参考資料1

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目次

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JOINT FAO/WHO FOOD STANDARDS PROGRAMME
CODEX COMMITTEE ON FOOD HYGIENE

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DISCUSSION PAPER ON RISK MANAGEMENT STRATEGIES FOR *SALMONELLA* SPP.IN POULTRY

(Prepared by Sweden with the assistance of Australia, Canada, China, Czech Republic, Denmark, France, Germany, Netherlands, New Zealand, Thailand, USA and the European Commission)

BACKGROUND

At its 34th session in Bangkok, the Codex Committee on Food Hygiene was informed about the outcome of the FAO/WHO expert consultations on risk assessment on *Listeria* and *Salmonella*. It was noted that there was a need to develop a discussion paper on Risk Management Strategies for *Salmonella* spp. in poultry based upon the risk assessment document (FAO Food and Nutrition Paper 72). The committee agreed that a drafting group, led by Sweden should develop a discussion paper to be considered at its next Session. The drafting group met in Uppsala, Sweden, the 25-26th of February 2002.

The outcome of the discussions are presented in this document. An alternative suggestion from the USA is presented in Annex I.

In order to facilitate an understanding of the document it is recommended that it should be red in conjunction with relevant sections of the Joint FAO/WHO Expert Consultation on Risk Assessment of Microbiological Hazards in Foods (FAO Food and Nutrition Paper 72, Rome 2000). The document is available from:

http://www.who.int/fsf/mbriskassess/Report_of%20_July2000_Consultation.pdf

1. INTRODUCTION

At the 33rd session of the CCFH, the preliminary report of the Joint FAO/WHO Expert Consultation was discussed and a number of risk management questions to be addressed by the FAO/WHO expert consultations were identified. Amongst these were questions concerning on-farm interventions. These could not however, be evaluated due to lack of representative data.

The drafting group, considering the result of the risk assessment and realising the current gaps in data concerning the efficacy of various strategies, decided to refrain from prioritising between specific strategies and instead list known options with their known advantages and disadvantages. The group acknowledges that a combination of risk management options is the best way of achieving a reduction of contaminated products on the market. The challenge is to find the optimal combination of options.

The choice of appropriate risk management strategies for *Salmonella* spp. in broilers falls within national competence and should be discussed in the national context. Each country can select those risk management strategies that are most appropriate to its national situation. What is, at one point of time, feasible and highly effective for one country might, at the same time, be quite unrealistic and/or ineffective for another.

It is preferable, that prior to selecting their strategies, the countries set their appropriate level of protection and the food safety objective as regards S*almonella* in broilers in order to guide the selection.

Since information about the effects of different risk management strategies is rarely available, all parties are invited and encouraged to forward such information.

2. RISK MANAGEMENT STRATEGIES IN THE BROILER PRODUCTION CHAIN

Good agricultural practices and good hygienic practices are necessary prerequisites for the successful application of specific risk management strategies. In particular, the facilities should be conceived, maintained and used to prevent contamination (biosecurity).

Depending on their situation, countries may initially select to target certain *Salmonella* serotypes with most public health significance.

2.1 BREEDER PRODUCTION

It is crucial to keep the breeder production flock free from *Salmonella* because an infected flock will spread the infection to a large number of commercial flocks.

- Buildings and facilities should be designed to prevent other animals from entering.
- The interior surfaces in the buildings should be easy to clean and disinfect.
- Access to the buildings by persons should be subject to precautions.
- Feed and drinking water should be free from *Salmonella.*
- The outdoor environment should be such that rodents and other pests are discouraged from approaching and entering the buildings.
- Pest control programmes should be in place, as well as hygienic instructions (e.g. protective clothing and footwear) for employees and visitors.
- The houses including all equipment should be cleaned and disinfected between flocks and dry-out time should be respected before new flocks are introduced.
- An all in – all out strategy should be used.

Specific strategies:

- Ensuring that incoming birds (future breeders) are *Salmonella*-free. This may require quarantine and sampling newly arrived birds (faecal or blood samples, lining of the box used for delivering the chicks, dead chicks).
- Positive animals should not enter the breeding stock.
- Testing birds during rearing and production according to specific sampling schemes.
- Excluding *Salmonella*-positive flocks from the breeding chain. The flocks should preferably be sent for slaughter or destruction, or the eggs may be handled in a special way (channelled separately from not contaminated eggs) until the infection has been successfully eradicated.
- Vaccines: for specific serotypes (for example *S.* Enteritidis and *S.* Typhi-murium) vaccines are available. *Salmonella* live vaccines may interfere with bacteriological testing whereas killed vaccines may interfere with serological testing. The use of vaccination depends on the epidemiological situation. Vaccines have very little chance of eradicating *Salmonella* from an infected flock, but may decrease the infectious burden.
- Competitive exclusion. A mixture of normal intestinal flora [from SPF birds] may be given [either as spray at the hatchery or in the transport crates or added to the drinking water to the day-old chicks].
- Use of probiotics or organic acids as feed supplements.

- Cleaning and disinfecting of houses before new birds are introduced: where a flock is found to be *Salmonella*-positive the houses should be meticulously cleaned and disinfected before new birds are introduced. Sampling from various locations and equipment in the houses should verify that no *Salmonella* infection persists.
- Due to questionable effect and the risk of resistant *Salmonella* strains the use of antibiotics[1] is not recommended, neither for prevention, therapy, nor cleaning the flock of *Salmonella*.

2.2 HATCHERY

- Buildings and facilities should be designed to prevent other animals from entering.
- The interior surfaces of the buildings should be easy to clean and disinfect.
- The equipment used must be easy to clean and disinfect and should be cleaned and disinfected between each batch.
- Hygienic instructions (e.g. protective clothing and footwear) for the personnel should be in place.

Specific strategies:

- Purchase of eggs only from flocks tested *Salmonella*-free.
- Separate handling in time and location of eggs from *Salmonella*-infected flocks and *Salmonella*-free flocks. Special cleaning and disinfection routines should be used after hatching of eggs from Salmonella-infected flocks.
- Sampling programmes should include testing dead chicks, chicken fluff, meconium and shells.
- Positive batches are sent for destruction or the chickens are kept separate from *Salmonella*-free flocks further along the food-chain. Trace back of the infection to the breeding flock of origin will allow measures to prevent further infection to be taken.
- Transportation of day-old chickens should be done in clean, disinfected and dry boxes and in clean and disinfected vehicles.

2.3 BROILER PRODUCTION

In the broiler production the same prerequisites apply as for breeder production.

Specific strategies:

- Meticulous cleaning and disinfection routines following a contaminated flock.
- Sampling to verify that no infection persists in the building and equipment before a new flock is introduced.
- Introduction of *Salmonella*-free day-old chickens.
- Competitive exclusion.
- Use of probiotics or organic acids as feed-supplements.
- Special attention to preventing litter-beetle infestation.
- Vaccination. Not very effective at this stage. Should be used at earlier stages.
- The use of antibiotics is not recommended due to questionable effect and the risk of resistant *Salmonella* strains.
- Sampling the flock before transportation to slaughter. This sampling should take place as late as possible during production while ensuring that the results are available before transportation. This will allow precautionary measures at slaughter and further down the chain (logistic slaughter and channelling) to be taken. Samples can be taken from dead birds, cloacal swabs, faeces or the litter-

[1] Antibiotics in this report refers to substances used or foreseen to be used for human medical or veterinary purposes

bed. Serological analysis can also be used, but the number of serotypes that can be detected will be limited.

