IDENTIFICATION OF CRITICAL CONTROL POINTS IN NON-ACCREDITED DRESSING PLANTS SUPPLYING UNBRANDED FRESH WHOLE DRESSED CHICKEN IN LOS BAÑOS, LAGUNA PUBLIC MARKETS

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ABSTRACT

A cross-sectional study was done to identify the critical control points in selected non-accredited dressing plants supplying unbranded fresh whole dressed chicken in two major wet markets in Los Baños, Laguna, Philippines. Detection of *Salmonella* spp. contamination was done in eighty (80) samples of fresh whole dressed chicken collected from selected delivery trucks prior to unloading in the wet markets following a systematic random sampling for four consecutive weeks and subjected to non-destructive rinsing method. The rinse samples were subjected to conventional laboratory tests and the presence of *Salmonella* spp. was confirmed using PCR-based Salmonella DNA Amplification System™ kit. Information about the dressing plants was obtained from the fresh chicken retailers. Interviews and plant visits in selected dressing plants were done to evaluate dressing and transport practices to identify critical control points. Results showed that 1.25% of the chicken samples were found positive for *Salmonella* spp. The identified critical control points were receiving of live chickens, washing of eviscerated carcass, packaging and transporting of fresh chickens to wet markets. These findings can be considered as preliminary basis in developing a food safety standard protocol along the supply of value chain of broiler chicken coming from non-accredited dressing plants in the Philippines.

Key words: critical control points, fresh chicken, non-accredited dressing plant, *Salmonella*, food safety

INTRODUCTION

In the Philippines, the demand for chicken meat, as well as food safety and product quality are increasing (Chang, 2007). According to Reyes (2009) and Gonzales (1995), as cited by Chang (2007), over 70% of chicken meat is distributed in the wet markets and consumers consider meat from wet markets as fresher, cheaper and more nutritious compared to frozen chickens in the supermarkets.

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Majority of fresh chicken sold in wet markets in the Philippines are coming from non-accredited dressing plants that supply unbranded chickens which are relatively cheaper compared to the branded ones. Non-accredited dressing plants are locally registered and are only allowed to operate by the local government units (LGU) following the Code of Sanitation in the Philippines (PD 856), and are not accredited by the National Meat Inspection Services (NMIS). The non-accredited dressing plants have business permits and sanitary permits but do not undergo a routine inspection from sanitary officers of the LGU.

The non-standardized handling and processing protocol of these non-accredited dressing plants can pose a concern to food safety and public health. Carcasses originating from backyards carry a heavier microbial load with respect to those of conventional production (Voidarou *et al*., 2011). Chicken samples from very small slaughterhouses were found to have 15% Salmonella positive compared to large establishments with only 7.6% (USDA/FSIS, 2008). Mishandling in the preparation, improper facility and storage conditions are the usual causes of *Salmonella* spp. contamination in food especially in meat. In poultry and other animal products, *Salmonella* spp. contamination can easily be prevented through environmental hygiene where practical control measures are implemented to improve all the steps within the supply chain. The absence of Salmonella in poultry meat is an important consideration in ensuring food safety and protecting public health since it frequently gets to food as a result of fecal contamination causing diarrhea, fever and abdominal cramps when ingested (Claudio *et al.*, 2001). Salmonella is normally carried asymptomatically in the alimentary tract and may be transported from the farm to the processing plants to retail markets where further spread and cross-contamination could occur. In the Philippines, the acceptable level of Salmonella in fresh meat should be 0 in a 25-gram sample (NMIS guidelines MC-09-2008-05).

Establishing an HACCP plan for small plant operators ensures safe food for consumers. An effective HACCP is a systematic approach that monitors each processing step to minimize risk by identifying and controlling hazards (Barbut, 2015). Critical control points (CCP) are important steps to prevent, eliminate or reduce food safety hazards to an acceptable level (USDA/FSIS).

This study aims to identify critical control points for fresh whole dressed chicken from non-accredited dressing plants by evaluating the actual dressing and transporting procedures of unbranded fresh chickens sold in the retail wet markets in Los Baños, Laguna and by screening meat samples for *Salmonella* spp. contamination. The initial findings could serve as a basis for preliminary basis in developing food safety standard protocol for non-accredited dressing plants.

