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Bacteriological Profile and Safety of Chicken Broiler Meat Cuts

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Abstract

Fifty samples each of fresh chicken fillet, shiesh, drum, shawarma, and wings were collected from a poultry processing plant, in Ismailia city, Egypt. The values of the mean total bacterial counts were $2x10^4\pm7x10^2$, $2x10^4\pm10^2$, $1x10^4\pm3x10^2$, $7x10^4\pm5x10^2$, and $6x10^3\pm2x10^2$ respectively, for total coliform counts were $2x10^2\pm4x10^{-1}$, $1x10^{-2}\pm3x10^{-1}$, $5x10^{-2}\pm2x10^{-1}$, $8x10^{-2}\pm4x10^{-1}$, and$3x10^{-2}\pm1x10^{-1}$, respectively. The mean value of *Staphylococcus aureus* count in fillet was $2x10^{-2}\pm2x10^{-1}$, in drum $1x10^{-2}\pm3x10^{-1}$, shiesh $2x10^{-2}\pm5x10^{-1}$, shawerma $2x10^{-2}\pm10^{-1}$, and wings $4x10^{-1}\pm10^{-1}$. For *E. coli* count in fillet was $9x10^{-1}\pm0.4x10^{-1}$, in drum $2x10^{-1}\pm0.2x10^{-1}$, in shiesh $2x10^{-1}\pm0.6x10^{-1}$, in shawerma $1x10^{-1}\pm0.2x10^{-1}$, and in wings was $1x10^{-1}\pm0.1x10^{-1}$. The prevalence of *Salmonella* spp.in the examined chicken fillet, drum, shiesh, shawarma, and wings were 6%, 8%, 6%, 6%, and 4%, respectively. The results showed that *E. coli* could be detected in all samples and laid within the accepted limits for fillet, drum, shiesh, shawerma, and wings. The Standard limits (SE) recommended by The Egyptian Organization for standardization (EOS) for *Salmonella* revealed that chicken broiler cut exceeded the accepted limits with 3(6%) for fillet, 4(8%) for drum, 3(6%) for shiesh, 3(6%) for shawerma, and 2(4%) for wings. For total aerobic plate count, the samples which exceed the SE limits were 4(8%) for fillet, 5(10%) for drum, 6(12%) for Shiesh,7(14%) for shawerma, and 4(8%) for Wings. The results showed that the processing techniques applied, type of packing, poultry abattoirs, and the farm environment need an effective procedure to produce safe chicken broiler meat cuts.

KEYWORDS
Chicken Broiler meat cuts, TBC, *E. coli*, *Staphylococcus*, *Salmonella*

INTRODUCTION

The term chicken meat principally referred to either whole or parts of the carcasses that belong to the Gallus species, which is considered a good source of high biological value protein, considerable price, delicious taste, and a low level of fat content when compared with other types of meats(Bhaisare et al., 2014). The broiler term was applied to the domestic fowl species which bred to grow rapidly and slaughtered at seven to eight weeks of age depending on the weight of the bird required, then sold to wholesale or retail outlets (Patterson, 1993). It is a universal truth that poultry meat has been recognized as a significant element of the human diet for centuries, providing high-quality nutrients, tasty, digestible, and nutritious when compared to beef in addition to their low cost in comparison to red meat and its acceptance by many people. Furthermore, according to the lifestyle changes resulting from urbanization, it was predicted that there will be further increases in the demand for poultry meat and its products (Assis et al., 2015; Yashoda et al., 2000). Poultry meat is a popular food item in most countries since it helps to solve the problem of animal food scarcity. Chicken broiler carcasses are more popular in the consumer markets due to their marketability as whole carcasses or parts that represented the consumers' demand. It is also suggested that replacing red meat with chicken meat, as well as fish, nuts, and legumes, lowers the incidence of type 2 and gestational diabetes by improving diabetics and heart risk factors (Donma and Donma, 2017).Throughout the world, the poultry industry suffers significant economic losses from infection with many pathogens in addition to the transmission of foodborne illnesses (Nossair et al., 2015). Chicken broiler meat products such as fillet, drum, shiesh, shawerma, and wings, are gaining popularity as they present as quick easily prepared chicken meals which exposed to direct or indirect contamination during processing, packaging, distribution, and storage, from the environment, equipment, and workers which constitute the most harmful source of microbiological contamination (Hassan, 2015).

