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Safety and Quality of Ready to Eat Chicken Meat products

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ABSTRACT

Contamination of ready-to-eat (RTE) chicken products with food borne pathogens remains an important public health issue, because it can lead to illness if there are mal practices during slaughtering, eviscerating, washing, handlingand subsequently preparation by cocking. Therefore, this study focused on the safety of some ready to eat chicken products during the preparation in terms of sensory attributes, chemical parametersfor detection of freshness and bacterialload. The samples were collected from different restaurants in Cairo andGiza Governorate. The research study focused on ten specificproducts including chicken shawerma, grilled chicken, chicken pane, shish tawoak, chicken fajita, chicken burger, chicken salad, chicken mandy, fried chicken and finally pop chicken. The bacteriological criteria used for integrity of the tested products were as follows:Aerobic Plate Count (APC), Enterobacteriaceae, coliformsand Staph. aureuscounts. The present studyindicated that the examined chicken salad was the most contaminated products in terms of APC, Enterobacteriaceae, coliforms and Staph. aureuscounts ($1.094x10^6 \pm 8.81x10^5$, $1.696x10^2 \pm 4.82x10$, $1.183x10^4 \pm 4.65x10^3$ and 30.0±21.34cfu/g)respectively. On the contrary, the lowest bacterial load of the aforementioned bacterial counts was recorded for fried chicken ($5.78x10^4 \pm 3.1x10^4$, <3, $3.1x10^2 \pm 43.33$ and <10 cfu/g), respectivelyfollowed by pop chicken products which recorded ($1.797x10^4 \pm 9.34x10^3$, <3, $2.20x10^2 \pm 72.7$ and <10 cfu/g), respectively. From these results, it was cleared that five chicken products(Salad, pane, shish tawoak, fajita and chicken burger)had higher mean values of bacteriological analysis, but still within the accepted range concerning APC as defined by Public Health Laboratory Service **(PHLS)(2000)** regarding judgment of RTE meals.Chemical characters were within the permissible limits. Moreover, sensory attributes and the reflection of microbial counts on the consumer and public health were discussed.

(Keywords: RTE chicken meals, PHLS, APC, Coliforms, Enterobacteriaceae)

Introduction

Ready- to-eat food products provide a source of readily available and nutrition meals for the consumers. However, questions have been raised about the safety and microbiological quality of these food products. In this respect, 12% of children (aged 2-16 years), 16% of adults (aged 17-69 years) and 13% of people aged 70 and above reported consumption of cooked chicken meat in the 1995 National Nutrition Survey(**McLennan and Podger, 1999**). Australian National Children's Nutrition and Physical Activity Survey 2007 reported that 33% of children (aged 2-16 years) reported consumption of cooked chicken meat (**DOHA, 2008**).It has been agreed that the product quality has a multidimensional nature including performance, durability, reliability, conformity, consistency, etc. (**Munoz et al., 1992 and Lawless, 1995**).After appearance and tenderness characteristics, flavour is considered the most important characteristic feature of meat quality perceived by the consumer (**Love, 1994 and Sow and Grongnet, 2010**).The importance of sensory evaluation for product development and for quality control has been reported extensively. However, the average acceptability scores of consumer responses have not been sufficiently meaningful for companies to understand the level of the product's sensory quality despite using different scales such as the 5-point hedonic scale, 7 or 9-point hedonic scale, and so on. (**Imm et al., 2009; Etaio et al., 2010 andImm et al., 2010**).Susceptibility of chicken meat and chicken-based meat products to microbial spoilage, presents a potential health hazard, since poultry meat may harbor pathogenic microorganisms (**Georgnaras et al., 1998**). Spoilage is commonly detected by sensory and/or microbiological analysis (**Dainty, 1996**). Poultry and poultry products have become a common food for humans in developing countries and they are often sold in streetrestaurants.Ready-to-eat cooked meat products are recognized to be contaminated during slicing which has been associated with several outbreaks (**Perez et al., 2010**).As any perishable meat, fish or poultry, bacteria can be found on raw or undercooked chicken. They multiply rapidly at temperatures between 4.4 °C and 60 °C out of refrigeration and before thorough cooking, occur. Freezing does not kill bacteria butonlythorough cooking destroys them. **USDA's Food Safety and Inspection Service (FSIS) (2012)**has a zero tolerance for

certain pathogens, including Salmonella and L. monocytogenes, in cooked and ready-to-eat products, such as chicken franks or lunch meat, that can be eaten without further cooking. Most food-borne illness outbreaks are a result of improper handling or contamination when meals are prepared. Sanitary food handling and proper cooking and refrigeration should prevent food-borne illnesses. Aerobic Plate Count and Enterobacteriaceae counts are considered as indication of bacteriological quality, which give an idea about the hygienic measures adopted during further processing and help in assuring the keeping quality of further processed chicken meat products **(Aberle et al., 2001 and Mohamed et al., 2015).**Detection of freshness is very important through conducting required chemical analysis of cocked and uncooked processed chicken meat products to ensure compliance of such products with national or international standard legal requirements **(Beckers, 1998 and Ibrahim, et al., 2014).**Staph. aureusare carried on human hands, in nasal passages, or in throats. The bacteria are found in foods made by hand and then improperly refrigerated, such as chicken salad. Staphylococcus aureus plays a great role in bacterial contamination of fast and RTE foods, because workers during preparation and processing may touch fast foods, which are usually eaten without sufficient cooking or heating **(Soliman, 1988).**Staphylococcus aureus have been implicated in cases of severe diarrhea as well as the main cause of food poisoning gastroenteritis among consumers **(Davies and Board, 1998 and Eidet al., 2014).Mulla (2002)** established that the increase in thiobarbeturic acid (TBA) value, resulted in the presence of detectable unaccepted flavor and lower degree of acceptability of poultry processed products. Fat oxidation was due to prolonged storage or due to the use of low quality meat in the processing of such products. Therefore, the present work planned out to assure the sensory, chemical and bacteriological quality of some RTE chicken products randomly collected from different supermarkets in Cairo and Giza Governorates.

