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Detection of *Salmonella* Bacteria in Raw Chicken Meat Retailed at Ozamiz City Public Market

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Abstract

Salmonella bacteria are among the major foodborne pathogens. Poultry products never cease to appear in the incidence of *Salmonella* infection worldwide. In Ozamiz City, Philippines, no study has been carried out about possible *Salmonella* contamination in raw meat and meat products retailed at the public market. Hence this study aimed to find out if the raw chicken meat at the city public market is contaminated with *Salmonella* bacteria. A total of 15 samples were collected comprising of drumsticks, thighs, and breasts from randomly selected five vending stalls. Standard microbiological analysis was performed for detecting *Salmonella* on the samples. Findings revealed that *Salmonella* were detected mostly in drumsticks and thighs but the bacterial counts were within the acceptable level with no-to-low risk of transmission. The findings of this study may be utilized to raise public awareness that may pave way to the development of any preventive program for bacteria contamination.

Keywords: contamination, foodborne, infection, pathogens, poultry

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Introduction

Outbreaks of foodborne diseases highlight the need for reducing bacterial pathogens in foods of animal origin (Hocking, 2003; Gaggìa et al., 2010). Hence, adequate knowledge relating to the epidemiology of foodborne agents in animal production is paramount to aid in the control of disease outbreaks. *Salmonella* bacteria are among the major foodborne pathogens in the world (Yildirim et al., 2011). These gram-negative, non-lactose fermenters, facultatively anaerobic bacilli of family Enterobacteriaceae are usually found in poultry, eggs, unprocessed milk, meat and water (Worden, 2014). There are two known species of *Salmonella*, namely: *S. bongori* and *S. enterica* with many subspecies (Fookes et al., 2011). The *S. enterica* subspecies are further subdivided into >2500 serovars which mostly cause disease in humans and other warm-blooded animals.

Salmonellosis is the enteric illness in both human and animals caused by *Salmonella* bacteria (Kabir, 2010). Symptoms of salmonellosis include watery diarrhea (sometimes with blood or mucus), high fever, headache, abdominal pain, nausea, vomiting, and loss of appetite that may complicate to serious damage of the liver, spleen, and small intestines of an infected individual [Control for Disease Control and Prevention (CDC), 2015]. Infections of the disease result from consumption of raw, undercooked or improper mishandling of food contaminated with the bacteria (Lawley, 2013).

Several cases of *Salmonella* infections have been documented worldwide (Matheson et al., 2010; Majowicz et al., 2010; Hendriksen et al., 2011; Sánchez-Vargas et al., 2011; Deng et al., 2012; Akil et al., 2014; Kirk et al., 2015). In the Philippines, detection of *Salmonella* spp. in various sources have been reported. Drug-resistance to these bacteria was also documented. A study in San Lazaro Hospital in Manila detected *Salmonella* spp. from patients with diarrhea (Adkins et al., 1987). *S. enterica* serotype Typhi strain was cultured from blood and fecal samples from a 54-year-old man with fever and diarrhea in Manila as well (Al Naiemi et al., 2008). The occurrence of *Salmonella* in aquaculture was also reported (Dalsgaard, 2003). Philippine bats were

also found to harbor this bacterium (Reyes et al., 2011). Antimicrobial resistant *S. enterica* isolates were detected from the tonsil and jejunum with lymph node tissues of slaughtered swine in Metro Manila (Ng & Rivera, 2014). *Salmonella* spp. was also detected in retailed fresh produce used in salad preparation such as bell pepper, cabbage, carrot, lettuce, and tomato (Vital et al., 2014) and in irrigation water, soil, and vegetable samples in Metro Manila (Garcia et al., 2015). *Salmonella* bacteria were also detected in street-vended foods consisting of chicken- and pork-based samples, mostly grilled and fried in Laguna (Manguiat & Fang, 2013). Hence, the University of the Philippines-Diliman study on fast and cost-effective methods of detecting *Salmonella* in raw meat and meat products has gained the full support of the Department of Agriculture to help the timely detection of these bacteria for immediate possible intervention (Galvez, 2015).

