Microbiological Quality of Chicken Carcasses at Modern Poultry Plant

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Abstract

A total number of one hundred chickens at modern poultry plant were examined for microbiological evaluation, the mean values of Aerobic Plate Count /cm^2 chicken at arrival to the plant; slaughtering, giblets, packaging, and receiving for saling were 2.4x10^6, 1.5x10^6, 5.7x10^5, 4.9x10^4, and 3.8x10^4 CFU/cm2, respectively. the mean values of total coliform count/ cm2 chicken at arrival to the plant , slaughtering , giblets, packaging , and receiving for saling were 1.1 x10^5, 8.9 x10^4, 6.1 x10^4, 2.4 x10^3,and 2.5 x10^3 CFU/cm^2 , respectively and the total *E.coli* count/cm2 chicken at arrival to the plant , slaughtering , giblets, packaging , and receiving for saling were 1.2 x10^4, 9.1 x10^3, 9.0 x10^2, 2.1 x10^2,and 2.0 x10^2 CFU /cm2 , respectively. The mean values of total Streptococcal count /cm2 of chicken at arrival to the plant , slaughtering , giblets, packaging , and receiving for saling were 1.2 x10^2, 5.1x10^2, 1.2x10^2, -,and - CFU/cm^2, respectively and total Staphylococcal counts were 8.1 x10^2, 2.1 x10^2, 2.0 x10^2, 4.-,and – CFU/cm^2 , respectively. Salmonella spp., *Clostridium perfringens* and fungi could not be detected in the examined samples. The public health significance of the isolated bacteria was discussed.

Introduction

Several different species of microorganisms have been reported in poultry meat. Some of these micro-organisms are pathogenic, while others are non-pathogenic. Chicken meat spoiled quickly and could cause diseases (15). Refrigeration means to cool down. When you lower the temperature of chicken meat, bacteria cannot grow as fast as in normal temperature. That meant that meat could last longer. Refrigerator is a common kitchen appliance that is used to preserve food by cooling it down. Freezing preserves food for even longer times. The chicken farming changed forever. Suddenly, people could raise thousands of chicken and transport them to markets far away. This meant the end of the small family farm. While in

some places in the world and some rural area there are still small family chicken farms that support families, they have now mostly been replaced with large commercial farms and modern poultry plants. These large farms and modern poultry plants supply grocery chains and restaurants and bring chicken products to our table. Poultry meat constitutes an excellent source of high quality animal proteins required for nutrition of human beings. The poultry fat is almost exclusively associated the skin resulting reducing dietary fat contrasted with mammalian fat. Also vitamins especially B complex and minerals such as potassium, magnesium, and phosphorus are present in considerable amounts in poultry meat (**4**). Live birds are highly contaminated with different microorganisms on their feathers, skin and intestinal tract. Accordingly, the contamination of chicken carcasses begins from the time of slaughtering, defeathering, evisceration, till the final product storage and distribution (**5**). The presence of many types of microorganisms in chicken meat as a result of different sources of contamination as feathers, feet, and intestinal content of slaughtered birds, so the bacterial flora may be a significant factor leading to spoilage food poisoning which may represent a public health hazard to consumers unless controlled by proper hygiene and cooking (**21**). Therefore the present study was planned out to perform Aerobic Plate Count, total coliform count, Total *E.coli* count, Total Streptococcus count, Total Staphylococcal *count* and detection of Salmonella spp, *Clostridium perfringens* and fungi in chicken carcasses at modern Poultry plant.

Material and Methods

The plant processes poultry from different farms. At this processing plant, the broiler carcasses are routinely dipped in chlorinated water prior to packing, using calcium hypochlorite. Initially, 200 grams of calcium hypochlorite are added to 500 liters of water, and a further 50 grams is added after about every three hours.

A total number of 100 chickens at modern poultry plant. These chickens were examined at different steps in the slaughter house at arrival. Slaughtering, liver (Giblets), packaging, and receiving for saling for microbial contamination. The carcasses were swabbed with sterile cotton

swabs Swapping of the chicken surfaces and serial dilutions were done according to the method recommended by **(1).**

1-Aerobic Plate count (APC): by plating on plate count agar and incubated at 37°C for 24 hours according to the method recommended by **(19).**

2-Total Coliform count: by plating on violet red bile agar medium and incubated at 37°C for 24 hours according to the method recommended by **(19).**