- Destruction of positive flocks or special slaughter and special treatment of the meat from positive flocks.
- Withholding of feed from the birds before transport to slaughter.
- Treatment that will kill *Salmonella* bacteria in manure from contaminated flocks.

2.4 TRANSPORT AND LAIRAGE

- Clean, disinfected and dry crates should be used for transporting chickens.
- Vehicles should be cleaned thoroughly between transporting different flocks and, when necessary, disinfected.
- People involved in collecting chickens for transportation should follow basic hygienic rules.
- The use of so-called broiler harvesters should be limited to not infected flocks. If not, they should be carefully cleaned and disinfected between flocks.

2.5 SLAUGHTER

Good Manufacturing Practices (GMP), Good Hygienic Practices (GHP) including good design, maintenance and cleaning of equipment, and implementation of HACCP principles are prerequisites for the slaughtering process.

Specific critical points in the slaughtering process:

- The water flow in tanks should be according to the counter-current principle.
- Evisceration should be carried out with care to prevent damage to the viscera leading to leakage of intestinal contents.
- Chilling should give a temperature of $\leq 4^{\circ}$C in all parts of the carcass in less than 4 hours.
- Air chilling might be preferable to water chilling due to reduced risk for cross-contamination.

Specific strategies:

- *Salmonella* positive flocks should be slaughtered at the end of the week or at least at the end of the day.
- Special (intensified) cleaning and disinfection routines after slaughtering infected flocks.
- Channelling of the meat from infected flocks e.g. to be used for heat-treated products or to other bactericidal treatments.
- Decontamination of poultry carcasses. Organic acids, tri-phosphates, chlorine, chlorine dioxide are the compounds that are usually used. Chemical decontamination may, according to published results, give a reduction in salmonellas of $1 - 2$ ^{10}logs. Therefore decontamination should only be used as part of an overall strategy for *Salmonella* control throughout the whole production chain. Decontamination should not be used as the primary pathogen reduction measure or as a substitute for appropriate control measures at the production level or at the slaughterhouse. Before any decontamination compound or decontamination technique is authorised for use its efficacy and safety should be fully assessed. Decontamination with irradiation or ionisation. Both methods are effective, according to published results, but public resistance against these methods exists in many countries. Before irradiation or ionisation techniques are authorised for use their efficacy and safety should be fully assessed.
- Sampling programmes to assess cross-contamination and the effect of the slaughtering processes and decontamination steps on the prevalence of *Salmonella* or concentration of indicator organisms on the carcasses. Microbiological criteria can be set to guide the assessment of the results and the corrective actions to be taken.

2.6 PROCESSING

Again GMP, GHP including good design, maintenance and cleaning of equipment, and implementation of HACCP principles are prerequisites. Practices that will prevent cross-contamination must be strictly applied.

Specific strategies:

- Sampling programmes to measure cross-contamination and changes in *Salmonella*-prevalence or concentration of indicator organisms. Microbiological criteria can be used either as guidelines in the processing or as end product criteria.
- Labelling of raw poultry products to inform the consumer that the product may carry *Salmonella* bacteria (or pathogenic bacteria) including handling instructions.
- Packing in controlled atmospheres.
- If contaminated flocks are slaughtered and the meat from such flocks is specially channelled, measures to prevent contamination of *Salmonella*-free meat batches should be in place. In particular, the physical separation of contaminated and not contaminated meat batches must be under control.

2.7 DISTRIBUTION AND RETAIL SALE

In these steps the aim is to prevent growth of *Salmonella* and to prevent the contamination of other products. Again GMP,GHP and HACCP are prerequisites and special attention should be paid to storage temperature, prevention of cross-contamination and the length of shelf-life.

Specific strategies:

- Physical separation of contaminated and not contaminated products.

2.8 CATERING

GMP, GHPand HACCP are prerequisites in all steps when preparing and serving food. Training personnel in food hygiene is considered to be very important. In institutional kitchens, preparing food for the diseased and the elderly people, special care must be taken to avoid cross-contamination and to ensure that the broiler products are cooked satisfactorily.

2.9 CONSUMPTION

Educating/informing the consumer about basic food hygiene and how to handle the risks with broiler products in their kitchen is considered to be effective in reducing the incidence of salmonellosis in humans. Press, radio, TV, video, cinema, information on the web, brochures, etc. may be used. This kind of information can be a part of the education given in schools. Information may be general or targeted to special sectors or groups, like susceptible groups at risk. Experience shows that a long time-perspective is necessary for this kind of education to be successful.

3. AVAILABLE INFORMATION AND MAJOR KNOWLEDGE GAPS

The risk characterization of *Salmonella* spp. in broilers (FAO Food and Nutrition Paper 72) starts at the end of slaughterhouse processing. The effects of interventions at the earlier stages in the farm- to-fork continuum are, because of lack of representative data, not presently included in the model.

In order to be able to estimate which risk management strategies that would give the best effects the data gaps need to be filled. When new data is available a risk assessment/[riskprofile] can be performed hopefully leading to more precise recommendations of which risk management strategies that would be most effective in reducing the probability of illness per serving.

The main data gaps identified for the primary production module are as follows

- *Salmonella* prevalence information is available for some countries world-wide, however many of these studies give *limited details of study design.*

- Regions for which there is a lack or limited amount of prevalence data include Africa, Asia and South America.
- No information relating to *sensitivity or specificity* of tests used is presented in the studies.
- There are very limited data relating to *numbers of organisms* per positive/contaminated bird.
- The effect on *Salmonella* prevalence of specific risk reduction options.

The main data gaps for processing are as follows:

- There is limited public information on *processing practices* followed by different countries of the world (for example scalding or chilling methods, including addition of chemicals).
- *Quantitative data* (i.e. numbers of organisms) are limited, for several steps of processing.
- Many studies are old, *more recent information* on changes in prevalence and numbers would be beneficial.

4. CONCLUSIONS

The drafting group has identified options to be taken in the entire food-chain for broiler chicken which may reduce the risk for the consumers for *Salmonella* infections. The potential effects of these options have not been quantified.

The document on risk assessment of *Salmonella* spp. in broiler chickens contained limited information concerning the effects of various risk reduction options. However, the outcome of the document is that the risk for *Salmonella* infection is related to the prevalence of *Salmonella* contaminated carcasses.

It was acknowledged that destruction of *Salmonella* positive flocks will influence public health outcomes, but due to lack of specific information on how this would translate to fewer infected birds or fewer *Salmonella* cells per infected bird at the completion of processing, the magnitude of risk reduction was not estimated.

It was nevertheless estimated that a reduction in the concentration of Salmonella cells on carcasses leaving the chill tank as well as a reduction in the prevalence of infected birds leaving processing would reduce the risk of illness per serving at least proportionally.

The expert group found the available data on the importance of various routes for introduction of *Salmonella* spp. into flocks, including feed, replacement birds, vectors and hygiene to be inconclusive. It was not possible therefore to evaluate the importance of on-farm routes of introduction of *Salmonella* spp.

