Bacteriological Study of Poultry Meat in Semi-Automatic Abattoir in Khartoum State-Sudan

Ahmed A. Abdalla; Siham E. Suliman ; Yassir A. Shuaib; and Mohamed A. Abdalla*

College of Veterinary Medicine, Sudan University of Science and Technology,
P.O. Box: 204, Khartoum North, the Sudan. WWW.sustech.
* Corresponding author email: salamaa2000@sustech.edu

Abstract

The current study was conducted to investigate the contaminating microorganisms that can be found on broiler carcasses during slaughtering in semiautomatic poultry abattoir in Khartoum State. Forty five swab samples were collected randomly from chicken carcasses and worker's hands. The samples were taken after following processing steps: defeathering, evisceration, spray wash, chilling and from workers hands. Total Viable Count (TVC) of contaminating bacteria was done besides isolation and identification of bacteria. The results revealed that there was statistically significant difference in the TVC after defeathering ($p \leq 0.05$). The highest contamination level was recorded after evisceration on the legs, 8.16 ± 0.11 $\log_{10}$ CFU/cm^2, back, 8.68 ± 0.25 $\log_{10}$ CFU/cm^2 and the breast, 9.18 ± 0.13 $\log_{10}$ CFU/cm^2. The contaminating bacteria isolated were *Escherichia coli*, *Pseudomonas spp.*, *Shigella spp.* and *Salmonella spp*. High levels of microbial contamination can be carried by bad evisceration and poor hygienic managements, but better facilities and processing units with better hygiene make broiler meat have a concern for suppliers, consumers and public health officials.

Keywords: Hygienic approaches, poultry meat, contamination, poultry abattoir

Introduction

Food borne infections and illness is a serious worldwide health problem associated with economic losses. Chicken and poultry products have become popular due to their specific sensory attributes and the increasing tendency of the public to consider white meat as being healthier compared to red meat. Poultry is an important part of the animal food market and production is increasing to satisfy public demand world-wide (Bryan 1980). The consumption of poultry meat has increased worldwide within the last decades (FAO1993; McNamara; 1997; Mead 1997).

Meat is considered as an important source of proteins to man and is the most perishable of all important foods because of its rich nutrients that supports microbial growth (Magnus, 1981; Ukut *et al.,* 2010). Epidemiological data suggest that contaminated products of animal origin, especially poultry; contribute significantly to food borne diseases, Reduction of raw poultry contamination levels have a large impact on reducing the incidence of illness (Keener *et al*, 2004). Each year, millions of people worldwide suffer from food-borne diseases (WHO, 2000), and illness resulting from the consumption of contaminated food

has become one of the most widespread public health problems in contemporary society (Notermans *et al.,* 1995). Some microorganisms such as *Salmonella spp.*, *Escherichia coli* 0157:H7, and *Listeria monocytogenes* pose a threat to consumer health *(*Samelis *et al.,* 2001*).*Number of bacteria on carcass surfaces vary considerably by different stage of processing (Barnes, 1960*;* Lahellec *et al*) 1972; Mead and Impey, 1970*)*. Broilers entering slaughter house are highly contaminated by microorganisms, including food borne pathogens such as *Salmonella* and *Campylobacter spp.*, and these pathogens tend to be disseminated in the processing plant during processing (Mead *et al.,* 1994*;* Kotula and Pandya*,* 1995).The aim of the present study was to investigate the contaminating microorganism associated with broiler meat in semiautomatic abattoir.

Materials and Methods
Sampling:
A total number of 45 swab samples from broiler carcasses were collected randomly from the legs, breast and backs after 5 Critical Control Points (CCPs), namely; defeathering, evisceration, spray wash, chilling and hands of workers. A sterile metal template was used to outline 10 cm ^{2} area of the thigh region on the broiler carcasses and then the area was swabbed vigorously with sterile cotton gauze wrapped around the end of a flat swab stick. The organisms were removed from each swab by shaking for few minutes in 10 ml of sterile 0.5% peptone water. The collected swabs of each carcass were marked, numbered and transported promptly on ice to the laboratory in College of Veterinary Medicine, Sudan University of Science and Technology.

Bacterial colony count:
The total viable count (TVCs) of the isolated microorganism was carried out according to the method of Harrigan and MacCance (1976).

Bacterial examination:
Smears were made from colonies on agar media, by clean slides fixed with heat and subjected to Gram stain and examined under microscopic oil immersion. In addition to that, the identification has been also based mainly on the procedure of Barrow and Feltham (2003).

