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Prevalent Characteristics of Fowl typhoid in Korea

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Abstract : The purpose of this study was to investigate the prevalent characteristics of fowl typhoid (FT) of chicken caused by *Salmonella gallinarum* in Korea. The occurrence of FT for 7 years from 1995 to 2001 in Korea was analyzed. The incidence of FT outbreaks was 10.3% of the total outbreaks of avian infectious disease cases diagnosed at National Veterinary Research and Quarantine Service (NVRQS) from 1995 to 2001. When the outbreaks of FT cases was analyzed in relation to the chicken breeds, the incidence of FT in commercial layers, commercial broilers, egg-type breeders, and meat-type breeders was 71.4%, 25.0%, 0.2% and 3.4%, respectively. Especially, the incidence in layers fell 25.8~27.6% in 2000 and 2001 from 1999, on the other hand, the amount of FT vaccines assayed at NVRQS for use in layers only jumped to 57,881.5× 1,000 dose in 2001, an increase of 4 times from the previous year. In the analysis of the seasonal distribution, it was found the incidence was high in summer (38.5%) and fall (33.9%). Also, the age comparison analysis showed that the rate of FT outbreaks in layers was highest (45.6%) between 10 to 30 weeks. However, in broilers, the highest percentage (61.6%) was shown at the age of below 2 weeks.

Key words **:** fowl typhoid, chicken, *Salmonella gallinarum*, prevalent characteristics

Introduction

Fowl typhoid (FT) is a septicemic disease of domestic birds caused by *Salmonella gallinarum* (*S. gallinarum*), which is one of the 2,463 different serovars of Salmonella species determined by the Kauffmann-White serological scheme[18,19]. The morbidity and mortality of FT are highly variable in chickens and are influenced by host age, host susceptibility, nutrition, flock management and virulence of *S. gallinarum*, which is a major impacting factor on the disease severity. Most pathological changes are found in the subacute and chronic stages of the disease and are commonly present in liver and spleen with multiple white foci, swelling, and discoloration[21,24].

FT was first recognized in 1888 as infectious enteritidis by Klein[11]. The name of FT was adopted in 1902 by Curtice[6] and was soon used in other parts of the world such as Germany[17] and Holland[23]. By the early 1900s, many outbreaks had been reported worldwide, and FT is still a leading disease problem in many areas of the world except for USA and other advanced countries[2,12,15,20,22].

Although the isolation of 4 *S. gallinarum* strains in domestic birds was first reported by Choi et al.[4] without exact identification of isolates and field situation, outbreaks of FT in Korea have been frequently reported since 1992[9]. At present, the prevalence of FT outbreaks is countrywide due to the failure of control and prevention. Although most outbreaks of FT in Korea have been reported in layers, the recent outbreaks of FT are frequently found in broilers during the first or second week of life.

In order to investigate the prevalent characteristics of FT in Korea, the occurrence of FT for 7 years from 1995 to 2001 was analyzed in this study.

Materials and Methods

FT cases diagnosed at National Veterinary Research and Quarantine Service (NVRQS) for 7 years from January, 1995 to December, 2001 were used for the epidemiological analysis. The confirmation of FT was based on the isolation and identification of *S. gallinarum*.

To identify *S. gallinarum*, C8-esterase spot reagent (Biolife, Milano, Italy) was used to select colonies producing a strong blue fluorescence under a wavelength of 366 nm[14]. Selected colonies were confirmed by agglutination test using *Salmonella* O antiserum group D1 (Difco Laboratories, Detroit, MI), and biochemical test such as IMViC, carbohydrate fermentation, amino acid decarboxylation and Jordan D-tartrate utilization[7].

The incidence of FT cases was analyzed in relation to the year, breed, season, and age of chickens. The chickens used in the analysis were placed into 4 breeder group; commercial layer (layer), commercial broiler (broiler) which includes Baeksemi (a crossbreed of male meat-type breeder and female layer) and Korean native chicken, egg-type breeder, and meat-type breeder.

