

## Food Poisoning Microorganisms in Chicken Broiler Meat

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**Abstract:** This study was carried out to investigate the prevalence of food poisoning microorganisms in chicken broilers in Fayoum city. Results showed that the mean count of coliforms (MPN), faecal coliforms (MPN), *Escherichia coli* (*E.coli*) (MPN) and *Staphylococcus aureus* (*staph.aureus*) count in fresh neck skin, breast skin, thigh skin, breast muscle and thigh muscle of chicken broiler samples was high when compared with frozen samples. There was a significant difference between fresh and frozen skin and muscle samples at  $P < 0.01$  in relation to coliforms count. There was a significant difference between fresh and frozen skin samples while there was no significant difference between fresh and frozen muscle samples at  $P < 0.01$  in relation to faecal coliforms count. Also there was a significant difference between fresh and frozen skin and muscle samples of chicken broilers at  $P < 0.01$  in relation to *E.coli* count. All the examined sites of fresh chicken broilers yield *E.coli* with total percentage was 100% while in frozen samples *E.coli* was isolated by 100%, 86.6%, 100%, 73.3% and 86.6% from neck skin, breast skin, thigh skin, breast muscle and thigh muscles respectively. On the other hand there was a significant difference between fresh and frozen skin and muscle samples at  $P < 0.01$  in relation to *staph.aureus* count. *Staph.aureus* was isolated from 46.6%, 26.6%, 40%, 20% and 26.6% from neck skin, breast skin, thigh skin, breast muscle and thigh muscles respectively while in frozen samples it was isolated from 26.6%, 26.6%, 33.3%, 20% and 26.6% from neck skin, breast skin, thigh skin, breast muscle and thigh muscles respectively. *Salmonella spp.* were isolated from 22.6%, 13.3%, 20%, 20% and 33.3% of neck skin, breast skin, thigh skin, breast muscle and thigh muscle, respectively with total percentage 22.6% of fresh chicken broiler samples while in frozen samples it was isolated from 13.3%, 13.3%, 6.6%, 6.6% and 6.6% of neck skin, breast skin, thigh skin, breast muscle and thigh muscle, respectively with total percentage 9.3%. The isolated serotypes were *Salmonella infantis* (*S. infantis*) and *Salmonella enteritidis* (*S. enteritidis*). *Campylobacter jejuni* was isolated from 80%, 73.3% and 66.6% of neck skin, breast skin and thigh skin, respectively with total percentage 44% in fresh chicken broiler samples while it was isolated from 33.3%, 46.6% and 53.3% of neck skin, breast skin and thigh skin, respectively with total percentage 26.6% from frozen samples of chicken broilers while it failed to be detected in muscle samples. Public health importance of the isolated bacteria and possible sources of chicken broiler meat contamination were discussed.

**Key words:** Food poisoning • Poultry meat • Coliforms • Salmonella • *Staph aureus* • *Campylobacter jejuni*

### INTRODUCTION

Meat of chicken broilers are more popular to the consumers because of its easy digestibility and acceptance by the majority of people, although it could be contaminated with a variety of potentially pathogenic food borne pathogens that may cause human illness such as *Salmonella*, *Campylobacter*, *Staphylococcus aureus*, *Escherichia coli* and *Listeria* [1]. Chicken broilers

entering slaughter processing 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 [2]. Epidemiological reports suggest that poultry meat is still the primary cause of human food poisoning [3]. The presence of pathogenic and spoilage microorganisms in poultry meat and its by-products remains a significant concern for suppliers,

consumers and public health officials worldwide [4]. Outbreaks of food borne illness occur following ingestion of undercooked meat, handling of raw meat, cross contamination of ready-to-eat products with microbial contaminants from the raw poultry or others introduced during preparation of food [5]. Poultry and poultry products are frequently contaminated with Salmonellae that can be transmitted to humans either through the handling of raw poultry carcasses and products or through consumption of undercooked poultry meat [6]. Because salmonella typically is found in poultry, this type of meat has been an important vehicle in food borne diseases rendering Salmonellosis is one of the most frequently reported food borne diseases worldwide [7]. Campylobacteriosis in man is mainly a food borne infection in which foods of animal origin, particularly poultry, play an important role. In the last 10 years Campylobacter jejuni has emerged as the most frequent cause of bacterial gastroenteritis in man in United States and reported as the most common bacterial cause of food borne infection [8]. Coliforms level, Mesophiles, psychrotrophs, *Escherichia coli* and *Staphylococcus aureus* in poultry carcasses can be routinely used to assess microbiological safety, improper hygiene methods and sanitation conditions during processing, keeping quality of products and incorrect storage conditions which can lead to the proliferation of pathogens [9]. Therefore the aim of this study was to investigate the prevalence of food poisoning microorganisms in chicken broiler meat as well as discuss the public health importance of the isolated microorganisms.