3-Total *E.coli* count: according to the methods recommended by **(11)** and **(29).**by plating on EMB medium (Eosin Methylin Blue) agar plates and then incubated at 35°C for 24 hours , *E.coli* are green shine metallic colonies

4-Total Streptococcal count: by plating on KF Streptococcus medium the development of red colonies in the agar medium is indicative of the presence of Streptococcus **(16)**

5-Total Staphylococcal count by plating on Baird Parker agar and incubated at 37°C for 48 hours. Suspected colonies appeared as black and shiny showing narrow white margin and surrounded by clear zone extended into the opaque medium were counted according to the method recommended by **(19 and 20).**

6- Screening for Salmonellae: according to the methods recommended by **(28); (7)** and **(17).** Two swabs were used; one swab was placed in 10 ml of selenite broth and the other in peptone broth directly after swabbing. The broths were returned to the laboratory and incubated at 37.5 °C for 24 hours. After incubation, one loop of selenite F. broth was plated on Xylose Lysine Desoxycholate and one loop of peptone broth on Trypticase soy agar (TSA,). The plates were incubated aerobically at 37.5 °C for 24 hours.

7 -Detection of *Clostridium perfringens* and fungi according to the recommended methods by **(7, 19 and 20).**

Results

Table (1): Aerobic Plate Count /cm^2 chicken

	Min.	Max.	Mean ± S.E
Arrival	$2.8x10^5$	7.3×10^7	$2.4\times 10^6 \pm 0.4x\ 10^6$
Slaughtering	$5.1X10^5$	$6.7X10^7$	$1.5X10^6 \pm 0.2x10^6$
Giblets	$2.3X10^4$	$4.1X10^6$	$5.7X10^5 \pm 0.5x10^6$
Packaging	$1.3X10^3$	$7.2X10^5$	$4.6X10^4 \pm 0,4x10^5$
Saling	$3.2X10^3$	$5.6x10^5$	$3.8x10^4 \pm 0.3x10^5$

Table (2): Total Coliform count/ cm^2 chicken

	Min.	Max.	Mean ± S.E.
Arrive	$6.4x10^4$	$5.2x10^6$	$1.1x10^5 \pm 0.5x10^5$
Slaughtering	$3.8x10^3$	$4.1x10^5$	$8.9x10^4 \pm 0.3x10^4$
Giblets	$4.5x10^3$	$7.4\ x10^5$	$6.1x10^4 \pm 0.2x10^4$
Packaging	$4.6x10^2$	$9.5x1o^4$	$2.4x10^3 \pm 0.4x10^3$
Saling	$1.2x10^2$	$6.7x10^4$	$2.5x10^3 \pm 0.4x10^3$

Table (3): Total E. coli count /cm^2 chicken skin

	Min.	Max.	Mean ± S.E
Arrival	$2.4x10^3$	$9.7x\ 10^5$	$1.2x\ 10^4 \pm 0.4x\ 10^4$
Slaughtering	$1.3x10^2$	$7.6x10^4$	$9.0x10^3 \pm 0.4x10^3$
Giblets	$1.0x10^2$	$6.4x10^3$	$9.3x10^2 \pm 0,6x10^2$
Packaging	$0.9x10^2$	$5.8x10^3$	$2.1x10^2 \pm 0.5x10^2$
Saling	$0.7x10^2$	$8.3x10^4$	$2.0x10^2 \pm 0.4x10^2$

Table (4): Total Streptococcal count/cm^2 chicken

	Min.	Max.	Mean ± S.E
Arrival	o.4x10^2	6.7x 10^3	1.2× 10^2 ± 0.4x 10^2
Slaughtering	0.5x10^2	5.3 x10^3	5.1x10^2±0.2x10^2
Giblets	0.6x10^2	6.1 x10^3	1.1x10^2±0.5x10^2
Packaging	–	–	–
Saling	–	–	–

Table (5): Total Staphylococcal count /cm^2 chicken

	Min.	Max.	Mean ± S.E
Arrival	0.4x10^2	6.8 x 10^3	8.7× 10^2 ± 0.4x 10^2
Slaughtering	0.3x10^2	5.6x10^3	2.3x10^2 ± 0.3 x10^2
Giblets	0.9x10^2	7.6x10^3	2.5x10^2 ± 0.1x 10^2
Packaging	–	–	–
Saling	–	–	–

Salmonella spp., *Clostridium perfringens* and fungi could not be detected

Discussion

Boiling water immersion intervention and removal of skin could reduce subsequent bacteria contamination of ground meat. This intervention could minimize the risk of pathogen-contaminated primary processed poultry carcasses used in further processing (34).