MATERIALS AND METHODS

A cross-sectional study was done to identify critical control points in dressing and transporting fresh chickens from non-accredited dressing plants supplying unbranded fresh whole dressed chicken in two major wet markets in Los Baños, Laguna (14.1699°N, 121.2441°E). Five (5) dressing plants were identified and scheduled for interview and observation.

The study included detection of *Salmonella* spp. in the unbranded fresh chicken supplied in the wet market through laboratory analysis, market profiling, describing the product, identifying intended use of the product, constructing process flow and confirming

it from non-accredited sources, and listing of potential hazards to establish critical control points.

The occurrence of *Salmonella* spp. in the wet market was done following a systematic random sampling, 80 samples of fresh whole chicken were collected during unloading from the delivery trucks in the two wet markets. Sampling was done for four consecutive weeks. Fresh chickens were separately placed in labeled sterile plastic upon purchased and were placed in a cooler with ice. The samples were subjected to a non-destructive rinsing method (Bailey and Cosby, 2003) where 100ml of sterile distilled water was added inside the sterile plastic and was shaken vigorously for 1 minute. The dressed chicken was rinsed inside and out with a rocking motion following the procedure of USDA/FSIS,2008. The rinse was transferred to a labeled sterile bottle, placed in a cooler with ice and transported to the laboratory within 4 hours. Samples were analyzed using Salmonella DNA Amplification System (DAS®) kit (National Institute of Molecular Biology and Biotechnology, Philippines) and the conventional method (Odumeru and Leon-Velarde, 2012), The Salmonella DAS kit contained a genus-specific primer Sal-05 and PCR were performed using a thermal cycle with an initial denaturation at 95°C for 5 minutes, 30 cycles of denaturation at 94°C for 2 min, annealing at 56°C for 1 minute and extension at 72°C for 1 minute. It was followed by the final extension by polymerase at 72°C for 10 minutes and holding temperature at 8°C. While in the conventional method, all of the enriched samples from BHI with BG were streaked in Bismuth Sulfite agar (BSA) plates and incubated for 24 hours at 37°C and the suspected colonies were purified (XLD and BSA) and subjected to biochemical tests (Triple Sugar Iron, Urease and Lysine Decarboxylase tests).

Preliminary steps for identifying Critical Control Points were conducted with the support of the Municipal Health Officer, Chief Officer of wet markets and (13) chicken retailers for market profiling, product description, and supplier identification. A structured questionnaire was used to identify handling procedures of fresh chickens, food safety concerns, and profile of purchased and origin of fresh chickens sold in wet markets. A flow diagram from receiving to transportation was developed through plant visitations and observations. Dressing plants were visited one time and the owner or in charge of the dressing plant was interviewed using a structured questionnaire. The gathered data were used in analyzing possible sources of contamination and cross-contamination. Observations from the operations were used to identify potential hazards such as biological, chemical, or physical hazards. The critical control points were based on the actual conditions of the operation, actual process, physical condition of the dressing plant and state of equipment used. Based on the identified potential hazards, decisions were made if these hazards will likely to occur in product or process and were compared to standards and other studies (NMIS, RA 9296, Rule 17.5; Manning *et al*., 2016; Finstad, 2012; Bauermeister *et al*., 2008, Humprey and Allen, 2002; Bryan and Doyle, 1995).

RESULTS AND DISCUSSION

Detection of *Salmonella* spp. in the wet market was done in a systematic random sampling during the unloading of fresh whole chickens from the delivery trucks in the wet markets. Only 1.25% of the 80 chicken samples were found positive for *Salmonella* spp. based on both PCR (Figure 1) and conventional tests (Figures 2 and 3). It is an indication that fresh chickens from non-accredited sources sold in wet markets in Los Baños, Laguna