## MATERIALS AND METHODS

**Samples Collection:** A total of 30 carcasses from chicken broiler (15 fresh and 15 frozen) were purchased from different grocery stores and poultry shops in Fayoum city. Each carcass was wrapped in a sterile polyethylene bag and identified. The collected carcasses were immediately transported to laboratory in ice box and examined up on arrival. Frozen samples were allowed to thaw in their original containers in the refrigerator for 8-10 hours.

**Sample Preparation:** Skin and muscle samples from fresh and frozen chicken broiler carcasses were prepared. Skin samples include neck, breast and thigh skin while muscle samples include breast muscle and thigh muscle. All samples were prepared according to the technique recommended by ICMSF [10] as follows:

Ten grams from all samples were aseptically removed and stomached in a sterile stomacher bag containing 90 ml of sterile peptone water (Oxoid CM0009 Ltd., Hampshire, England) for 2 min. this represent the original food homogenate from which ten-fold serial dilutions were prepared using the same diluents. The prepared samples were subjected to the following examination:

**Bacterial Count:** By using the technique recommended by APHA [11]:

**Coliforms Most Probable Number (MPN):** by using the 3 tubes protocol, faecal coliforms most probable number (MPN), *E.coli* most probable number (MPN) and *staph aureus* count.

**Bacterial Isolation:** *salmonella* isolation according to ISO 6579:2002 [12], *E.coli* isolation according to APHA [11], *staph.aureus* isolation according to APHA [11] and *campylobacter* isolation according to ISO 10272-1: 2006 [13].

**Statistical Analyses:** analysis of variance was conducted and means were compared according to Knapp and Miller [14].

## RESULTS AND DISCUSSION

Results obtained in tables (1,2) showed that there was a significant difference between fresh and frozen skin and muscle samples at  $P < 0.01$  in relation to coliforms count. Nearly similar result was reported by Northcutt *et al.* [15] while higher value was recorded by Bhandari *et al.* [16] on the other hand lower coliform counts were reported by Buhr *et al.* [17] in breast skin, Abu-Ruwaida *et al.* [18] in neck skin, Gad [19] in breast and thigh muscles of chickens also Daoud *et al.* [20] in frozen chicken breast and thigh muscles.

Higher coliforms count may be attributed to the fact that live birds and animals are hosts to a large number of different microorganisms residing on their skin, feathers or in the alimentary tract. Birds admitted to slaughtering generally highly contaminated with bacteria, especially with potential human pathogenic bacteria, such as Coliforms. During slaughter most of these microorganisms are eliminated, but subsequent contamination is possible at any stage of the production process, from feather plucking, evisceration and washing to storage by cooling or freezing also microorganisms from the environment, equipment and operator's hands can contaminate meat this agreed with Kotula and Pandya [21] and Geornaras *et al.* [22].

Table 1: Statistical analysis of the bacterial count of fresh and frozen skin of chicken broilers

	Fresh			Frozen		
	Neck skin	Breast skin	Thigh skin	Neck skin	Breast skin	Thigh skin
Coliforms MPN	$2 \times 10^5 \text{ a} \pm 7 \times 10^4$	$6 \times 10^4 \text{ a,b} \pm 10^4$	$2 \times 10^5 \text{ a} \pm 4 \times 10^4$	$5.6 \times 10^3 \text{ b} \pm 3 \times 10^3$	$10^3 \text{ b} \pm 4 \times 10^2$	$3.5 \times 10^4 \text{ b} \pm 1.5 \times 10^4$
Faecal coliforms MPN	$4 \times 10^4 \text{ a} \pm 9 \times 10^3$	$2.6 \times 10^4 \text{ a} \pm 3 \times 10^3$	$8 \times 10^4 \text{ b} \pm 2 \times 10^4$	$1.5 \times 10^3 \text{ a} \pm 6 \times 10^2$	$7 \times 10^2 \text{ a} \pm 2 \times 10^2$	$2.6 \times 10^4 \text{ a} \pm 10^4$
E.coli MPN	$9 \times 10^3 \text{ a} \pm 4 \times 10^3$	$10^4 \text{ a} \pm 2 \times 10^3$	$3 \times 10^4 \text{ b} \pm 8 \times 10^3$	$6 \times 10^2 \text{ a} \pm 1.6 \times 10^2$	$4 \times 10^2 \text{ a} \pm 16 \times 10^2$	$2 \times 10^3 \text{ a} \pm 3 \times 10^2$
Staph aureus count	$5 \times 10^5 \text{ a} \pm 8 \times 10^4$	$4 \times 10^5 \text{ a} \pm 5 \times 10^4$	$5 \times 10^5 \text{ a} \pm 4 \times 10^4$	$10^5 \text{ b} \pm 4 \times 10^4$	$10^5 \text{ b} \pm 3 \times 10^4$	$1.5 \times 10^5 \text{ b} \pm 3.5 \times 10^4$

