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Bacteriological Profile of Chicken Meat Products

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ABSTRACT

A total of 90 random samples of semi-cooked chicken Pane, Nuggets and Strips products (30 samples of each) were collected from different supermarkets in different districts at Monofia governorate for determination of their bacteriological aspects. The obtained results indicated that the mean values of total bacterial count, total Enterobacteriace and total coliforms counts/g in the examined samples were $4.25 \times 10^6 \pm 1.40 \times 10^6$, $5.47 \times 10^4 \pm 1.98 \times 10^4$ and $8.32 \times 10^3 \pm 3.33\times 10^3$ for pane, $7.12 \times 10^6 \pm 2.11 \times 10^6$, $6.58 \times 10^4 \pm 1.98 \times 10^4$ and $6.87 \times 10^3 \pm 2.00 \times 10^3$ for Nuggets and $5.96 \times 10^6 \pm 1.49 \times 10^6$, $6.19 \times 10^4 \pm 1.30 \times 10^4$ and $5.49 \times 10^3 \pm 2.00 \times 10^3$ for Strips, respectively. Furthermore, *Staphylococcus aureus*, *E. coli* and Salmonella could be detected in examined sample with different percentages. The public health significances of isolated bacteria were discussed.

Keywords: Chicken pane, Chicken nuggets, Chicken strips, Salmonella, *E. coli*, *Staphylococcus aureus*

INTRODUCTION

Chicken and chicken products provide animal protein of high biological value for consumers at all ages, where they contain all the essential amino acids required for human growth, higher proportion of unsaturated fatty acids and less in cholesterol value. Moreover, chicken meat is not only highly susceptible to spoilage, but also frequently implicated in the spread of food-borne diseases. During the various stages of slaughter and processing, all potential edible tissues are subjected to contamination from a variety of sources within and outside the animal [1]. Increased consumer awareness and concern about microbial food borne diseases has resulted in intensified efforts to reduce contamination of chicken meat products, as evidenced by new meat and poultry inspection regulation. Moreover, requiring operation of poultry slaughtering and processing plant under the principle of the hazard analysis critical control point (HACCP) system, the new regulation has established microbiological testing criteria for *E. coli* and Salmonella, as methods of evaluation plant performance [2]. Therefore, the present investigation was planned out to throw light on the bacteriological profile of the examined samples of chicken meat products.

MATERIALS AND METHODS

Collection of samples

A total of 90 random samples of chicken meat products pane, nuggets and strips, (30 of each) were collected from different super markets located in Menofia governorate for bacteriological examination. The weight of each sample was about 50 g and each sample was collected and kept in separated sterile plastic bag and put in an icebox and transferred to laboratory under complete aseptic conditions without undue delay to evaluate their bacteriological quality and evaluate the hygienic health hazard of contaminated with some food borne pathogens.

Bacteriological examination

Total bacterial count (aerobic plate count): Determination of aerobic plate count was carried out according to the method recommended by ICMSF (1996) [3].

Total Enterobacteriaceae count: The total Enterobacteriaceae count was done by plating on violet red bile glucose agar medium at 37°C for 24 h through the

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method recommended by ISO (2004) [4].

Total Coliforms count: The total coliform count was done by plating on violet red bile agar medium at 37°C for 24 h through the method recommended by ICMSF (1996) [3].

Isolation and identification of *Staphylococcus aureus*:

Total Staphylococci count: The total Staphylococcus count was done by plating on Baird Parker agar plate at 37°C for 48 h through the method recommended by ICMSF (1996) [3].

Identification of *Staphylococci* spp.:

- Morphological examination recommended by Cruickshank et al. [5].
- Biochemical identification recommended by MacFaddin [6].

Isolation and identification of *E. coli*: Isolation was done according to the methods recommended by ICMSF (1996) [3] and identification was done through the following:

- Morphological identification [5].
- Biochemical identification [7].
- Serological identification [8] by using rapid diagnostic *E. coli* antisera sets (DENKASEIKEN Co., Japan) for diagnostic enteropathogenic types.

