



Short communication

Seroprevalence of *Toxoplasma gondii* infection in cattle, horses, pigs and chickens in JapanKayoko Matsuo^{a,b,*}, Rika Kamai^a, Hirona Uetsu^a, Hanyu Goto^a, Yasuhiro Takashima^b, Kisaburo Nagamune^c^a Gifu Prefectural Meat Inspection Office, 3-167-1 Hayashimachi, Oogaki, Gifu 503-0015, Japan^b Department of Veterinary Parasitological Diseases, Faculty of Applied Biological Science, Gifu University, 1-1 Yanagido, Gifu 501-1193, Japan^c Division of Protozoology, Department of Parasitology, National Institute of Infectious Diseases, 1-23-1 Toyama, Shinjuku-ku, Tokyo 162-8640, Japan

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ABSTRACT

The presence of antibodies to *Toxoplasma gondii* in livestock and poultry was investigated by latex agglutination tests; samples that agglutinated at dilutions of 1:64 or higher were regarded as positive. Sera were collected from fattening beef cattle (102 Japanese black, 105 crossbreeds and 114 castrated Holstein), culled dairy cattle (101 Holstein), 100 horses, 115 fattening pigs and 235 chickens (163 free-range and 72 broilers) at abattoirs in Gifu Prefecture, Japan, from August 2012 to August 2013. Antibodies to *T. gondii* were found in 7.3% (31/422) in cattle, 5.2% (8/155) in pigs, but not in horses or chickens. These results suggest that toxoplasmosis may be transmitted to humans via consumption of *T. gondii*-infected raw beef in Japan.

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Toxoplasma gondii is an important zoonotic parasite that infects many warm-blooded animals including livestock and poultry as intermediate hosts [1–5]. The current global estimated incidence of congenital toxoplasmosis is 190,100 cases a year in humans [6]. Human toxoplasmosis is transmitted mainly through the ingestion of tissue cysts in contaminated raw or undercooked meat, or through sporulated oocysts in soil and water, or on vegetables. However, today's consumers and many medical doctors in Japan believe that toxoplasmosis is only transmitted by oocysts from cats or by tissue cysts in raw pork meat. Japanese consume many kinds of raw meat in “sashimi (sliced raw fish)” style foods. The rate of primary *Toxoplasma* infection during pregnancy has been estimated at 0.25% in Japan, with raw meat consumption recognized as a risk factor [7]. In view of this, we investigated the seroprevalence of *T. gondii* in livestock and poultry.

Sera were collected from fattening beef cattle (102 heads of Japanese black, 105 crossbred animals and 114 castrated Holstein) and 101 culled dairy Holstein, 100 horses, 115 fattening pigs and 235 chickens (163 free-range and 72 broilers) at abattoirs in Gifu Prefecture, Japan, from August 2012 to August 2013. Therefore, this survey is based not only on a single prefecture, but reflects somewhat the current situation in Japan. The presence of *T. gondii* antibodies in the animals was evaluated

using a commercially available latex agglutination test (LAT) kit (Toxocheck-MT; Eiken-Kagaku, Tokyo, Japan). Each serum sample was diluted 16-fold in a diluting buffer and 25 µL of each diluted test sample was re-diluted with an equal volume of buffered saline to obtain serial 2-fold dilutions from 1:32 to 1:1024. Samples that agglutinated at 1:64 or above were regarded as positive, according to the LAT kit instructions. The LAT kit used in our study has been evaluated as a serologic screening test for toxoplasmosis in animals and has been widely used in serological surveys with various animal species [8–12]. Statistical analysis of *T. gondii* seroprevalence in the animals was performed by Chi-square tests.

The *T. gondii* seropositive rate was 7.3% in cattle, and 5.2% in pigs (Table 1). There were no seropositive horses or chickens. Japanese black beef cattle had the highest seroprevalence value of all the breeds of cattle (Table 1). It was significantly higher than that of the castrated Holstein cattle ($P < 0.01$). The fattening periods of the Japanese blacks were longer than those of the castrated Holsteins, but these periods were not correlated with the presence of seropositive individuals or the age of the cattle. The feeding and fattening methods may be very different in Japanese blacks and other breeds. Further investigation of the individual farms will be required to elucidate why differences in *T. gondii* seroprevalence exist in cattle. *T. gondii* has been rarely isolated from cattle worldwide [1], but we are not aware of any reports to isolate it from Japanese beef cattle.