Results

The incidence of FT outbreaks was 10.3% of the total outbreaks of avian infectious disease cases diagnosed at NVRQS

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Table 1. Fowl typhoid cases among avian infectious diseases diagnosed at NVRQS* from 1995 to 2001

1995	1996	1997	1998	1999	2000	2001	Total
23/534**(4.3)	35/359(9.8)	56/450(12.4)	72/472(15.3)	57/563(10.1)	35/359(9.8)	47/394(11.9)	325/3,131(10.3)

*National Veterinary Research and Quarantine Service.
**No. of fowl typhoid cases/No. of avian infectious disease cases (%).

from 1995 to 2001 (Table 1). The incidence of the disease in 1995 was 4.3% and rapidly increased to 9.8% in 1996. But, the occurrences of the disease have steadily declined since 1999.

The incidence of FT in layers, broilers, egg-type breeders and meat-type breeders was 71.4, 25.0, 0.2 and 3.4%, respectively. The incidence of FT outbreaks in layers fell 25.8~27.6% in 2000 and 2001 from 1999, while the incidence in broilers increased by 28.9~32.8% (Fig 1).

Because the amounts of FT vaccines have marketed since 1995, we also investigated the relationship between the vaccine dosage and outbreaks of FT (Fig 2). Two kinds of vaccines, killed vaccine and live vaccine contains *S. gallinarum* 9R strain, were introduced to the Korean market in 1995 and in 2001, respectively. However, by regulated authorizations, these vaccines were limited to use in only the layer breeds. According to the data surveyed at NVRQS, FT vaccines for market use has been slowly increasing each year since 1995, and jumped to 57,881.5× 1,000 doses in 2001, increase of 4 times from the previous year.

In the analysis of the seasonal distribution of FT outbreaks for 7 years from 1995 to 2001, it was found that the incidence rate was high in summer (June to August ; 38.5%) and fall (September to November ; 33.9%) in comparison with the winter (December to February ; 14.5%) and spring (March to May ; 16.0%), (Fig 3).

The age comparison analysis from 1995 to 2001 showed that the rate of FT outbreaks in layers was highest (45.6%) between 10 to 30 weeks and the lowest (2.6%) at below 10 weeks of age. However, in broilers including Baeksemi and Korean native chickens, the highest percentage (61.6%) was shown in chickens under 2 week old (Fig 4).

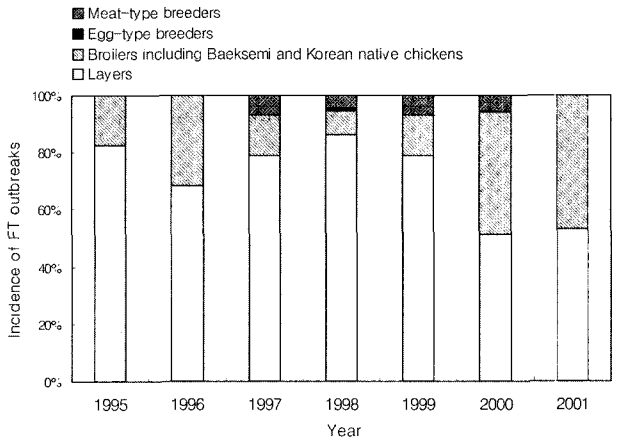

Fig 1. Fowl typhoid cases diagnosed at NVRQS from 1995 to 2001 in chicken breeds.

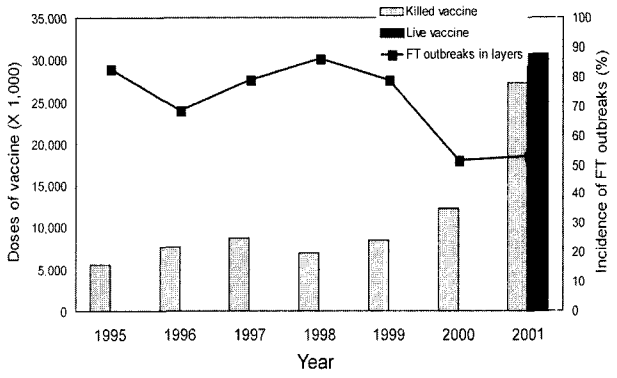

Fig 2. Doses of fowl typhoid vaccine surveyed at NVRQS and the incidence of FT outbreaks in layers from 1995 to 2001.