Isolation and identification of Salmonella:

Identification of Salmonellae: Suspected isolates of Salmonella organisms were identified according to MacFaddin [6].

Serological identification of Salmonellae: Serological identification of Salmonellae was carried out according to Kauffman-White scheme [9] for the determination of Somatic (O) and flagellar (H) antigens using Salmonella antiserum (DENKA SEIKEN Co., Japan).

Statistical analysis

The obtained results were statistically evaluated by application of Analysis of Variance (ANOVA) test according to Feldman et al. [10].

RESULTS AND DISCUSSION

In recent years there is great awareness of food poisoning and how such is of great public health hazards and this is due to consumption of food especially poultry meat and its products contaminated with various hazards kinds of microorganisms from different sources starting from the chicken carcass itself and throughout the processing plant and their products, in the latest many efforts were made to produce food products free from those microbial hazards and of high quality to be fit for human consumption.

It is evident from the result recorded in **Table 1** that the total APC in the examined samples was varied from 2.00×10^2 to 2.40×10^6 cfu/g in chicken Pane, 1.00×10^4 to 3.00×10^6 cfu/g in chicken Nuggets and 1.60×10^5 to 3.00×10^6 cfu/g in chicken Strips with mean value of $4.25\times 10^5 \pm 1.40 \times 105$ cfu/g for chicken Pane, 7.12×10^5 to 2.11×10^5 cfu/g for chicken Nuggets and 5.96×10^5 to 1.49×10^5 cfu/g for chicken strips.

Table 1. Statistical analytical results of total bacterial counts (CFU/g) (APC) in the examined samples (n=30).

Products	Min.	Max.	Mean ± S.E.M.	S.D
Chicken Pane	2.00×10^2	2.40×10^6	$4.24 \times 10^6 \pm 1.40 \times 10^6$	7.66×10^6
Chicken nuggets	1.60×10^4	3.00×10^6	$7.12 \times 10^6 \pm 2.11 \times 10^6$	1.15×10^7
Chicken Strips	1.60×10^5	3.00×10^6	$5.96 \times 10^6 \pm 1.49 \times 10^6$	8.17×10^6

In other words, there is a no significant difference of total APC between the examined chicken pane, chicken nuggets and chicken strips (P>0.05).

Nearly similar results for chicken products were obtained by Hassan [11] and Mohamed [12]. But this results are higher than which obtained by Shaltout [13], Sengupta et al. [14], Ahmed et al. [15], Ibrahim et al. [16], Marwan [17] and Elsayed [18].

The results in **Table 2** indicated that the total Enterobacteriacae count in the examined samples was ranged from 6.00×10 to 3.00×10^4 with an average value of $5.47 \times 10^4 \pm 1.80 \times 10^4$ cfu/g for chicken Pane, 8.00×10^2 to 3.00×10^4 with an average value of $6.58 \times 10^4 \pm 1.98 \times 10^4$ cfu/g for chicken Nuggets and 8.00×10^2 to 2.40×10^4 with an average value of $6.19 \times 10^4 \pm 1.30 \times 10^4$ cfu/g for chicken strips.

Table 2. Statistical analytical results of total Enterobacteriace counts (CFU/g) in the examined samples (n=30).

Products	Min.	Max.	Mean ± S.E.M.	S.D
Chicken Pane	6.00×10^2	3.00×10^4	$5.47 \times 10^4 \pm 1.98 \times 10^4$	9.85×10^4
Chicken nuggets	8.00×10^2	3.00×10^4	$6.58 \times 10^4 \pm 1.98 \times 10^4$	1.98×10^4
Chicken Strips	8.00×10^2	2.40×10^4	$6.19 \times 10^4 \pm 1.30 \times 10^4$	7.12×10^4

In other words, there is a no significant difference of total Enterobacteriace between the examined chicken pane, chicken nuggets and chicken strips (P>0.05).