T. gondii has been isolated from goat meat in Okinawa [11] and *T. gondii* seroprevalence in sheep was 28.7% in Hokkaido [12]. There

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Table 1
Seroprevalence and titer of *Toxoplasma gondii* in livestock and chickens at abattoirs in Gifu, Japan.

		Breed	Range of age (Av.)	Seropositive	No. of positive/examined	Titer of antibodies			
Cattle	Beef	Japanese black	19–40 (28.0) months	13.7%	14/102	1:64	1:128	1:256	1:512
		Crossbred	18–49 (27.6) months	4.8%	5/105	10	2	1	1
		Castrated Holstein	17–31 (21.8) months	3.5%	4/114	4	1		
	Discard	Dairy Holstein	23–166 (69.6) months	7.9%	8/101	3			1
Total				7.3%	31/422	23	5	1	2
Pig	Fattening	LWD	6 months	5.2%	8/155	8			
Horse		Percheron etc.	2–7 years	0.0%	0/100				
Chicken		Broiler	51–53 days	0.0%	0/103				
		Free-range	83–90 days	0.0%	0/163				

are no recent reports of *T. gondii* infection in other Japanese livestock. Our study suggests that toxoplasmosis may be transmitted to humans via consumption of cyst-infected raw beef in Japan. To prevent infection, before consumption, meat needs to be thoroughly cooked to inactivate *T. gondii* tissue cysts.

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References

- [1] Dubey JP. Toxoplasmosis in animals and humans. 2nd edition. Boca Raton, Florida: CRC Press; 2009.
- [2] Fajardo HV, D'ávila S, Bastos RR, Cyrino CD, de Lima Detoni M, Garcia JL, et al. Seroprevalence and risk factors of toxoplasmosis in cattle from extensive and semi-intensive rearing systems at Zona da Mata, Minas Gerais state, Southern Brazil. *Parasit Vectors* 2013;25(6):191.
- [3] Jones JL, Dubey JP. Foodborne toxoplasmosis. *Clin Infect Dis* 2012;55:845–51.
- [4] Miao Q, Wang X, She LN, Fan YT, Yuan FZ, Yang JF, et al. Seroprevalence of *Toxoplasma gondii* in horses and donkeys in Yunnan Province, Southwestern China. *Parasit Vectors* 2013;6(6):168.
- [5] Yang N, Mu MY, Li HK, Long M, He JB. Seroprevalence of *Toxoplasma gondii* infection in slaughtered chickens, ducks, and geese in Shenyang, northeastern China. *Parasit Vectors* 2012;18(5):237.
- [6] Torgerson PR, Mastroiacovo P. The global burden of congenital toxoplasmosis: a systematic review. *Bull World Health Organ* 2013;1(91):501–8.
- [7] Sakikawa M, Noda S, Hanaoka M, Nakayama H, Hojo S, Kakinoki S, et al. Anti-*Toxoplasma* antibody prevalence, primary infection rate, and risk factors in a study of toxoplasmosis in 4466 pregnant women in Japan. *Clin Vaccine Immunol* 2012;19:365–7.
- [8] Murata K. A serological survey of *Toxoplasma gondii* infection in zoo animals and other animals. *Jpn J Vet Sci* 1989;51:935–40.
- [9] Matsuo K, Husin D. A survey of *Toxoplasma gondii* antibodies in goats and cattle in Lampung province, Indonesia. *Southeast Asian J Trop Med Public Health* 1996;27:554–5.
- [10] Shahiduzzaman M, Islam R, Khatun MM, Batanova TA, Kitoh K, Takashima Y. *Toxoplasma gondii* seroprevalence in domestic animals and humans in Mymensingh District, Bangladesh. *J Vet Med Sci* 2011;73:1375–6.
- [11] Kyan H, Taira M, Yamamoto A, Inaba C, Zakimi S. Isolation and characterization of *Toxoplasma gondii* genotypes from goats at an abattoir in Okinawa. *Jpn J Infect Dis* 2012;65:167–70.
- [12] Giangaspero M, Bonfini B, Orusa R, Savini G, Osawa T, Harasawa R. Epidemiological survey for *Toxoplasma gondii*, *Chlamydia psittaci* var. ovis, *Mycobacterium paratuberculosis*, *Coxiella burnetii*, *Brucella* spp., leptospirosis and Orf virus among sheep from northern districts of Japan. *J Vet Med Sci* 2013;75:679–84.