An estimate of more than one million cases go unreported, those cases coming from a variety of sources including raw chicken (CDC, 2015). Poultry products never cease to appear in the incidence of Salmonellosis worldwide (Lawley, 2013). Detection of *Salmonella* spp. in chicken meat samples from Japan was reported by Kudaka et al. (2006). In United States, the *Salmonella* Heidelberg outbreak in 29 states and Puerto Rico from March 1, 2013 to July 11, 2014 had caused a total of 634 individuals infected with this *S. enterica* serovar which had been associated with the consumption of a brand of chicken (CDC, 2014). A study also showed *S. enteritidis* contamination in a rat-infested chicken layer farm, an attached egg processing facility, and liquid egg samples (Lapuz et al., 2007). Presence of *Salmonella* spp. in the day-old chick and sauce samples obtained from the various stages of food preparation and vending was documented in the study of Azanza and Ortega (2004) in the Philippines. In the report of CDC in 2013, a total of 356 persons infected with the outbreak strain of *S. typhimurium* have been reported from different places in the world, all were linked to exposure to live poultry.

Poultry are exposed to *Salmonella* through environmental contamination as infected birds will excrete the bacteria in feces that facilitate the transmission either direct or indirect. Consumers are,

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therefore, expected to exercise caution to never consume raw or half-cooked chicken. The meat has to be cooked at least 165°C degrees (Andrews, 2013). Exposure to high temperature has resulted to reduction of *S. typhimurium* in "guinataang kuhol" which is an indigenous Filipino dish (Gabriel & Ubana, 2007). Exposure to high temperature increases lethality of Salmonella spp. in chicken meat breasts (Murphy et al., 2003).

In Ozamiz City so far, no study has yet been carried out on possible *Salmonella* contamination in raw meat and meat products retailed at the public market. Hence this study aimed to find out if the raw chicken meat sold in the public market is contaminated with *Salmonella* bacteria. The findings of this study may be utilized to raise public awareness which may pave way to the development of any preventive program for bacteria contamination.

Materials and Methods

Sample collection

Chicken meat samples were obtained from Ozamiz City Public Market. The 15 samples collected from five chicken meat vendors between 9 am to 4 pm were placed in separate sterile bags. The packed samples were placed in a cooler and transported immediately to the Microbiology Laboratory of Misamis University.

Salmonella detection

The standard microbiological procedure employing the horizontal method for the detection of *Salmonella* from food was used with some modifications. Five grams of each sample (with the skin included) were homogenized in 45 mL buffered peptone water for two minutes. Furthermore, tenfold serial dilution of the homogenate was carried out and inoculated in *Salmonella shigella* (SS) agar. All the plates containing between 30 and 300 colonies were counted. Counts obtained were expressed as colony forming units per gram (cfu/g) of chicken meat which was calculated by multiplying the number of colonies by the dilution factor. Suspected colonies were confirmed using

the Triple Sugar Iron (TSI) agar and incubated at 35 ± 2°C for 18 to 24 hours. Gram stain was the technique used to describe the cell morphology of the *Salmonella* and classify these gram-negative bacteria.

Data analysis

Bacterial counts obtained for cfu/g of the sample were converted to $\log_{10}$ values. Bacterial counts >5.0 $\log_{10}$ cfu/g were classified as medium-to-high risk of transmission of *Salmonella* spp. and can possibly cause Salmonellosis among consumers, while counts <5.0 $\log_{10}$ cfu/g were classified as no-to-low risk of transmission of *Salmonella* bacteria.

Results and Discussion

Table 1 presents the results of the biochemical test using triple sugar iron (TSI) agar as the medium to determine the presence of *Salmonella* on samples. The drumstick samples had 100% contamination of the *Salmonella* bacteria, followed by the thigh at 80% and the breast at 20%. Detection of *Salmonella* bacteria in raw chicken meat from the public market in Ozamiz City could be attributed to the handling procedures practiced by the vendors. While most of the vendors were wearing gloves, there were those who did not use any gloves and failed to wash their hands before and after holding the chicken meat. Cleaning of chopping boards, knives, and weighing scales was less observed during sample collection.

