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# Microbiological quality of retail chicken carcasses and their products in Turkey*)

AYDİN VURAL, MEHMET EMIN ERKAN, SIMTEN YEŞILMEN*

Department of Food Hygiene and Technology, Faculty of Veterinary Medicine, Dicle University, 21280, Diyarbakır, Turkey
*Department of Microbiology, Faculty of Veterinary Medicine, Dicle University, 21280, Diyarbakır, Turkey

Vural A., Erkan M. E., Yeşilmen S.

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Summary

**The aim of the study was to investigate the prevalence of Salmonella spp. L. monocytogenes, E. coli 0157:H7 in chicken carcasses and their products (legs, wings, breast meat and giblets) and their microbiological quality. Samples were evaluated for total aerobic mesophilic bacteria, psycrofils, enterobacteriaceae, coliform, Escherichia coli, Staphylococcus-Micrococcus, Staphylococcus aureus, mould and yeast, and Yersinia enterocolitica counts.**

**Salmonella spp., L. monocytogenes and E. coli 0157:H7 were isolated in 18.4%, 9.6% and 4.8% of the samples, respectively. The highest contamination levels of these bacteria were 48%, 24% and 20% in chicken breast meat, and the lowest: 8%, 0% and 0% in legs, respectively. E. coli was found in all samples and S. aureus was found in 65% of the samples.**

**The results of the study indicate that chicken carcasses and their products may contain significant hazards to humans and are a danger to public health.**

**Keywords: chicken, microbiological quality, Salmonella spp. L. monocytogenes, E. coli 0157:H7**

Poultry edible by-products are purchased due to their low cost, low content of fat and the short time needed for preparation (1). However; the presence of pathogens, capable of causing food poisoning in humans, are often contaminating of the poultry meat. The most important pathogens are *Salmonella* spp., *Campylobacter* spp., *Clostridium perfringens*, *Listeria monocytogenes* and *Enterohaemorrhagic Escherichia coli* (20). Contamination of poultry meat with foodborne pathogens remains an important public health issue, because it can lead to illness if there are malpractices in handling, cooking or post-cooking storage of the product. In developed countries, foodborne illness causes human suffering and loss of productivity. As well as mortality, which is even greater problem in developing regions, where the health status of many individuals is already compromised (21). Mesophiles, psychrotrophs, coliforms, *Escherichia coli*, *Staphylococcus aureus*, *Yersinia enterocolitica*, yeast and mould have been used to assess microbiological safety, sanitation conditions during processing and keeping quality of poultry products (1, 5, 6, 13, 19, 31).

The aim of this study was to determine the occurrence of *Salmonella* spp. *L. monocytogenes*, *E. coli 0157:H7* and the microbiological quality of retail chicken carcasses and their cuts and giblets in Diyarbakır, Turkey.

## Material and methods

**Collection of samples.** One hundred twenty five samples of chicken carcasses (25 carcasses) and their primary and secondary cuts (25 legs, wings, breast and giblets) were collected at different locations in the Diyarbakır, Turkey. Each sample was placed in a separate sterile plastic bag. Samples were transported to the laboratory immediately after collection in an ice chest and tested upon arrival or stored at 4°C for no longer than 2 h.

**Preparation of samples for analysis and general microbiological evaluation.** The rinse method was used to analyze the chicken carcasses. The carcass was placed aseptically into a heavy-duty, sterile plastic bag containing 300 ml peptone water (Oxoid Ltd., Hampshire, England). The bag was closed, and the enclosed carcass shaken vigorously, vertically and horizontally, for 30 sec. The rinse fluid was poured into a sterile container and stored at 4°C until laboratory process (14). 25 ml of the rinse fluid was taken for counting of microorganisms and incidence of pathogens. For the examination of the other samples i.e. legs, wings, breast and giblets, a 25 g of skin and muscle of each product was taken aseptically by scalpel excision and placed in a sterile stomacher bag containing 225 ml of peptone water (Oxoid Ltd., Hampshire, England). The samples were homogenized in a stomacher for 2 min. Decimal dilutions

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were carried out using the same diluents. All analyzes were realized as two parallels. The selective agar bases used and incubation conditions are shown in tab. 1.