According to the CDC (2021) about one million people in the United States become ill each year after eating infected poultry meat. *Salmonella* is thought to cause more foodborne illnesses than any other pathogen; the main source of these ailments is chicken meat and meat products. *Salmonella* spp. and *E. coli* are the two most common foodborne pathogens that cause food-

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borne disease and are transferred through poultry flesh. According to the researchers, *Salmonella* is the second most frequent foodborne illness, accounting for millions of instances of illness each year. Therefore, the present study was planned to estimate the total bacterial count, *E. coli* count, coliform count, *Staphylococcus aureus* count, and detection of *Salmonella* spp.in the processed broilers' parts including fillet, shiesh, drum, wings, and shawarma.

MATERIALS AND METHODS

Fifty samples from each freshly processed broiler cut; fillet, shiesh, drum, wings,and shawerma were collected from a poultry processing plant, in Ismailia, Egypt.

Preparation of samples

Twenty-five grams from each sample of fillet, drum, shish, shawerma, and wings were aseptically excised, and homogenized with 225 ml of 0.1% sterile peptone water in a laboratory blender for one minute to form a dilution of 1:10, from which ten-fold dilutions were accomplished up to 106.

Total aerobic bacterial counts

The pour plate technique recommended by ISO (2003) was applied. The number of countable colonies was enumerated to obtain the total aerobic colony count per g.

Total coliforms count (MPN/g) was carried out according to the methods recommended before (AOAC, 1980).

The procedure recommended by ISO 6888-1:2021 was applied for *Staphylococcus aureus* count.

Prevalence of *Salmonella*e spp. was carried out according to the method described by ISO (2002). The suspected *Salmonella* colonies (red colonies with or without black center) were picked up and kept for further identification.

RESULTS AND DISCUSSION

The given results in Table 1 revealed that the minimum, maximum, and mean values±SD of the total aerobic plate count in the chicken fillet were $1x10^3$, $2x10^5$, and $2x10^4\pm 7x10^2$; in the chicken drum were $1x10^3$, $1x10^5$, and $2x10^4\pm1x10^2$; in the chicken shiesh $4x10^3$, $3x10^5$ and $1x10^4\pm3x10^2$; in the chicken shawerma $2x10^3$, $2\ x10^5$, and $7x10^4\pm5x10^2$; and in chicken wings $2x10^3$, $9x10^4$, and $6x10^3\pm2x10^2$, respectively. The obtained results are considered high when compared with those reported by Awadallah et al. (2014); Khalafalla et al. (2015); Hassanien et al. (2016); Pesewu et al. (2018); Faruque et al. (2019) and El-Sayed et al. (2020). While lower counts were reported by Kumar and Saravanan (2011); Adu-Gyamfi et al. (2012); Hertano et al. (2017) and Enver et al. (2021). Nearly similar counts were recorded by Daoud et al. (2012); Hossain et al. (2015); Nossair et al. (2015); Kim and Yim (2016); Hassanen et al. (2017); Al Bayati and Khidhir (2018) and Maharjan et al. (2019). The variation in the results obtained was attributed to the low hygienic nature of poultry slaughterhouses, degree of contamination, cross-contamination, fecal pollution, and personal hygiene during handling, packaging, and storage.

The results recorded in Table 2 revealed that the mean values ± SD of total coliform count in the examined chicken fillet were $2x10^{-2}\pm4x10^{-1}$, in chicken drum $1x10^{-2}\pm3x10^{-1}$, in chicken shiesh $5x10^{-2}\pm2x10^{-1}$, in chicken shawerma $8x10^{-2}\pm 4x10^{-1}$, and in chicken wings $3x10^{-2}\pm1x10^{-1}$, respectively. Higher counts were obtained by Javadi and Safarmashaei (2011); Adu-Gyamfi et al. (2012); Bhandari et al. (2013); Shaltout et al. (2015); Hossain et al. (2015); Nossair et al. (2015); Hassanien et al. (2016); Al Bayati and Khidhir (2018); Faruque et al. (2019); Mpundu et al. (2019) and Yar et al. (2020). These variations were attributed to the neglected good manufacturing practices during processing. The contamination with coliforms may occur due to faults during evisceration and rupture or injury of the intestine, inadequate personnel hygiene, knives, shackles, dirty live birds, and contaminated water. According to ES1090 (2019), such products are considered safe as the mean valuesofthe coliform count were within the permissible limits (>10^2 cfu/g).

