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Microbiological status of chicken cuts and its products

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ABSTRACT

A total of 90 random samples of raw, half cooked (which were exposed to moderate heat treatment) and cooked wings, breast and thigh were collected from supermarkets and restaurant at Qalyubia governorate for evaluation to the microbial status. The obtained results indicated that the mean values of Aerobic plate count for raw samples (wings, breast and thigh) were $4.0\times10^6\pm0.3\times10^6$, $4.5\times10^6 \pm 0.5\times10^6$,$5.7\times10^6\pm 0.4\times10^6$ and for the half cooked were $3.6\times10^5\pm 0.2\times10^5$, $5.1\times10^5\pm 0.2\times10^5$,$6.3\times10^5 \pm 0.2\times10^5$,$1.7\times10^4 \pm 0.1\times10^4$,$2.1\times10^4 \pm 0.2\times10^4$,$2.3\times10^4 \pm 0.2\times10^4$ respectively. The total Enterobacteriaceae counts of raw (wings, breast and thigh) were32.3×105±1.4×105,18.0×105±1.7×105,23.3×10±1.4×105, for half cooked (wings , breast and thigh) were$25.6\times10^4\pm 2.3\times10^4$, $38.7\times10^4 \pm 2.0\times10^4$, $30.7\times10^4 \pm 3.01\times10^4$ and for cooked wings, breast and thigh) were $23.7\times10^4 \pm 1.2\times10^4$, 34.3×104 $\pm2.0\times10^4$, $17.1\times10^4 \pm 1.1\times10^4$. Total coliforms mean values for raw samples were$37.3\times10^2 \pm 0.8\times10^2$, $21.6\times10^2 \pm 2.4\times10^2$, $27.7\times10^2 \pm 4.4\times10^2$for half cooked were$10.3\times10^2\pm0.8\times10^2$,$12.3\times102\pm0.8\times10^2$, $14.0\times10^2\pm1.2\times10^2$, forcooked $12.3\times10^2 \pm 1.4\times10^2$,$12.0\times10^2\pm1.,5\times10^2$,$15.3\times10^2\pm2.6\times10^2$,respectively .Incidence of E. coli isolated from raw samples were 20%, 10% and 30% and for half cooked were 10%, 10% and 20% respectively. Salmonella spp. were isolated only from raw wings The total *staphylococcus aureus* for raw (wings, breast and high) were $21.7\times10^2\pm2.0\times10^2$,$24.0\times10^2\pm5.2\times10^2$,$25.3\times10^2\pm4.2\times10^2$,for half cooked (wings ,breast and thigh) were $47.3\times10^2\pm2.7\times10^2$, $41.7\times10^2\pm2.0\times10^2$, $50.0\times10^2 \pm 3.2\times10^2$,and for cooked wings ,breast and thigh were22.3×10 ± 0.9×10, 12.3×10± 1.5×10, 14.7×10 ± 1.2×10. The mean values of total yeast and mould in raw samples breast and thigh were 20.3×10 ± 1.0×10, 41.2×10 ± 1.2×10respectively. The present study concluded that there is a need to educate consumers, food handlers and all others who have access to food about the importance of hygiene and it is necessary to cook food properly.

1. INTRODUCTION

Chicken meat and chicken meat products are very popular food throughout the world since they are delicious and nutritious food, characterized by good flavor and easily digestion (Smith, 2001).

Microbial contamination of poultry carcasses and their cuts are a natural result of different procedures necessary to produce retail products from living birds. Contamination of poultry meat products may be occurred throughout initial processing, packaging and storage until the product is sufficiently cooked and consumed. Heavy bacterial loads enter the processing operations with the living birds and these bacteria can be disseminated throughout the plant during processing (Zhang *et al*., 2001).

Chicken is an important low-cost source of animal protein, so its consumption is increased (Cohen et al., 2007). Poultry contamination mostly occurs during slaughter and processing due to contact of carcass with intestinal content, feet and feathers (Allerberger et al., 2003).

Presence of large numbers of microorganisms in raw meat, there will be changes such that it becomes unappealing and unsuitable for human consumption (Fung et al 2010). Various hazards kinds of microorganisms from different sources starting from the chicken carcass itself and

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throughout the processing plant contaminated poultry meat and its products (Shaltout et al., 2018).

