



**Quality of leftover cooked chicken meat cuts served in student hostels**

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**Abstract**

Leftover foods are cooked foods that were not consumed within 4 hours after cooking or cooked foods that may be consumed after they have been stored in the refrigerator or freezer. This leftovers should be utilized carefully as it may harbor and support growth of food borne pathogens and causing food borne outbreaks. A total of 25 samples of leftovers cooked chicken cuts (14 chicken thigh and 11 chicken breast) were collected from the central kitchen of the student hostel of Cairo University in Giza in order to investigate their sensory, chemical and bacteriological quality. The obtained results showed that the mean values of APC, total Staphylococcal count, Total coliforms count, Pseudomonas & Aeromonas counts and Psychrotrophic count were  $2.39 \pm 0.38$ ,  $2.07 \pm 0.17$ ,  $3.29 \pm 1.07$ ,  $1.88 \pm 0.45$ ,  $2.12 \pm 0.27$  log cfu/g for the frozen cooked leftover chicken thigh, respectively and  $2.53 \pm 0.49$ ,  $2.31 \pm 0.35$ ,  $3.73 \pm 1.67$ ,  $2.27 \pm 0.33$ ,  $2.30 \pm 0.42$  log cfu/g for frozen cooked leftovers chicken breast. Salmonellae and Escherichia coli failed to be isolated from any of the examined samples. The majority of the investigated leftovers cooked chicken samples from the University student hostel revealed bacterial loads within the standard acceptable levels, however, the sensory scores showed slightly lower scores for flavor.

**(Key words:** leftover, chicken cuts, bacteriological, sensory, keeping quality)

**Introduction**

Outbreaks of food poisoning commonly increase in closed communities where food is prepared and served centrally for a sizable population such as student's hostels, elders homes, prisons, hospitals and nursing homes, due to community kitchen practice (Kunwar et al., 2013). This increase may be due to the high number of individuals using the kitchen and the lack of feeling of responsibility and their differing standards of hygiene (Sharp and Walker, 2003). The incorrect storage of cooked foods is one of most important factors that increase the chance of food poisoning; therefore, cooked poultry meat should be kept under 5 °C or above 63 °C.

Leftover is a major challenge facing community, kitchen, where large number of meals are prepared as reported by management sector, while the real number of consumed meals is lower than the prepared meals.

The leftover meats are always stored under refrigeration or freezing until consumed. Cooked leftover foods have reduced levels of background microflora, however, if cross-contamination occur during refrigerated storage leftover foods may harbor and support growth of food borne pathogens, especially Psychrotrophic pathogens such as *Listeria monocytogenes* and *Yersinia enterocolitica* (Murphy et al., 2001). Both food-borne pathogens and food spoilage microorganisms can multiply if food is not maintained at proper temperature and if there are prolonged time between food preparation and

distribution or serving (Reglier et al., 2005). Although cooking destroys most micro-organisms, the product is easily contaminated after cooking, by food handler, utensils and surfaces in the kitchen. Therefore, there is a danger of food poisoning from such contamination. The storage temperature will affect the shelf-life of the cooked chicken. Moreover, fluctuations of temperature during storage give a chance for growth of these microorganisms. Spoilage of the chicken cuts during frozen storage is considered as one of the most the greatest problems affect the meat quality and consumer acceptance, Moreover, factors such as temperature, time and storage conditions have direct effect on microbial, physical and chemical quality of such meat. (Zuset et al., 2000). In addition, oxidative deterioration which occurs rapidly during refrigerated or frozen storage leads to loss of quality of the chicken cuts because of rancid odor and taste development. The chicken cuts are more susceptible to rancidity due to higher content of unsaturated fatty acids (Ang, 1988) In the student hostel the leftovers are always present in large quantities especially in certain days of the weeks and kept under freezing to be utilized in the next day. The data about the quality (sensory, deterioration criteria and bacteriological) of these leftovers chickens are scarce; therefore, the main objective of the current study was to evaluate the quality of leftover cooked chicken cuts utilized in the student hostels and to determine

the conformity of these leftovers to the standard specification.

### Materials and methods

#### Collection and preparation of samples:

Total of 25 samples of leftover cooked chicken cuts (14 chicken thigh and 11 chicken breast) were collected from the student hostel of Cairo University in Giza at the period between November 2015 and February 2016. At the hostel kitchen, chicken were cooked to core temperature 75°C and served to the students, however, the leftover cooked chicken cuts were stored at -18°C in stainless steel trays rolled with stretch for the next day to be served. Leftover samples were collected in the frozen state before being served and placed in well identified sterile polyethylene bags then transported in sterile ice box for examination in the laboratory of Food Hygiene and Control department, Faculty of Veterinary medicine, Cairo University. The frozen samples were kept in refrigerator at 5°C for thawing then examined for (sensory, deterioration criteria and bacteriological) examinations.