Data analysis
The data were analyzed with SPSS software (Statistical package for social science version 20, IBM/SPSS). Descriptive statistics were used to analyze the data. In addition, all TVCs bacteria were converted to log10 CFU/cm^2 for analysis. ANOVA was performed. Statistical significance was set at P- value of≤ 0.05.

Results
The study revealed a statistically significant difference at (p$\leq$ 0.05) after defeathering between the legs, backs and breast respectively but there was no significant difference after the other CCPs (evisceration, washing , chilling and hands of workers).

As shown in Table 1, the TVC revealed the highest contamination level of the legs, backs and breasts recorded after evisceration 8.16±0.11 $\log_{10}$ $CFU/cm^{2,}$ 8.68±0.25 $\log_{10}$ CFU/cm^2, 9.18±0.13 $\log_{10}$ CFU/cm^2 respectively, whereas the lowest contamination level of the legs, backs and breasts recorded after chilling 3.84±0.16 $\log_{10}$ $CFU/cm^{2,}$ 4.50±0.41$\log_{10}$ CFU/cm^2 4.14±0.20 $\log_{10}$ CFU/cm^2 respectively.

Table 1: Comparison of mean total viable count of bacteria ($\log_{10}$ CFU cm^{-2}) ± Sd at different operational points at different sites on poultry carcasses

operation Site	Legs	Backs	Breast	Significance
After Defeathering	5.40±0.52	7.06±0.59	7.08±0.34	*
After Evisceration	8.16±0.11	8.68±0.25	9.18±0.13	NS
After washing	4.18±0.13	5.76±0.32	6.20±0.32	NS
After chilling	3.84±0.16	4.50±0.41	4.14±0.20	NS

*significant difference at level ($P < 0.05$); N.S. Not significant ($P > 0.05$)

Isolation and identification of bacteria at different operational points under investigation revealed 4 species of bacteria (Table2), which were, after defeathering *E. coli* (15.6%), *Pseudomonas spp.* (2.2%) and *Shigella spp.* (2.2%), after evisceration *E.coli* (11.1%) , *Pseudomonas spp.* (6.7%), *Salmonella spp.* (2.2%), after spray washing *E. coli* (6.7%) , *Pseudomonas spp.* (11.1%) , *Salmonella spp.* (2.2%) after chilling, *E. coli* (17.8%), *Pseudomonas spp.* (2.2%), and hand of workers *E.coli* (11.1%) , *Pseudomonas spp.* (6.7%) and *Salmonella spp.* (2.2%).

Table 2: Number and percentage of bacteria isolated and identified in different operational points

Operations	*E.coli*	*Pseudomonas spp*	*Salmonella spp*	*Shigella spp*	Total
After defeathering	7 (15.6%)	1(2.2%)	0(0.0%)	1(2.2%)	**9(20.0%)**
After evisceration	5(11.1%)	3(6.7%)	1(2.2%)	0(0.0%)	**9(20.0%)**
After spray washing	3(6.7%)	5(11.1%)	1(2.2%)	0(0.0%)	**9(20.0%)**
After chilling	8(17.8%)	1(2.2%)	0(0.0%)	0(0.0%)	**9(20.0%)**
Hand of workers	5(11.1%)	3(6.7%)	1(2.2%)	0(0.0%)	**9(20.0%)**
Total	**28(62.2%)**	**13(28.9%)**	**3(6.7%)**	**1(2.2%)**	**45(100.0%)**

Discussion

In the present study the majority of the samples had coliform bacteria specially after defeathering. Contamination may occur due to bacterial population associated with water from the scald tank, rubber fingers at the exit of defeathering machine (Geornaras *et al.,* 1997). Feathers generally may contaminate external surface of the carcass during early processing stages .The highest level of viable aerobic bacteria recovered from the samples in this study after evisceration (table1), this result is in agreement with finding of Ramires *et al* ., (1997) and Hinton *et al* ., (2000) who reported that broiler carcass can be contaminated by bacteria when contact with ingesta or faeces from alimentary tract during grow-out, transport to the processing plant holding or evisceration. In this study the bacterial contamination at various processing steps at slaughterhouse have revealed that evisceration markedly increased bacterial counts on broiler carcasses, this contribute to contamination of carcasses by visceral content during evisceration.

The mean total viable counts obtained from our result after evisceration were lower than recorded by Mohammed –Noor *et al*., (2012)this may be due to using of evisceration machine in modern abattoir which may rupture the viscera and contaminate the carcasses. Also this result come in line with observation of Iroha, *et al.,* (2011), who mentioned that the method of slaughtering of animals is responsible for microbial contamination; traditional method of butchering using knives and cutting line appear more capable of minimizining faecal contamination than modern machine systems which are managed by team of operator. Moreover the bacterial count obtained from this study after spray wash

was lower than that obtained from carcass after defeathering and after evisceration, this data in accordance to the finding of Mead (2004) who reported that a substantial decrease in TVCs and coliform bacteria counts after washing and after chilling. Contamination of poultry meat by microorganism that cause food borne disease which are not able to prevent them (Afshin *et al* 2013).

