NOTE ***Public Health***

Prevalence of *Salmonella* spp. in Pigs, Chickens and Ducks in the Mekong Delta, Vietnam

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(Received 26 November 2003/Accepted 23 March 2004)

ABSTRACT. In order to determine the prevalence of *Salmonella* spp. in domestic animals in 6 provinces of the Mekong Delta, Vietnam, 1,098 fecal or intestinal content samples from pigs, chickens, and ducks were examined in the period from July to October, 2000. *Salmonella* spp. were isolated from 78 (7.1%) of the total samples, which included 23 (5.2%) of 439 pigs, 24 (7.9%) of 302 chickens, and 31 (8.7%) of 357 ducks. From those samples, 80 *Salmonella* strains were isolated and 25 serovars were identified. The predominant serovars were *S.* Javiana, *S.* Derby, and *S.* Weltevreden. *S.* Javiana and *S.* Weltevreden were detected together in pigs, chickens, and ducks. These results indicate that the serovars of *Salmonella* are widely distributed in domestic animals in the Mekong Delta, Vietnam.
KEY WORDS: domestic animal, *Salmonella*,Vietnam.

J. Vet. Med. Sci. 66(8): 1011–1014, 2004

Salmonella is recognized worldwide as an important foodborne human pathogen, and is found in the intestinal tract of both animals and humans [8]. Animals that carry *Salmonella* play an important role in the spread of salmonellosis [16]. In the past decade, the incidence of systemic infection of typhoid *Salmonella* has declined markedly all over the world including Japan, but food poisoning caused by other *Salmonella* serovars such as Enteritidis has increased [8, 14], and meat from domestic animals (pigs, chickens, and ducks) has been reported to be the major cause of foodborne disease of *Salmonella* [16].

The Mekong Delta consisting of 12 provinces is located in the southern area of Vietnam, and 3 millions pigs and 44 million poultry were raised in this area in 2000. However, few reports have been published regarding the prevalence of *Salmonella* spp. in domestic animals in the Mekong Delta, although there have been some case reports regarding *Salmonella* Typhi in Vietnam [6, 17]. The present study was therefore conducted in order to determine the prevalence of *Salmonella* in pigs, chickens, and ducks in the Mekong Delta, Vietnam.

During the period from July to October 2000, 1,098 fecal or intestinal content samples from pigs, chicken and ducks in 6 provinces of the Mekong Delta were examined for the prevalence of *Salmonella* spp. A total of 439 fecal samples were taken from 2- to 4- month-old pigs kept in 47 small-scale farms and 5 commercial farms. The small-scale farms raised only a few pigs which were kept inside simple pens and were mostly given leftovers from the household and water from nearby rivers or ponds. In the commercial farms, the pigs were caged and were given commercially produced food and disinfected tap water. A total of 302 samples of adult chickens from 27 slaughter houses were also analyzed. The chicken came from both small-scale and commercial farms and their habitat was similar to those of the pigs. Cecal samples of 357 adult ducks were also collected. Only a few samples of ducks came from commercial farms which produced mainly ducklings for sale to small-scale farms. In small-scale farms, the ducklings fed on snails, insects, etc. in the rice fields. After the rice had been harvested, the grown ducks fed on the leftover rice.

The samples from the pigs were taken as rectum swabs or fresh feces. The swabs were put in Carry-Blair transport medium (Nissui, Tokyo, Japan), and the samples of the feces placed in sterile plastic bags. All samples were cooled in an icebox and immediately transported to Cantho University in Vietnam for examination. The intestines of the ducks and chickens were collected aseptically in the slaughterhouses after evisceration. All samples were put into sterile plastic bags, cooled, and brought to the laboratory where cecal samples were taken aseptically.