Fresh carcasses have higher coliforms, faecal coliforms, *E. coli* and *S. aureus* counts than the frozen one. Lack of sanitary measures in traditional poultry shops lead to contamination of chicken carcasses as cross contamination occurs during processing (Khalafalla, 2015).

Total aerobic plate count is used as indicator for bacterial population on the sample but not differentiate types of bacteria (APHA, 2001). Aerobic plate counts can be useful to indicate quality, shelf life and post heat-processing contamination (GuaranTek Analytic Labo-ratories, 2003).

Enterobacteriaceae count may be used as indicator for enteric contamination and as assessment of the general hygienic status of a food product (HPA, 2004). Sources of coliforms in meat are soild hands, knives used for cutting, and contaminated water (Yadav et al., 2006). Fecal coliforms had been used as indicator for fecal contamination.

Escherichia coli is a very important indicator for fecal contamination and its presence in poultry meat reveal to improper sanitation (Synge, 2000).

Salmonella identified as etiological agent of food born outbreaks (Siqueira et al., 2003). Salmonella was reported as the most frequent food born pathogen worldwide (Capita et al., 2007). Also, Salmonellae may undergo multiplication steps along food chain including production, processing, distribution, marketing, handling and preparation (Dookeran et al., 2012).

Presence *S. aureus* in poultry meat indicate non-hygienic habits during slaughter, contamination with intestinal contents or skin of the carcass and through contaminated knives (Javid et al 2014).

The aim of the study was to evaluate microbiological status of chicken meat and its product.

2. MATERIAL AND METHODS

2.1. Collection of samples:

A total of 90 random fresh, half cooked treated and cooked samples (30 of each) and each type represent wings, breast and thigh samples (10 of each) were collected from local supermarkets and retail shops in Qalyubia governorate. The collected samples were transferred directly to the laboratory, in an icebox under complete aseptic conditions to evaluate chemical and bacteriological quality.

2.2. Preparation of samples:

2.3. Bacteriological quality evaluation

2.3.1. Determination of Aerobic plate count "APC" (ISO, 2013)

2.3.2. Determination of Total Enterobacteriaceae count (APHA 2001)

2.3.3. Determination of Total coliform count (ISO, 2004):

2.3.4. Isolation and identification of E. coli (ISO 2001):

2.3.4.1. Morphological examination:

2.3.4.1.1. Gram's Stain (Cruickshank et al., 1975)*:*

2.3.4.1.2. Motility test (Mac Faddin, 2000):

2.3.4.2. Biochemical identification of E. coli (Mac Faddin, 2000):

Indole, methyl red, voges proskaur, citrate utilization, hydrogen sulphide, Gelatin hydrolysis, urease, Eijkman, nitrate reduction and sugar fermentation tests were applied. Nutrient gelatin stab cultures were grown at room temperature and observed daily after cooling to about 18°C. *E. coli* showed a negative reaction.

2.3.4.3. *Serological Identification.*

2.3.5. Determination of Total count of S. aureus *(ISO, 2017):*

2.3.5.1. Morphological examination.

2.3.5.2. Biochemical identification.

2.3.6. Isolation and identification of Salmonellae (ISO 2001):

2.3.6.1. Morphological examination.

2.3.6.2. Biochemical identification.

2.3.6.3. Serological identification.

It was carried out according to Kauffman – White scheme for the determination of Somatic (O) and flagella (H) antigens using Salmonella antiserum (DENKA SEIKEN Co., Japan).

3. RESULTS AND DISCUSSION

Chicken meat contamination mostly occur during slaughter and processing stages due to contact of carcass mainly with intestinal content, feet, and feathers (Allerberger et al., 2003). Presence of large number of microorganisms in raw meat, there will be changes such that it becomes unfit for human consumption or even harmful to consumers. (Fung et al., 2010).

The total aerobic plate count gives an idea about hygienic measures applied through processing. For that, it is the most reliable method for detection of sanitary levels of proper processing, storage and marketing of food products.