The expert group also pointed out the need to increase the understanding of cross-contamination processes in all the different steps in the production chain.

The drafting group realises that this lack of data makes it difficult to evaluate the effects on the prevalence of infected broiler chickens as well as the concentration of Salmonella cells per infected bird that can be expected from various risk management options.

5. RECOMMENDATION

The drafting group recommends that the Committee:

- Request that the drafting group established at the 34th session of CCFH determine whether existing Codex codes of hygienic practice provide sufficient information for the hygienic control of *Salmonella* spp. in broiler chickens.
- If the guidance provided in current Codex codes is insufficient, the drafting group will recommend good production and manufacturing practices for the production, slaughter and processing of broiler chickens. Such new work may involve amending existing Codex texts or the development of new microbiological risk management guidance.

In order to assure that such recommendations are based on the best available knowledge the drafting group further recommends the Committee to:

- Encourage all Codex member countries to supply to the drafting group relevant scientific data related to risk management strategies reported in this document for control of *Salmonella* spp. in broiler chickens.
- Request that the drafting group in the light of new scientific data assess the likely impact on prevalence in broiler chickens and/or risk to human health of the various risk management strategies reported in this document.

Annex I

RISK PROFILE FOR *SALMONELLA* SPP. IN BROILER CHICKENS

SCOPE AND RATIONALE

At the 33rd session of the CCFH, the preliminary report of the Joint FAO/WHO Expert Consultation was discussed and a number of risk management questions to be addressed by the FAO/WHO expert consultations were identified. Amongst these were questions concerning on-farm interventions. These could not however, be evaluated by JEMRA due to lack of representative data. It was acknowledged that destruction of *Salmonella* positive flocks will influence public health outcomes, but due to the lack of specific information on how this would translate to fewer infected birds or fewer *Salmonella* cells per infected bird at the completion of processing, the magnitude of risk reduction was not estimated. It was nevertheless estimated that a reduction in the concentration of *Salmonella* cells on carcasses leaving the chill tank as well as a reduction in the prevalence of infected birds leaving processing would reduce the risk of illness per serving at least proportionally. The expert group found the available data on the importance of various routes for introduction of *Salmonella* spp. into flocks including feed, replacement birds, vectors and hygiene to be inconclusive. It was not possible therefore to evaluate the importance of on-farm routes of introduction of *Salmonella* spp. The expert group also pointed out the need to increase the understanding of cross-contamination processes in all the different steps in the production chain.

The drafting group, considering the result of the risk assessment and realising the current gaps in data concerning the efficacy of various strategies, decided to refrain from prioritising between specific strategies and instead listed known options with their known advantages and disadvantages. The group acknowledges that a combination of risk management options is the best way of achieving a reduction of contaminated products on the market. The challenge is to find the optimal combination of options.

The choice of appropriate risk management strategies for *Salmonella* spp. in broilers falls within national competence and should be discussed in the national context. Each country can select those risk management strategies that are most appropriate to its national situation. What is, at one point in time, feasible and highly effective for one country might, at the same time, be quite unrealistic and/or ineffective for another.

It is preferable, that prior to selecting their strategies, the countries set their appropriate level of protection and the food safety objective as regards *Salmonella* in broilers in order to guide the selection.

Since information about the effects of different risk management strategies is rarely available, all parties are invited and encouraged to forward such information.

Note: portions of the text have been copied [*with permission*] from the JEMRA Risk Assessment of *Salmonella* Enteritidis in eggs and *Salmonella* spp. in broiler chickens.

1. PATHOGEN FOOD COMMODITY COMBINATION OF CONCERN

1.1 PATHOGEN OF CONCERN

Salmonella spp. (non-typhoidal).

1.2 DESCRIPTION OF THE FOOD OR FOOD PRODUCT AND/OR CONDITION OF ITS USE WITH WHICH PROBLEMS (FOODBORNE ILLNESS, TRADE RESTRICTIONS) DUE TO THIS PATHOGEN HAVE BEEN ASSOCIATED.

Broiler chicken is the commodity of interest

2. DESCRIPTION OF THE PUBLIC HEALTH PROBLEM

2.1 DESCRIPTION OF THE PATHOGEN INCLUDING KEY ATTRIBUTES THAT ARE THE FOCUS OF ITS PUBLIC HEALTH IMPACT (E.G. VIRULENCE CHARACTERISTICS, THERMAL RESISTANCE, ANTIMICROBIAL RESISTANCE).

Salmonella are gram-negative, rod shaped, facultative bacteria in the family Enterobacteriacea. For the purpose of this report all *Salmonella* are considered to belong to the genus enterica, following the nomenclature suggested by WHO (1988, WHO).

Virulence Characteristics

Non-typhoid *Salmonellae* possessing certain adaptive characteristics are more likely to produce foodborne disease. First, they must be acid tolerant to survive the pH of the stomach. They must also be able to attach themselves to and invade the intestinal epithelia and Peyer's patches (D'Aoust, 1997). Bacterial virulence factors include those that promote adhesion to host cells in the intestines: specific fimbriae, chromosome-coded bacterial surface adhesins, hemagglutinins, and epithelial cell induction of bacterial polypeptides which can promote colonization and adhesion.

Resistance of *Salmonellae* to lytic action of complement varies with the length of the O side chains of lipopolysaccharide (LPS) molecules (D'Aoust, 1991). Smooth varieties are more resistant than rough types. O side chains of the LPS have also been shown to affect invasiveness and enterotoxin production (Murray, 1986).

Siderophores, which chelate iron, are necessary for the accumulation of sufficient environmental iron to allow growth of *Salmonellae*. Siderophores include hydroxamate, phenolate, and catechol types. Porins are hydrophobic bacterial cell proteins which enhance the virulence of *Salmonella* by repression of macrophage and polymorphonuclear-dependent phagocytosis. *Salmonella* porins may however have a limited importance in pathogenicity. Chromosomal determinants include specific virulence genes whose potential for action is tightly controlled by regulatory genes. Expression of the genes is determined by the environment and invasion occurs by the two-component regulatory system PhoPQ which enables survival of *Salmonellae* within the hostile environment of phagocytes (Slauch et al., 1997).

Virulence plasmids in the range of 50-100 kb have been associated with the ability to spread after colonization, invasion of the intestine, ability to grow in the spleen, and a general suppression of the host immune response (Slauch et al., 1997). The presence of virulence plasmids in *Salmonellae* is limited. Chiu *et al* (1999) studied virulence plasmids in 436 clinical human samples in Taiwan: 287 isolates were from faeces, 122 from blood and the remaining were isolated from other sites. Sixty-six percent of the non-faecal isolates compared with 40% of the faecal isolates contained a virulence plasmid. All the isolates (n=50) of the three highly invasive serotypes - *S.* Enteritidis, *S. dublin* and *S. choleraesuis* contained virulence plasmids. Virulence plasmids have also been confirmed in *S. typhimurium, S. gallinarum-pullorum* and *S. abortusovis*, but are notably absent in *S. typhi*, which is host-adapted and highly infectious.

Other factors that affect the ability of the organism to cause disease include the presence of cytotoxins and diarrhoeagenic enterotoxins. The enterotoxin is released into the lumen of the intestine and results in the loss of intestinal fluids (D'Aoust, 1991).