**Isolation and identification of *Salmonella* spp.** 25 g of the sample (or 25 ml rinse fluid) was weighed and 225 ml buffered peptone water (Merck 1.07228) was added. This was incubated for 16-20 h at 35--37°C for pre-enrichment of *Salmonella* spp. RVS Broth (Merck 1.07700) was incubated for 13-24 h at 42°C and Selenite Cystine Broth (Merck 1.07709) was incubated for 24 h at 35-37°C for selective enrichment. Modified Brilliant Green Agar (Oxoid CM329) and Salmonella – Shigella Agar (Merck 1.07667) were used as selective agar medium. After incubation for 24 h at 35-37°C; biochemical tests were performed on typical colonies and final diagnosis was made by Salmonella latex test (Oxoid FT 203) (15).

**Isolation and identification of *L. monocytogenes*.** 25 g sample (or 25 ml rinse fluid) was added to 225 ml of Listeria Enrichment Broth (Oxoid CM 862) and incubated for 24-48 h at 30°C for pre-enrichment of *L. monocytogenes*. Passages from pre-enrichment medium was done onto Listeria Selective Agar (Oxford formulation, Oxoid CM856) and incubated for 48 h at 35°C. Typical colonies were purified at TSYE Agar (Merck). Biochemical and serological tests were applied for the identification of *L. monocytogenes* (2).

**Isolation and identification of *E. coli O157:H7*.** Modified Tryptic Soy Broth (Merck 1.092.5) was used for the enrichment of *E. coli O157:H7*. 25 gr sample (or 25 ml rinse fluid) was weighed; 225 ml of enrichment media was added and incubated for 18 h at 35°C. Sorbitol MacConkey Agar (Merck 1.09207) was used as selective agar medium. Colorless and sorbitol negative colonies were evaluated as typical *E. coli O157:H7* and final diagnosis was made by Dryspot *E. coli* O157: H7 (Oxoid DR120M) latex test kit (2).

**Statistical evaluation.** Microbial counts were transformed to $\log_{10}$ cfu/g. Data were analyzed statistically. SPSS packet program was used in formation of statistics and variance analysis method (ANOVA) was utilized. Duncan multiple analysis method was used to determine the differences between groups. Significance was determined at the 5% level (30).

**Tab. 1. Medias and incubation conditions used in microbiologic analysis**

| Microorganisms | Selective Medium | Incubation conditions | | |
|---|---|---|---|---|
| | | Temp. °C | Time | Aerob/ anaerob |
| TAMB | PCA (Oxoid CM 463) | 35 | 48 h | Aerobic |
| Psycrofils | PCA (Oxoid CM 463) | 5-7 | 7-10 days | Aerobic |
| Enterobacteriaceae | VRBGA (Oxoid CM 485) | 32 | 24-48 h | Anaerob |
| Coliform | VRBA (Oxoid CM 107) | 35 | 24 h | Anaerob |
| *E. coli* | VRBA (Oxoid CM 107) | 44 | 24 h | Anaerob |
| *Staphylococcus-Micrococcus* | BPA (Oxoid CM 275) | 35 | 48 h | Aerob |
| *S. aureus* | BPA (Oxoid CM 275) | 35 | 48 h | Aerob |
| Mould & Yeast | PDA (Oxoid CM 139) | 25 | 5 days | Aerob |
| *Y. enterocolitica* | CIN Medium (Oxoid CM 653 + SR109) | 32 | 18-24 h | Aerob |

**Tab. 2. Rates of *Salmonella* spp., *L. monocytogenes* and *E. coli O157:H7* contamination of chicken samples**

| Sort of chicken samples | *Salmonella* spp. | *L. monocytogenes* | *E. coli* O157:H7 |
|---|---|---|---|
| Chicken carcasses | 4/25 (16 %)* | 5/25 (20 %) | 0/25 (0 %) |
| Legs | 2/25 (8 %) | 0/25 (0 %) | 0/25 (0 %) |
| Wings | 3/25 (12 %) | 0/25 (0 %) | 1/25 (4 %) |
| Chicken breast meat | 12/25 (48 %) | 6/25 (24 %) | 5/25 (20 %) |
| Giblets | 2/25 (8 %) | 1/25 (4 %) | 0/25 (0 %) |
| Total | 23/125 (18.4 %) | 12/125 (9.6 %) | 6/125 (4.8 %) |

Explanation: *number of positive samples/number of samples (percentage of positive samples)

## Results and discussion

Between February and December 2005, a total of 125 samples taken from chicken carcasses, legs, wings, chicken breast meat and giblets were analyzed. Samples weighing approx. 500 g were collected from poulterers' shops and supermarkets. Also whole chicken carcasses weighed approximately 1500-2000 g were collected. The prevalence of *Salmonella* spp. *L. monocytogenes* and *E. coli O157:H7* are showen in tab. 2. High levels of *Salmonella* spp., (48%), *L. monocytogenes* (24 %) and *E. coli O157:H7* (20%) contaminations were found in chicken breast meat. The high contamination of breast meat resulted from duration of contact with workbench during processing and preservation, the size of surface area and fecal contamination.