Material and Methods

A grand total of 100 random samples of RTE chicken products including chicken shawerma, grilled chicken, chicken pane, shish tawoak, chicken fajita, chicken burger, chicken salad, chicken mandy, fried chicken and finally pop chicken(ten samples each)were collected from different restaurants in Cairo and Giza Governorates and aseptically transferred in its original containers without delay to the laboratory and subjected to the following examinations:

I.Analysis of sensory attributes:

Collected samples were examined in terms of their appearance, color, taste, flavor, consistency and juiciness using9 points hedonic scale as (1) was dislike extremely and (9) was liked extremely. Panel team formed from 1-12 members (Food Hygiene Department, Animal Health Research Institute) with experience with RTE chicken products were examined the RTE chicken products by using 9 point hedonic scale according to **Anna. 1998.**

II.Bacteriological examination:

Culture media used in this study was prepared, produced and measured its performance to define its efficiency in carrying bacteriological examination according to **ISO/TS 11133-2014. Sample preparation:** according to **ISO 6887-2:2003:**

Twenty-five grams of the examined samples were removed by sterile scissors and forceps and stomached using stomacher (Seward stomacher 80 Biomaster, Serial No. 46464. England) with 225ml of sterile buffered peptone water (0.1%) to give a homogenate of 1/10 dilution. One ml from the original dilution was transferred with sterile pipette to another sterile test tube containing 9 ml of sterile peptone water 0.1% and mixed well to make the next dilution from which further decimal dilutions were prepared. The prepared dilutions were subjected to the following examinations:

1-Aerobic Plate Count (APC) according to **APHA, (2001),** on APC agar at 35°C for 48±2 hrs.

2-Total Coliform count (as a Most Probable Number (MPN) according to **FDA, (2002),** onLauryl Sulphate Tetrathionate (LST)broth at 35°C for 24-48hrs.

3-Enterobacteriaceae count according to **ISO 21528-2 :(2004),** on Violet Red Bile Glucose Agar (VRBGA) at 37°C for 24±2hrs.

4-Staphylococcus aureus count according to **FDA, (2001),** on Baired Parker media at 35°C for 24-48 hrs.

III. Chemical analysis for detection of freshness

1-Determination of Hydrogen Ion Concentration (pH) according to **E.O.S 63/11 (2006)**by using pH meter,

2-Determination of Total Volatile Basic Nitrogen (TVB-N) according to **E.O.S 63/10 (2006)**by distillation method.

3-Determination of TBA value of lipid oxidationaccording to **E.O.S 63/9 (2006)**by distillation method.

IV. Statistical analysis:

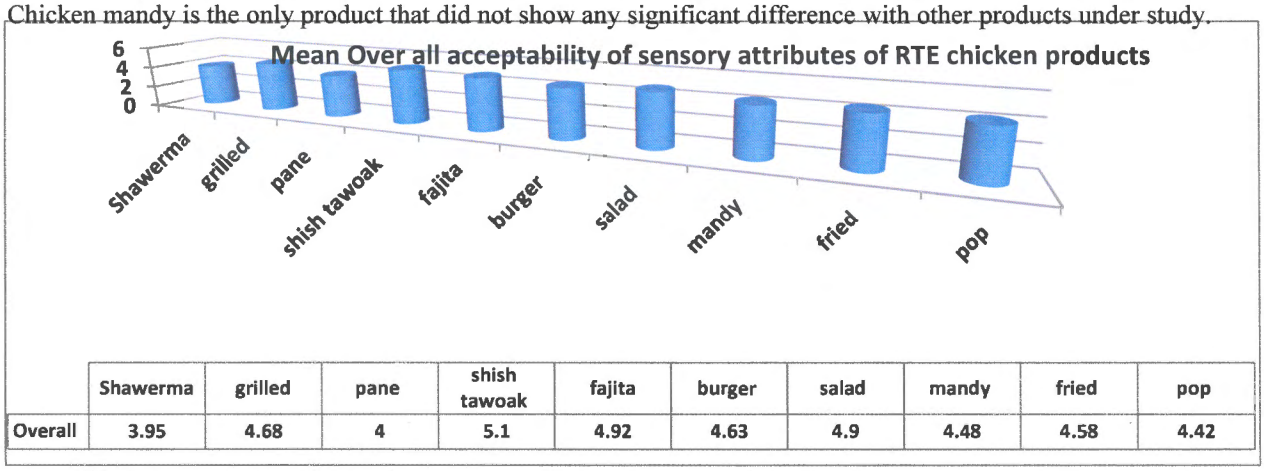
Results were recorded as mean values of 3replicates for each analysis ±SD/SE. on way ANOVA were used for the collected data by SPSS statistics 17.0for Windows. Comparison among different products was performed by LSD and significance was defined at P<0.05.

Results

Table (1) Overall acceptability of sensory attributes of examined RTE chicken products (n=10).

Products	Sensory attributes						Overall acceptability
	Appearance	Color	Taste	Flavor	Consistency	Juiciness	
Shawerma	4.2±0.33	4.3±0.34	3.8±0.20	3.8±0.25	4.0±0.26	3.6±0.34	3.95 ± 0.29^{A}
Grilled chicken	4.9±0.23	4.7±0.21	4.9±0.18	4.5±0.17	4.7±0.15	4.4±0.16	4.68 ± 0.18^{aB}
Chicken Pane	4.2±0.47	4.4±0.52	3.8±0.44	3.6±0.43	4.1±0.35	3.7±0.65	4.0 ± 0.48^{bC}
Shish tawoak	5.4±0.27	5.1±0.23	5.1±0.23	4.9±0.18	4.7±0.15	5.1±0.23	5.1 ± 0.22^{acD}
Fajita	4.9±0.43	4.8±0.25	5.1±0.32	4.8±0.20	4.8±0.20	5.1±0.32	4.92 ± 0.29^{ac}
Chicken Burger	4.6±0.37	4.8±0.33	4.6±0.22	4.4±0.16	4.7±0.26	4.7±0.26	4.63 ± 0.27^{ac}
Chicken Salad	4.8±0.13	4.8±0.13	5.0±0.15	4.8±0.20	4.8±0.20	5.2±0.13	4.90 ± 0.16^{ac}
Chicken Mandy	4.7±0.15	4.6±0.16	4.3±0.15	4.3±0.15	4.5±0.17	4.5±0.17	4.48±0.16
Fried chicken	4.9±0.18	4.9±0.18	4.5±0.22	4.4±0.22	4.5±0.22	4.3±0.15	4.58 ± 0.20^{ac}
Pop chicken	4.5±0.17	4.6±0.16	4.5±0.17	4.0±0.00	4.4±0.16	4.5±0.17	4.42 ± 0.14^{d}