<sup>a-b</sup>Means within the same raw with no common superscript are significantly different at  $p < 0.01$   
Results expressed as Mean  $\pm$  S.E.

Table 2: Statistical analysis of bacterial count of fresh and frozen muscle samples of chicken broilers

	Fresh		Frozen	
	Breast	Thigh	Breast	Thigh
Coliforms MPN	$4 \times 10^{4a} \pm 10^4$	$5 \times 10^{4a} \pm 10^4$	$1.5 \times 10^3 \text{ b} \pm 7 \times 10^2$	$4.5 \times 10^{3b} \pm 2 \times 10^3$
Faecal coliforms MPN	$9 \times 10^{3a} \pm 2 \times 10^3$	$3 \times 10^{4a} \pm 1.5 \times 10^4$	$7 \times 10^{2a} \pm 2 \times 10^2$	$1.6 \times 10^3 \text{ a} \pm 7 \times 10^2$
E.coli MPN	$2 \times 10^{3a} \pm 3 \times 10^2$	$6 \times 10^3 \text{ b} \pm 2 \times 10^3$	$3 \times 10^2 \text{ a} \pm 10^2$	$4 \times 10^{2a} \pm 1.7 \times 10^2$
Staph aureus count	$2 \times 10^5 \text{ a} \pm 7 \times 10^4$	$3 \times 10^5 \text{ a} \pm 5.5 \times 10^4$	$5 \times 10^{4b} \pm 10^4$	$5.5 \times 10^{4b} \pm 10^4$

<sup>a-b</sup>Means within the same raw with no common superscript are significantly different at  $p < 0.01$   
Results expressed as Mean  $\pm$  S.E.

Results in tables (1,2) showed that there was a significant difference between fresh and frozen skin samples while there was no significant difference between fresh and frozen muscle samples at  $P < 0.01$  in relation to faecal coliforms count. Lower figures of faecal coliforms counts were reported by Cohen *et al.* [23], Guergueb *et al.* [24], Chaiba *et al.* [4] and Daoud *et al.* [20].

Coliform bacteria, especially fecal coliforms, are good microbial indicators of the potential presence of disease causing bacteria and also showed the general sanitary quality of the food. Faecal coliforms had been used as indicator for faecal contamination. During the slaughter of poultry birds, there can be fecal contamination of the carcasses from the gut of these birds which means bacteria present in the spilled gut content is passed on as contaminants. Also improper evisceration (intestinal breakage) may significantly increase carcass contamination with bacteria from the intestinal tract of the bird. This agreed with that reported by Russell and Walker [25] and Adeyanju and Ishola [26].

Results obtained in tables (1,2) showed that there was a significant difference between fresh and frozen skin and muscle samples of chicken broilers at  $P < 0.01$  in relation to *E.coli* count. Nearly similar figures for *E.coli* count were obtained by Berrang *et al.* [27] and Berrang *et al.* [28] while lower figures were reported by Chaiba *et al.* [4], Cohen *et al.* [23] in chicken meat, Abu-Ruwaida *et al.* [18] in neck skin, Buhr *et al.* [17] in breast skin samples and Daoud *et al.* [20] in frozen chicken breast and thigh muscle samples.

Concerning *E.coli* isolation, *E.coli* was isolated from 100% of neck skin, breast skin, thigh skin, breast muscle and thigh muscle while in frozen samples *E.coli* was isolated by 100%, 86.6%, 100%, 73.3% and 86.6% from neck skin, breast skin, thigh skin, breast muscle and thigh muscles respectively with total percentage 89.3% (table, 3). The isolated serotypes were O157 and O18 from chicken broiler samples.