Discussion

The Salmonella serovars are classified as either host-specific or non-host specific serovars depending on their host range. The non-host specific Salmonella serovars such as *S. enteritidis* and *S. typhimurium* are the agents of paratyphoid infections in domestic poultry and a major concern with food safety. The two avian-adapted serovars *S. gallinarum* and *S. pullorum* are causative organisms of FT and PD, respectively. Both diseases have many similarities in terms of history, clinical signs, and control and eradication procedures, while they have slightly different biochemical properties and age of host commonly infected[21].

The outbreak of FT in Korea was officially confirmed in 1992[9]. The chickens with greenish-yellowish diarrhea, pale-

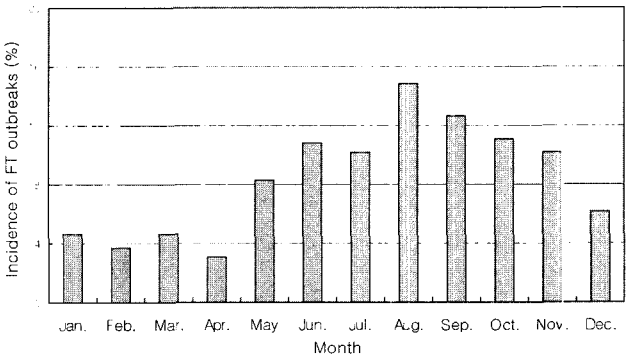

Fig 3. Monthly distribution of fowl typhoid cases diagnosed at NVRQS for 7 years from 1995 to 2001.

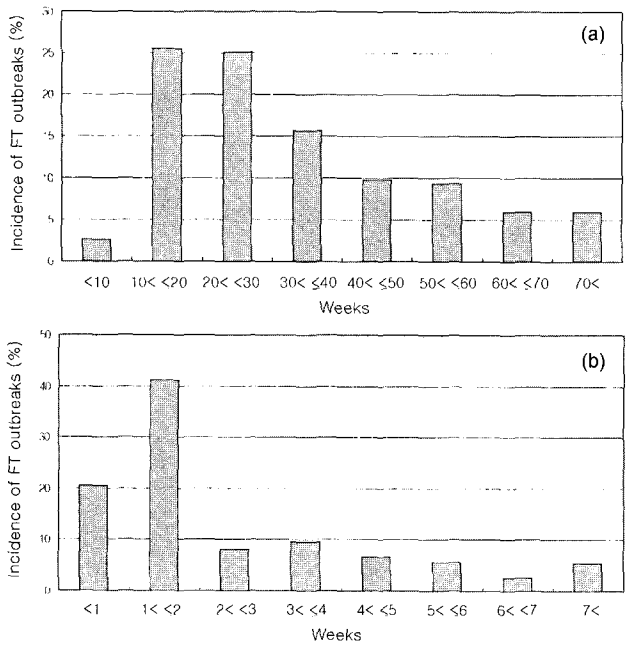

Fig 4. Distribution of fowl typhoid cases diagnosed at NVRQS for 7 years from 1995 to 2001 by age (A: Layers, B: Broilers including Baeksemi and Korean native chickens).

ness and sudden death, and high mortality from several farms of different areas, such as Kimpo in Kyunggi-do, and Guechang and Chungmu in Gyeonsangnam-do, were submitted to NVRQS in 1992. In necropsy, greenish brown and swollen liver with multiple white foci, enlarged spleen, and misshapen ova were observed. Bacterial agents isolated from these chickens were confirmed as *S. gallinarum* by biochemical and serological tests. Since that time, FT has occurred all over the country and become the most serious problem in the chicken industry.

The incidence of FT outbreak was 10.3% of the total cases of avian infectious diseases diagnosed at NVRQS for 7 years from 1995 to 2001. Because the diagnosis of FT can be easily done by area veterinarians, the actual incidence of FT may have been much higher than results shown in this study.