There are significant differences (P<0.05) between means having the same capital and small litters in the same column. Chicken mandy is the only product that did not show any significant difference with other products under study.



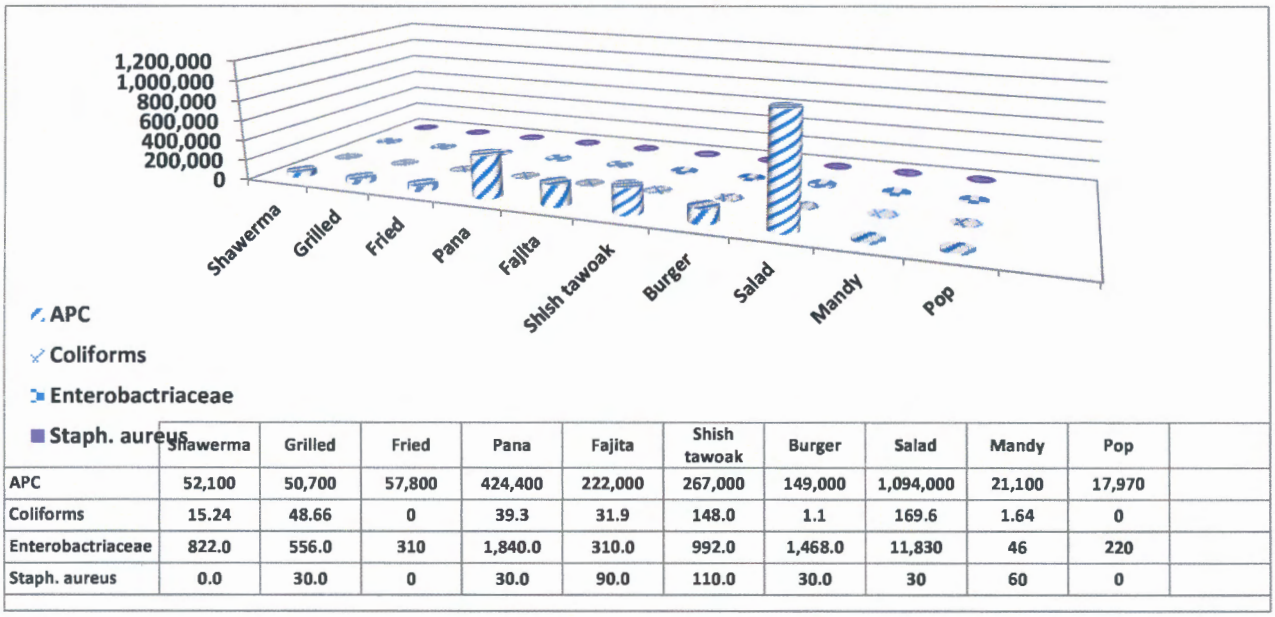
	Shawerma	grilled	pane	shish tawoak	fajita	burger	salad	mandy	fried	pop
Overall	3.95	4.68	4	5.1	4.92	4.63	4.9	4.48	4.58	4.42

Fig. (1) Mean values of overall sensory attribute of examined RTE chicken products.

Table (2) Mean statistical value of different bacterial counts in RTE chicken meat products.

product	Bacterial counts (Mean±SE)			
	APC (cfu/g)	Coliforms (MPN/g)	Enterobacteriaceae (cfu/g)	Staph. aureus (cfu/g)
Shawerma	$5.21x10^{4}\pm2.11x10^{4\,A}$	15.24±9.60	$8.22x10^{2}\pm2.73x10^{2A}$	<10
Grilled chicken	$5.07x10^{4}\pm3.9x10^{4\,B}$	48.66±45.76	$5.56x10^{2}\pm4.39x10^{2B}$	30.00±21.34
Fried chicken	$5.78x10^{4}\pm3.1x10^{4\,C}$	<3	$3.1x10^{2}\pm43.33^{\,C}$	<10
Chicken Pane	$4.244x10^{5}\pm3.76x10^{5\,D}$	39.26±19.84	$1.84x10^{3}\pm8.08x10^{2bD}$	30.0±21.34
Fajita	$2.22x10^{5}\pm8.4x10^{4\,bcE}$	31.90±21.1	$3.10x10^{2}\pm54.7^{\,E}$	90.0±64
Shish tawoak	$2.67x10^{5}\pm1.41x10^{5\,bcF}$	$1.48x10^{2}\pm1.08x10^{2}$	$9.92x10^{2}\pm3.25x10^{2F}$	$1.1x10^{2}\pm99.39$
Chicken Burger	$1.49x10^{5}\pm8.0x10^{4\,bG}$	1.10±0.79	$1.468x10^{3}\pm8.64x10^{2G}$	30±21.34
Chicken Salad	$1.094x10^{6}\pm8.81x10^{5\,abcdH}$	$1.696x10^{2}\pm4.82x10$	$1.183x10^{4}\pm4.65x10^{3abcdefgH}$	30.0±21.3
Chicken Mandy	$2.11x10^{4}\pm8.18x10^{3\,efgh}$	1.64±.96	$46.0\pm19.56^{\,abcdefgh}$	60.0±49.89
Pop chicken	$1.797x10^{4}\pm9.34x10^{3\,efgh}$	<3	$2.20x10^{2}\pm73^{\,acdefgh}$	<10

There are significant differences (P<0.05) between means having the same capital and small litters in the same column.