The obtained results in APC in raw wings ,breast and thigh were 5.2×10^3 to4.2×10^7cfu with mean $4.0\times10^6 \pm 0.3\times10^6$, 5.3×10^3 to2.0×10^7 with mean $4.5\times10^6\pm0.5\times10^6$ and 6.1×10^3 to 3.3×10^7 with mean $5.7\times10^6\pm0.4\times10^6$, respectively. The result revealed high values than Mahmoud and Hamouda Seham (2006), Saikia and Joshi (2010), Rban and Fairoze (2011). Hassan-Ola (2015) and Fathy-Ola (2015) but higher values obtained with Chaiba et al. (2001), Vural et al. (2006), Saif et al. (2015) and Farhat et al. (2019).

The processing of carcass into more parts lead to further spread of contamination by exposing more carcass surface to contamination if the same cutting tables and knives are used. The obtained APC count for half cooked wings, breast and thigh were3.2×10^3 to$4.1 \times10^6$with mean $3.6\times10^5\pm 0.2\times10^5$,$4.8\times10^3to5.5\times10^6$with mean $5.1\times10^5 \pm 0.2\times10^5$ and 1.7×10^3 to 2.5×10^6 with mean $6.3\times10^5 \pm0.2\times10^5$, respectively. This obtained result is lower than that obtained from Shaltout (2006). and Saad et al. (2015). The contamination of half cooked chicken meat product samples may be due to inadequate sanitary condition during processing ,bad handling ,dirty equipment, polluted water, contaminated cold stores and temperature fluctuation during storage(Saad et al.,1989, Refaie et al., 1991,Farghaly 1998).

The obtained APC count in cooked wings, breast and thigh 1.3×10^2to2.2×10^4 with mean $1.7\times10^4\pm0.1\times10^4$,$1.7\times10^2$to 2.5×10^4 with mean $2.1\times10^4\pm0.2\times10^4$ and 2.1×10^2 to2.6×10^4 with mean $2.3\times10^4\pm0.2\times10^4$, respectively. Higher results obtained from Noha and Gehad (2005), Rady et al. (2011) and Fathy Ola (2014).

According to the safe permissible limit stipulated by EOS(2005)NO.(1651-2005)for APC in raw poultry products not exceed 10^5cfu /g , No.(3493-2005)for half cooked samples(heat treated products) not exceed 10^4 and No.(3493-2005) for cooked samples not exeed10^4,it was indicated that 20%, 30%, 20%, 30%, 40%, 40%, 10%,20% and 10% of the examined samples raw wing ,breast ,thigh, half cooked wing, breast ,thigh and cocked wing ,breast and thigh , respectively were not in accordance with this limit (Table 1).

Moreover, Enterobacteriaceae count in table (2) for raw samples (wing, breast and thigh)30×10 to35×10^5 with mean $32.3\times10^5\pm1.4\times10^5$, 15×10 to 27×10^5 with mean $18.0\times10^5\pm 1.7\times10^5$ and 22×10 to 35×10^5 with mean $24.3\times10^5\pm1.4\times10^5$, respectively. While for half cooked (wing, breast and thigh) were 22×10^4 to30×10^4 with mean $25.6\times10^4\pm2.3\times10^4$,$35\times10^4to42\times10^4$ with mean $38.7\times10^4\pm2.0\times10^4$ and 24×10^4 to35×10^4 with mean $30.7\times10^4\pm3.01\times10^4$, respectively.

Finally, the result of cooked samples (wings, breast and thigh) were 21×10^4 to26×10^4 with mean $23.7\times10^4\pm1.2\times10^4$,$30\times10^4$to 38×10^4 with mean $34.3\times10^4\pm2.0\times10^4$ and 12×10^4 to22×10^4 with mean $17.1\times10^4\pm1.1\times10^4$respectivelly.

The result is higher that obtained with Vural (2006), Nwar (2007) , El-Deeb et al. (2011) and Fathyola (2015). Enterobacteriaceae group has an epidemiological importance as some of its members are pathogenic and may cause serious infections and food poisoning to man. Moreover, the total Enterobacteriaceae count can be taken as indicative of possible enteric contamination in the absence of coliform bacteria (Pogorelova *et al.*, 1993). Consequently, the total Enterobacteriaceae count can be applied to monitor the hygienic level during handling of chicken meat products. The examined sample showed that raw chicken samples were more contaminated, and this may be due to exposure of samples to fecal contamination by worker's hands during evisceration.