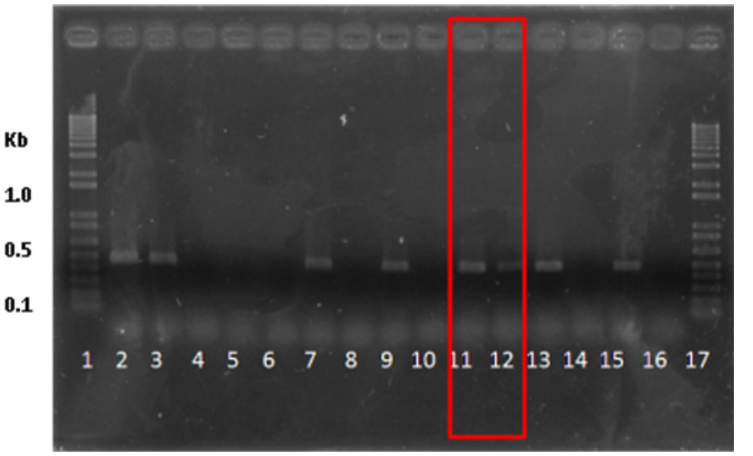

Figure 1. Polymerase Chain Reaction Amplification of *Salmonella* spp. (0.45Kb products) from unbranded fresh chicken rinses. 1 – Kb ladder; 2 – positive control; 3 – 2A1 positive control; 4 – 2A1 sample; 5 – 2A2 positive control; 6 – 2A2 sample;7 – 2A3 positive control; 8 – 2A3 sample; 9 – 2A4 positive control; 10 – 2A4 sample; 11 – 2A5 positive control; 12 – 2A5 sample; 13 – 2A6 positive control; 14 – 2A6 sample; 15 – 2A7 positive control; 16 – 2A7 sample; 17 – Kb ladder. *Salmonella* spp. was successfully amplified as indicated by the bands in lanes 11 and 12 as highlighted in the red box.

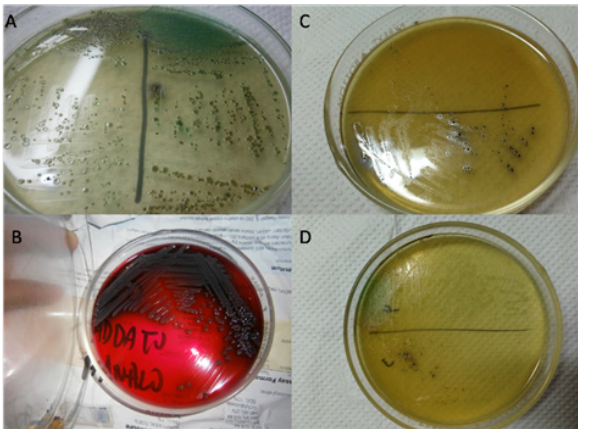

Figure 2. Conventional method of detecting *Salmonella* spp. from unbranded fresh chicken rinses. A – 2A5 sample streaked in Bismuth Sulfide Agar (BSA); B – 2A5 sample streaked in (XLD); C and D – purification of suspected colonies (black with metallic sheen) in BSA.

could be considered a potential source of Salmonella since almost all chicken retailers (12 out of 13) acquire fresh dressed chickens from non-accredited dressing plants. The positive result did not conform to the national standard of 0 *Salmonella* spp. on 25g sample (NMIS guidelines MC-09-2008-05). Fresh chicken retailers should maintain the low temperature of

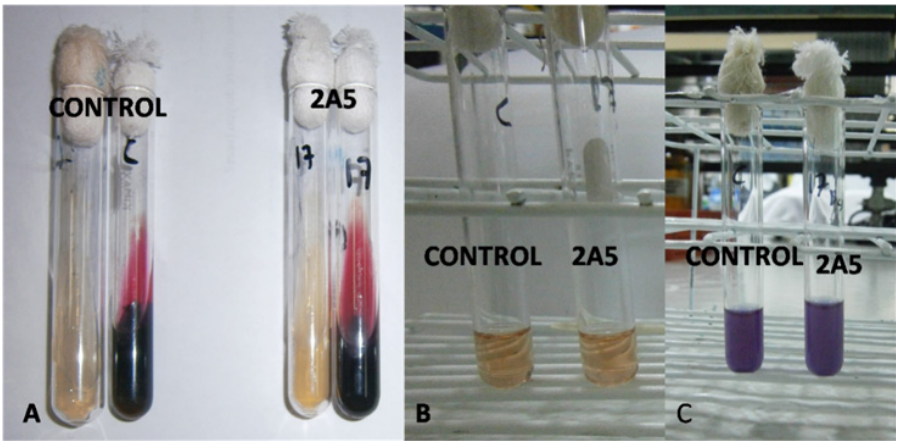

Figure 3. Biochemical test results of *Salmonella* spp. from unbranded fresh chicken rinses. A – Triple sugar test of control and sample 2A5; B – Urease test of control and sample 2A5 and; C – Lysine decarboxylase test of control and sample 2A5.

carcasses by putting ice on display trays and use clean and sanitized utensils at all times to prevent cross-contamination.