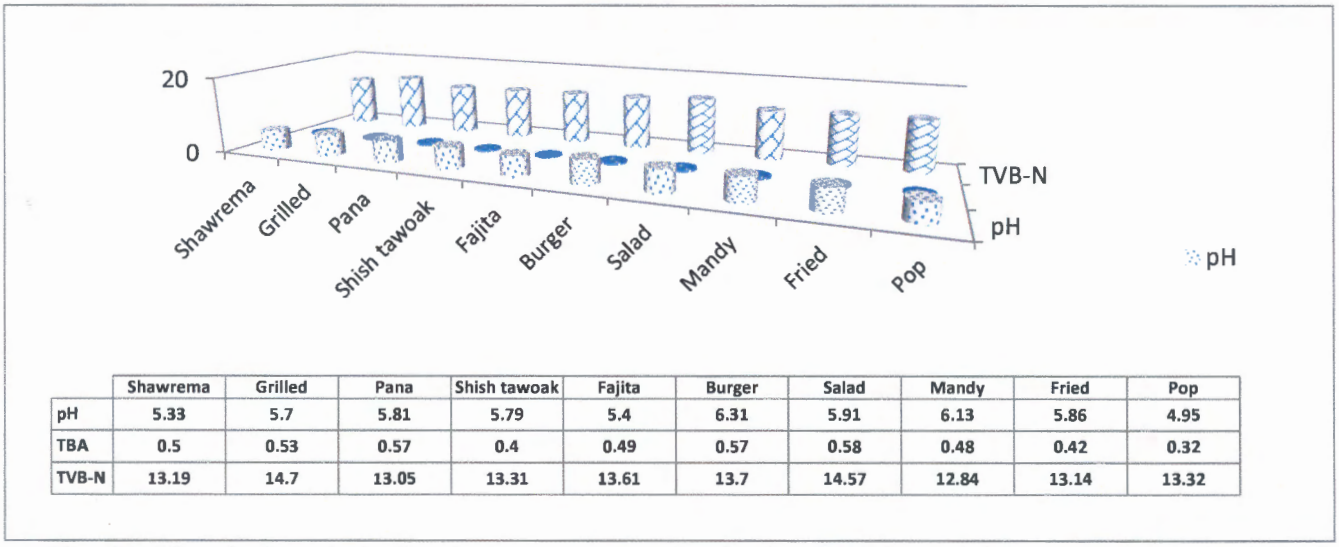


	Shawerma	Grilled	Fried	Pana	Fajita	Shish tawoak	Burger	Salad	Mandy	Pop	
APC	52,100	50,700	57,800	424,400	222,000	267,000	149,000	1,094,000	21,100	17,970	
Coliforms	15.24	48.66	0	39.3	31.9	148.0	1.1	169.6	1.64	0	
Enterobactriaceae	822.0	556.0	310	1,840.0	310.0	992.0	1,468.0	11,830	46	220	
Staph. aureus	0.0	30.0	0	30.0	90.0	110.0	30.0	30	60	0	

Fig. (2) Mean of different bacterial counts in examined RTE chicken meat product samples.

Table (3): Mean values of chemical analysis for deterioration of RTE chicken meat products.

Products	Chemical analysis for product freshness		
	pH	TBA	TVB-N
Shawerma	5.33±0.135	0.50±0.077	13.19±0.184
Grilled chicken	5.70±0.133	0.53±0.021	14.70±0.369
Chicken Pane	5.81±0.131	0.57±0.040	13.05±0.717
Shish tawoak	5.79±0.048	0.40±0.026	13.31±0.440
Fajita	5.40±0.087	0.49±0.031	13.61±0.788
Chicken Burger	6.31±0.064	0.57±0.033	13.70±0.535
Salad	5.91±0.118	0.58±0.044	14.57±0.620
Chicken mandy	6.13±0.075	0.48±0.025	12.84±0.156
Fried chicken	5.86±0.184	0.42±0.047	13.14±0.492
Pop chicken	4.95±0.025	0.32±0.025	13.32±0.289



	Shawrema	Grilled	Pana	Shish tawoak	Fajita	Burger	Salad	Mandy	Fried	Pop
pH	5.33	5.7	5.81	5.79	5.4	6.31	5.91	6.13	5.86	4.95
TBA	0.5	0.53	0.57	0.4	0.49	0.57	0.58	0.48	0.42	0.32
TVB-N	13.19	14.7	13.05	13.31	13.61	13.7	14.57	12.84	13.14	13.32

Fig. (3) Chemical analysis for deterioration associated with detection of freshness of examined RTE chicken meat products.