In the laboratory, one gram of each fecal sample or a swab were put aseptically into a tube containing 9 m*l* EEM broth (Eiken, Tokyo, Japan) for pre-enrichment and incubated at 37°C for 24 hr. Then 1 m*l* of the pre-enrichment broth in each tube was transferred to 9 m*l* Hajna tetrathionate broth (Eiken) and further incubated at 37°C for 24 hr. One loopful of each enrichment was inoculated onto a plate with brilliant green agar (BGA; Oxoid, Hampshire, UK) and mannitol lysine crystal violet brilliant green agar (MLCB, Nissui). The plates were incubated at 37°C for 24 hr. Colonies morphologically similar to those of *Salmonella* spp. were subcultured for biochemical examination. Biochemical characteristics were examined using triple-sugar iron agar (Eiken), VP medium (Eiken), and lysine indol motility medium (Eiken). When typical *Salmonella* reactions were

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Table 1. Prevalence of *Salmonella* spp. in domestic animals in the Mekong Delta, Vietnam

Animal	Type of farm	No. of samples examined	No. of *Salmonella* positive animals (%)
Pig	Industrial farms	220	5 (2.3)[a)]
	Small scale farms	219	18 (8.2)
	Total	439	23 (5.2)
Chicken	Industrial farms	192	12 (6.3)
	Small scale farms	110	12 (10.9)
	Total	302	24 (7.9)
Ducks	Industrial farms	36	3 (8.3)
	Small scale farms	321	28 (8.7)
	Total	357	31 (8.7)
Grand Total		1.098	78 (7.1)

a) Small scale farms > Industrial farms ($p<0.01$).

seen, additional biochemical tests were performed as described by Barrow and Feltham [3]. Serotyping of *Salmonella* isolates was accomplished with commercial O and H antisera (Denka Seiken, Tokyo, Japan) according to the method of Popoff and Le Minor [19].

In this study, relatively high percentages of *Salmonella* were detected in the three domestic animals examined. The percentage of *Salmonella*- positive samples from the different animals ranged from 5.2% in pigs to 8.7% in ducks (Table 1). The positive rate was significantly higher if the pigs had been raised in small-scale farms than in commercial farms. However, for chicken and ducks no significant difference was observed in the isolation rate of *Salmonella* between small-scale and commercial farms. In the positive samples, 80 *Salmonella* strains were isolated and 25 serovars were identified (Table 2). The predominant serovars in pigs were *S.* Javiana, *S.* Derby, and *S.* Weltevreden, in chickens *S.* Emek, *S.* Javiana, and *S.* Typhimurium, and in ducks *S.* Typhimurium and *S.* Weltevreden, with *S.* Javiana and *S.* Weltevreden being isolated in pigs, chickens, and ducks (Table 2).

The higher prevalence of *Salmonella* in pigs in the small-scale farms than in the commercial farms may be due to differences in the feed and the water. The pigs in the small-scale farms usually have been able to contact with other animals such as insects, birds, and rats which may be carriers of *Salmonella*. The *Salmonella*-positive rate of pigs from commercial farms, however, was almost the same as for pigs from developed countries such as Canada, 3.7% (7/187) [10], Germany, 3.7% (445/11,930) [13], and Japan, 2.3% (58/ 2,511) [12]. The most frequent *Salmonella* serovars from pigs reported in European countries and the U.S.A. are *S.* Typhimurium and *S.* Derby [7, 9, 10]. In Japan, according to Hiratsuka *et al.* [11], the same serovars such as *S.* Derby (22.4%), *S.* Typhimurium (20.7%), *S.* Infantis (19.0%), and *S.* London (13.8%) were reported to be dominant in pigs. In the present study, the dominant serovars of the pig isolates were *S.* Javiana (9/25), *S.* Derby (4/25) and *S.* Weltevreden (3/25). No *S.* Typhimurium was detected.

Salmonella contamination in poultry is a worldwide problem [18]. In Japan, Limawongpranee *et al.* [15] reported that *Salmonella* was isolated from 14.3% (336/2,345) of the cecal contents of broiler chickens in commercial farms and the predominant *Salmonella* serovars were *S.* Blockley, *S.* Hadar, and *S.* Bredeney. Akiba *et al.* [1] also reported that the most common *Salmonella* serovars from chickens in Japan in the period from 1980 to 1995 were *S.* Agona, *S.* Hadar, and *S.* Enteritidis, in that order. In Thailand, Boonmar *et al.* [4] reported that *Salmonella* was isolated from 6.7% (19/285) of the feces of broiler chickens and the predominant *Salmonella* serovar was *S.* Enteritidis. In Malaysia, *Salmonella* was isolated from 14.3% (14/98) of