The percentage of Salmonella detected in fresh chicken in this study is lower compared to previous studies of Martin (18%) and Balala (4.92%) in 1996 and 2006, respectively. In selected wet markets in Metro Manila, 12% breast, 9% inner thigh and 8.43% perennial region were positive for Salmonella (Baldrias and Capistrano, 1990). In the study by Velasco (1996), the isolation rate of Salmonella was only 3% for selected poultry dressing plants. The low percentage obtained is possibly due to the collection time and method used. Other studies collected samples at random times of the day while samples in this study were collected straight from the delivery trucks. Moreover, the rinse used in other studies was buffered peptone water while this study used sterile distilled water. Evidence suggests that the number of Salmonella during processing is generally low and still within the limits of detection (WHO/FAO, 2002).

Based on the interview, out of the 13 chicken retailers in the wet market, 12 obtained fresh chicken from non-accredited sources. Five (5) dressing plants were identified and scheduled for interview and observation based on their availability. The selected non-accredited dressing plants have 200 to 1,000-bird capacity per day. Live broiler chickens were purchased from middlemen coming from North Luzon and nearby farms in CALABARZON regions. Most were delivered in hauling trucks with coop crates. Upon arrival in the dressing plant, the live birds were then placed in the holding pen in the dirty area. Dressing plant owners checked the physical attributes of live chickens to prevent the purchase of sick or dead animals. No licensed veterinarian or livestock inspector was conducting an antemortem inspection. Major observations in the actual step-by-step dressing procedure were enumerated in Table 1.

Dressing plants have no partition between the dirty area where they perform bird hanging to evisceration and the clean area where final washing, weighing and packaging are done. These are possible sources of contamination despite having different personnel assigned in each area (Bryan and Doyle, 1995). In the absence of physical barriers, it was

Table 1. Stages of poultry processing in non-accredited dressing plants showing entry sites for possible biological contaminants.

Process Stages	Observations	Possible biological contaminations	Suggested preventive measures	Remarks*
1. Receiving	• No ante-mortem inspection by authorized personnel • Feces on feathers	• Pathogens on exterior surface/ intestines • Birds contaminated with unacceptable level of pathogens (Manning *et al*., 2016; Humprey and Allen, 2002)	• Request health certificates from farm veterinarians • Observe good manufacturing practices (GMP), feed withdrawal	CCP #1
2. Hanging	• Rusted hooks, impro-vised hangers	• Dirty/rusted hooks and improvised hangers (Bryan and Doyle, 1995)	• Remove rusted hooks and clean hangers/improvised hangers before and after use	CP
3. Sticking and Bleeding	• Knives not being washed • Feces on feathers	• Contaminated knives • Contamination from external sur-face of birds (Bryan and Doyle, 1995)	• Use clean and sanitized knives • Prevent contact with contaminated feathers	CP
4. Scalding	• Uncontrolled temperature in scalding tank	• Scalding tempera-ture (Finstad, 2012) • Possible cross contamination due to dirt and fecal matters removed from the birds (Bryan and Doyle, 1995)	• Monitor and standardize scalding temperature	CP
5. Defeath-ering	• Improvised defeathering machine	• Cross contami-nation • Potential increase of pathogens (Bryan and Doyle, 1995)	• Clean and sanitize defeathering machine specially rubber fingers	CP

Table 1 continued...

Process Stages	Observations	Possible biological contaminations	Suggested preventive measures	Remarks*
6. Removal of head and feet	• Cut head and feet on the floor	• Contamination due to floor dressing (Bryan and Doyle, 1995)	• Use stainless tables	CP
7. Evisceration	• Fast movement of workers in removing internal organs • Floor dressing • Insufficient washing/ cleaning of tables/ floors	• Contamination due to gut breakage, leads to leakage of fecal materials into the body cavity • Contamination due to floor dressing • Internal organs: contamination in equipment (Bryan and Doyle, 1995)	• Proper training of employees • Use stainless tables • Wash equipment • Formulate standard operating procedure • Indicate separate area for cleaning of internal organs (intestines, gizzard, liver, lungs)	CP
8. Washing (Final washing)	• 2x dipping in basin with water • Do not use chilled water	• Contamination from external surfaces • Insufficient washing is not enough to reduce microbiological contamination from previous steps • Improper carcass temperature could lead to increase in number of pathogens (Bryan and Doyle, 1995; Bauermeister *et al*., 2008)	• Effective washing • Clean inside and outside of the carcass; proper chlorination and use of pressured water • Maintain carcass temperature (4°C) to minimize microbial growth by adding ice or using cold water	CCP #2
9. Weighing	• Weighing scales were not clean from time to time	• Contamination between carcasses and weighing scales (Bauermeister *et al*., 2008)	• Clean weighing scales before and after use • Handlers use plastic gloves	CP

Table 1 continued...