In the present study *E.coli* (62.2%) *Pseudomonas spp* (28.9%) were isolated from all operational points, this finding is in agreement with finding of Mead (2004) and Kabour *et al* (2012). The isolation of *E. coli*, *Pseudomonas spp* and *Salmonella spp* (table1) from the hands of the workers in our study was in accordance with study of Jeffery *et al* (2003) who revealed that the hands of workers and the equipment are the source of contamination .The increase of the prevalence of *Salmonella spp* in the poultry processing may be due to evisceration if the gut of the bird is colonized with pathogen (WHO, 2000). Poultry is considered as the source of food poisoning by *Salmonella spp*. to the human (Afshin *et al* 2013). In this study *Shigella spp*. (2.2%) was isolated; this result is inline with those recorded by Mead (2004).

In conclusion, when the evisceration is not correctly done, then the microbial level on poultry carcasses is increased due to occurrence of pathogenic bacteria which reflect to the poor hygienic management in meat processing. But better facilities and processing units with better hygiene make broiler meat safe and suitable for consumers.

References

Afshin, J; Saeid, S.and Resa, G. (2013). Study on Salmonella contamination in poultry lean meat and meat with skin in Tabriz slaughterhouse. *African Journal of Biotechnology*, **13** (1): 131-184.

Barnes, E.M., (1960). Bacteriological problems in broiler preparation and storage. *R. Soc. Health J.,* **80**: 145-148.

Barrow, G.I. and Feltham, R.K.A. (1993). *Manual for the identification of medical bacteria* (3rd Ed). Cambridge University Press, Cambridge.

Bryan F.L. (1980). Poultry and meat products. [Edited by Silliker J.H., Elliot R.P., Baird- Parker A.C., Bryan F.L., Christian J.H.B., Clark D.S., Olson J.C. and T.A. Roberts] In: *Microbial Ecology of Foods,* Vol.**2**: Food Commodities. (ICMSF) 410 – 458.

Food and Agriculture Organization, FAO (1993). Record Poultry Meat Consumption. *Poultry Int*., **32**: 70-72.

Geornaras, I.; De-Jesus, A. E.; Van-Zyle, Eandvon-holy, A. (1997). Bacterial population of different sample types carcasses in the dirty area of South Africa Poultry abattoir. *Journal of Food Protection* **60:** 551-554.

Harrigan, W. F. and MacCance, M.E. (1976). *Laboratory Methods in food and Diary Microbiology*. Academic Press New York.

Hiton, Jr.; Buher, R.J. and Ingram, K. D. (2000). Physical, chemical and microbiological changes in the crop of broiler chickens subjected to incremental feed withdrawal. *Poultry science*.**79**: 212-218.

Iroha, a I. R; Ugbo E. C., Ilang D. C., Oji A. E. and Ayogu T. E (2011). Bacteria contamination of raw meat sold in Abakaliki, Ebonyi State Nigeria. *Journal of Public Health and Epidemiology* **3** (2): 49-53.

Jeffery, B., Donald A.B., Gill, C.O. (2003). Implementation of validated HACCP system for the control of microbiological contamination of pig carcass at a small abattoir. *Canadian Veterinary Journal*, **44**(1): 51-55

Kabour, G. A.; Suliman, S. E.; Ghali, A.; and Abdalla, M. A. (2012). microbial contamination of chicken carcasses during processing in Khartoum state. *Assiut veterinary medical Journal*. **58** (134): 279-282.

Keener KM, Bashor MP; Curtis PA; Sheldon BW; Kathariou, S. (2004)

Comprehensive review of *Campylobacter* and poultry processing. *Compr Rev Food Sci Food Safety* **3**: 105-116

Kotula, K. L., and Pandya, Y. (1995). Bacterial contamination of Broiler chickens before scalding. *J. Food Prot*. **58:**1326–1329.

Lahellec, C., Meurier, C. and Catsaras, M. (1972). The psychotropic flora of poultry carcasses. I. Development at various stages through a slaughter house. *Ann. Rech. Vet*., **3**: 421-434.

Magnus, P. (1981). Meat Composition. Food Science and Technology, 4th edition. Gohumunary Pub. London. Pp- 108-215.