In this study, the percentage of Salmonella contamination in chicken carcasses and their cuts were calculated as 18.4% (25/125). The highest Salmonella contamination was found as 48% (12/25) in chicken breast meat, the lowest contamination was found as 8% (2/25) in legs and giblets. Salmonella contamination in chicken and chicken meat samples were ranged between 3.6%-35.83% and 8%-25.5%, respectively (4, 9, 16, 17, 22, 23, 26). The contamination rate of Salmonella in poultry meat and their products were calculated between 19.4% and 36.7% by Uyttendaele et al. (33); it was found 55% in chicken carcasses, 40% in wings, legs, and giblets by Capita et al. (8); 2.36%, 4.25% and 0.82% in broiler legs, breasts and wings by Pieskus et al. (24), respectively.

Salmonella contamination that found in this study looks similar to the results of Plummer et al. (26) and Tibaijuka et al. (32). The contamination rate that we found in chicken parts is higher than determined by Pieskus et al. (24) in legs, breasts and wings. Our re-

sults are lower than Capita et al. (8) and Plummer et al. (26) values.

We found as 9.6% (12/125) *L. monocytogenes* contamination in our study. While the level of contamination in this study is 24% in chicken breast meat, 20% in carcasses and 4% in giblets, *L. monocytogenes* could not be isolated from the leg and wing samples. These findings are lower than other findings determined between 11.5-85% *L. monocytogenes* percentage (3, 7, 11, 25, 27, 29, 34, 35).

*E. coli* contamination was found as 4.8% (6/125), and couldn't isolate from carcasses, legs and giblets. *E. coli VTEC 0157* contamination rate was found as 12% in chicken by Samadpour et al. (28), and as 1.5% in poultry by Doyle and Schoeni (10). Mayrhofer et al. (19) noted prevalence of hemolytic *E. coli* was 2.4%.

**Tab. 3. The mean microorganism counts in chicken samples log10 cfu/g (log10 cfu/ml of rinse fluid in chicken carcasses) ± SD (n = 25)**

| Microorganisms | Sort of chicken samples | | | | |
|---|---|---|---|---|---|
| | Chicken carcasses | Legs | Wings | Chicken breast | Giblets |
| TMAB | $5.81^{a} \pm 0.90$ | $7.35^{bc} \pm 0.45$ | $7.41^{c} \pm 0.47$ | $7.17^{bc} \pm 0.49$ | $6.95^{b} \pm 0.57$ |
| Psycrofils | $4.56^{a} \pm 0.94$ | $6.77^{c} \pm 0.32$ | $6.66^{bc} \pm 0.39$ | $6.27^{b} \pm 0.55$ | $4.51^{a} \pm 0.57$ |
| Enterobacteriaceae | $3.99^{a} \pm 0.87$ | $6.44^{c} \pm 0.35$ | $6.40^{c} \pm 0.51$ | $5.78^{b} \pm 0.59$ | $3.86^{a} \pm 0.69$ |
| Coliforms | $3.67^{a} \pm 0.95$ | $6.00^{c} \pm 0.36$ | $5.97^{c} \pm 0.43$ | $4.92^{b} \pm 0.56$ | $3.56^{a} \pm 0.60$ |
| *E. coli* | $2.91^{a} \pm 1.35$ | $5.54^{c} \pm 0.33$ | $5.50^{c} \pm 0.57$ | $4.05^{b} \pm 0.73$ | $2.77^{a} \pm 1.33$ |
| *Staphylococcus-Micrococcus* | $3.29^{b} \pm 1.06$ | $3.64^{b} \pm 1.71$ | $1.45^{a} \pm 1.63$ | $3.50^{b} \pm 0.49$ | $3.76^{b} \pm 0.86$ |
| *S. aureus** | $1.55^{a} \pm 1.56$ | $1.54^{a} \pm 1.66$ | $1.06^{a} \pm 1.36$ | $2.14^{a} \pm 1.48$ | $1.69^{a} \pm 1.63$ |
| Mould - yeasts | $2.34^{a} \pm 1.41$ | $4.56^{c} \pm 0.60$ | $3.97^{bc} \pm 1.56$ | $3.63^{b} \pm 0.67$ | $2.69^{a} \pm 0.57$ |
| *Y. enterocolitica* | $3.95^{b} \pm 1.23$ | $4.36^{b} \pm 0.28$ | $4.35^{b} \pm 0.52$ | $4.88^{c} \pm 0.29$ | $2.90^{a} \pm 0.65$ |