Process Stages	Observations	Possible biological contaminations	Suggested preventive measures	Remarks*
10. Packaging	• Use of crates and plastic bags • No ice were placed in each containers	• Improper carcass temperature could lead to increased number of pathogenic microorganisms (Bauermeister *et al*., 2008)	• Put ample amount of ice in each container to minimize growth of microorganisms	CCP #3
11. Transporting	• Use of unrefrigerated delivery vehicles (uncontrolled temperature) • Use of plastic bags/ crates with no ice	• Contamination from delivery vehicles • Growth of pathogenic microorganisms due to improper temperature (Bauermeister *et al*., 2008)	• Clean and sanitize vehicles before and after delivery • Use of refrigerated delivery truck • Shortest transport time to wet markets • Maintain carcass temperature (4°C) to minimize microbial growth by adding enough ice on crates	CCP # 4

*CP - Control points; CCP - critical control points

observed that the movement of people inside the plant was not being controlled. Moreover, feces and feathers were also present in the clean area. These materials adhered to the clothes and footwear of personnel. Processes were carried out early morning (1:00 am to 3:00 am) at room temperature (23-25°C) since the plant has no cooling units. Carcasses processed at ambient temperature could affect the growth of *Salmonella* spp. Salmonella growth occurs at a temperature of 5.2 to 46.2°C and has an optimum growth at 35°C-43°C (WHO/FAO, 2002).

Kotula and Pandya (1995) reported that, upon delivery, live chickens brought in dressing plants are often contaminated with Salmonella in the feathers, skin, crop and cloaca. Cross-contamination can occur during transport from both birds and cages. Transport cages are important sources of cross-contamination (Humprey and Allen, 2002). The bacteria from live birds can adhere to equipment surfaces and contaminate processing water.

Possible sources of biological contaminations from each step suggested preventive measures, and identification of control points and critical control points were also enumerated in Table 1. Control points and critical control points were identified based on the actual conditions of the operation, actual process, physical condition of dressing plant and state of equipment used. Control points are any step at which hazards such as biological, chemical, or physical factors can be controlled (NACMCF, 1998) while critical control points are steps at which control can be applied and are essential to prevent or eliminate a food safety hazard or reduce it to an acceptable level (Codex, 1997). If control is lost, the probability of health

risk might occur.

The current dressing practices for fresh whole dressed chicken in non-accredited sources could pose a risk to human health. The antemortem inspection was conducted by the personnel only but a certified inspector was not present. Possible contamination from receiving, evidence of feces on the movement of the people from dirty area passing through the clean area, the temperature of water for washing and carcass temperature were not monitored. Carcasses placed at room temperature have increased the growth of microorganisms since Salmonella occurs at a temperature of 5.2 to 46.2°C and have an optimum growth at 35°C-43°C (WHO/FAO, 2002). "Floor dressing" commonly practiced in non-accredited dressing plants can also be a source of fecal contamination. According to Bryan and Doyle (1995), contamination and cross-contamination may increase during slaughtering. It usually occurs during scalding, defeathering, evisceration and giblet operations.

Critical control points were identified based on the possible occurrence of a hazard in the product or process. The potential hazards presented in Table 2 were based on preliminary data presented in Table 1. The identified critical control points are receiving of live chickens, final washing of eviscerated carcass, packaging and transporting of fresh chickens in wet markets. These steps were compared to standards (NMIS, RA 9296, Rule 17.5; Manning *et al.*, 2016; Finstad, 2012; Bauermeister *et al*., 2008; Humprey and Allen, 2002; Bryan and Doyle, 1995). The monitoring method and action to take if the standard is not met were also enumerated in Table 2.