The data recorded in table (1) revealed that the mean values of Aerobic Plate Count /cm^2 chicken at arrival to the plant , slaughtering , giblets, packaging , and receiving for saling were $2.4x10^6$, $1.5x10^6$, $5.7x10^5$, $4.9x10^4$,and $3.8x10^4$ CFU /cm2 , respectively. Several bacterial indicators are used to evaluate hygiene during the meat slaughtering process. Monitoring of *Escherichia coli* counts (ECC) and aerobic colony counts (ACC). The sampling method was neck skin excision for broiler and layer chicken carcasses. The 75th and 95th percentiles of ECC were 4.05 and 5.24 log CFU/g for chicken carcasses. *E. coli* may be considered as a good indicator for enteric zoonotic agents (**12**). Microbial contamination of chicken carcasses is a natural result of different processes necessary to produce retail products from living birds. Contamination of chicken meat products can occur through a long chain including processing, packaging, storage and distribution as well as preparation .among chicken meat pathogens, Salmonella organism; their presence in chicken meat depends upon the hygienic status of processing plants (**27**).The bacteriological profile of raw, frozen chicken nuggets manufactured at a chicken processing facility in Queensland, Australia, was determined. Chicken nuggets are manufactured by grinding poultry, adding premixes to incorporate spices, forming the meat to the desired size and shape, applying a batter and breading, freezing, and packaging. A total of 300 frozen batches were analyzed for aerobic plate count, *Escherichia coli*, and Salmonella over a period of 4 years. The mean of the aerobic plate count was 5.4 log CFU/g, and counts at the 90th, 95th, and 99th percentiles were 5.7, 5.9, and 6.5 log CFU/g, respectively. The maximum number of bacteria detected was 6.6 log CFU/g. *E. coli* prevalence was 47%, and of the positive samples, the mean was 1.9 log CFU/g; counts at the 90th, 95th, and 99th percentiles were 2.3, 2.4, and 2.8 log CFU/g, respectively. The maximum number of *E. coli* was 2.9 log CFU/g. There was a significant relationship ($P < 0.05$) between season and both aerobic plate counts and E. coli counts, and no correlation between *E. coli* counts and Salmonella prevalence (**10**). (**2**) could detect *Escherichia coli* (41.7%), Staphylococcus spp. (2.49%), bacteria found in the chicken carcasses in a poultry processing plant in Zambia, The lower bacterial count in chicken meat produced at high level may be attributed to the chlorination of water used in processing plant ,

good manufacturing practices and antimicrobial substances such as lactic acid and trisodium phosphate which may be used during slaughtering and processing of chicken (30).The contaminated equipments and knives are probably the principle contributing factors to high bacterial counts of chicken meat (8) , Also poor hygiene within the processing plant may result in cross contamination from living birds onto processed chicken meat products rendering them unmarketable or even unfit for human consumption (14). In addition, the role of hands and clothes of employees in contamination of such food should not be overlooked (9).

The data recorded in tables (2&3) revealed that the mean values of total coliform count/ cm2 chicken at arrival to the plant , slaughtering , giblets, packaging , and receiving for saling were 1.1 $x10^5$, 8.9 $x10^4$, 6.1 $x10^4$, 2.4 $x10^3$,and 2.5 $x10^3$ CFU /cm2 , respectively and the total *E.coli* count/cm2 chicken at arrival to the plant , slaughtering , giblets, packaging , and receiving for saling were 1.2 $x10^4$, 9.1 $x10^3$, 9.0 $x10^2$, 2.1 $x10^2$,and 2.0 $x10^2$ CFU /cm2 , respectively. Scraping method for enumerating bacteria on broiler carcasses. In experiment 1, coliforms and *Escherichia coli* were determined by the whole-carcass rinse (WCR) method and by scraping the skin surface and rinsing the blade (BR). In each of 2 replicate trials, 4 prechill broiler carcasses were collected from 2 different commercial processing plants. The WCR method was conducted on each carcass, and then a blunt edge blade was used to scrape an area measuring approximately 80 cm (2) of the breast (front) skin and on the back of the carcass. After scraping, each blade and adhering residue was rinsed in 30 mL of 0.1% peptone. One milliliter of rinsate each from the WCR and BR was plated to determine total coliforms and *E. coli*. In experiment 2, 6 carcasses were collected from a processing plant in each of 2 replicate trials. Carcasses were split, with one half scraped on all skin surfaces, and the other half remaining unscraped as a control; all halves were then subjected to half-carcass rinses using 200 mL of 0.1% peptone. Coliforms and *E. coli* were enumerated. Results from both experiments are reported as log cfu/mL. In experiment 1, mean coliform WCR counts (5.1) were significantly higher ($P < 0.05$) than back BR (2.8), which were higher than front BR (2.2). Mean *E. coli* WCR counts (4.5) were higher than back BR (2.4), which were higher than front BR (1.6). The counts for BR adjusted for the greater surface area

