Understanding food safety throughout the poultry processing chain

Outbreaks of salmonellosis and campylobacteriosis are threatening consumer health and can lead to 'juicy' headlines in newspapers, affecting the image of poultry processing. Therefore, all stakeholders in the poultry processing industry have good ethic and economic reasons to maximise poultry-related food safety.

by Willem Heemskerk, Poultry Processing Researcher, Meyn Food Processing Technology BV, The Netherlands. www.meyn.com

This article looks at food safety and the prevention of contamination throughout the entire poultry processing chain.

Food safety is defined as: 'the assurance that a food will not cause harm to the consumer when it is prepared and/or consumed according to its intended use.'

A food may harm the consumer if it contains any sort of contaminant, defined as: 'any biological, chemical or physical agent not intentionally added to food, as a result of production, manufacture, processing, preparation, transport or storing of such food.'

These definitions underline that food safety is a chain-event, it is very complex and requires knowledge especially of microbiological food safety (root cause analysis) and requires a systematic approach to prevent problems. In the poultry industry, a chain of stakeholders like farmers, processors, transporters and retailers have a shared interest and responsibility to improve food safety to protect consumer health.

The basic question is: why and when do people get ill, and what can stakeholders do to prevent this?

Microbiological food safety in general

Bacteria are small organisms of 1-4 micron large, able to multiply themselves by splitting. The multiplication time depends on the circumstances (temperature, oxygen, water, acidity, nutrients).

Circumstances may be perfect for one type but deadly for another type. Under ideal circumstances it takes only 20 minutes to split into two cells. So, the bacterial count can increase from one to two after 20 minutes, to four after 40 minutes and to eight after 60 minutes. If the count doubles every 20 minutes, the count will reach 680,000,000,000 within 12 hours. Luckily, the growth of bacteria is reduced and stopped by a lack of food, and a surplus of waste.

Thousands of different bacterial types exist, all with their own characteristics. Salmonella and campylobacter are the most dangerous bacterial species for the poultry industry. Due to the body temperature of a chicken (around 42°C) and the circumstances in the intestines, a chicken is an ideal host for these bacteria. Luckily, consumers are aware that raw chicken products may contain pathogenic bacteria.

Proper cooking of poultry products will always kill all these illness-causing (pathogenic) bacteria. However, in case of poor cooking or poor kitchen hygiene, some bacteria will still be present at the moment of consumption.

In order to cause illness, the bacteria need to pass two more barriers and the vulnerability varies per bacterial species.

Barrier 1: The human stomach

The acidity of the stomach will kill the vast majority of the bacteria. However, if a consumer uses medicine to neutralise excess stomach acids (antacids), the stomach becomes less acid and therefore less bacteria are killed. So, such antacids may improve the survival rate of bacteria.

If the kill rate in the stomach is, for example, 99.9%, an attack by 100 bacterial cells will not cause problems, while an attack by 100,000 bacterial cells may be successful, as statistically some will survive the stomach. If the kill rate in the stomach is reduced from 99.9% to 90% (by antacids), even a low dose of 100 bacteria cells may cause problems.

Barrier 2: The human defence system

Bacteria which survive the stomach will start to multiply in the intestines. The bacteria may penetrate the blood vessels, where they will be attacked by the antibacterial defence system; the white blood cells in the blood. If the white blood cells lose the first battle, illness occurs.

- **Salmonella:** After 6-48 hours (incubation time) the consumer suffers from salmonella-related illness called salmonellosis, leading to abdominal cramps, diarrhoea and vomiting for several days.

- **Campylobacter:** After 72 hours (incubation time) the symptoms of campylobacteriosis are even worse than the symptoms of salmonellosis. In some cases, campylobacteriosis may lead to long term neural damage (Guillain Barré syndrome).

The body will continue the fight until the war is won. One of the weapons of the body (fever) is not very effective because salmonella

and campylobacter like fever-temperatures of 38-42°C.

Obviously, this defence system is more effective in young healthy people than in vulnerable people.

The infectious dose is the number of bacteria which may cause a disease. Obviously, this infectious dose depends on the sensitivity of the bacterial species and the condition of the two barriers.

Despite the fact that bacterial problems can only happen after improper cooking or food handing in the kitchen, the whole production chain has an interest in improving and securing food safety.

Microbial food safety starts with keeping bacterial numbers low, avoiding spread, maximising removal/rinsing and avoiding growth in all stages of the chain:

- The farm.
- The processing plant.
- Transport and storage.
- The consumer.

Microbiological food safety at the farm

- **Contamination of a flock:**

Day-old chicks are generally salmonella and campylobacter-negative. A flock can become infected by, for example, a mouse (or even just a fly) entering the house.

Salmonella and campylobacter do not make the birds ill, but they easily multiply in the intestines of chickens; they are excreted with the faeces and subsequently contaminate other birds.

In the case of campylobacter, the % of infected birds may stay 0% for four weeks. Once a bird is infected, campylobacter easily grows and spreads, leading to a sudden rise to 100% within a week.

- **Feed withdrawal time:**

At the day of slaughter, feed must be withdrawn at the correct time: if the feed withdrawal time is less than eight hours the intestines may still be full at slaughter, increasing the risk of biological contamination.