Antimicrobial resistance of the organism may also affect the severity of the outcome of infection. The effects of underlying illnesses often complicate evaluation of the added clinical impact of resistant *Salmonella*. In a study referring to the United States and the years 1989-90, after accounting for prior antimicrobial exposure and underlying illness, patients with resistant *Salmonella* were more likely to be hospitalized (Lee et al., 1994). A longer duration of illness and hospitalization was also noted for resistant infections.

Serotypes

More than 2,200 *Salmonella* serotypes have been identified based on the Kauffman-White scheme (e.g. Enteritidis).

Thermal resistance

"*Salmonella* are sensitive to heat, and, generally speaking, the organisms are killed at temperatures of 70°C or above. Because of this characteristic, ordinary cooking is sufficient to destroy *Salmonella* cells if applied for times sufficiently long enough to reach this temperature throughout the food being cooked." (Guthrie, 1992)

Susceptibility to antimicrobial agents

Antimicrobial resistance may affect the severity of the outcome of illness from *Salmonella*. In a study referring to the years 1989-1990, patients with resistant *Salmonella* were more likely to be hospitalized, after accounting for prior antimicrobial exposure and underlying illness (Lee et al., 1994). A longer duration of illness and hospitalization was also noted for resistant infections. The National Antimicrobial Susceptibility Monitoring System provides susceptibility information on *Salmonella* from human and animal populations. A summary of susceptibility testing of several *Salmonella* serotypes to 17 antimicrobial agents can be found in Table 1 (Headrick and Cray, 2001). As part of the 1999 study, 8,508 *Salmonella* isolates of animal origin were tested against 17 antimicrobial drugs. The results in Table 1 clearly indicate that many *Salmonella* serotypes are resistant to some of the antibiotics commonly used in human and animal health, and as growth promoters in the animal production industry.

Antimicrobial	Percent Sensitive
Amikacin	>99.9
Amoxicillin/clavulanic acid	88.4
Ampicillin	81.9
Apramycin	98.9
Ceftiofur	96
Ceftriaxone	97.7
Cephalothin	92.3
Chloramphenicol	90.1
Ciprofloxacin	100
Gentamicin	90.8
Kanamycin	87.7
Nalidixic Acid	98.8
Streptomycin	69
Sulfamethoxazole	71.1
Tetracycline	64.8
Trimethoprim/sulfa	96.6

2.2 CHARACTERISTICS OF THE DISEASE, INCLUDING:

Susceptible populations

Epidemiologic information indicates that susceptibility is highest in infants, elderly people and immuno-compromised hosts. However, the dose response relationship developed by the Expert Group could not distinguish between normal and susceptible (children less that five years of age) populations.

- Annual incidence rate in humans including, if possible, any differences between age and sex and any differences according to regional and seasonal variations

A common observation is that the age of patients with *Salmonella* infections is distributed according to a bimodal distribution with peaks in children and elderly.

However, it should be pointed out that association with age may be spurious. Children and the elderly with diarrhoea may be expected to be more frequently cultured than other age groups (Banatvala

et al., 1999). Moreover, age association may reflect behavioural characteristics. For instance, eating snow, sand, or soil - a behaviour more likely in children - was found to be associated with infection by *S. typhimurium* O:4-12 (Kapperud et al., 1998a).

In terms of number of isolates, men seem to be generally more affected than women. A male-to-female ratio of 1.1 has been reported on various occasions (Blaser and Feldman, 1981;Le Bacq et al., 1994;Wong et al., 1994). The significance of such a finding does not appear to have been addressed. Several factors, such as proportion of the two genders as well as different age distributions for males and females within a country or hospital catchment area, may play an important role. In the evaluation of a single study, it should be pointed out that the occurrence of other factors, e.g. use of antacids or pregnancy, relates to one gender more often or exclusively and gender may thus have the effect of a confounder.

The potential role of race and ethnicity has seldom been considered. As mentioned above, an association with black race and Hispanic origin was reported for resistant *Salmonella* infections (Lee et al., 1994;Riley et al., 1984). In the former case, the association was explained by differences in the distribution of infecting serovars among ethnic groups, which in turn depended on varying food preferences or methods of food preparation.

An association between altered nutritional status and acute gastroenteritis has been shown in AIDS patients (Tacconelli et al., 1998). Apart from this report, no direct reference to the role of nutritional status was found in the literature.

Isolation rates of several *Salmonella* serovars among groups of different socioeconomic extraction have been compared on the basis of the Townsend score, an index for deprivation (Banatvala et al., 1999). While isolation rates for *S. typhimurium* were not related to the Townsend score, highest isolation rates of *S.* Enteritidis were observed in more prosperous areas. A theory was advanced that proposes populations living in such areas more frequently ingested vehicles harboring *S.* Enteritidis.

CDC data (1996) demonstrates that the foodborne disease outbreaks caused by *Salmonella* in the United States occur more frequently in the summer as compared to the winter months (Figure 1). Temperature may be a major factor impacting the survival and proliferation of *Salmonella Enteritidis* (SE), i.e., warm temperatures provide an environment in which *Salmonella* can grow during the processes of production, transport, and storage (Guthrie, 1992; Latimer, 1999).

Outcome of exposure

Infection usually causes a self-limiting enterocolitis with symptoms resolving within 5 days.

Severity of clinical manifestation

Salmonellosis generally manifests as a self-limiting episode of enterocolitis, with symptoms resolving within 5 days. Incubation period is generally 8-72 hours; watery diarrhoea and abdominal pain are common symptoms. Susceptibility is highest in infants, elderly people and immunocompromised hosts. However, the dose response relationship developed by the Expert Group could not distinguish between normal and susceptible (children less that five years of age) populations.. Occasionally, systemic infections can occur, particularly with *Salmonella dublin* and *Salmonella cholerasuis* infections which exhibit a predilection toward septicaemia (D'Aoust, 1997).

Case fatality rate

The average case-fatality rate among cases reported to FoodNet, 1996-1997 in the U.S. was 0.0078 (Mead, 1999).

Nature and frequency of long-term complications

Salmonella has been implicated as a triggering organism for reactive arthritis (ReA) and Reiter's syndrome. Reactive arthritis is characterized by the development of synovitis (joint swelling and tenderness) within a few weeks after the occurrence of gastroenteritic symptoms. Reiter's syndrome is

defined as the occurrence of arthritis with one or more extra-articular symptoms typical of the disease such as conjunctivitis, iritis, urethritis, and balanitis. The prognosis for ReA is usually favourable with symptoms lasting for <1 year in most persons, although 5 to 18% may have symptoms that last more than 1 year and 15 to 48% may experience multiple episodes of arthritis.

Availability and nature of treatment

For uncomplicated enterocolitis in an otherwise healthy adult, no specific treatment other than rehydration and electolyte replacement is usually perscribed. Antibiotics may result in production of resistant strains of bacteria. (Guthrie, 1992).

Percentage of annual cases attributable to foodborne transmission

Although occasionally associated with exposure to pets, reptiles, and contaminated water, salmonellosis is primarily a foodborne disease. Mead et al. (1999) estimated that 95% of non-typhoidal salmonellosis cases are foodborne in the US.