Ante-mortem inspection is necessary for obtaining healthy flocks for slaughtering. Efficient washing is required to further remove microbial contamination such as *Salmonella* spp. (Northcutt *et al*, 2005). Cold water and ice should be provided at this stage to minimize the growth of *Salmonella* spp., which is critical in controlling the growth of *Salmonella* spp. The use of packaging material should allow proper circulation of cold temperature to carcasses. The temperature during transport should still be maintained at 40°C (Bauermeister *et al*., 2008), to further control the growth of *Salmonella* spp. A shorter route from dressing plants to the wet market should also be considered.

Since no prerequisites program of HACCP was established for fresh whole dress chicken from non-accredited dressing plants, each step should be properly controlled. The steps from receiving to transporting are all considered control points. It is important to identify critical control points and control hazards in the process that might pose a high health risk to consumers (Humber, 1992). It is recommended to establish food safety measures such as Good Manufacturing Practices (GMP), Good Hygienic Practice (GHP) and Sanitation Standard Operating Procedures (SSOP's) in dressing plants for safe processing of fresh chickens. The following practices are necessary to prevent and eliminate food safety hazards whether physical, biological, or chemical, with the potential to cause an adverse effect on health and to maintain a hygienic environment suitable for dressing and transporting safe end products and safe food for human consumption (Seng, 2009).

The initial findings can be considered as preliminary basis in developing the HACCP plan for fresh whole dressed chicken from non-accredited dressing plants. The LGU should further monitor and verify the gathered data until an effective HACCP plan is developed. Based on the preliminary data, they could establish critical limits for each suggested CCP, monitor the CCPs, establish corrective actions and verify the procedure. Documentation and record-keeping are essential in achieving an effective HACCP plan. LGU should follow

Table 2. Critical Control Points of *Salmonella* spp. contamination in dressing and transporting fresh whole dressed chickens from non- accredited sources.

Critical Control Points	Potential Hazard	Standard	Monitoring Method	Actions to Take if Standard Not Met
Receiving of live birds	Presence of pathogenic microorganisms	All animals must show no evidence of any disease or abnormal condition (NMIS, RA 9296, Rule 17.5)	Health certificates from farm veterinarians (NMIS AO 19 series of 2010, section 8) Ante-mortem inspection (NMIS AO 19 series of 2010, section 9)	Reject live birds
Final Washing of Eviscerated Carcass	Presence of pathogenic microorganisms due to insufficient washing	Inside and outside washing (chiller tank 90 sec/bird) (Northcott *et al*, 2005); chlorine (30-50ppm) (Bauermeister *et al*., 2008)	Check washing time at specified frequency (i.e. hourly basis) Measure chlorine level before washing (initial start per batch)	Extend washing time in chilled water
	Presence of pathogenic microorganisms due to improper temperature of carcass	Carcass temperature <4°C (Bauermeister *et al*., 2008) Water temperature 0-20°C	Check temperature of water at specified frequency (i.e. hourly basis) Check temperature of carcass at specified frequency (i.e. hourly)	Use of ice, cold water
Packaging of carcass	Growth of pathogenic microorganisms due to improper temperature of carcass	Carcass temperature <4°C (Bauermeister *et al*., 2008)	Check temperature of carcass at specified frequency (i.e. hourly basis	Use of ice, cold water

Table 2. Continued...

Critical Control Points	Potential Hazard	Standard	Monitoring Method	Actions to Take if Standard Not Met
Transport-ing of Fresh Chickens	Growth of pathogenic microorgan-isms due to improper temperature	Refrigerated trucks 0-20°C Carcass temperature 4°C (Bauermeister *et al*., 2008)	Check temperature before loading to trucks and after unloading to wet markets	Deliver in nearest wet market using refrigerated trucks or ample amount of ice in crates Require stall vendors to use ice upon display

strict coordination with the NMIS for effective implementation of proper and hygienic handling of fresh chickens from non-accredited dressing plants.

To further improve the study, it is recommended to collect samples at different time intervals to consider the increase in the number of the organisms since after processing these are damaged and still recovering. Salmonella is common in low numbers thus detecting it at an early stage (lag phase) particularly isolation of the microorganism might have been difficult. Sample size collection and length of collection time can also be increased to have a wider range of data collected. Plant visitation and observation time can also be increased to further verify the flow diagram and identify other possible potential hazards.

CONFLICT OF INTEREST

The authors declare no conflict of interest with materials or other resources used in this study.

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