Discussion

From the results reported in **table (1) and fig.** (1), the overall acceptability of sensory attributes of RTE chicken meat products including shawerma, grilled chicken, pane, shish tawoak, fajita, burger, chicken salad, mandy, fried chicken and pop chicken were3.95±0.29, 4.68±0.18, 4.0±0.48, 5.1±0.22, 4.92±0.29, 4.63±0.27, 4.90±0.16, 4.48±0.16, 4.58±0.20 and 4.42±0.14,respectively. The statistical analysis of the obtained results regarding the overall acceptability sensory attributes of shawerma meals in comparison with other different RTE chicken meat products revealed that there were a significant differences ($P<0.05$) between examined shawerma and each of grilled chickens, chicken fajita, chicken burger, chicken salad ,shish tawoak and fried chicken . On the other hand, there were no significant difference ($P>0.05$) between shawerma samples and each of chicken pane, chicken mandy and pop chicken. In this respect, **Ibrahim, et al., (2014)** mentioned higher results than that in the present investigation where mean values of organoleptic scores of examined chicken shawerma samples were ranged from 6.3 and 7.45 with overall acceptability of 7.05 using 9-points hedonic scores. The overall acceptability of examined grilled chicken meat products recorded 4.68±0.18, meaning that the sensory evaluation was laid between borderline and good area but they tended to shift towards the good. Moreover, the obtained results revealed that there were a significant differences in sensory attributes between examined RTE grilled chicken and both of chicken shawerma and chicken pane ($P<0.05$), while the data analysis showed no significant difference ($P>0.05$) between grilled chicken and rest of the products under study. Nearly similar result regarding overall acceptability (6.4) for grilled chicken was reported by **Ibrahim et al. (2014)** which also located in the good area when evaluating the rate of sensory scores. In this respect, **Sow and Grongnet (2010)** stated that RTC broiler was the least preferred one as compared with other treatments.Moreover, table (1) and fig. (1), revealed the overall acceptability of examined chicken pane samples were 4.0±0.48, it could be concluded that chicken pane samples were more aligned to the border lined area. Otherwise, pane samples were better than shawerma in terms of sensory properties. There were a significant difference ($P<0.05$) between RTE chicken pane and other products under study except for samples of chicken shawerma, chicken mandy and pop chicken ($P>0.05$). High significant difference was recorded with RTE chicken shish tawoak ($P<0.001$).These results were supported by **Ibrahim, et al. (2014)** as the overall acceptance of organoleptic score was 7.9 that it has been evaluated by the ten panelists. The same table declared the mean±SE of overall acceptance of sensory parameters of examined RTE chicken shish tawoak was 5.1±0.22,meaning that shish tawoak had good sensory attributes. The results showed that there was a highly significant difference ($P<0.001$) between examined RTE shish tawoak and each of chicken shawerma and chicken pane samples, while the difference was significant ($P<0.05$) between shish tawoak and pop chicken. On the contrary, absence of significant differences ($P>0.05$) between chicken shish tawoak and other products under study. RTE chicken shish tawoak is a traditional marinated chicken shish kebab of Middle Eastern cuisine **(Virginia, 2010 and Ozan, 2013)**. It is widely eaten in Turkey, Lebanon and Egyptas well as many cities around the world **(Yvonne, 2002 and Lisa and Lisa 2009).** The results in table and fig. (1) illustrated the mean overall acceptability of examined chicken fajita meals which recorded a score of 4.92±0.29 that more shifted towards the good area. Otherwise, fajita meals were nearly similar to grilled and shish tawoak meals, while they were better in sensory parameters as compared with chicken shawerma and pane meals. The statistical analysis declared that there were significant differences ($P<0.05$) between examined samples of RTE chicken fajita and each of chicken shawerma and chicken pane. On the other hand, there were no significant differences between chicken fajita and the other products under investigation. In this respect, **Chuaynukool, et al. (2007)** and **Jaturasitha et al., (2002)** concluded that toughness and firmness of chicken products may be attributed to the age and breed of chickens at slaughter, as the lower the age, increased the proportion of muscle collagen which earns a good appearance, texture and consistency of the product.Regarding the overall acceptability of chicken burger sensory attributes, it was found to be 4.63±0.27. The results declared that chicken burger meals were located between poor and good area but more shifted towards the good area. Otherwise, chicken burger meals looked like grilled, shish tawoak and fajita meals, while better than shawerma and pane meals. The obtained results assured that there were significant differences ($P<0.05$) between examined samples of RTE chicken burger and both of chicken shawerma and chicken pane. On the other hand, the results proved the absence of

significant differences (P>0.05) between burger and the rest of the products under study. Differences in sensory character between the chicken samples may be as a result of many factors including differences in lipid oxidation "Tocopherol and fatty acid profiles". In general the extent of lipid oxidation was higher in burgers than other products **(Lawlor et al., 2003).** During heat denaturation, insoluble cross-linked collagen shrank and effectively compressed heat-denatured myofibrils, and eventually resulting in moisture loss, decreases in fiber diameter and a tougher texture; Differences in the microstructures and cross-linked collagen content that exist between breeds might account for the varied textural appearance of meat **(Wattanachant et al., 2004).** The obtained results regarding RTE chicken salad, the overall acceptability of sensory parameters registered 4.90±0.16.Chicken salad meals were located between border line and good area but more shifted towards the good area. Otherwise, chicken salad meals were nearly similar to grilled, shish tawoak, fajita and chicken burger meals, while they were better in sensory attributes than chicken shawerma and pane meals. The obtained results confirmed that there were significant differences (P<0.05) between examined samples of RTE chicken salad and both of chicken shawerma and chicken pane. On the other hand, the results proved the absence of significant differences (P>0.05) between chicken salad and the rest of the products under study. In this respect, **Esperance (2016)** concluded that when chicken salad has a strong, unpleasant odor, this means that the salad has gone bad, the objectionable smell is caused by the chicken absorbing off-flavors of the other salad ingredients such as lettuce, onions, tomatoes or apples. **Table and Fig. (1)** also stated that overall acceptance of sensory parameters of examined RTE chicken mandy assigned to be 4.48±0.16, the results declared that chicken mandy meals were located in the border line area. Otherwise, chicken mandy meals were nearly similar to shawerma, and chicken pane meals, while they had lower sensory attributes than grilled chicken, shish tawoak, fajita, salad and chicken burger meals. The obtained results specify that there were no significant differences (P>0.05) between examined RTE chicken mandy samples and the rest of the products in this study. Nearly similar results were reported by **Lawlor, et al. (2003)** who carried out One-way ANOVA on the sensory scores, the results showed significant (P<0.05) differences between roast chicken samples and other chicken products for appearance, flavor, odor and texture attributes. The authors clarified that the sensory panel was easier to distinguish between chicken samples using appearance and texture rather than odor and flavor attributes. **Table (1) and Fig. (1)** described also the overall acceptance of sensory parameters of examined RTE fried chicken meals were 4.58±0.20. The results declared that fried meals were located between border line and good area but more shifted towards good area. Otherwise, fried chicken meals were nearly similar to grilled, shish tawoak, fajita, salad and chicken burger meals, while they were better in sensory parameters than chicken shawerma, mandy and chicken pane meals. The results obtained confirmed the existence of significant differences **(P<0.05)** between RTE fried chicken samples and each of chicken shawerma and chicken pane, while there were no significant differences with other examined RTE chicken product in this study. Consumers usually evaluate the fried product as acceptable or not first by its color**. Krokida, et al. (2001)** stated that oil temperature and sample thickness are the process parameters that affect the color significantly during frying. The difference in texture scores could be due to differences in frying time (**Altunakar et al., 2004)**, where frying in oil with higher degree of hydrogenation resulted in products of lighter color and harder texture **(Li, 2005).** Pop chicken showed the mean overall acceptability of sensory attributes of 4.42±0.14. Moreover, the obtained results proved the existence of significant difference (P<0.05) between examined RTE pop chicken and shish tawoak only, while did not established existence of statistically significant differences with other RTE products in this study. **Indumathi and Obula (2015)** found that organoleptic properties of chicken popcorn (Mean ± S.E) were 7.16±0.02 for color, 6.61±0.05 for flavor, 6.44±0.09 for tenderness and 6.31±0.04 for juiciness. The overall acceptability was 6.43±0.08. They added that the spent hen chicken popcorn with different types of enrobing batters has good palatability. Based on the physic-chemical and proximate evaluation, enrobing can be successfully employed to add value to the products and develop a low calorie fried products. The obtained results in **Table (2) and Fig. (2)** revealed that chicken salad was the most contaminated meals in terms of APC, coliform, Enterobacteriaceae and Staph. aureus counts ($1.094x10^6$±$8.81x10^5$,$1.696x10^2$±4.82x10,$1.183x10^4$±$4.65x10^3$ and30.0±21.34)respectively, followed by chicken pane, shish tawoak, fajita, chicken burger, shawerma and grilled chicken