The result obtained in table(3) for raw samples(wing, breast and thigh)were $12\times$ 10 to54×10^2 with mean 37.3×10^2 $\pm0.8\times10^2$,17×10 to$25\times10^2$with mean 21.6×10^2 $\pm2.4\times10^2$ and 19×10 to33×10^2 with mean 27.7×10^2 $\pm4.4\times10^2$, respectively.

Table 1 Statistical analytical results of Aerobic plate count (cfu/g) in examined chicken meat samples (n = 30).

Samples	No. of samples	Min.	Max.	Mean ± S.E.M*	MRL[1]	No . of positive samples	Accepted samples		Unaccepted samples	
							No.	%	No.	%
Raw samples										
Wings	10	5.2x10^3	4.2 x10^7	4.0^a x10^6 ±0.3 x 10^6	*10^5* *E..S 1651/2005*	10	8	80	2	20
Breast	10	5.3 x10^3	2.0 x10^7	4.5 ^{a} x10^6±0.5 x 10^6		10	7	70	3	30
Thigh	10	6.1 x10^3	3.3 x10^7	5.7 ^{a} x10^6±0.4 x 10^6		10	8	80	2	20
Half cooked samples										
Wings	10	3.2 x10^3	4.1 x10^6	3.6^b x10^5±0.2x 10^5	*10^4* *E..S 3493/2005*	10	7	57	3	30
Breast	10	4.8 x10^3	5.5 x10^6	5.1^a x10^5 ±0.2 x 10^5		10	6	50	4	40
Thigh	10	1.7 x10^3	2.5 x10^6	6.3^a x10^5 ±0.2 10^5		10	6	33	4	40
Cooked samples						10				
Wings	10	1.3 x10^2	2.2 x10^4	1.7^c x10^4±0.1 x 10^4	*10^4* *E..S 3493/2005*	10	9	86	1	10
Breast	10	1.7 x10^2	2.5 x10^4	2.1^b x10^4±0.2 x 10^4		10	8	80	2	20
Thigh	10	2.1 x10^2	2.6 x10^4	2.3^b x10^4±0.2 x 10^4		10	9	75	1	10

*S. E.M = Standard error of mean. ^{abcd} values within a column with different superscript letters were significantly different at ($P \leq 0.05$).

Table 2 Statistical analytical results of Enterobacteriaceae (cfu/g) in examined chicken meat samples (n = 30).

Samples	No. of samples	Min.	Max.	Mean ± S.E.M*	MRL[1]	No. of positive samples	Accepted samples		Unaccepted samples	
Raw samples							No.	%	No.	%
Wings	10	30x10	35x10^5	32.3^a x10^5 ±1.4 x10^5	*10^2* *C.F.S/2014*	10	5	50	5	50
Breast	10	15 x10	27x10^5	18.0 ^{b} x10^5 ±1.7 x10^5		9	7	70	3	30
Thigh	10	22 x10	35x10^5	24.3 ^{b} x10^5 ±1.4 x10^5		6	8	80	2	20
Half cooked samples										
Wings	10	22 x10	30x10^4	25.6 ^{b} x10^4±2.3 x10^4	*10^2* *C.F.S/2014*	4	8	80	2	20
Breast	10	35 x10	42x10^4	38.7^a x10^4±2.0 x10^4		6	9	90	1	10
Thigh	10	24 x10	35x10^4	30.7^b x10^4±3.01 x10^4		2	8	80	2	20
Cooked samples										
Wings	10	21 x10	26x10^4	23.7 ^{b} x10^4±1.2 x10^4	*10^2* *C.F.S/2014*	9	7	70	3	30
Breast	10	30 x10	38x10^4	34.3 ^{a} x10^4±2.0 x10^4		3	9	90	1	10
Thigh	10	12 x10	22x10^4	17.1^b x10^4±1.1 x10^4		5	8	80	2	20

*S. E.M = Standard error of mean. ^{abcd} values within a column with different superscript letters were significantly different at ($P \leq 0.05$).