In this respect Adesiji *et al.* [29] reported that *E. coli* has been isolated worldwide from poultry meat. High figures of *E.coli* isolation were reported by Berrang *et al.* [30] who isolated *E.coli* from 90 and 100% of breast and thigh skin respectively, Saikia and Joshi [31] isolated *E.coli* by 98% from raw chicken meat samples and Odwar *et al.* [32] who found that contamination by *E. coli* in chicken meat samples was 78%. Lower figures of *E.coli* isolation were reported by Adeyanju and Ishola [26] and Cohen *et al.* [23].

*E. coli*, a natural inhabitant of the intestinal tracts of humans and warm-blooded animals, is used as an indicator bacterium. Its presence therefore reliably reflects faecal contamination, indicating a possible contamination by enteric pathogens. Raw or undercooked foodstuffs get contaminated either during primary production e.g. slaughtering or further processing and handling e.g. cross contamination during processing, human-to-food contamination via food handlers [26].

In traditional poultry shops after slaughtering poultry carcasses scalded in a common scaling tank, under poor conditions (stagnant water, excessive excreta and or non

Table 3: prevalence of isolated microorganisms in chicken broilers

		Neck skin		Breast skin		Thigh skin		Breast muscle		Thigh muscle		Total	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
E.coli	fresh	15	100	15	100	15	100	15	100	15	100	75	100
	frozen	15	100	13	86.6	15	100	11	73.3	13	86.6	67	89.3
Salmonellae	fresh	4	26.6	2	13.3	3	20	3	20	5	33.3	17	22.6
	frozen	2	13.3	2	13.3	1	6.6	1	6.6	1	6.6	7	9.3
Staph aureus coagulase positive	fresh	7	46.6	4	26.6	6	40	3	20	4	26.6	24	32
	frozen	4	26.6	4	26.6	5	33.3	3	20	4	26.6	20	26.6
Campylobacter jejuni.	fresh	12	80	11	73.3	10	66.6	0	0	0	0	33	44
	frozen	5	33.3	7	46.6	8	53.3	0	0	0	0	20	26.6

bacteriocidal temperatures), the scalding tank can serve essentially as an enrichment system, through which pathogens are spread widely to all birds entering the tank [33].

Results in tables (1, 2) illustrated that there was a significant difference between fresh and frozen skin and muscle samples at  $P < 0.01$  in relation to *staph.aureus* count. High figure of *staph.aureus* count was reported by Bhandari *et al.* [16] while nearly similar result was reported by Amara *et al.* [34] on the other hand lower results were reported by Chaiba *et al.* [4], Cohen *et al.* [23] and Guergueb *et al.* [24].

*Staph aureus* was isolated from 46.6%, 26.6%, 40%, 20% and 26.6% from neck skin, breast skin, thigh skin, breast muscle and thigh muscles respectively with total percentage 32% while in frozen samples it was isolated from 26.6%, 26.6%, 33.3%, 20% and 26.6% from neck skin, breast skin, thigh skin, breast muscle and thigh muscles respectively with total percentage 26.6% (Table, 3).

In this respect nearly similar results were obtained by Guergueb *et al.* [24] and Karimi [35]. Higher figures were reported by Javadi and Safarmashaei [36] and Kozačinski *et al.* [37] while lower figures were obtained by Akbar and Anal [38] and Shareef *et al.* [39].

The reason for the high prevalence of *staph.aureus* in this study may be attributed to the poor personal hygiene of the workers and the technique used for opening the abdomen. With the technique of hand evisceration predominantly practiced in the traditional shops under study and with infrequent hand washing, a high prevalence of bacteria related to human contact was expected in these samples as reported by Cohen *et al.* [23].

In this respect Javadi *et al.* [40] stated that contamination of poultry meat with *S. aureus* can be occurred through non-hygienic practices during slaughter as well as contamination with intestinal contents and/or skin of the carcass and through contaminated work surfaces and Knives.

Concerning *salmonella* isolation results illustrated in table (3) clarified that *salmonella spp.* were isolated from 22.6%, 13.3%, 20%, 20% and 33.3% of neck skin, breast skin, thigh skin, breast muscle and thigh muscle, respectively with total percentage 22.6% of fresh chicken broiler samples while in frozen samples it was isolated from 13.3%, 13.3%, 6.6%, 6.6% and 6.6% of neck skin, breast skin, thigh skin, breast muscle and thigh muscle, respectively with total percentage 9.3%. The isolated serotypes were *S. infantis* and *S. enteritidis*.