sampled by WCR were still lower than the WCR counts. Experiment 2 results showed no difference between control and scraped carcass halves for coliforms (4.7) or *E. coli* (4.6). Scraping either prior to or after rinsing did not increase enumeration of coliforms or *E. coli*. Scraping could be a viable method to compare the numbers of bacteria on different areas of the same carcass (**33**). The presence of coliforms in greater number may be responsible for inferior quality of chicken meat resulting in economic losses and possibility of presence of other enteric pathogens which constitute at time public health hazard (**4**). The presence of coliforms in chicken meat products has probably received more attention than most of other bacterial groups for their significance as indicator organisms of faecal contamination and their ability to grow well over a wide range of temperature below 10 up to 46 °C (**13**).The importance of coliforms bacteria in chicken meat technology is due to the fact that their presence in such products is frequently a reliable indication of faulty methods in preparation, handling and storage of chicken meat products as well as plant sanitation (**6**).

The data recorded in tables (4 and 5) revealed that the mean values of total Streptococcal count /cm^2 of chicken at arrival to the plant , slaughtering , giblets, packaging , and receiving for saling were 1.2 $x10^2$, $5.1x10^2$, $1.2x10^2$, -,and - , respectively and total Staphylococcal counts were 8.1 $x10^2$, 2.1 $x10^2$, 2.0 $x10^2$, 4.-,and – CFU/ cm^2 respectively. The epidemiological data showed that *S. aureus* continue to be a major cause of food borne intoxication and its presence in food constitutes an important problem for food processor, food service workers and consumers (**31 and 15**). Doubling the amount of water during immersion chilling (3.3 vs. 6.7 L/kg) did not improve the removal of bacteria from the surfaces of chilled carcasses (**25**). Raw poultry must be handled carefully to prevent cross-contamination. This can occur if raw poultry or its juices contact cooked food or foods that will be eaten raw such as salad. An example of this is chopping tomatoes on an unwashed cutting board just after cutting raw chicken on it. *Staphylococcus aureus* can be carried on human hands, in nasal passages, or in throats. The bacteria are found in foods made by hand and improperly refrigerated, such as chicken salad. Preventing cross-contamination and using proper cooking methods reduces infection by this bacterium.. It is destroyed by cooking, but a cooked product can be

contaminated by poor personal hygiene. Observe "keep refrigerated" and "use-by" dates on labels. Organisms often found in poultry carcasses also include a number of bacteria causing food poisoning due to extensive growth and eventual production of potent toxins in foods. These organisms are *Staphylococcus aureus* (**24**). A survey of *Staphylococcus aureus* contamination of commercial raw minced meat at 3 supermarkets in Hyogo Prefecture was conducted over a period of half a year (January to June 2006). In total, the contamination rate was 77.8% (28/36) for beef, 91.7% (33/36) for pork and 91.7% (33/36) for chicken samples (**32**).
Contamination of chicken meat with microorganisms could attribute to food handlers, utensils, air, soil and unsatisfactory hygienic conditions during processing, packaging and storage (**8**).

Refrigerator cools down the temperature of the chicken. This means that microorganisms that may be dangerous and are in chicken will grow much slower. You should touch it to feel if it is cool. The absence of Salmonella spp in chicken samples of high level of hygiene could be attributed to the use of antimicrobial substances (**23**), as well as the application of good manufacturing practices (GMPs) and HACCP system in the poultry processing plant (**29**). Raw poultry products were purchased from the retail market place in two Australian states. The products sampled on a proportional volume basis were chicken portions with the skin off or skin on, in bulk or tray packs, and whole carcasses. They were collected from butcher shops, supermarkets, and specialty stores from urban areas during the winter (2005) and summer (2006) months. The samples were analyzed to determine the prevalence and concentration of *Escherichia coli.*, *E. coli* was detected in all winter samples and on 92.9 and 85.7% of summer samples in New South Wales and South Australia, respectively; the log of the geometric mean per square centimeter was 0.5 in winter and slightly lower in summer. On chicken portions, *E. coli* was detected in around 90% of winter samples in both states, and in summer on 75.1 and 59.6% of samples in New South Wales and South Australia, respectively. The log of the geometric mean CFU per square centimeter for *E. coli* was 0.75 and 0.91 in winter, and 0.66 and 0.5 in summer in New South Wales and South Australia, respectively (**26**). Accordingly, chicken meat products, if properly processed, should contain low number of bacteria provided that the