While for half cooked samples 19×10 to 12×10^2 to with mean $10.3\times10^2\pm0.8\times10^2$,9×10 to 14×10^2 with mean $12.3\times10^2\pm0.8\times10^2$ and 12×10 to 16×10^2 with mean $14.0\times10^2\pm1.2\times10^2$, respectively. Moreover, for cooked (wing, breast and thigh) were 10×10 to 15×10^2 with mean $12.3\times10^2\pm 1.4\times10^2$,$9\times10$ to14×10^2 with mean $12.0\times10^2\pm$ 1.5×10^2 and 11×10 to20×10^2 with mean $15.3\times10^2\pm$ 2.6×10^2, respectively.

The obtained results nearly similar to obtained by Oumokhtar (2000) and Huong et al. (2009) but lower than obtained with Hegazy (1995), Javadi and Safaramashaei (2004), Vural et al. (2006) and Zakaria-Marwa (2015).

Detection of coliform is used as a general indicator of sanitary condition in food-processing environment or indication of water pollution (Feng et al., 2002).

The contamination with coliforms may occur during slaughtering, cutting, or dressing of carcasses. Soiled hands, shopping blocks or knives used for handling and cutting, or contaminated water were considered as sources of coliforms in meat (Yadav et al., 2006). Therefore, the results obtained in table (4&5) for raw samples revealed that wings with an incidance20%,the two strains isolated were O_{55}:H_7 and O_{125}:H_{18},(10%) for breast sample with serotype O_{55}:H_7 and for thigh (30%)with strains O_{114}:H_{21} and O_{125}:H_{18}.

Half cooked showed that wings 10% with strain O_{125}:H_{18}, breast (10%) with strain O_{114}:H_{21} and for thigh 20%with strains O_{114}:$H_{21}$and O_{55}:H7

The result is nearly to obtained by Hossam (2012), higher than obtained by Lee et al. (2009) and the higher result obtained by Huong et al (2009), Zakaria-Marwa (2015) and Hassan Ola (2015). The presence of *E. coli* in the examined samples is an indicator for unhygienic conditions. *E. coli* strains are normal commensals in gut of animals so the carcass may be contaminated with these bacteria during slaughter process. Manual evisceration and unsatisfactory hygienic measures of handling and processing are the mean reasons for contamination of chicken meat with E. coli (Whyte et al., 2014). Furthermore, results recorded in table (6) showed that raw wings were infected with 10%by strain *S. Enteritidis* . This strain considered as one of main reasons of food borne outbreaks throughout the world (Herikstad et al., 2002).

Table 3 Statistical analytical results of total coliforms (cfu/g) in examined chicken meat samples (n = 30).

Samples	No. of samples	Min.	Max.	Mean ± S.E.M*	MRL[1]	No. of positive samples	Accepted samples		Unaccepted samples	
Raw samples							No.	%	No.	%
Wings	10	12 x10	54 $x10^2$	37.3^a $x10^2$±0.8 $x10^2$	10^2 E..S 1651/2005	9	6	60	4	40
Breast	10	17 x10	25 $x10^2$	21.6 ^{a} $x10^2$±2.4 $x10^2$		4	9	90	1	10
Thigh	10	19 x10	33 $x10^2$	27.7^a $x10^2$±4.4 $x10^2$		7	6	60	4	40
Half cooked samples										
Wings	10	19 x10	12 $x10^2$	10.3 ^{b} $x10^2$±0.8 $x10^2$	10^2 E..S 3493/2005	3	9	90	1	10
Breast	10	9 x10	14 $x10^2$	12.3^b $x10^2$±0.8 $x10^2$		2	8	80	2	100
Thigh	10	12 x10	16 $x10^2$	14.0 ^{b} $x10^2$±1.2 $x10^2$		4	8	80	2	20
Cooked samples										
Wings	10	10 x10	5 $x10^2$	12.3 ^{b} $x10^2$±1.4 $x10^2$	10^2 E..S 3493/2005	2	9	90	1	10
Breast	10	9 x10	14 $x10^2$	12.0 ^{b} $x10^2$±1.5 $x10^2$		1	10	100	-	-
Thigh	10	11 x10	20 $x10^2$	15.3 ^{b} $x10^2$±2.6 $x10^2$		1	10	100	-	-

*S. E.M = Standard error of mean. ^{abcd} values within a column with different superscript letters were significantly different at ($P \leq 0.05$).