Nearly similar results for chicken products were obtained by Vural et al. [19] and Marwan [17]. But this results are higher

than which obtained by Shaltout [13], Kozačinski et al. [1] and Nawar [20] and lower than which obtained by Osman [21] and Saikia and Joshi [22].

The results in **Table 3** indicated that the total coliform count in the examined samples was ranged from 1.70 × 10 to 9.00 × 10^3 with an average value of 8.32 × 10^3 ± 3.33 × 10^3 cfu/g for chicken Pane, 8.00 × 10 to 3.00 × 10^3 with an average value of 6.87 × 10^3 ± 2.00 × 10^3 cfu/g for chicken Nuggets and 8.00 × 10^2 to 3.00 × 10^3 with an average value of 5.49 × 10^3 ± 2.00 × 10^3 cfu/g for chicken strips.

Table 3. Statistical analytical results of coliform counts (CFU/g) in the examined samples (n=30).

Products	Min.	Max.	Mean ± S.E.M.	S.D
Chicken Pane	1.70 × 10^2	9.00 × 10^3	8.32 × 10^3 ± 3.33 × 10^3	1.82 × 10^3
Chicken nuggets	8.00 × 10^2	3.00 × 10^3	6.87 × 10^3 ± 2.00 × 10^3	1.09 × 10^3
Chicken Strips	8.00 × 10^2	3.00 × 10^3	5.49 × 10^3 ± 2.00 × 10^3	1.10 × 10^3

In other words, there is a no significant difference of total Coliform between the examined chicken pane, chicken nuggets and chicken strips (P>0.05).

The current results were nearly similar to those obtained by Cohen et al. [23] and Nawar [20]. These results are higher than which obtained by Javadi and Safarmashaei [24], Ruban and Fairoze [25], but lower than which obtained by Ibrahim et al. [16], Hassan [11] and Marwan [17].

Results achieved in **Table 4** declared that the Staphylococus count ranged from 1.20 × 10 to 2.00 × 10^3 with mean value 2.99 × 10^3 ± 9.82 × 10^3 for Pane, 2.00 × 10 to 3.00 × 10^3 with mean value 6.41 × 10^3 ± 1.9 × 10^4 for Nuggets and 8.00 × 10 to 3.00 × 10^3 with mean value 1.06 × 10^3 ± 2.26 × 10^3 for Strips.

Table 4. Statistical analytical results of total Staphylococcus counts (CFU/g) in the examined samples (n=30).

Products	Min.	Max.	Mean ± S.E.M.	S.D
Chicken Pane	1.20 × 10^2	2.00 × 10^3	2.99 × 10^3 ± 9.82 × 10^3	5.38 × 10^3
Chicken nuggets	2.00 × 10^2	3.00 × 10^3	6.41 × 10^3 ± 1.90 × 10^4	1.08 × 10^3
Chicken Strips	8.00 × 10^2	3.00 × 10^3	1.06 × 10^3 ± 2.26 × 10^3	1.24 × 10^3

In other words, there is a highly significant difference of Total Staphylococcus between the examined samples pane, nuggets and strips ($p \leq 0.01$).

These results are come in agreement with Abbas [26], Ibrahim et al. [27], Saif [28], Mohamed [12] and Elsayed [18]. These results are higher than which obtained by Sengupta et al. [29], but lower than results which obtained by Marwan [17].

The result obtained in the **Table 5** showed that 42 isolates of Coagulase positive *S. aureus* were isolated from examined chicken meat samples represented as 17 (56.60%) from pane samples, 13 (43.30%) from nuggets samples and 12 (40.00%) from strips samples.

Table 5. Incidence of coagulase positive *S. aureus* in examined samples (n=30).

Sample	No.	Positive	
		No.	%
Pane Chicken	30	17	56.60%
Chicken Nuggets	30	13	43.30%
Chicken Strips	30	12	40.00%
Total	90	42	46.60%

These results came in accordance with those obtained by Mohamed et al. [30] and Ali [31]. These results are lower than which obtained by Buyukcangaz et al. [32], Ahmed [33] and Elsayed [18]. But higher than results which obtained by Kozacins et al. [34], Abo-Samra [35], Abd El-Fattah [36] and Marwan [17].