Table 2. Serovars of *Salmonella* spp. isolates by animal

Serotype	No. of isolates			
	Pig	Chicken	Duck	Total (%)
S. Aberdeen	1			1 (1.3)
S. Anatum		1		1 (1.3)
S. Braenderup			1	1 (1.3)
S. Bovismorbificans			2	2 (2.5)
S. Derby	4		1	5 (6.3)
S. Dublin			1	1 (1.3)
S. Emek		8		8 (10.0)
S. Enteritidis		1		1 (1.3)
S. Hadar	1		1	2 (2.5)
S. Heibron	1			1 (1.3)
S. Javiana	9	5	3	17 (21.3)
S. Lexington			3	3 (3.8)
S. Lome			1	1 (1.3)
S. London	1			1 (1.3)
S. Newport			1	1 (1.3)
S. Senftenberg			3	3 (3.8)
S. Singapore	1			1 (1.3)
S. Southampton		1		1 (1.3)
S. Stanley			1	1 (1.3)
S. Tennessee	1			1 (1.3)
S. Typhimurium		4	6	10 (12.5)
S. Tyresoe		1		1 (1.3)
S. Wirchow	1			1 (1.3)
S. Wagenia			1	1 (1.3)
S. Weltevreden	3	3	4	10 (12.5)
Untyped	2	1	1	4 (5.0)
Total	25	25	30	80 (100)

intestinal samples of broilers and 35.5% (158/445) of broiler carcasses [22]. The predominant serovars were *S.* Enteritidis, *S.* Muenchen, and *S.* Kentucky. The *Salmonella*-positive rate of chickens from commercial farms in Vietnam was not significantly high relative to other countries such as Japan, Thailand, and Malaysia. Although *S.* Enteritidis has become the predominant serovar worldwide [18, 21], in the present study only one strain of *S.* Enteritidis was isolated from chicken. However, since *S.* Enteritidis is the predominant serovar in the neighboring countries, Thailand and Malaysia [2], it may spread widely in Vietnam in the future.

Ducks are the one of the more important domestic food stock animals in Vietnam. Few reports regarding the prevalence of *Salmonella* in ducks have been published. Price *et al.* [20] reported that 457 (93%) of 491 *Salmonella* strains originating from ducks in the U.S.A. were *S.* Typhimurium. The predominant *Salmonella* serovar from ducks in Slovenia was *S.* Typhimurium (61%), but *S.* Anatum (22%) and *S.*Meleagridis (4%) were also found [24]. Saitanu *et al.* [23] reported that the predominant *Salmonella* serovar in duck eggs in Thailand were *S.* Typhimurium(23.3%), *S.* Cerro(17.7%), and *S.* Tennessee(12.0%). In the present study, the predominant serovar from ducks in Vietnam was also *S.* Typhimurium. Therefore, ducks seem to be sensitive to *S.* Typhimurium. *S.* Typhimurium was also found in water samples from ponds and waterways in Vietnam as found in Cantho province by Tran *et al.* [25]. The serovar in ducks may have been brought from European countries because many ducks have been imported from the countries to the Mekong Delta.

S. Javiana and *S.* Weltevreden were isolated together in pigs, chicken and ducks. Both serovars are rare in developed countries but are sometimes detected in Southeast Asian countries such as Thailand and Malaysia [2, 5, 26]. However, a major outbreak of human *Salmonella* infection due to *S.* Javiana has been reported in the USA [11]. *S.* Weltevreden has been reported to be a major cause of human Salmonellosis in Thailand [4] and Malaysia [26]. Since, as far as we know, no studies have been published regarding the prevalence of *Salmonella* serovars in Vietnam, the above serovars may be widely distributed in nature and may cause foodborne diseases in this country.

In the present study, *Salmonella* was isolated at a relatively high rate from domestic animals such as pigs, chickens and ducks in 6 provinces in the Mekong Delta, Vietnam. These results indicate that *Salmonella*, especially *S.* Javiana and *S.* Weltevreden, may be widely distributed in domestic animals and these animals may play an important role as a reservoir of *Salmonella* in the Mekong Delta. In order to learn more about the implications of this situation in regard to animal and public health, further surveys should be carried out to examine the contamination of *Salmonella* in foods of animal origin and the antimicrobial resistance of the *Salmonella* isolates in Vietnam.

ACKNOWLEDGEMENT. The authors wish to thank Japan International Cooperation Agency (JICA) for funding this study and Dr. Hilde Nissen (Norway) for revising the manuscript.

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