Table 1. Results of biochemical test using triple sugar iron (TSI) agar showing the presence of *Salmonella* on samples.

Sample	No. of tested samples	No. of positive samples	%
Drumstick	5	5	100
Thigh	5	4	80
Breast	5	1	20
Total	15	10	66.7

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Contamination may likely occur with noncompliance with proper handling procedures of meat retailed in the market. The presence of *Salmonella* bacteria in the chicken samples in this study may indicate fecal contamination of the meat. All chickens have *Salmonella* growing in the gastrointestinal tract but the numbers are kept within the normal level in the absence of triggering factors for salmonellosis. *Salmonella* bacteria from the surface or digestive tract of the chicken may be transferred onto the carcasses during slaughter and dressing. This transfer may be caused by direct contact or through cross-contamination by slaughterhouse staff, equipment, surfaces, water or aerosols. It is noted that the drumstick (the lower part of the leg of the chicken) and the thigh are parts of the chicken proximal to its anus relative to the breast with lesser number of samples contaminated. During the evisceration process, the thigh and/or legs are highly prone to contamination from the gut contents in case of improper handling (Ruban et al., 2010). *Salmonella* bacteria are transmitted via fecal-oral route by either consumption of contaminated food, animal contact or person infected with the *Salmonella* bacteria (Jay et al., 2003).

The number and severity of *Salmonella* infections vary with food preparation (White et al., 1997). The juices from the meat can also contaminate other materials that come in contact with the chicken (Rettner, 2013). It is best for consumers to assume that all raw poultry could be contaminated with bacteria and exercise appropriate caution in proper handling and cooking practices. Consumers are therefore expected to never eat the chicken raw. The meat has to be cooked at least 165^0C degrees (Andrews, 2013). Exposure to high temperature has resulted to reduction of *Salmonella* bacteria (Murphy et al., 2003; Gabriel & Ubana, 2007).

The total bacterial counts in raw chicken samples are presented in Table 2. Each count was less than 5.0 $\log_{10}$ cfu/g which indicates that there is no-to-low risk of transmission of the *Salmonella* bacteria. The result is not similar with the findings of Cohen et al. (2007) showing that high levels of microbial contamination and occurrence of pathogenic bacteria reflect the poor hygienic quality of poultry meat. In spite of the no-to-low risk of transmission due to its low count, the presence of

these bacteria in raw chicken could be associated with the noncompliance of the food safety criteria for meat products made from poultry intended to be eaten cooked. Hence, strict compliance with meat handling and retailing is very important. Screening programs and reliable monitoring can help lessen the incidence of *Salmonella* infection in consumers and prevent foodborne illness outbreaks (Myint, 2004).

Table 2. Total bacterial counts in raw chicken samples from Ozamiz City public market.

Stall no.	Chicken part	Log_{10} cfu/g
1	Drumstick	2.66
2	Drumstick	2.65
	Thigh	2.83
3	Drumstick	2.81
	Thigh	2.26
4	Drumstick	3.96
	Thigh	3.76
	Breast	2.60
5	Drumstick	3.76
	Thigh	3.03

>5.0 log_{10} cfu/g - medium-to-high risk of transmission of *Salmonella* spp.
<5.0 log_{10} cfu/g - no-to-low risk of transmission

Conclusion and Recommendations

Salmonella bacteria were detected in raw chicken retailed at the Ozamiz City Public Market but the bacterial counts were within the acceptable level with no-to-low risk of transmission. However, caution to exercise the proper food handling and cooking procedures is still necessary to prevent the occurrence of salmonellosis. The findings of this study call for dissemination to the City Health office in the area for possible implementation of preventive programs and information warning to customers, slaughterhouse staff, and vendors about the risk of *Salmonella* infection.

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