meals. On the contrary, the lowest microbial load of the aforementioned bacterial counts was recorded for fried chicken ($5.78x10^4 \pm 3.1x10^4$, <3, $3.1x10^2 \pm 43.33$ and <10 cfu/g), respectively as well as pop chicken meals which recorded $1.797x10^4 \pm 9.34x10^3$, <3, $2.20x10^2 \pm 72.7$ and <3 cfu/g, respectively. In the present study, shawerma was one of the contaminated RTE meals. This agreed with those reported by **Ibrahim, et al., (2014).** Nearly similar result for APC was recorded by **Hassanein et al., (2015)** who found that APC of chicken shawerma was $5.91\times10^4 \pm 1.08\times10^4$. Moreover, **Hassanein (2010)** could detect APC count with 5.28 log cfu/g in examined chicken shawerma samples. This agreed with the present study. In this respect, **Gad (2004) and Sharaf and Sabra (2012)** failed to detect Staph. aureus count in examined chicken shawerma samples in Al-Taif Governorate KSA. This agreed with the present study, while **Sharaf and Sabra (2012)** recorded higher APC ($1.2x10^5$ cfu/g) and Enterobacteriaceae mean count ($2x10^4$ cfu/g). Meanwhile, mean value of APC, coliforms and Staph. aureus of examined chicken shawerma meals recovered by **Ibrahim, et al., (2014)** represented by $4.58\times10^5 + 0.74\times10^5$ (cfu/g), $9.97\times10^3 + 2.53\times10^3$ (MPN/g) and $1.75\times10^4 + 0.31\times10^4$ (cfu/g) respectively, which were higher than that recorded in the present study. Chicken meals are subjected to be contaminated with several types of microorganisms from different sources during the period elapsed from the time of slaughtering, preparation, processing and cooking to consumption. These microorganisms varied according to the method of manufacture, quality of used non-meat ingredients, and contamination level during the processing chain, packaging and storage. This substantiates the findings of **Narasimha and Ramesh (1988).** Grilled chicken meals are subjected to be contaminated with severaltypes of microorganisms from different sources during the period elapsed from the time of slaughtering, preparation, processing and cooking to consumption. These microorganisms varied according to the method of manufacture, quality of used non-meat ingredients, and contamination level during the processing chain, packaging and storage. This substantiates the findings of **Narasimha and Ramesh (1988).**The results regarding mean values of APC, coliforms and Staph. aureus of RTE chicken pane meals in the present study were higher than those reported by **Eid et al., (2014)** ($21.6\times10^3 \pm 3\times10^3$, 3.33 ± 0.6 and $2.0\times10^3 \pm 1.1\times10^2$), respectively. Meanwhile, **Abd El-Aziz (2015)** could detect Staph. aureus in examined half cooked chicken pane ranged from <10 to $7x10^4$ with a mean value of $9.29x10^2 \pm 5.54x10^2$ cfu/g. In this respect, **Ibrahim, et al. (2014)** could detect APC, with $7.35\times10^4 + 1.17\times10^4$ (cfu/g), which was lower than the present study, while mean values of coliforms and Staph. aureus were higher than those of the present study ($1.18\times103 + 0.26\times10^3$ (MPN/g) and $3.01\times10^3 + 0.46\times10^3$ cfu/g), respectively. Also **Arab (2010)** found higher APC count ($6.3x10^4 \pm 0.35x10^4$) in examined chicken pane. Nearly similar results regarding Min, Max and Mean± SE of Staph. aureus count of examined shish tawoak was recorded by **Eid et al.,(2014)** (<10, $3x10^3$ and $2.6x10^2 \pm 7.4x10^2$), respectively. On contrary, higher mean value of Staph. aureus was observed by **Abo El-Enaen, et al., (2012)** who recorded $2.39X10^3$ cfu/g. and **Sampers, et al., (2010)** who detected mean Staph. aureus count of $7.9x10^3$ cfu/g. Moreover, **Eid, et al., (2014)** recorded$2x10^2$, $2.2x10^4$ and $5.1x10^3 \pm 6.6x10^4$ as min, max and mean ±SE of coliform count (MPN/g) of examined RTE chicken shish tawoak, respectively. These results were higher than those reported in the present study. Also higher coliform count was reported by **Sampers et al.,(2010) and USDA-FSIS, (2012)** ($2.51x10^5$ and $2.5x10^3$), respectively.Moreover, **Ibrahim, et al., (2014)** illustrated higher mean values of APC, coliform and Staph. aureus represented by $1.92\times10^5 \pm 0.46\times10^5$, $4.32\times10^3 \pm 0.85\times10^3$ and $9.84\times10^3 \pm 1.68\times10^3$ (cfu/g) for examined shish tawoak, respectively. The obtained results of chicken burger meals declared that The mean value of APC and Enterobacteriaceae of examined chicken burger samples in the present study was similar to that obtained by **Ali, 2011** ($6.33x10^4 \pm 1.84x10^4$ and $1.1^3x10^3 \pm 0.25x10^3$cfu/g.) for fried beef burger samples, respectively, Also the obtained result in this study regarding APC was more or less agreed with those reported by **Hassanein, (2010)** (5.53 log cfu/g) in examined beef burger samples. Higher result ($1.85x10^3 \pm 0.42x10^3$ cfu/g) was recorded for Staph. aureus count. Moreover, the trend in the present study, was lower than that reported by **Hassanein, et al., (2015)** who found that the mean values and incidences of APC, coliforms and Staph. aureus cfu/g were $3.58\times10^5 \pm 0.72\times10^5$ (100%), $2.39\times10^3 \pm 0.61\times10^3$ (73.33%) and $2.73\times10^3 \pm 0.52\times10^3$ (80%) of examined chicken burger respectively. Moreover, Nearly similar results for APC were reported by **Becker, et al. (2002)**who carried out a survey of deli salads at retail and found APC at a range of 5 to almost 8 log cfu/g with a mean of 6.5 log cfu/g