excellent plant sanitary conditions are maintained during and after processing. Since the processing operations can exert an influence on of the chicken meat products. Salmonella spp., *Clostridium perfringens* and fungi could not be detected in the examined samples. The aqueous ClO2 treatment should be useful in improving the microbial safety of chicken during storage (**18**). The efficacy of a scald additive, RP scald, to reduce *Salmonella typhimurium* (ST) levels on inoculated poultry carcasses. The RP scald (contains sodium hydroxide) in a 1% solution has a pH of 11.0, which may reduce bacteria levels on carcasses. The addition of RP scald increased ST reduction; therefore, RP scald may be effective in reducing ST on broiler carcasses in poultry scolder applications, particularly when hard scald temperatures are used (**22**).There are many diseases that can spread from inappropriate handling or preparation of chicken. People can get food poisoning by eating undercooked chicken meat. These bacteria can also spread on kitchen counters, forks, knives and plates - so, we can get infection even if we don't eat chicken. The best way to deal with diseases that can be spread by raw chicken is prevention. We can prevent diseases by handling and preparing chicken appropriately. Identification and monitoring of the most critical points in the production process in order to reduce the contamination rate. Much more attention should be paid to the processing plants in order to control the bacterial contamination of poultry meat.

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الجوده الميكروبيولوجيه لذبائح الدواجن في مجزر حديث

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الملخص العربي

أجريت هذه الدراسه في مجزر الي حديث علي عدد ١٠٠ دجاجه عند الوصول الي المجزر و عند الذبيح و الكبدة (الاحشاء) و التغليف و التسليم و تم تحديد العد البكتيري الكلي/سم٢ و الكوليفرم و الايشريشيا كولاي واستربتوكوكس و ميكروب العنقود الذهبي وفحص تواجد ميكروب السالمونيلا و الكلوستريديوم برفرنجنز و الفطريات.
و كانت النتائج كالاتي:
- متوسط العد البكتيري الكلي للدجاج عند الوصول الي المجزر و عند الذبيح و الكبدة (الاحشاء) و التغليف و التسليم كالاتي ٢,٤×١٠٦و ١,٥×١٠٦و ٥,٧× ١٠٥و ٤,٩×١٠٤ و٣,٩×١٠٤ /سم٢.
- متوسط العد الكلي للكوليفورم عند الوصول الي المجزر و عند الذبيح و الكبدة (الاحشاء) و التغليف و التسليم كالاتي ٢,٤×١٠٦و ١,٥×١٠٦و ٥,٧× ١٠٥و ٤,٩×١٠٤ و ٣,٩×١٠٤ /سم٢.
- متوسط العد الكلي للايشريشيا كولاي للدواجن عند الوصول الي المجزر و عند الذبيح والكبدة (الاحشاء) و التغليف و التسليم كالاتي ٢,٤×١٠٦و ١,٥×١٠٦و ٥,٧× ١٠٥ و ٤,٩×١٠٤ و ٣,٩×١٠٤ /سم٢.
- متوسط العد الكلي للاستربتوكوكس للدواجن عند الوصول الي المجزر و عند الذبيح والكبدة (الاحشاء) و التغليف و التسليم كالاتي ٢,٤×١٠٦و ١,٥×١٠٦و ٥,٧× ١٠٥ و ٤,٩×١٠٤ و٣,٩×١٠٤ /سم٢.
- متوسط العد الكلي لميكروب العنقود الذهبي للدواجن عند الوصول الي المجزر و عند الذبيح و الكبدة (الاحشاء) و التغليف و التسليم كالاتي ٢,٤×١٠٦و ١,٥×١٠٦و ٥,٧× ١٠٥و ٤,٩×١٠٤ و ٣,٩×١٠٤ /سم٢.
و لم يستدل علي وجود ميكروبات السالمونيلا و الكلوستريديم برفرنجنز و الفطريات
و تم مناقشه الاهميه الصحيه للميكروبات المعزوله و خطورتها علي الصحه العامه.