If the time is more than 12 hours, their intestines become weaker, also increasing the risk of biological contamination. A too long feed withdrawal time also reduces animal welfare and yield.

- **Biosecurity:**

Biosecurity is the definition for the group of preventive measures taken to lower or eliminate the risk on the import of animal diseases within a company and the spread of those diseases to other enterprises.

Typical measures are, for example, the ban on transport of poultry in case of avian influenza, placing footbaths at the entrance of a poultry house, requirement to wash hands and to wear clean clothes and boots on the farm.

Microbiological food safety at the processing plant

Healthy birds may harbour huge numbers of bacteria in their intestines, on their skin and between the feathers. During primary processing the feathers and the intestines are removed, and after chill the temperature of the skin is generally too low to allow growth. So, food safety is mainly related to primary processing.

- **Immersion scalding:**

Most bacteria will die during scalding, depending on scald temperature, scald time configuration and the rinsing effect of the scalder. After scalding the bacterial counts on the carcases show a 90-99% reduction in Enterobacteriaceae (like E. coli and Salmonella species) and campylobacter on the carcases.

Until about 20 years ago, immersion scalders were equipped with systems to inject air into the scald water to improve the immersion of the birds.

These air-injected scalders had some drawbacks (cleanability, construction, energy consumption), which were solved by the introduction of the jet stream scalder.

- **Jet stream scalding:**

Years ago, Meyn introduced the jet stream scalder as the successor of the so-called 'Jacuzzi' scalder.

• **Pasteurisation:**

A benefit of jet stream scalding, compared to air-injected scalding, is the fact that the scalder can pasteurise itself, simply by increasing the temperature to pasteurisation levels.

• **No foam:**

Foam is a perfect environment for bacterial growth, so this should be avoided. Unlike air-injected scalders, jet stream scalders do not produce any foam.

• **Cleanability:**

A jet stream scalder uses much less heat, so it does not require a double plate heat exchanger, but only a single plate heat exchanger, which is much easier to clean. The air duct system of an air-injected scalder is the hardest part to clean; a jet stream scalder does not require an air duct system.

• **Other benefits:**

Water saving, reduced energy consumption and less emission of scald smell.

Food safety in the evisceration department is determined by three related activities: vent cutting, opening and evisceration. During these activities it is vital that intestines are not damaged and that the entire intestinal packs of all birds are removed.

To secure food safety, Meyn released a new generation of the vent cutter, opener and eviscerator.

- **Improved vent cutter:**

Vent cutting is the first step of evisceration; the purpose is to cut the vent loose from the abdominal skin, and hang it over the back of the carcase, without damaging the intestines.

For that purpose, the Meyn Vent Cutter 3.0 was released, a new generation which is equipped with a patented inner bushing system, reducing intestinal damage to an absolute minimum (<3% damage (internal + external damage). The drill unit is effectively cleaned from the inside, after each bird.

The vent cutter reaches an efficiency of >99% properly cut, >98% correctly hanging over the back, which is the best in the market and provides an excellent basis for the next steps in evisceration.

- **Improved opener:**

The second step of evisceration is the newly launched Meyn Opener 3.0 which contains a patented cutting mechanism to ensure a consistent and exact cut in a very wide weight range. The opener reaches a level of >99.5% correctly opened birds, thanks to the accuracy of the vent cutter.

Damage to the intestines is reduced to <0.5%, which is excellent. Real-life measurements confirm that (visual) contamination is reduced by at least 50%, compared to the previous equipment range.

- **Improved eviscerator**

Since 1992, the Maestro has reached a level of >99% correct evisceration, which means that >99% of the carcases are empty which saves (unhygienic) rework. Furthermore, little intestines remain in the eviscerator itself, also improving hygiene.

Virtually all intestinal packs are presented with the corresponding carcase for veterinary inspection. However, a bottle neck remained the complexity of giblet harvesting.

Recently, the successor of this eviscerator, the Maestro Plus was launched, reaching the same level of evisceration efficiency but giblet harvesting has improved considerably, as the eviscerated packs are rehung into grippers in which the packs are presented for veterinary inspection.

Subsequently, the edible giblets (liver, heart and gizzard) are automatically harvested with a high efficiency.

- **Improved washing cabinets:**

After the slaughter department the bacteria are still loosely attached to the skin, so their count can be reduced by rinsing.

Rinsing stages have been optimised by using the Undine technology.

A technology that involves mixing water with air for a high efficiency of rinsing.

Microbiological food safety during transport and storage

At refrigeration temperatures (<3°) salmonella and campylobacter do not grow, so numbers remain stable or decrease. It is crucial that such low temperatures are maintained by the transporter, the retailer, and the consumer, until the product is fully cooked.

Conclusion

Food safety issues are the joint responsibility of all stakeholders in the chain, from farm to fork. It is crucial that all understand how contamination works, realise their interest, are aware of their responsibility and act accordingly.

Leading poultry processing equipment manufacturers like Meyn have recognised their responsibility by improving existing equipment and developing new equipment to keep the consumers and the poultry business as healthy as possible. ■