Park[16] reported that 250 cases of 339 poultry specimens in Korea from October, 1992 to December, 1997 were diagnosed as FT. Oh et al.[13] also reported that the incidence of *S. gallinarum* among 120 Salmonella isolates from 25 poultry farms, from November, 1998 to November, 1999 was 85.8%, therefore these reports indicated FT was the most predominant among the salmonellosis.

Most of FT cases appeared in commercial layers (layers), and this result was in agreement with reports by Park[16] and by Oh et al.[13]. This is supposed because layer raised in Korea are, for the most part, brown egg layers with high susceptibility to Salmonella spp.[3,8,10]. Recently, the outbreaks of FT in layers showed a tendency to decrease by degree, and it seemed to be more or less associated with the application of FT vaccine to the layers.

The outbreaks of FT in Korea remained high in summer and fall as indicated in the other reports[5,10,13]. Stress such as heat and egg-laying is often the common trigger in clinical outbreaks of FT. One possibility is that the stress causes a depression in a chicken's cellular immunity by reduction of the number of helper T cells in circulation.

This study showed that in layers, the incidence of FT was as low as 2.6% at the onset of the breeding periods (less than 10 weeks old). The result implies the chance of vertical transmission in the layers seems to be low. It is supposes that the layers could be died before the outbreaks of vertical transmission. Therefore, the breeding flocks are indeed infected, mainly via mechanical carries, feed, and farm environment including improperly cleaned and disinfected houses.

The prevalence of FT in commercial broilers (broilers) remained high in 2000 (42.9%) and 2001 (46.9%), compared with that in 1999 (14.0%). Especially, 61.6% of the incidence occurred within first two weeks after hatching in contrast to that of layers. Oh et al.[13] also reported that all 8 isolates of *S. gallinarum* from broilers were isolated within first two weeks. Park[16] also reported the isolation of *S. gallinarum* from meat-type breeders. According to those results, the outbreak of FT in broilers seems to be closely related to the infection of meat-type breeders, and egg transmission seems to be the main means of FT infection in broilers.

In USA, the National Poultry Improvement Plan (NPIP) was established to develop central programs for egg transmitted and hatchery disseminated disease, PD, in 1935 and adopted the programs for FT control in 19541. Although, prior to the establishment of the NPIP, these two diseases caused devastating losses in the poultry industry, today, these two disease have been practically eradicated from the commercial poultry breeding flocks in USA.

The similar policy to that of NPIP for the control and eradication of PD and FT in poultry has been also performed since 1970s in Korea. According to this policy, all breeder chickens at 120-day old or more should be tested for PD using the whole blood S. pullorum antigen, and seropositive chickens must be slaughtered. Some breeders, however, remain infected with *S. gallinarum*. It would seem that this control program must be applied strictly to all of the breeder farms in the country.

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국내 가금티푸스의 발생특징

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초 록 : 가금티푸스는 *Salmonella gallinarum*의 감염에 의해 발생되는 조류의 세균성 전염병으로 간장과 비장의 종대, 황갈색의 설사 및 높은 폐사 등을 특징으로 한다. 본 연구에서는 국내 가금티푸스의 발생특징을 조사하기 위하여 1995년부터 2001년까지 7년동안 국립수의과학검역원에 병성감정의뢰된 닭가검물을 대상으로 발생역학을 분석하였다. 1995년부터 2001년까지 국립수의과학검역원에 병성감정 의뢰된 가금전염성 질병중 가금티푸스의 검색율은 10.3%이었으며, 품종별로는 실용산란계, 실용육계, 육용종계 및 산란종계에서 각각 71.4%, 25.0%, 0.2% 및 3.4%가 검색되어 산란계에서의 발생이 가장 많음을 알 수 있었다. 또한 계절별로는 여름 (35.8%)과 가을 (33.9%)에 높은 발생율을 나타났으며, 일령별로는 실용산란계는 10-30주령 사이 (45.6%)에서, 실용육계는 2주 이하 (61.6%)에서 빈번하게 발생되었다.

주요어 : 가금티푸스, *Salmonella gallinarum*, 발생역학