($3.2x10^6$ cfu/g) and **Christensen and King (1971)** who found chicken salad have bacterial levels ranging from 4 to 7 log cfu/g, with a median of (5.8 log cfu/g). They also reported lower contamination with coleslaw at a range of 2.7 to 4.5, and a median of 3.6, log cfu/g. In another study of deli salads from various manufacturers, egg salads were found to have the poorest initial quality of 4.1 and 6.8 log cfu/g **(Folwer and Clark, 1975).** Regarding fried chicken meals, APC was agreed with that reported by **Mohamed et al.,(2015)** ($7.18x10^4$±$1.44x10^4$ cfu/g), while they reported higher Enterobacteriaceae, coliforms and Staphylococcal counts than that in the present study ($8.73x10^3$±$1.96x10^3$, $6.40x10^3$±$1.23x10^3$ and $2.10x10^3$±$.32x10^3$ cfu/g), respectively. The author also detected a significant difference ($P<0.01$) between boiled and fried chicken regarding APC and Enterobacteriaceae which was compatible with the results of this study, while obtained results of APC was lower than that obtained by **Zaki, et al. (2012)** who mentioned that the mean value of APC in fried chicken sandwiches was $1.3x10^6$±$1.2x10^6$ cfu/g. Fast foods might not only have an impact on health but also could cause serious problem when contaminated with pathogenic microorganisms. Dangerous microorganisms, i.e. Salmonella and Escherichia coli might be transmitted to foods through preparation practices (**Adams and Moss, 2000).**In the recent years; all the fast food service restaurants have added fresh vegetables and seasonings in their meals. The contamination during processing and changes in microbial growth during storage might quantitatively and qualitatively alter microflora of foods. Regardless its inner tissues might be free from microorganisms, its surfaces could be contaminated with a variety of microorganisms depending on condition of the raw product, handling method and time and conditions during storage **(Odumeru et al., 1997 and Pelczar et al., 2006).** The consumption of such served meals has become very serious public health concern (**Meng and Doyle, 1998).** Consumers became more concerned about the food they consume; therefore consumers must attain information about the consumed product. One way ANOVA of APC among meals declared presence of highly significant differences **($P<0.01$)** between pop chicken meals and both of chicken fajita, shish tawoak, burger and chicken salad meals. Enterobacteriaceae using One Way ANOVA, the results revealed a highly significant difference **($P<0.01$)** between pop chicken and all chicken meals under investigation, except for grilled and chicken mandy meals, which proved absence of significant difference with pop chicken meals. **(Table and Fig. 2).**The obtained results in **Table (3) and Fig. (3)** displayed the chemical analysis of RTE chicken products, pH and TBA value as well as TVB-N. pH of all chicken recorded low value as 4.95±0.025 in pop chicken and as high as 6.31±0.064 and 6.13±0.075 in chicken burger and mandy, respectively. TBA value recorded lower values (0.32±0.025mg mal. /kg) in pop chicken and 0.42±0.047 mg Mal. /kg in fried chicken meals, higher value (0.58 mg Mal./kg) was recorded in chicken salad and 0.57±0.040 in chicken pane. Moreover, TVB-N recorded lower value (12.84±0.156 mg) in examined chicken mandy meals as well as higher values in grilled chicken and chicken salad (14.70±0.369 mg and 14.57±0.620 mg), respectively.In this object, **Edris, et al., (2013)** recorded pH of chicken pane (5.86±0.01) and chicken fillet of 5.95±0.01 which is similar to the obtained results in the present study. Nearly similar results for pH were obtained by **Shedeed, (1999)** (5.7 to 6.1); **Afifi, (2000)** (5.9 to 6.4) and **Fathy, 2012** (5.6 to 6.2). While, higher results were obtained by **Hassanein and Hassan, (2003)** (6.57±0.03 to 6.67±0.02) for chicken pane.Regarding TVB-N, nearly similar values of examined chicken products were obtained by **Afifi, (2000)** (12.57±0.222 mg %). Higher result was recorded by **Hassanein and Hassan, (2003)** (30.76±1.07 mg %) and **Eid, (2014)** (27.4±6.2 mg %) for shish tawoak. While lower findings were recorded by **Edris, et al. (2013)** (7.06±0.26mg %) and **Fathy, (2012),** (6.57±0.19 mg %) as well as for chicken fillet (7.89±0.28**).** It is important to emphasize that the meat and chicken meat products begin to deteriorate when it contains 30 mg TVN per 100 grams **(Pearson, 1984).** Thus, all examined samples were within the accepted limit. Moreover, TVB-N can be considered as a reliable indicative measure for the quality of various food articles specially poultry and its products. The results obtained by **Eid (2014)** for the mean value of TBA of heat treated poultry products were 0.59 mal./kg, **Hassanein, and Hassan, (2003)** (0.352± 0.015) and **Koreeski and Dwiatkiewicz, (2006)** (0.454 mg/kg.) which were similar to that in the present study. Lower TBA values were recorded by **Shedeed, (1999)** (1, 69 to 0.28%), **Afifi, (2000)** (0.051% to 0.223 mg %) and **Edris, et al. (2013)** (0.05±0.01) for chicken pane and (0.03±0.01) for chicken fillet. Accurately, TBA-value tends to decrease during frozen storage **(Lai, et al., 1991).** Oxidative rancidity was