Table 4 Incidence of *E. coli* isolated from examined chicken meat samples(n=30)

Samples	No. of positive samples	Accepted samples		Unaccepted samples	
Raw samples		No.	%	No.	%
Wings	2	-	-	2	20
Breast	1	-	-	1	10
Thigh	3	-	-	3	30
Half cooked samples					
Wings			-		10
Breast	1	-	-	1	10
Thigh	2	-	-	2	20
Cooked samples					
Wings	-	-	-	-	
Breast	-	-	-	-	
Thigh	-	-	-	-	

Table 5 Serotyping of E. coli isolated examined chicken meat samples(n=30)

E.coli strains	Raw chicken samples			Half treated chicken samples			Strain characteristics
	wings	breast	thigh	wings	breast	thigh	
O114 : H21	-	-	1	-	1	1	EPEC
O55 : H7	1	1	-	-	-	1	EPEC
O125 : H18	1	-	2	1	-	-	ETEC
Total	2	1	3	1	1	2	

EPEC = Enter pathogenic *E. coli* **ETEC** = Enter toxigenic *E. coli*

The presence of these pathogens may be due to contamination during processing or due to poor handling (Kagambega et al., 2012). Principal sources of Salmonella organisms are dust, food handlers, pet animals, insects, rodents, birds and the air (Wabec, 2002).

The presence of Salmonella in chicken meat may be attributed to contamination during slaughtering and / or processing from worker's hands (Cardoso *et al*., 1997). Organic matters scattered on the bird surface may harbor Salmonella and act as a source of contamination to scalding tanks, therefore, facilitate cross contamination

between chicken. Rubber fingers of plucking machine may have several cracks carrying organic matter and act as source of cross- contamination between chickens moreover, during evisceration step cross-contamination may occur through escape of gut content (Berrang *et al*., 2011).

The higher result obtained from Ruban et al. (2010), Nawar (2007) and Ruban and Fairoze (2011). Lower results obtained by Samaha et al. (2012) and Zaki et al., 2013).

The results recorded in table (7) revealed that raw samples (wings, breast and thigh) ranged from 18×10 to25×10^2 with mean $21.7\times10^2\pm2.0\times10^2$, 15×10 to 33×10^2 with mean $24.0\times10^2\pm5.2\times10^2$ and 17×10 to 31×10^2 with mean 25.3×10^2 to 4.2×10^2, respectively.

While for half cooked wings, breast and thigh were 12×10 to 51×10^2 with mean $47.3\times10^2\pm2.7\times10^2$,11×10 to 45×10^2 with mean $41.7\times10^2\pm2.0\times10^2$and 15×10 to 56×10^2 with mean $50.0\times10^2\pm3.2\times10^2$, respectively.

Meanwhile, for cooked wings, breast and thigh 8×10 to24×10 with mean 22.3×10±0.9×10.5×10 t0 15×10 with mean 12.3×10±1.5×10 and 6×10 to 17×10 with mean14.7±1.2×10. Higher results were obtained from Cohen et al. (2007) and HeetunIrfan (2015) but lower results were obtained by Kozacinski et al. (2006).

Staphylococcus aureus was recognized as the second most common pathogen isolated from food samples (Hotee, 2011). Chicken meat becomes contaminated with Staphylococcus, usually through expulsion of these organisms into the air by infected humans through sneezing, coughing, breathing or talking (Wabeck, 2002).

Moreover, the results reported in table (8) for total yeast and mould count regarding for raw breast and thigh to 15×10 to 40×10 with mean 20.3×10±1.0×10 and 25×10 to 63×10 with mean 41.2×10±1.2×10, respectively. According to E.S five samples of raw breast were unaccepted, and 3 samples of raw thigh were unaccepted. The half cooked and cooked samples were less than 10 for all examined samples. Yeast and mould present normally in nature. The ability of the yeast species to grow at low temperatures. Yeasts may play a more significant role in the spoilage of poultry meat products (Deak, 2001).