#### Bacteriological examination

##### Preparation of homogenate and serial dilution:

Sample homogenate was prepared by homogenizing ten grams from each sample in 90 ml of 0.1 peptone water (LAB104,UK) for intermitted 1.5 minutes using stomacher (Lab blender 400, Sward lab. Model No. AB 6021). From the original homogenate, tenfold decimal dilution was prepared using the same diluents (APHA, 1992).

**Analysis of different bacterial groups:** The samples were analyzed for bacteriological profile using standard procedure (APHA, 1992). From each serial dilution, 0.1 ml of diluted samples were spread on agar plates. APC was determined on Plate Count Agar (PCA Oxoid CM0463B, Hampshire, England). Plates were incubated at 35 °C for 48 h. For enumeration of Psychrotrophic count the Plate Count Agar (PCA Oxoid CM0463B) plates were incubated at 5-7° C for 10 days and the number of psychotropic bacteria/g was calculated. Enumeration of *Staphylococcus aureus* was performed on Baird Parker Agar at 37 °C for 48 h. Coliforms were determined using Laruyle sulphate tryptose broth and the Most Probable Number technique "MPN" technique was applied. From each dilution of prepared sample, aseptically 1 ml was inoculated separately into each of 3 tubes of Laruyle sulfate tryptose broth. Inoculated tubes were incubated at 37 °C for 48 h.

cooked samples were analyzed for Salmonellae by pre enrichment on buffer peptone then enrichment on Rappaports Vassiliadis broth (Oxoid, CM 669) and plating on Xylose- Lysine Desoxycholate (XLD) agar(Oxoid,CM469) and MacConkey agar (Oxoid, CM109) as described by ISO(2002), the positive colony were exposed to further biochemical and serological examination. Pseudomonas and Aeromonas count were enumerated by inoculation of Glutamate Starb Phenol-red agar(GSP)(Merck) were with 0.1 ml from previously prepared serial dilutions and evenly distributed on the medium as described by Kielwein (1969). Inoculated plates were incubated at 25 °C for 3 days.

#### Deterioration criteria (measurement of incipient deterioration)

For measurement of pH value, five grams from each of the leftover cooked chicken cuts were homogenized with 20 ml distilled water for 10-15 seconds (Kandeepan et al., 2009). The pH was measured using pH meter (Lovibond Senso Direct) with a probe type electrode (Senso Direct Type 330) where three reading for each sample was obtained and the average was calculated. The pH meter was calibrated every two samples using two buffers 7.0 and 4.0. The thiobarbituric acid reactive substances (TBARS) value was measured by the method outlined by (Du & Ahn, 2002) and expressed as milligrams of malonaldehyde per kilogram of sample. Moreover, the Total Volatile Base Nitrogen (TVBN, mg/100 gram sample) was measured according to the method of (Kearsley et al., 1983) using a macro-Kjeldahl distillation method.

#### Sensory examination:

Sensory panel analysis was performed by 7 panelists from the members of Food Hygiene and Control Department, Faculty of Veterinary medicine, Cairo University. The frozen cooked chicken samples were reheated after thawing in refrigerator in a forced draught oven at 230 °C for core temperature 75 °C. The chicken cuts were examined according to the schemes of Sumarmono and Rahardjo (2008), Baston and Barna (2010) and Kenawi (2005) for appearance, flavor, tenderness, juiciness and overall acceptability using a 7-point scale (where 7 denote extremely acceptable and 1 denotes extremely unacceptable). Prior to the analysis panelists were

obtained a training session to be familiar with the

parameters examined.

**Results and Discussion**

**Bacteriological quality**

The bacterial profiles of leftover cooked chicken cuts obtained from the student hostel of Cairo University are presented in Table (1). It revealed that the mean values of APC were  $2.39 \pm 0.38$  log cfu/g and  $2.53 \pm 0.49$  log cfu/g for thigh and breast samples, respectively. The obtained results were within the limits provided by the E.S.S (ES 3493/2005) and were in accordance with The International Commission of Microbiological Specifications for Foods (ICMSF, 1986). The results were in good agreement with the results recorded by Reglier-Poupet et al.(2005) and Hassanien et al. (2015). However, they were lower than the results reported by Shaltout et al. (2015) who obtained 4.28 log cfu/g, El-taher (2009) who recorded 3.96 log cfu/g and Arab (2010) who recorded 5.38 log cfu/g and Ghanem (2009) who obtained 7.80 log cfu/g of APC for cooked leftover meat.