The results in **Table 6** revealed that the incidence of *E. coli* was 46.6%, 36.6% and 30% of examined samples of chicken pane, nuggets and strips, respectively. This results is nearly similar to which obtained by Rashid et al. [37] 40%, Ibrahim et al. [24] 33.33% and Hemeda [38] 44%. This results were lower than which obtained by Saikia and Joshi [22] 98% and

Ruban et al. [39] 85.7%, but higher than Samaha et al. [40] 12% and Hasanin et al. [41] 15%.

Table 6. Incidence of *E. coli* in examined samples (n=30).

Sample	No.	Positive	
		No.	%
Pane	30	14	46.60%
Nuggets	30	11	36.60%
Strips	30	9	30.00%
Total	90	34	37.70%

The results in **Table 7** showed that the incidence of serologically identified *E. coli* in Pane, as Enteropathogenic *E. coli* (*E. coli* O_{78} (13.3%), *E. coli* O_1:H_7 (3.3%) and *E. coli* O_2:H_{11} (6.6%), Enterotoxogenic *E. coli* (*E. coli* O_{128}:H_2 (6.6%), Enterheamorrhagic *E. coli* (*E. coli* O_{91}:H_{21} (6.6%) and *E. coli* O_{26}:H_{11} (3.3%) and enteroinvasive *E. coli* (*E. coli* O_{114}:H_4 (3.3%) and *E. coli* O_{124} (3.3%)).

Table 7. Incidence and serotyping of *E. coli* isolated from positive samples of pane products (n=30).

Sample	Pane		Strain Characteristics
***E. coli* serotyping**	**No.**	**%**	
O_{78}	4	13.30%	EPEC
O_{128}:H_2	2	6.60%	ETEC
O_{114}:H_4	1	3.30%	EIEC
O_1:H_7	1	3.30%	EPEC
O_{91}:H_{21}	2	6.60%	EHEC
O_{26}:H_{11}	1	3.30%	EHEC
O_2:H_6	2	6.60%	EPEC
O_{124}	1	3.30%	EIEC
Total	14	46.60%	------

The results in **Table 8** revealed that the incidence of serologically identified E. coli in Nuggets, as Enteropathogenic *E. coli* (*E. coli* O_{78} (6.6%), *E. coli* O_1:H_7 (3.3%) and *E. coli* O_2:H_6 (3.3%), *E. coli* O_{55}:H7 (3.3%) and *E. coli* O_{146}:H_{21} (3.3%) , Enterotoxogenic *E. coli* (*E. coli* O_{128}:H_2 (3.3%), Enterheamorrhagic *E. coli* (*E. coli* O_{91}:H_{21} (6.6%) and *E. coli* O_{26}:H_{11} (3.3%) and *E. coli* O_{121}:H_7 (3.3%).

Table 8. Incidence and serotyping of *E. coli* isolated from positive samples of nuggets products (n=30).

Sample	Nuggets		Strain Characteristics
***E. coli* serotyping**	**No.**	**%**	
O_{78}	2	6.60%	EPEC
O_{128}:H_2	1	3.30%	ETEC
O_{91}:H_{21}	2	6.60%	EHEC
O_{26}:H_{11}	1	3.30%	EHEC
O_2:H_6	1	3.30%	EPEC
O_1:H_7	1	3.30%	EPEC
O_{55}:H_7	1	3.30%	EPEC
O_{140}:H_{21}	1	3.30%	EPEC
O_{121}:H_7	1	3.30%	EHEC
Total	11	36.60%	--------

The results in **Table 9** showed that the incidence of serologically identified E. coli in strips as enteropathogenic *E. coli* (*E. coli* O_{78} (3.3%), *E. coli* O_1:H_7 (3.3%), *E. coli* O_{146}:H_{21} (3.3%) and *E. coli* O_{163}:H_2 (6.6%), Enterotoxogenic *E. coli* (*E coli* O_{128}:H_2 (3.3%), Enterheamorrhagic *E. coli* (*E. coli* O_{121}:H_7 (3.3%) and *E. coli* O_{91}:H_{21} (3.3%).