The results recorded in Table 3 revealed that the means ± SD of *Staphylococcus aureus* counts in the examined chicken fillet were $2x10^{-2}\pm2x10^{-1}$, in the drum $1x10^{-2}\pm3x10^{-1}$, in shiesh $2x10^{-2}\pm 5x10^{-1}$, in shawerma $2x10^{-2}\pm1x10^{-1}$, and wings $4x10^{-1}\pm1x10^{-1}$, respectively. The obtained results were lower than that reported by Saikia and Joshi (2010); Yemisi et al. (2011); Shaltout et al. (2014; Edris et al. (2015); Khaled and Hendy(2015); Olukem et al. (2015); Das and Mazumder (2016); Reham et al. (2016); Herve and Kumar (2017); Bantawa et al. (2018); Bounar–Kechih et al. (2018); Ma-

Table 1. Total Aerobic Plate Count in examined chicken broilers cuts (n=50 each cut)

Chicken Broiler Cuts	Min.	Max.	Mean ± SD
Fillet	$1x10^3$	$2x10^5$	$2x10^4\pm7x10^2$
Drum	$1\ x10^3$	$1x10^5$	$2x10^4\pm1x10^2$
Shiesh	$4\ x10^3$	$3x10^5$	$1x10^4\pm3x10^2$
Shawerma	$2\ x10^3$	$2x10^5$	$7x10^4\pm5x10^2$
Wings	$2\ x10^3$	$9x10^4$	$6x10^3\pm2x10^2$

Table 2. Total Coliform Count in examined chicken broilers cuts (n=50 each cut)

Chicken broiler cuts	Min.	Max.	Mean± SD
Fillet	<10	$1x10^{-3}$	$2x10^{-2}\pm4x10^{-1}$
Drum	<10	$2x10^{-3}$	$1x10^{-2}\pm3x10^{-1}$
Shiesh	$2x10^{-1}$	$1x10^{-3}$	$5x10^{-2}\pm2x10^{-1}$
Shawerma	$5x10^{-1}$	$1x10^{-3}$	$8x10^{-2}\pm4x10^{-1}$
Wings	$1x10^{-2}$	$5x10^{-2}$	$3x10^{-2}\pm1x10^{-1}$

harjan et al. (2019); Dutta et al. (2020); Yar et al. (2020); Mohamed et al. (2021) and Whardana et al. (2021). Meanwhile, the obtained results were nearly similar to Awadallah et al. (2014). These variations in the results obtained were attributed to poor personal hygiene, during the handling of such products. According to ES: 1090 (2019), such a product is considered safe as the mean values of the *Staphylococcus aureus* counts were within the permissible limits ($>10^2$ cfu/g).

The given results in Table 4 revealed that the means ±SD of *E. coli* count in the examined chicken fillet were $9x10^{-1}\pm0.4x10^{-1}$, in drum $2x10^{-1}\pm 0.2x10^{-1}$, in shiesh $2x10^{-1}\pm0.6x10^{-1}$, but in shawerma were $1x10^{-1}\pm0.2x10^{-1}$, and in wings $1x10^{-1}\pm0.1x10^{-1}$, respectively. Higher counts were obtained by Vural et al. (2006); Saikia and Joshi (2010); Yemisi et al. (2011); Daoud et al. (2012); Ruban et al. (2012); Ahmed et al. (2013); Adeyanju and Ishola (2014); Hassanin et al. (2014); Khaled and Hendy (2015); Albarri et al. (2017); El Bayoumi et al. (2018); Faruque et al. (2019); Kulasooriya et al. (2019); Uddin et al. (2019); Yar et al. (2020) and Whardana et al. (2021). While lower results were reported by Adu-Gyamfi et al. (2012). The presence of *E. coli* in food indicates the possibility of fecal contamination. *E. coli* is considering the best food indicator for fecal contamination. These variations in the results obtained were attributed to improper slaughtering techniques, contaminated surfaces, and handling of the meat by infected food handlers. According to ES 1090 (2019), poultry meat is regarded safe when the mean value of *E. coli* count is less than 10^2 cfu/g.

The results reported in Table 5 revealed that the prevalence of *Salmonella* in examined chicken fillet, drum, shiesh, shawarma, and wings were 6%, 8%, 6%, 6%, and 4%, respectively. The results obtained were nearly similar to that reported by Rabie et al. (2012) and higher than that reported by Kozaciniski et al. (2006); Parveen et al. (2007); Abdellah et al. (2008); Maripandi and Al-Salamah (2010); Saikia and Joshi (2010); Javadi and Safarmashaei (2011); Rumya et al. (2012); Demirok et al. (2013); Bhaisare et al. (2014); Khalafalla et al. (2015); Recto et al. (2016); Nossair et al., (2017); Gonçalves-Tenório et al. (2018); Faruque et al. (2019); Uddin et al. (2019); Yammine and Karam (2020); Yar et al. (2020) and Whardana et al. (2021).While lower results were obtained by Zhao et al. (2001); Cohen et al. (2007); Yemisi et al. (2011); Awadallah et al. (2014); Khaled and Hendy (2015) and Mpundu et al. (2019). This variation in the results obtained was attributed to the fact that *Salmonella* infection was uncontrolled in poultry farms, cross-contamination during the processing of the chicken cuts, contaminated processing boards or tables, and fecal contamination. According to ES1090 (2019), it was stated that poultry should be free from *Salmonella*.