Nearly similar figures were reported by Chaisatit *et al.* [41] and Jimenez *et al.* [42]. High prevalence was recorded by Boonmar *et al.* [43], Saeed *et al.* [44], and Hassanein *et al.* [45] while lower figures were recorded by Moussa *et al.* [46], Medeiros *et al.* [47], Saad *et al.* [48] and Rabie *et al.* [49].

*Salmonella* is of an increasing public health concern because they are the most incriminated pathogenic microorganisms of bacterial food poisoning especially present in poultry meat, with infection being through the handling of raw poultry carcasses and products, together with the consumption of undercooked poultry meat [50].

Poultry are the most important reservoir for *salmonella*. The high prevalence of *salmonella* in chicken meat may be a result of cross-contamination from intestines during processing and cutting or from cages, floor and workers during retailing or marketing. Also the water used for washing of carcasses is mostly from the same container and it could be contaminated with *salmonella* from feces or from the butcher's hands during washing, this is in agreement with Shah and Korejo [51].

Contamination of poultry by *salmonella* may be occurred at different phases of poultry meat production and processing, i.e. on the farm, during transportation to the poultry-processing plant or during the steps involved in slaughtering, scalding, defeathering, plucking and chilling of the poultry carcasses [52, 53].

In this respect Nde *et al.* [54] declared that Scald water may also contribute to the contamination of *Salmonella*-free flocks when they are processed following *salmonella* positive flock so scald water is considered a potential vehicle for the transfer of *Salmonella* between birds.

Concerning *Campylobacter* isolation results shown in table (3) clarified that *campylobacter jejuni* was isolated from 80%, 73.3% and 66.6% of neck skin, breast skin and thigh skin, respectively with total percentage 44% in fresh chicken broiler samples while it was isolated from 33.3%, 46.6% and 53.3% of neck skin, breast skin and thigh skin, respectively with total percentage 26.6% from frozen samples of chicken broilers.

*Campylobacter jejuni* failed to be detected in muscle samples, this agreed with Berrang *et al.* [30], Kozačinski *et al.* [37] and Gritti *et al.* [55] and disagreed with Stoyanchev [56], Granić *et al.* [57] and Rahimi and Tajbakhsh [58]. Nearly similar results for *campylobacter* isolation were obtained by Atanassova and Ring [59] and Stoyanchev [56]. High figures in chicken broilers were reported by Willis and Murray [60], Zhao *et al.* [61] and Jeffrey *et al.* [62]. Lower figures were reported by Jones *et al.* [63] and Giacoboni *et al.* [64].

*Campylobacter jejuni* is commonly found in the intestinal tract of chickens and is transferred to the skin during slaughter and processing [60]. Evisceration process is a potential source for poultry carcasses to become contaminated with *Campylobacter* from their intestinal contents during the slaughter process. Improper evisceration (intestinal breakage) may significantly increase carcass contamination with bacteria from the intestinal tract of the bird. Visceral rupture and intestinal breakage lead to escape of fecal content leading to the contamination of equipment, working surfaces, processing water, and air and increasing the opportunities for cross contamination of *Campylobacter*-free carcasses during processing. This agreed with that reported by Genigeorgis *et al.* [65] and Russell and Walker [25]. Crop contents may be an important source of *campylobacter* contamination during processing. The crop has been found to be a significant source of *Campylobacter*, thus potentially contributing to carcass contamination [66]. This agreed with that reported with Jeffrey *et al.* [62] who isolate *campylobacter* from crop by 48% suggesting that crop splitting during processing may be a potential source for contamination of carcass specially neck and breast skin.

## CONCLUSION

Chicken broiler meat can be contaminated with a wide variety of pathogenic bacteria as *salmonellae*, *E.coli*, *Staph.aureus* and *Campylobacter jejuni* during processing, so it could be considered as a potential source for these pathogenic food poisoning microorganisms. Fresh carcasses have higher coliforms (MPN), faecal coliforms (MPN), *E.coli* (MPN) and *staph.aureus* count than the frozen ones. Lack of sanitary measures in traditional poultry shops lead to contamination of chicken broiler carcasses as cross contamination occurs during processing. Hygienic measures must be adopted in traditional shops to prevent such contamination.

## ACKNOWLEDGEMENT

The authors are very grateful to all members of Meat Hygiene Department and members of Reference Lab for Veterinary Quality Control on poultry production, Fayoum branch for their support.

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