Sanitary hygiene implementation at *Salmonella* sp. critical control points in layer farms

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Abstract. Contamination in food products can occur at any stages, from pre-production to producer, post-production to the product being distributed and presented to consumers. This study aims to determine the extent of the application of sanitation hygiene at the critical control points of *Salmonella* sp. so that the description of the conditions and the relationship between the presence in the chicken egg chain in farms until it is ready to be distributed. This research was conducted on 72 laying hen farms in the same area using a cross-sectional study design. Data collection methods are observations and interviews regarding sanitation hygiene practices that include the application of sanitation hygiene to eggs, feed, cages, and workers. Critical control points of *Salmonella* sp. the spread, which was observed consisted of poultry cages, egg collection process, egg evaluation, and chicken eggs ready for distribution. The results showed that sanitation hygiene practices in layer farms were mostly implemented in cages (67%) and eggs (56%), while the application of sanitation hygiene was not widely applied in the feed (20%) and workers (28%).

1. Introduction

The availability of food that is guaranteed safe animal origin is very important to ensure consumer inner peace, so food safety is a major factor that must be considered. Harmful contamination for humans can occur in every chain, from preproduction to producers, post-production to products distributed and presented to consumers. One of these dangers is livestock-borne diseases called food-borne diseases, as well as contamination or contamination of chemicals and other toxic substances.

Chicken eggs are one of the products that are very easy to obtain, easy to be processed, and the price is affordable by the community on all social strata. Eggs also have nutritional content that is beneficial to the body. However, some studies have reported that infection of microorganisms on chicken eggs can be harmful to human health, especially by the *Salmonella* sp. microbe. This microbe should not be found in consumption eggs [1].

*Salmonella* sp. contamination in poultry farms in Sleman Yogyakarta reaches 11.40% in meat and 1.40% in eggs [2] and the prevalence rate of 2.8% [3]. In Sidrap regency, South Sulawesi, the prevalence rate of Salmonellosis in cattle was 76.39% [4]. Research by [5] reported that *Salmonella*...
Enteritidis bacteria have been found on commercial laying chicken farms (layers) and have infected the Grand Parent Stock in Indonesia. Based on the condition, *Salmonella* sp. has become a threat to human health because it can infect the chicken eggs consumed by the wider community. This bacterial infection also causes harm to the poultry industry in the homeland in addition to the decline in productivity will also be the carrier for birds because it can infect horizontally or vertically. Research on the existence of *Salmonella* sp. at critical control points is expected to describe the condition and linkage between the chain of chicken eggs in the farm to be ready to be distributed with hygiene aspects and sanitation.

2. Materials and methods
The research was conducted to 72 laying hen farms in the same area using a cross-sectional study design. Cross-sectional research is a study in which variables include risk factors and variables that include effects observed at once at the same time [6].

Data was collected through direct observation on the implementation of sanitation and hygiene practices on the farm, interviews with the questionnaire related to the sanitation and hygiene practices included the implementation of hygiene and sanitation in eggs, feed, cage, and workers, as well as the characteristics of farmers. The more the application of sanitation hygiene carried out by farmers, the higher the percentage. The percentage of implementation is measured through comparisons between the amount of sanitary hygiene applied and the total number of questions.

3. Results and discussion
The contamination of *Salmonella* sp. bacteria in eggs can occur through vertical and horizontal transmission [2]. The horizontal transmission was preceded by a feed contaminated by feces containing *Salmonella* sp. or derived from an environment such as air, dirty litter, infrastructure facilities of the dirty cage and vector [7]. Contaminated feed based on the microbiological test that became part of the study was then consumed by laying hens to start contamination. *Salmonella* sp. goes through an oral route then invades the intestinal epithelium cell or local lymphoid tissue especially in the payer patch and caecum. Phagocytes are infected and persist in them as intracellular organisms then free bacteria migrate to the lymphoid tissue (liver, spleen, bone marrow) where bacteria can multiply. These bacteria enter back into the lymphoid tissue in the intestines and colonized in the intestines then contaminate the feces [8,9]. This is evidenced by the discovery of *Salmonella* sp. in the feces which is also a part of this research, while the alleged eggshell is contaminated at the time through the cloaca.