occurred at TBA-value more than 0.9 mg % according to **(Pearson, 1984).** Thus, all samples were within the accepted limit. TBA value is closely related with the sensory characteristics of food article as rancidity **(Salem, 1992).** TBA values of examined chicken meals in present study were within the acceptable limit (<0.9 mg mal/kg).

Conclusion

The achieved results in the current study allow concluding that chicken salad was the highly contaminated product, while pop and fried chicken meals were the least contaminated products. The variation in bacterial load in chicken meat products may be due to many causes mainly bad hygiene. Furthermore, the examined samples of chicken meat products as chicken salad was more contaminated with the highest level of microorganisms because such products may receive more handling during preparation as well as absence of heat treatment. Other products may be due to addition of spices which act as a source of bacterial contamination. However, among the control measures applied during chicken processing it was seen that the equipments comes in contact with personnel hands considered the main source of secondary microbial contamination. The initial microbial load of chicken carcasses can be controlled as a result of application of hygienic measures including Good Manufacture practices (GMP), Good Hygienic practices (GHP) as well as Risk Management program (RMP) which help identifying the existed hazard to evaluate the risk consequence in order to apply risk mitigation in due time to obtain a safe and healthy food for consumer. Effective control strategies for this diverse array of bacteria that currently limit the shelf life of ready-to-eat chicken meals and may constitute public health hazard and adversely affect on consumer health and this will require comprehensive integrated efforts along the food chain Generally , especially Restaurants manufacture and processing of those meals.

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الملخص العربي

امان و جودة منتجات الدجاج الجاهزة للأكل

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قسم الرقابة على اللحوم و منتجاتها** – كلية الطب البيطري – جامعة القاهرة**
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تلوث منتجات الدجاج الجاهزة للأكل بمسببات الامراض التي تنقلها الأغذية لا تزال مشكلةصحية عامة مهمة لانها تؤدي الى المرض اذا كان هناك سوء ممارسة اثناء الذبح ، نزع الاحشاء ، المعالجة و بعد ذلك التحضير عن طريق الطهي . لذلك هذه الدراسة ركزت على امان بعض وجبات الدجاج الجاهزة للأكل اثناء التحضير من خلال النواحي الحسية ، و الكميائية لكشف مدى طزاجتها و سلامتها من الميكروبات . وقد تم تجميع هذه المنتجات من مطاعم مختلفة بمحافظتي القاهرة و الجيزة ،و الدراسة البحثية ركزت على عشرة منتجات تشمل شاورما الدجاج ، الدجاج المشوي ، بانيه الدجاج ، الشيش طاووق ، فاهيتا الدجاج ، برجر الدجاج ، سلطة الدجاج ، المندي ، الدجاج المقلي و أخيرا كور الدجاج . و المعايير البيكترولوجية المستخدمة هي : عدد الميكروبات الكلي ، عدد المكيروبات القولونية ، عدد الميكروبات المعوية ، عدد ميكروب الاستافيلوكوكاس اورياس . و قد أوضحت الدراسة ان سلطة الدجاج هي اكثر المنتجات تلوثا من حيث العد البكتيري الكلي ، القولوني، المعوي ، الاستافيلوكوكاس اورياس (x8.81±10^6x 1.09410^5 ١٠ x١. ٦٩٦ ٨٢±١٠٢ . ٤x ١٠ ،x 10 ٤. ٦٥ ± ١٠ x ٣ . ٣٣,٠±٣٤, ٢١ وحدة خلية /جم) على التوالي . و بالمقابل اقل عدد ميكروبات وجد في منتج الدجاج المقلي و هي (وحدة خلية /جم) على التوالي و كذلك كور الدجاج (x٥,٧٨ ١٠٤ ±x٣.١ ١٠٤ ، > ٣ ، x٣.١ ١٠٢ ± ٤٣.٣٣ ، > ١٠) و على التوالي . و كذلك كور الدجاج(٧٩٧. x١ ١٠٤± x٩.٣٤ ١٠٣ ، > ٣ ، ٢٠. x٢ ١٠٢± ٧. ٧٢ و >١٠).من خلال هذه النتائج من الواضح ان خمسة منتجات و هي (السلطة ، البانيه ، الشيش طاووق ، الفاهيتا ، البرجر) لديها اعلى متوسط قيمة للفحص البكتيري و لكن مازالت بالحد المسموح به في العد البكتيري الكلي تبعا لخدمات معمل الصحة العامة . و من حيث الخواص الكيميائية فكانت في الحدود المسموح بها . علاوة على ذلك تم فحص السمات الحسية و مناقشة انعكاس عدد الميكروبات على المستهلك و الصحة العامة.