2.3 CHARACTERISTICS OF THE FOODBORNE TRANSMISSION

Epidemiology and etiology of foodborne transmission, including characteristics of the food or its use and handling that influence foodborne transmission of the pathogen

Salmonellosis is one of the most frequently reported foodborne diseases worldwide. Poultry and poultry products are common food vehicles of the disease in many countries. Each year, approximately 40,000 *Salmonella* infections are culture-confirmed, serotyped, and reported to the United States Centers for Disease Control and Prevention (CDC), which estimates an annual rate of 1.4 million cases, 16,430 hospitalizations, and 582 deaths in the United States alone (Mead *et al.*, 1999). Of total cases, 96% are estimated to be caused by foods. International data summarized by Thorns (2000) provides estimated incidences of salmonellosis per 100,000 people for the year 1997: 14 in the USA, 38 in Australia, and 73 in Japan. In the Europe Union, the estimates range from 16 cases per 100,000 (The Netherlands) to 120 cases per 100,000 in parts of Germany.

Foods implicated

A wide range of foods has been implicated in foodborne illness due to *Salmonella* with poultry as a principal source (Bryan and Doyle, 1995; Humphrey, 2000).

The food vehicles implicated in outbreaks from *Salmonella* spp., in the United States between 1993 and 1997 include eggs (17), beef (14), ice cream (11), chicken (6), and pork (4), (Table 1) (CDC, 2000).

Frequency and characteristics of foodborne outbreaks

In the US between 1993 and 1997, there were a total of 655 foodborne disease outbreaks involving 43,821 illnesses, attributable to bacterial pathogens. A total of 357 (54.5%) outbreaks involving 32,610 (74.4%) illnesses were due to *Salmonella* spp. (Mead, 1999).

Frequency and characteristics of foodborne sporadic cases

Epidemiological data from outbreak investigations

2.4 ECONOMIC IMPACT OR BURDEN OF THE DISEASE

Medical, hospital costs

Costs of foodborne salmonellosis have been calculated for the United States population, and are estimated as high as US $2,329 million annually (in 1998) for medical care and lost productivity (Frenzen *et al.*, 1999).

Working days lost due to illness, etc

Normally 1-3 days are lost due to illness.

Damage to broiler markets

Damage to international trade does occur due to disputes between countries over the presence of *Salmonella* spp. in broilers.

- Food Production, processing, distribution and consumption
- Characteristics of the commodity (commodities) that are involved and that may impact on risk management.
- Description of the farm to table continuum including factors which may impact the microbiological safety of the commodity (i.e., primary production, processing, transport, storage, consumer handling practices).

RISK MANAGEMENT STRATEGIES IN THE BROILER PRODUCTION CHAIN[1]

3. OTHER RISK PROFILE ELEMENTS

Regional differences in the incidence of foodborne illness due to the pathogen

Regional differences in the incidence of salmonellosis occur within and among countries. International data summarized by Thorns (2000) provides estimated incidences of salmonellosis per 100,000 people for the year 1997: 14 in the USA, 38 in Australia, and 73 in Japan. In the European Union, the estimates range from 16 cases per 100,000 (The Netherlands) to 120 cases per 100,000 in parts of Germany.

The extent of international trade of the food commodity

Public perceptions of the problem and the risk

In general the public is well informed of the risk from *Salmonella* spp. on chickens. Recent large-scale outbreaks in the US and other countries reinforce the need to prevent cross-contamination in kitchens as well as to cook meat (including chicken) thoroughly.

Potential public health and economic consequences of establishing Codex risk management guidance.

4. RISK ASSESSMENT NEEDS AND QUESTIONS FOR THE RISK ASSESSORS

Questions posed to the risk assessment group by the 33rd CCFH (Alinorm 01/13A)

- Estimate the risk from pathogenic *Salmonella* spp. in chicken (broilers) consequential to a range of levels in raw poultry for the general population and for various susceptible population groups (elderly, children, and immuno-compromised patients).
- Estimate the change in risk likely to occur for each of the interventions under consideration including their efficacy.
    - Reduce the prevalence of positive flocks
        - Destruction of positive breeder and chicken /(broiler)flocks
        - Vaccination of breeding flocks
        - Competitive exclusion (e.g. with *Salmonella* sofia)
    - Reduce the prevalence of positive birds at the end of slaughter and processing
        - Use of chlorine in water chilling of chicken (broilers)
        - Water chilling vs air chilling for chicken (broilers)

[1] The US suggestion is to include the text from section 2 in the main document here.

- Evaluate the importance of various routes for introduction of pathogenic *Salmonella* into flicks including feed, replacement birds, vectors, and hygiene.

5. AVAILABLE INFORMATION AND MAJOR KNOWLEDGE GAPS

The main data gaps identified for the primary production module are as follows:

- *Salmonella* prevalence information is available for some countries world-wide, however many of these studies give *limited details of study design.*
- Regions for which there is a lack or limited amount of prevalence data include Africa, Asia and South America.
- No information relating to *sensitivity or specificity* of tests used is presented in the studies.
- There are very limited data relating to *numbers of organisms* per positive/contaminated bird.

The main data gaps for processing are as follows:

- There is limited public information on *processing practices* followed by different countries of the world (for example scalding or chilling methods, including addition of chemicals).
- *Quantitative data* (i.e. numbers of organisms) are limited, for several steps of processing.
- Many studies are old, *more recent information* on changes in prevalence and numbers would be beneficial.

RECOMMENDATION

The working group reviewed the conclusions of the risk assessment provided by JEMRA:

> The expert group found the available data on the importance of various routes for introduction of *Salmonella* spp. into flocks including feed, replacement birds, vectors and hygiene to be inconclusive. It was not possible therefore to evaluate the importance of on-farm routes of introduction of *Salmonella* spp. The expert group also pointed out the need to increase the understanding of cross-contamination processes in all the different steps in the production chain.

and therefore recommend that the Committee:

> Determine whether existing Codex codes of hygienic practice provide sufficient information for the hygienic control of *Salmonella* spp. in broiler chickens. If the guidance provided in current Codex codes is insufficient, the Committee will recommend good production and manufacturing practices for the production, slaughter, and processing of broilers chickens. Such new work may involve amending existing Codex texts or the development of new microbiological risk management guidance.

References

Banatvala N, Cramp A, Jones IR, Feldman RA (1999) Salmonellosis in North Thames (East), UK: associated risk factors. *Epidemiology and Infection*, 122:201-207.

Blaser MJ, Feldman RA (1981) *Salmonella* bacteremia: reports to the Centers for Disease Control, 1968-1979. *Journal of Infectious Diseases*, 143:743-746.

Centers for Disease Control and Prevention. Outbreaks of *Salmonella* Serotype Enteritidis Infection Associated with Consumption of Raw Shell Eggs- United States, 1994-1995. *MMWR*, 1996. 45: 737-747.

Centers for Disease Control and Prevention. Surveillance for Foodborne-Disease Outbreaks-United States, 1993-1997. *Morbidity and Mortality Weekly Report* March 17, 2000;*49*:1-63.

D'Aoust JY (1991) Pathogenicity of foodborne *Salmonella*. *International Journal of Food Microbiology*, 12:17-40.

