leptospira* spp. e de *Trichinella spiralis* em nenhum animal avaliado. Foi detectada, porém, a presença de *Salmonella* Enteritidis em um *Rattus norvegicus* e em um *Didelphis albiventris*. Nas condições em que esse estudo foi realizado, os nossos resultados indicam que ratos e gambás que habitam granjas avícolas não constituem um fator de risco na transmissão de *Trichinella* e de *Leptospira*. A detecção de *Salmonella* Enteritidis tanto em ratos quanto em gambás, porém, sugere a necessidade de aplicar medidas profiláticas em granjas avícolas para maior controle desse agente.

Palavras-chave: zoonose, *Salmonella*, granjas avícolas, ratos, gambás

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