Table 6 Incidence of *Salmonella* isolated from examined breast and thigh samples (n=30)

samples	No. of samples	MRL[1]	No . of positive samples	Accepted samples		Unaccepted samples		Salmonella strain
				No.	%	No.	%	
Raw samples								
Wings	10		1	9	90	1	10	*S. Enteritidis* O 1,4,5,12 H i : 1,2
Breast	10	free E.O.S 1651/2005	-	10	100	-	-	-
Thigh	10		-	10	100	-	-	-
Half cooked samples								-
Wings	10		-	10	100	-	-	-
Breast	10	free E.O.S 3493/2005	-	10	100	-	-	-
Thigh	10		-	10	100	-	-	-
Cooked samples			-	10	100	-	-	-
Wings	10		-	10	100	-	-	-
Breast	10	free E.O.S 3493/2005	-	10	100	-	-	-
Thigh	10		-	10	100	-	-	-

Table 7 Statistical analytical results of Total *staphylococcus aureus* (cfu/g) in examined chicken meat samples (n = 30)

Samples	No. of samples	Min.	Max.	Mean ± S.E.M*	MRL[1]	No. of positive samples	Accepted samples		Unaccepted samples	
							No.	%	No.	%
Raw samples										
Wings	10	18 x10	25 x10^2	21.7 [b] x10^2±2.0 x10^2		10	3	0	7	70
Breast	10	15 x10	33 x10^2	24.0 [b] x10^2±5.2 x10^2	<10^2 E..S 1651/2005	7	8	80	2	20
Thigh	10	17 x10	31 x10^2	25.3 [b] x10^2±4.2 x10^2		9	3	30	7	70
Half cooked samples										
Wings	10	12 x10	51 x10^2	47.3 [a] x10^2±2.7 x10^2		10	5	50	5	50
Breast	10	11 x10	45 x10^2	41.7 [a] x10^2±2.0 x10^2	<10^2 E..S 3493/2005	5	7	40	3	30
Thigh	10	15 x10	56 x10^2	50.0 [a] x10^2±3.2 x10^2		8	6	50	4	40
Cooked samples										
Wings	10	8 x10	24 x10	22.3 [b] x10±0.9 x10		3	9	90		10
Breast	10	5 x10	15 x10	12.3 [c] x10±1.5 x10	<10^2 E..S 3493/2005	2	10	100	-	-
Thigh	10	6 x10	17 x10	14.7[b]x10±1.2 x10		1	10	100	-	-

*S. E.M = Standard error of mean. [abcd] values within a column with different superscript letters were significantly different at ($P \leq 0.05$).

Table 8 Statistical analytical results of Total yeast and mould (cfu/g) in examined chicken meat samples (n =30)

Samples	No. of samples	Min.	Max.	Mean ± S.E.M*	MRL[1]	No. of positive samples	Accepted samples		Unaccepted samples	
							No.	%	No.	%
Raw samples					Free					

wings	10	< 10	< 10	-	E..S 1651/2005	-	10	100	-	-
Breast	10	15 x10	40 x10	20.3 [a] x10 ±1.0 x10		5	5	50	5	50
thigh	10	25 x10	63 x10	41.2 [a] x10 ±1.2 x10		3	7	70	3	30
Half cooked samples										
Wings	10	< 10	< 10	-	Free E..S 1651/2005	-	10	100	-	-
breast	10	< 10	< 10	-		-	10	100	-	-
thigh	10	< 10	< 10	-		-	10	100	-	-
Cooked samples										
Wings	10	< 10	< 10	-	Free E..S 1651/2005	-	10	100	-	-
breast	10	< 10	< 10	-		-	10	100	-	-
thigh	10	< 10	< 10	-		-	10	100	-	-

*S. E.M = Standard error of mean. MRL[1] Maximum permissible limit [a] values within a column with different superscript letters were no significantly different at (P > 0.05).

4. CONCULOSION

It could be concluded that, the half-cooked chicken meat samples contamination is more than raw and cooked samples that may be due to contamination of meat itself used in manufacture, inadequate sanitary condition during processing, bad handling, dirty equipment, polluted water, contaminated cold stores and temperature fluctuation during storage

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