D'Aoust JY (1997) *Salmonella* Species. In: Doyle MP, Beuchat LR, Montville TJ, eds, *Food microbiology: Fundamentals and frontiers*. Washington, DC, American Society for

Microbiology Press, pp.

Guthrie RK. (1992). *Salmonella* CRC Press, Boca Raton Ann Arbor London.

Frenzen PD, Riggs TL, Buzby JC, Breuer T, Roberts T, Voetsch D, Reddy S, FoodNet

Working Group (1999) *Salmonella* cost estimate updated using FoodNet data. *FoodReview*, 22:10-15.

Headrick M and Cray P. Antimicrobial Susceptibility Patterns for *Salmonella* Isolates of Animal Origin, NARMS 1999. *From a poster presented at the American Society of Microbiologists (ASM) Meeting held May 20 – 24, 2001, in Orlando, FL.*

Kapperud G, Stenwig H, Lassen J (1998a) Epidemiology of *Salmonella typhimurium* O:4-12 infection in Norway: evidence of transmission from an avian wildlife reservoir. *American Journal of Epidemiology*, 147:774-782.

Latimer, HK. Quantitative Microbial Risk Assessment for Human Salmonellosis Associated with the Consumption of Raw Shell Eggs. 1999. PhD Dissertation. Chapel Hill, NC.

Le Bacq F, Louwagie B, Verhaegen J (1973) *Salmonella typhimurium* and *Salmonella*

enteritidis: changing epidemiology from 1973 until 1992. *European Journal of Epidemiology*, 10:367-371.

Lee LA, Puhr ND, Maloney EK, Bean NH, Tauxe RV (1994) Increase in antimicrobial-

Resistant Salmonella infections in the United States, 1989-1990. *Journal of Infectious*

Diseases, 170:128-134.

Mead PS, Slutsker L, Dietz V, McCraig LF, Bresee JS, Shapiro C, Griffin PM, Tauxe RV (1999) Food-related illness and death in the United States. *Emerging Infectious Diseases*,

5:607-625.

Murray MJ (1986) Salmonella: virulence factors and enteric salmonellosis. *Journal of the American Veterinary Medical Association*, 189:145-147.

Slauch J, Taylor R, Maloy S (1997) Survival in a cruel world: how Vibrio cholerae and Salmonella respond to an unwilling host. *Genes and Development*, 11:1761-1774.

Tacconelli E, Tumbarello M, Ventura G, Leone F, Cauda R, Ortona L (1998) Risk factors, nutritional status, and quality of life in HIV-infected patients with enteric salmonellosis. *Italian Journal of Gastroenterology and Hepatology*, 30:167-172.

Thorns CJ (2000) Bacterial food-borne zoonoses. *Revenue Scientifique et Technique Office International.des Epizooties*, 19(1): 226-239.

WHO Expert Committee. Salmonellosis control: the role of animal and product hygiene, Tech Rep. Ser. No. 774, World Health Organization, Geneva, 1988

Wong SS, Yuen KY, Yam WC, Lee TY, Chau PY (1994) Changing epidemiology of human salmonellosis in Hong Kong, 1982-93. *Epidemiology and Infection*, 113:425-434.

Tables and Figures

Table 1: Food vehicles implicated in Foodborne Outbreaks due to *Salmonella* spp., United States, 1993-1997.[1]

	1993	1994	1995	1996	1997	Total
Beef	-	7	4	1	2	14
Chicken	1	-	2	1	2	6
Pork	1	1	1	1	-	4
Eggs	3	2	6	3	3	17
Ice Cream	3	3	-	5	-	11
Total known	39	40	44	36	25	184
Total unknown	29	30	46	33	35	173

1. CDC. "Surveillance for Foodborne-Disease Outbreaks-United States, 1993-1997". *Morbidity and Mortality Weekly Report* March 17, 2000;*49*:1-63.

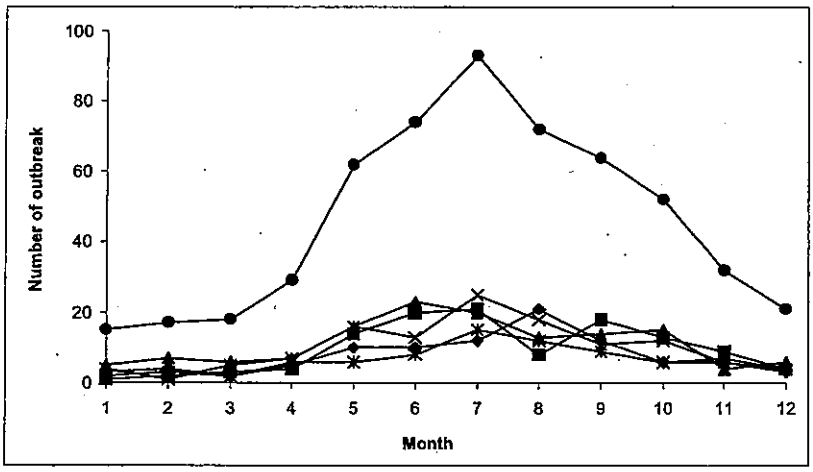

Figure 1. Temporal Distribution of Foodborne disease outbreak from *Salmonella* in the United State including Guam, Puerto Rico, and the U.S. Virgin Islands in 1988-1992 (CDC, 1996, from Latimer, 1999).

別添

鶏肉における *Campylobacter jejuni / coli* 食中毒に関するリスクプロファイル

（平成１６年度版）

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１．問題となる病原微生物・媒介食品の組み合わせについて

● 対象病原微生物

Campylobacter jejuni / coli

● この病原微生物による感染症もしくは食品衛生上の問題（食中毒など）に関与する食品または加工食品についての概略

１人事例は原因食品不明であるが、一部は、鶏肉であった。

２人以上例で原因食品が判明したものは

焼き肉（焼き鳥）、とりわさ、白レバー、鳥刺し（推定）、とりたたき、さび焼きなど

ほとんどが鶏肉に関連しており、生もしくは加熱不十分なものが原因であった。

牛レバーからの感染も報告されている。(厚生労働省食中毒統計)

２．公衆衛生上の問題点について

● 当該病原微生物の、公衆衛生上に大きな影響を及ぼしうる鍵となる特性（病原性、血清型、菌の増殖及び抑制条件、温度抵抗性、薬剤抵抗性）

Campylobacter 属菌の特徴

Campylobacter 属菌は幅 0.2-0.8μm、長さ 0.5-5μm で、1ー数回螺旋しているグラム陰性菌で，5-15%酸素存在下でのみ発育可能な微好気性菌で，一端または両端に鞭毛を有する菌である。この菌は 31～46℃で発育し、それ以下では発育しない。