Contamination of eggshells on this research is also suspected to be a *Salmonella* sp. transmission vertically through the reproductive tract. The reproductive tract is divided into 5 parts [10], each section has a specific function. The infundibulum is a membrane that captures yellow when released from the ovaries. The infundibulum is the place where fertilization occurs if there is no fertilization, the commercially produced eggs are not fertilized, and the process lasts for 15 minutes. The egg yolk is next to Magnum, where the albumen will be secreted and coated with egg yolks (about 3 hours). When the albumen is formed, the egg yolk revolves around the albumen fiber's to form the chalazae. From Magnum then yolk to the isthmus which is where the inner and outer egg membranes are added (for 1–1.25 hours), as well as some mineral water and salt. According to [11], before the formation of eggshells (deposition), the egg formed is the largest target of infection of *Salmonella* sp. in ovarian tissue, the smallest infection comes from the colony of vaginal and cloaca tissue, and lateral infections originated from the colony over the oviduct tissue. A uterus is a place where water is added to make the outer layer thinner and more white and the addition of eggshells (especially calcium carbonate). Eggs in the uterus for a long enough time (during ± 21 hours) due to the laying process and the formation of an eggshell. Then the last is the cloaca, where the egg came out through the cloaca before laying approximately 1-minute eggs. The surface of the eggshell can be infected with *Salmonella* sp. At the time of oviposition where the reproductive tract of the lower part of the chicken has been infected with *Salmonella* sp. *Salmonella* is a microorganism that is resistant to different environmental conditions during processing and in the gastrointestinal tract [12]. Therefore, adequate hygiene measures should be a
priority in the layer farms and no disinfection procedure can prevent egg contamination. The cleansing and disinfection procedure in white eggs should be done before 2:16 hours, and before 2:44 hours on the egg yolks so that the action to prevent or reduce contamination by pathogenic bacteria, one of which is *Salmonella* Enteritidis, so it is more effective in its implementation [13].

There is an increase in the number of *Salmonella* enteritidis along with increasing egg storage temperature. *Salmonella* Enteritidis has a slight increase in eggs stored at a temperature of 4°C compared to temperatures higher than 4°C [14], this is due to changes in physiology and chemistry resulting in a decrease in egg quality. Other studies have mentioned that *Salmonella* Enteritidis is rarely found on eggs deposited with room temperature 6 °C and 25 °C for two weeks, while storage of eggs at 6°C for six weeks and temperature storage of 25 °C for 2 to 8 weeks showed an increase in the number of these bacteria up to 109 CFU/mL in egg contents [15]. It can be a reference in the process of storing and transporting commercial eggs to inhibit the growth of *Salmonella*.

Based on the results of the identification and description above, then in the area of the farm, there are several critical control points spread *Salmonella* sp., including poultry cage, egg collection process, evaluation of eggs, and chicken eggs race who the distribution primarily at the time of storage. The flow of transmission of *Salmonella* sp. sources of chicken eggs ready to distribute in the livestock area presented in figure 1.

**Figure 1.** Transmission flow of *Salmonella* sp. contamination on chicken eggs ready for distribution in the layer farm.

*Salmonella* sp. critical control points in layer farms can be controlled by maximizing personal hygiene and sanitary cage facility action. Based on the results of the survey on the application of sanitary hygiene in 72 laying hen farms that the application of sanitation hygiene > 50% in the farmers conducted on the cage (67%) and eggs (56%). The application of hygiene sanitation of the farmers < 50% is done in feed (20%) and employees (28%). Respondents generally have known the procedures of hygiene sanitation in the cage and eggs obtained from the socialization of local government that accompanied the disinfectant procurement aimed at some farmers. The information on the implementation of hygiene and worker sanitation is minimal, so it is less to get attention from farmers.
Sanitation hygiene practices in layer farms enclosure is a period of discharge from the previous maintenance period, performing sanitary measures against the empty cage of the previous maintenance period (providing disinfectant, weaning, insecticide, disinfection of equipment in the cage, drinking water, feeding place, etc.). The application of sanitary hygiene on the egg that is routinely done is to do the sorting stage of the physical egg (whole/rupture) and to do storage on the new egg rack.

The data analysis showed that there is no influence between the sanitary hygiene practices on eggs, feed, cage, and workers to the level of livestock density or the number of livestock owned. Farmers apply sanitation hygiene with the same pattern, this is evident from the data on the observation and the implementation of sanitation hygiene applications distributed evenly to the farmers with different levels of density. The picture above should be a motivation for farmers laying chickens to further improve the knowledge and implementation of hygiene in the main sanitation in feed and workers.

4. Conclusions

Hygiene sanitation practices on poultry farming in Tanete village of Maritengae district of Sidrap has mostly been implemented in the cage (67%) and eggs (56%), while the ones that have not been widely applied to feed (20%) and workers (28%).

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