Explanations: **S. aureus* was detected in 65% of samples; a.b.c means within the same row with the different superscript letter are significantly different ($p < 0.05$)

The results of microbiological analysis of chicken carcasses and their parts are shown in tab. 3. Capita et al. (5) reported mean counts of 4.84, 3.80, 3.67 and 2.99 log cfu/g for psychrotrophs, micrococcaceae, *S. aureus*, yeast and moulds, respectively. Alvarez-Astorga et al. (1) were found mean counts as 5.79, 7.07, 3.56, 2.60 and 2.47 $\log_{10}$ cfu/g in leg; 5.85, 7.21, 4.27, 3.68 and 3.48 $\log_{10}$ cfu/g in wing; 5.56, 5.96, 4.61, 4.33 and 2.56 $\log_{10}$ cfu/g in giblets, for mesophiles, psychrotrophs, coliforms, *E. coli* and *S. aureus* respectively.

*E. coli* was found in all samples examined in this study, while Zhao et al. (36) calculated as 38.7% in chicken samples.

Statistically significant differences weren't found among samples with respect to *S. aureus*. *S. aureus* was isolated from 65% of samples. While this result has a similarity to the counts that of Kıtai et al. (18) using enrichment culture method in raw chicken meats (65.8%), it is higher than counts that Gündoğan et al. (12) found as 17% in chicken carcasses and 9% in giblets. The number of average *S. aureus* in samples investigated is lower than the results of Capita et al. (5) and Alvarez et al. (1).

While *Y. enterocolitica* contamination was determined as 44.9% and 55% by Mayrhofer et al. (19) and Capita et al. (6) respectively, we isolated this bacteria in all investigated samples.

When results of our study has been compared with other similar research findings, our results in comparison to both microbiological quality and pathogen bacteria existing. These different our findings resulted from difference of material studied and its amount, method of analysis, production and processing conditions, personnel hygiene, region and country where analysis were carried out.

It is accepted as $5 \times 10^{6}$, $1 \times 10^{2}$ ve $5 \times 10^{3}$ cfu/g the highest counts (values) of aerob mesophilic bacteria, *E. coli* and *S. aureus* at Turkish Food Codex (31). *E. coli 157:H7* and Salmonella aren't accepted to exist in the Codex. In this study, the rates of microorganism exceeds the limits found for aerob mesophilic bacteria were 24%, 96%, 100%, 88% and 56%; *E. coli* were 80%, 100%, 100%, 96% and 88%; and *S. aureus* were 0%, 4%, 0%, 4% and 0% in carcass, legs, wings, chicken breast meat and giblets, respectively.

## Conclusion

This study result of shown that microbiological quality of chicken carcasses and their products is low and creates potential danger with regard to public health. Because of the need for a systematic and universally applicable approach to food safety control, the Hazard Analysis Critical Control Point (HACCP) concept is increasingly being introduced into the Poultry Industry, and Quantitative Risk Assessment (QRA) is being applied to microbial hazards. Although use of the Hazard Analysis Critical Control Point system in poultry processing is aimed primarily at the control of foodborne pathogens, there is also the potential to reduce contamination of carcasses with spoilage organisms (21). The application of Hazard Analysis Critical Control Point system, plant hygiene, and hygienic work of personal, food safety of consumers training about will effect to decrease possible risks.

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**Author's address: Assist. Prof. Aydın Vural, Department of Food Hygiene and Technology, Faculty of Veterinary Medicine, Dicle University, 21280 Diyarbakır, Turkey; e-mail: avural@dicle.edu.tr**