Table 9. Incidence and serotyping of *E. coli* isolated from positive samples of strips products (n=30).

Sample	Strips		Strain Characteristics
***E. coli* serotyping**	**No.**	**%**	
O_{163}:H_2	2	6.60%	EPEC
O_{146}:H_{21}	1	3.30%	EPEC
O_{121}:H_7	1	3.30%	EHEC
O_1:H_7	2	6.60%	EPEC
O_{78}	1	3.30%	EPEC
O_{91}:H_{21}	1	3.30%	EHEC
O_{128}:H_2	1	3.30%	ETEC
Total	9	30.00%	-------

Tables 10-12 revealed that the incidence of Salmonella in examined samples of chicken pane, chicken nuggets and chicken strips were 20%, 16.60% and 6.60%, respectively. This agrees with those reported by Saikia and Joshi [22] 12.37%, Kozacins et al. [34] 7.4%, Khallaf et al. [42] 12.66% and El-Gayar [43] 16% in pane and 8% in nuggets. This results were lower than those reported by Ruban et al. [39] 65.71%, Bhandari et al. [44] 46.2% and Ibrahim et al. [16] 33.33%, but the results were higher than those reported by Colmegna et al. [45] 4.7% and Hemeda [38] 4%.

Table 10. Incidence of identified Salmonella serotypes isolated from examined samples of pane products (n=30).

Sample	Pane			Antigenic Structure	
Isolated bacteria	**No.**	**%**	**Group**	**O**	**H**
S. tsevie	1	3.30%	B	4,5	i:e,n,Z_{15}
S. kentucky	2	6.60%	C3	8,20	i:Z_6
S. typhimurium	1	3.30%	B	1,4,5,12	i:1,2
S. apeyeme	1	3.30%	C3	8,20	Z_{38}:-
S. enteritidis	1	3.30%	D1	1,9,12	g,m:-
Total	6	20.00%	--------	--------	--------

Table 11. Incidence of identified Salmonella serotypes isolated from examined samples of nuggets products (n=30).

Sample	Nuggets			Antigenic Structure	
Isolated bacteria	**No.**	**%**	**Group**	**O**	**H**
S. larochelle	1	3.30%	C1	6,7	e,h:1,2
S. typhimurium	2	6.60%	B	1,4,5,12	i:1,2
S. kentucky	1	3.30%	C3	8,20	i:Z_6
S. tsevie	1	3.30%	B	4,5	i:e,n,Z_{15}
Total	5	16.60%			

Table 12. Incidence of identified Salmonella serotypes isolated from examined samples of strips products (n=30).

Sample	Nuggets			Antigenic Structure	
Isolated bacteria	**No.**	**%**	**Group**	**O**	**H**
S. kentucky	1	3.30%	C3	8,20	i:Z_6
S. enteritids	1	3.30%	D1	1,9,12	g,m:-
Total	2	6.60%			

CONCLUSION

Salmonella could be identified serologically as *Salmonella typhimurium* (3.3%) in Pana and (6.6%) in Nuggets, *Salmonella enteritidis* (3.3%) in Pana and Strips, *Salmonella tsevie* (3.3%) in Pana and Nuggets, *Salmonella kentucky* (6.6%) in Pana and (3.3%) in Nuggets and Strips. While, *Salmonella apeyeme* isolated only from Pana with percentage (3.3%) and *Salmonella larochelle* (3.3%) in Nuggets. These results were in agreement with that of Nawar [20] and Ibrahim et al. [16] who found that the isolated Salmonella was serologically identified as *S. typhimurium*, *S. enteritidis* and *S. kentucky*. Chicken meat products were highly contaminated with food poisoning bacteria [46,47].

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