生残性：室温もしくはそれ以上では数日で死滅、4℃で 10 日～14 日、ー20℃で１ヶ月程度

加熱致死：市販鶏肉 30g をグラム当たり 10 の４乗の菌数に調整、160℃で 240 秒加熱により完全死滅[1、2)]。

● 引き起こされる疾病の特徴：

○ 感受性人口（疾病に陥る可能性のある人々）

すべての日本人

○ 食中毒発生状況

	事件数	患者数
平成8年	65	1557
平成9年	257	2648

平成10年	553	2114
平成11年	493	1802
平成12年	469	1784
平成13年	428	1880
平成14年	447	2152

（厚生労働省食品安全部）

○ 原因施設　飲食店　20/22、不明 2/22

○ 人からの病原体検出情報（図１）

（国立感染症研究所）

○ 病原微生物への暴露による臨床症状、致死率、重傷度、長期後遺症の正常と発生頻度

食品を摂食後 1～7 日（平均 3 日）で、下痢、腹痛、発熱、頭痛、全身倦怠感などの症状が認められる。ときに嘔吐や血便などもみられる。下痢は 1 日 4～12 回にもおよび、便性は水様性、泥状で膿、粘液、血液を混ずることも少なくない。

特定の血清型がギランバレー症候群と関係ありとされている。

ギランバレー症候群

ギラン・バレー症候群(Guillan-Barre Syndrome)は 1919 年に Guillan と Barre および Stohl によって記載された急性突発性多発性根神経炎であり、神経根や末梢神経における炎症性脱髄疾患である。発症は急性に起き、多くは筋力が低下した下肢の弛緩性運動麻痺から始まる。典型的な例では下肢の方から麻痺が起こり、だんだんと上方に向かって麻痺がみられ、歩行困難となる。四肢の運動麻痺の他に呼吸筋麻痺、脳神経麻痺による顔面神経麻痺、複視、嚥下障害がみられる。運動麻痺の他に、一過性の高血圧や頻脈、不整脈、多汗、排尿障害などを伴うこともある。予後は良好で、数週間後に回復が始まり、機能も回復する。ただし、呼吸麻痺が進行して死亡することもまれでない。ギラン・バレー症候群の 15～20%が重症化し、致死率は２～３%であると言われている。ギラン・バレー症候群にはさまざまなサブタイプがあり、その一つにフィッシャー症候群がある。ギラン・バレー症候群は発症１～３週前に感冒様ないし胃腸炎症状があり、肝炎ウイルス、サイトメガロウイルス、ＥＢウイルスなどのウイルスやマイコプラズマによる先行感染後が疑われていたし、これらの微生物による感染が証明された症例もある。カンピロバクターとギラン・バレー症候群との関わりはカンピロバクター腸炎の病原診断が一般化してきた 1980 年代になってからである。最初の症例は 1982 年に英国において 45 歳の男性がカンピロバクターによる下痢症状がみられてから 15 日後にギラン・バレー症候群を起こした。その後、英国や米国など諸外国で *Campylobacter jejuni* 感染後に起きるギラン・バレー症候群が多数報告されてきた。米国の統計ではギラン・バレー症候群患者の 10～30%がカンピロバクター既感染者であり、その数は 425～1,275 名と推定されている。

ギラン・バレー症候群患者からの分離菌株は Penner の血清群O19 該当株が多いことから、ギラン・バレー症候群はO19 菌株感染に関連していると考えられたこともあったが、現在ではO19 に限定されない。これまでに諸外国でギラン・バレー症候群患者から検出された *C. jejuni* のO群は1、2、4、5、10、16、23、37、44、64 である。ただし、わが国ではO19 が多いことは事実である[3]。

3．農場での鶏群汚染状況

● リスクマネジメントに関与し、影響を与えうる生産段階での要因

カンピロバクターは、多くの健康な家畜、家きん、野生動物の腸管内に広く分布しており、この中でも鶏の保菌率は20%から100%に至る報告もあり、多くの動物における保菌率から比較すると非常に高い。また、腸管内容物の保菌量も高い。豚では、*C. coli* が、牛では *C. jejuni* が分離される。ハエ・ダニなどの衛生害虫や飼育者、飼育者の履き物、ドリンカーなどの器具、飲料水、周辺の川・井戸水、土壌から検出されており、高い汚染率を示した報告もある。総合的には、鶏が最も保菌率が高く、ヒトへの汚染源となりうる保菌動物である[4,5]。

○ 養鶏場での汚染実態調査

養鶏農場での分離には、著しい違いがある。分離率の相違は、検査日齢、採材時期（季節）、分離方法、分離技術、各農場の衛生状態に影響される。

○ 鶏からの病原体分離の季節変動

分離率は5月から上昇し、7-9月頃が最も高い。検査日齢では、初生ヒナではほとんど検出されないものの、加齢により分離率は高くなり、十数週齢時に最高に達し、その後加齢に従い次第に低下する傾向も認められている[6]。

○ 養鶏場での汚染機序

鶏卵の汚染率は低い、鶏卵からの菌分離報告では、卵ひゅおうめんお洗浄液から菌がぶんりされたものの、0.9%にすぎず、コレラの鶏卵の表面には糞便が付着しており、2次汚染の可能性が高い。また、種卵への侵入試験や、汚染主鶏から付加した鶏の追跡調査から、カンピロバクターの鶏への感染機序としては、垂直感染よりも水平感染と考えられる[7]。

養鶏場での汚染実態報告から明らかなように、ブロイラー出荷時におけるカンピロバクターの汚染率は高く、大半が腸管に保菌し、糞便等による体表汚染があると考えられる。また、汚染の広がりは非常に迅速であり、農場への導入時には陰性だったヒナも、2週間以降は容易に保菌し、以後急速に拡大していく[4]。

○ ワクチンの効果

こうした養鶏場での拡大を防ぐために、ワクチンの応用、抗菌剤・生菌剤の使用等による排菌抑制、飼育環境の改善による汚染防止策が検討されている[8,9]。

カンピロバクターは、鶏の腸管内の常在菌であり、組織内に侵入しないため免疫応答によって排除することは非常に困難であると言われている[10]。

○ 抗菌剤の使用

カンピロバクターの薬剤感受性試験から、感受性が認められたオキシテトラサイクリンの飼料添加による汚染防止効果[11]。

○ 感染の拡大

群ごと感染鶏数は農場により様々であるが、全く汚染のない農家からほぼ100%汚染している農家まである。これらの差は鶏の飼養環境の感染率、感染菌数等が大きく影響している。

食鳥処理場への輸送に際して、糞便汚染により羽毛の汚染率及び汚染菌数が増加する。輸送ストレスによる糞便中の菌数、排便回数が増加することにより、感染が拡大する。輸送時の感染拡大を防止するため出荷前絶食処置(8～10時間)が取られている。

その他、必要な定量データ

農家数

農家別飼養羽数

養鶏群数

4．食鳥処理場

● リスクマネジメントに関与し、影響を与えうる食鳥処理場段階での要因

養鶏場で飼育された鶏は食鳥処理場に運ばれとさつ・解体される。処理場搬入時の鶏（生鳥）のカンピロバクターの汚染率は30数%から100%であり、糞便汚染鶏は途中の工程においても汚染を拡大する[12]。

○ 中抜き解体法と外むき解体法の比較

汚染率は外むき法の方が中抜き法に比べて低い傾向にある。中抜き法では機械による内臓摘出を行うため、腸管破裂し糞便汚染が拡大する[13,14]。

○ 処理工程ごとにおける と体のカンピロバクターの汚染

懸鳥、放血とさつ後、湯漬け工程において一旦菌は減少する。(熱湯の温度：55～60℃、カンピロバクターのD値0.2～0.4分以下であるが、鶏体表の本菌のD値は0.5～2.2分である[15]。