McNamara, A.M (1997). Generic HACCP applications in broiler slaughter and processing. National Advisory Committee on Microbiological Criteria for Foods. *Food prot.* **26** (5): 462-604 , pp. 579- 604

Mead, G.C. and C.S. Impey, (1970). The distribution of clostridia in poultry processing plants. *Br. Poult. Sci.,* **11**: 407-414.

Mead, G. C. (1997). Safety of poultry products past, present and future. *Meat and Poultry News* **8**:26–27.
Mead, G. C., W. R. Hudson, and M. H. Hiton. (1994). Use of a marker organism in poultry processing to identify sites of cross-contamination and evaluate possible measures. *Br. Poultry. Sci*. **35** (3): 12-16

Mead, G.C. (2004). Microbiological quality of poultry meat: *a Review.*

Brazilian Journal of Poultry Science, **6**(3), 135 – 142

Mohamed-Noor, S.E., Shuaib, Y.A., Suliman, S. E., Abdalla, M.A. (2012). Study of microbial contamination of broilers in modern abattoirs in Khartoum state. *AUDJG - Food Technology*, **36** (1) 74-80.

Notermans, S.; G. Gallhoff, M. Zweitering and G. Mead (1995). Identification of critical control points in the HACCP system with a quantitative effect on the safety of food products, *Food Microbiology* **12**, 93-98.

Ramires , G. A.; Sarlin, L. L.; Caldwell, D. J.; I; Yezak, C. R.; Jr., Hume, M. E.; Corrier, D. E.; Deloach, J. R. and Hargis, B. M. (1997). Effect of feed withdrawal on the incidence of salmonella in the crops and seca of market age broiler chicken. *Poultry Science.* **67**(4): 654-656.

Samelis J, Sofos JN, Kendall PA, Smith GC (2001). Fate of *Escherichia coli* O157:H7, *Salmonella* Typhimurium DT 104 and *Listeria monocytogenes* in fresh meat decontamination fluids at 4 and 10°C.*J. Food Prot.* **64**: 950–957.

Ukut, I-O.E., Okonko, I. O., Ikpoh, I. S., Nkang, A.O., Udeze, A.O., Babalola, T. A., Mejeha, O. k and Fajobi, E. A. (2010). Assessment of Bacteriological quality of fresh meats sold in Calabar Metropolis, Nigeris. *EJEAFChe,* **9** (1): 89-100.

WHO (2000). Food safety: Resolution of the Executive Board of the WHO. 105th session.

دراسة البكتريا في لحوم الدواجن بمسلخ   شبه آلي في ولاية الخرطوم– السودان

احمد عبد الرحيم عبدالله , سهام الياس سليمان , ياسر ادم شعيب و محمد عبدالسلام عبدالله

كلية الطب البيطري – جامعة السودان للعلوم والتكنولوجيا

المستخلص

التلوث الميكروبي لذبائح الدواجن يمكن أن يتأثر بالعديد من العوامل أثناء عملية الذبح والتجهيز . أجريت الدراسة الحالية للتقصي عن الكائنات الدقيقة الملوثة التي يمكن العثور عليها على ذبائح فراخ اللاحم أثناء الذبح   في مسلخ دواجن شبه اوتوماتيكي في ولاية الخرطوم . تم جمع خمسة وأربعين عينة مسحة عشوائيا من ذبائح الدجاج وأيادي العمال. وتم أخذ العينات بعد خطوات عملية الذبح التالية : نتف الريش , إزالة الأحشاء ، الغسيل الرزازي، التبريد ومن أيادي العمال. وقد تم حساب إجمالي العدد الحي (TVC) من البكتيريا الملوثة إلى جانب العزل والتعرف على أنواع البكتيريا . و كشفت نتيجة الدراسة أن هناك اختلاف إحصائي بعد عملية نتف الريش (ع ≥ 0.05) . وسجل أعلى مستوى للتلوث بعد إزالة الأحشاء على الساقين ، 8.16 ± 0.11 ، الظهر ، 8.68 ± 0.25 و الصدر ، 9.18 ± 0.13 أنواع البكتيريا الملوثة كانت الإيشريشية القولونية ، الزائفة، أنواع الشيجلا النيابة. وأنواع السالمونيلا .المستوى العالي من التلوث الميكروبي كان بسبب سوء عملية إزالة الأحشاء وضعف إتباع الإرشادات الصحية ، ولكن تجويد مرافق المجزر و وحدات الذبح والمعالجة مع النظافة تجعل لحوم الدواجن ذات أهمية للموردين والمستهلكين و مسؤولي الصحة العامة .