The results recorded in Table 6 showed the acceptability of the examined broiler meat cuts according to the ES 1090 (2019). The results showed that *E. coli* counts in all examined samples were within the accepted limits for fillet, drum, shiesh, shawerma, and wings. The results showed that the broiler meat cut samples that exceeded the accepted limits for *Salmonella* spp. were 3 (6%) for fillet, 4 (8%) for drum, 3 (6%) for shiesh, 3 (6%) for shawerma, 2(4%) for wings. For *Staphylococcus aureus*, all examined broiler meat cut samples were within the accepted limits. For total aerobic plate count, the samples which exceed the SE limits were 4 (8%) for fillet, 5 (10%) for drum, 6 (12%) for shiesh, and 7 (14%) for shawerma, and 4(8%) for wings.

Table 3. *Staphylococcus aureus* count in chicken broilers cuts (n=50 each cut)

Chicken broiler cuts	Min.	Max.	Mean± SD
Fillet	$2x10^{-1}$	$5x10^{-3}$	$2x10^{-2}\pm2x10^{-1}$
Drum	$5x10^{-1}$	$3x10^{-3}$	$1x10^{-2}\pm3x10^{-1}$
Shiesh	$5x10^{-2}$	$5x10^{-3}$	$2x10^{-2}\pm5x10^{-1}$
Shawerma	$3x10^{-2}$	$4x10^{-3}$	$2x10^{-2}\pm1x10^{-1}$
Wings	$2x10^{-1}$	$6x10^{-2}$	$4x10^{-1}\pm1\ x10^{-1}$

Table 4. *E. coli* count in chicken broilers cuts (n=50 each cut)

Chicken broiler cuts	Min.	Max.	Mean± SD
Fillet	$1x10^{-1}$	$7x\ 10^{-2}$	$9x10^{-1}\pm0.4x10^{-1}$
Drum	$2x10^{-1}$	$6x10^{-2}$	$2x10^{-1}\pm0.2x10^{-1}$
Shiesh	$1x10^{-1}$	$7x10^{-2}$	$2x10^{-1}\pm0.6x10^{-1}$
Shawerma	$2x10^{-1}$	$5x10^{-2}$	$1x10^{-1}\pm0.2x10^{-1}$
Wings	$1x10^{-1}$	$4x10^{-2}$	$1x10^{-1}\pm0.1x10^{-1}$

Table 5. Incidence of *Salmonella* in chicken Broilers cuts (n=50 each cut)

Chicken Broiler Cuts	Prevalence	
	No	%
Fillet	3	6%
drum	4	8%
shiesh	3	6%
Shawerma	3	6%
Wings	2	4%
Total	15	7.5

Table 6. Accepted and unaccepted Chicken broiler meat cuts according to the ES: 1090 (2019)

Chicken Cuts	Samples lied within the ES limits								Samples exceed the ES limits							
	E. coli[1]		Sal[2]		Staph[3]		TAPC[4]		*E. coli*		Sal		Staph		TAPC	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Fillet	50	100	47	94	50	100	46	92	0	0	3	6	0	0	4	8
Drum	50	100	46	92	50	100	45	90	0	0	4	8	0	0	5	10
Shiesh	50	100	47	94	50	100	44	88	0	0	3	6	0	0	6	12
Shawerma	50	100	47	94	50	100	43	86	0	0	3	6	0	0	7	14
Wings	50	100	48	96	50	100	46	92	0	0	2	4	0	0	4	8

1 = *E. coli* did not exceed 10^2 CFU/g sample
2 = *Salmonella* must be free in 25 g sample
3= Staph. aureus not more than 10^2 CFU/g sample
4 = Total plate Count should not exceed 10^5 CFU/g

CONCLUSION

The obtained results of the present study indicated unsatisfactory hygienic measures adopted during the preparation of chicken meat products. Therefore, strict hygienic measures are required in the poultry meat processing plants, and the application of the principles of HACCP, and GMP is also highly recommended.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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