その後、脱羽工程で汚染が拡大する。

1）脱羽機の構造と汚染の状況

2）と体の冷却：冷却水に次亜塩素酸ナトリウムを添加

塩素濃度 100ppm が適正。通常、20～50ppm に調整している 15)。

○ 食鳥肉ササミの汚染状況

機械器具からの汚染をチェック可能

その他、必要な定量データ

年間処理羽数

月別処理羽数

5．カット工場

● リスクマネジメントに関与し、影響を与えうるカット工場での要因

もも肉、むね肉、手羽、ササミの汚染率は数%～100%である。

手袋、まな板からの２次汚染によると考えられる[16]。

塩素水による消毒効果についても検討あり[16]。

6．食肉加工各工程

● リスクマネジメントに関与し、影響を与えうる食肉加工工程での要因

鶏肉の汚染率および汚染菌数の変動に関しては加熱温度時間が大きく関与する。

食肉中での菌の増減、加熱致死動態などの実験的データや加熱食肉製品製造業におけるデータが必要である。

7．流通・販売

● リスクマネジメントに関与し、影響を与えうる流通・販売段階での要因

生鮮食鳥肉における汚染率はブロック肉同士の接触およびまな板・包丁などの調理器具や手指を介した２次汚染により増加する。また、菌数は温度と時間により変化する[5,16,17,18,19,21]。外むきと中抜き処理の差によって市販鶏肉の菌数が変化する[20]。

丸と体：10 の２乗から 10 の５乗

部分肉 100 グラム当たり 10 の１乗から 10 の６乗

皮の有無、検査法、ふき取りかすすぎか（サンプリング）の相違によりデータが変化

その他必要な定量データ

販売量

8．消費

● リスクマネジメントに関与し、影響を与えうる消費段階での要因

食肉加工工程と同じく調理による器具からの２次汚染や保存温度、調理温度と時間により菌数が変化する。

その他必要な定量データ

レストランや家庭における鶏肉消費量

年間１人当たり、１日１人当たりの消費量

調理方法

9．発症菌数

海外での実験的感染報告あり[22]。

10．リスクアセスメントにおけるリスクマネージャーからリスクアセッサーへの質問事項及び解析を希望する事項

農場での感染防止

感染の拡大防止

食鳥処理場での汚染拡大防止

カット工場での汚染拡大防止

各段階での温度管理による菌数増加阻止

加熱調理

11．既存のリスクアセスメント

● この病原体・媒介食品の組み合わせに対する、既存のリスクアセスメント

1. Risk assessment of Campylobacter spp. in broiler chickens. http://www.who.int/foodsafety/publications/micro/aug2002.pdf
2. Aamir M. Fazil, et. al. A quantitative risk assessment model for C. jejuni in fresh poultry. 1999 (Canadian Food Safety Inspection Agency)

● この病原体の他のリスクアセスメント

U.S. Food and Drug Administration. *Draft Risk Assessment on the Human Health Impact of Fluoroquinolone Resistant* Campylobacter *Associated with the Consumption of Chicken.* 2000. (Revised Jan. 5, 2001.) http://www.fda.gov/cvm/Risk_asses.htm

12．文献

1. 大畑克彦，山崎史恵，佐原啓二，大村正美，増田高志，堀　渉，内藤　満，赤羽荘資，花村悦男，山口人志，森田剛史，木村隆彦，山口俊英，興津　馨，勝又國久，久嶋　弘，幾島隆雄，長谷川進彦，早川敦子，大成幸男，服部道明，岡村芳静，宮下　弘、バーベキュー料理に起因するカンピロバクター食中毒の予防に関する研究．静岡県衛生環境センター報告．36. 1-6. 1993.

2. 斉藤志保子，山脇徳美，和田恵理子，森田盛大.、検食における *Campylobacter jejuni* の生存性・増殖性と検食の保管管理方法に関する調査研究（第１報）．秋田県衛生科学研究所報．34. 73-75. 1990.

3.IASR Vol.20 No.5 May 1999.
4. Berndtson, E. Campylobacter incidence on a chicken farm and the spread of Campylobacter during the slaughter process. Int. J. Food. Microbiol. 32: 35-47, 1966.
5. Ono, K. Contamination of meat with Campylobacter jejuni in Saitama, Japan. Int. J. Food Microbiol. 47: 211-219, 1999.
6. Jacobs-Reitsma, W.F. Cecal carriage of Campylobacter and Salmonella in Dutch broiler flocks at slaughter: a one-year study. Poult. Sci. 73:1260-1266, 1944.
7. Doyle, M.P. Association of Campylobacter jejuni with laying hens and eggs. Appl. Environ. Microbiol. 47: 533-536, 1984.
8. Rice, B.E. Campylobacter jejuni in broiler chickens: colonization and humoral immunity following oral vaccination and experimental infection. Vaccine 15: 1922-1932, 1997.
9. Noor, S. M., In ovo oral vaccination with Campylobacter jejuni establishes early development of intestinal immunity in chickens. British Poultry Scinece 36: 563-573, 1995.
10. Widders, P.R. Immunization of chickens to reduce intestinal colonization with Campylobacter jejuni. British Poultry Science 37: 765-778, 1996.
11. 向原要一　カンピロバクター実験感染鶏に対するオリゴ糖、生菌剤の飼料添加の効果　鶏病研報　28: 203-205, 1993.
12. Stern, N.J., Campylobcater spp. in broilers on the farm and transport. Poultry Science 74: 937-941, 1995.
13. 石井営次　鶏肉の Campylobacter jejuni 汚染と食鳥処理工程の改善　食品と微生物 6: 69-79, 1989.
14. 石井営次　鶏肉の Campylobacter jejuni 汚染と食鳥処理工程の改善　食品と微生物 6: 129-134, 1989.
15. Yang, H. Survival and Death of Salmonella Typhimurium and Campylobacter jejuni in processing water and on chicken skin during poultry scalding and chilling. J. Food Protect. 64: 770-776, 2001.
16. 八嶋　務、食鳥肉のカンピロバクター汚染と防止方法　食品と微生物 3: 109-114, 1986.
17. 伊藤　武、市販食肉及び食肉店舗や食鳥処理場の環境における Campylobacter の汚染状況ならびに分離菌株の血清型別に関する研究　感染症誌　62: 17-24, 1988.
18. Tokumaru, M. Rates of detection of Salmonella and Campylobacter in meats in response to the sample size and the infection level of each species. Int. J. Food Microbiol. 13: 41-46, 1991.

19. 細田康彦、ニワトリ肉及び内臓の Campylobacter 汚染について　食品と微生物 1: 126-129, 1984.
20. 品川邦汎、食鳥処理場および小売店から採取した食鳥肉の微生物汚染　食品衛生研究 36: 71-90, 1986.
21. 八嶋　務、食鳥肉のカンピロバクター汚染と防止法　食品衛生研究　37: 31-41, 1987.
22. Black, R.E., Levine, M.M., Clements, M.L., Hughes, T.P., and Blaser, M. 1988. Experimental *Campylobacter jejuni* infection in humans. *J. Infect. Dis.* 157, 472-479.