The mean values of Total staphylococcus aureus counts were  $2.07 \pm 0.17$  and  $2.31 \pm 0.35$  for thigh and breast, respectively with no evidence of presence of typical S. aureus in all the investigated samples. These results were in harmony with that obtained by Abd Allah and Hassan (2000) as well as Zaki (2003) who found that the mean value of staphylococci count was 2.08 logs cfu/g in the cooked shawerma with no any typical S. aureus was isolated from any of the examined samples. Moreover, they were similar to the results recorded by Osimani et al., (2015) who obtained count between 2.0 and 2.9 log cfu/g. However, the counts were lower than the counts reported by Hassanien et al. (2015) who recorded 3.97 log cfu/g for chicken shawerma, Nasser (1988) and Moussa et al. (1992) who recorded 4.76 log cfu/g of

Staphylococcus aureus count in the examined samples of ready to eat meat.

The mean value of Psychrotrophic count recorded in this study were  $2.12 \pm 0.27$  and  $2.30 \pm 0.42$  log cfu /g for thigh and breast, respectively. The counts were within the limits of the standard specifications and in accordance with The International Commission on Microbiological Specifications for Foods (ICMSF,1986) which established counts lower than  $10^6 - 10^7$  cfu/g as safe standards for consumption in the case of Psychrotrophic counts. These counts were in agreement with the results reported by Pizato et al., (2014) and Pizato et al., (2015). The mean values of total coliforms count were  $3.29 \pm 1.07$ ,  $3.73 \pm 1.67$  MPN/g for the thigh and breast, respectively. These results were similar to that recorded by Hassanien et al. (2015) who recorded 3.93 MPN/g for ready to eat chicken kofta, 3.38 MPN/g for ready to eat chicken burger and 3.26 MPN/g for chicken shawerma. Moreover, they were higher than the results reported by Elwi (1994) and Saad et al. (2011) who obtained 2.71 MPN/g for coliforms. However, the results were higher than those obtained by El-Rayes (2008) and Yassien (1992) who found that the mean value of coliform was 3.58 MPN/g for cooked meat samples. The majority of the investigated leftovers cooked chicken samples from the University student hostel yielded low microbial load that may be attributed to the proper cooking of chicken to the core temp. 75°C which is sufficient to kill both food spoilage and the food borne pathogens and the freezing of this leftovers causes mechanical damage in the microbial cell walls and membranes due to formation of intracellular crystals (Geiges, 1996) which leads microorganisms to die or be injured.

**Table 1: Bacteriological profile of cooked leftover chicken cuts (n =14 thigh, n =11 breast).**

Log (cfu/gm)	Minimum		Maximum		Mean± SD.	
	Thigh	Breast	Thigh	Breast	Thigh	Breast
APC	2.00	2.00	3.08	3.30	$2.39 \pm 0.38$	$2.53 \pm 0.49$
Total <i>Staph. aureus</i> count	2.00	2.00	2.48	2.90	$2.07 \pm 0.17$	$2.31 \pm 0.35$
Coliform count (MPN/g)	3.00	3.00	3.00	7.00	$3.29 \pm 1.07$	$3.73 \pm 1.67$
<i>Ps</i> & <i>Ar</i> count	0.30	2.00	2.00	2.58	$1.88 \pm 0.45$	$2.27 \pm 0.33$
Psychrotrophic count (cfu/g)	2.00	2.00	2.90	3.11	$2.12 \pm 0.27$	$2.30 \pm 0.42$

The mean values for pH, TBA and TVBN of leftover thigh and breast samples are presented in Table (2). The pH values were  $6.48 \pm 0.09$  and  $6.15 \pm 0.09$  for thigh and breast, respectively. These values are considered higher than the limits of ESS for raw poultry. The higher values for cooked chicken may be attributed to the effect of cooking which results in higher degree of oxidation along with loss of free acid groups from the meat proteins when subjected to heat that result in elevation of pH of cooked meat than that of raw material (Reddy and Vijayalakshmi, 1998). These values were higher than those observed by Mendes (2001) who recorded pH values for chicken breast meat between 5.7 and 5.9. However, these values were in agreement with those recorded by Pizato et al. (2014 and 2015). The pH values between  $6.1 \pm 6.2$  was recorded by Galarz et al., (2010) and Fletcher et al. (2000). Quio et al. (2002) attributed the increase in pH of chicken breast meat to the accumulation of ammonia and amines by psychotropic bacteria. The pH values of  $5.9 \pm 0.1$ , 5.8 to 5.9, and 5.96 were recorded in chicken breast by Nunes et al., (2006) and Quiao et al. (2001) and Fletchers et al. (2000) respectively. It has been observed that chicken meat products were marginally spoiled at pH value of 6.6 and were markedly spoiled at pH above these values (Potter, 2001).

The mean values of thiobarbituric acid reactive substances (TBARS) were  $1.43 \pm 0.61$  and  $0.85 \pm 0.42$  mg/kg for thigh and breast, respectively. The TBA values in the thigh were higher than those of breast. These values were similar to those

recorded by Wilson et al. (1976) indicating that high cooking temperatures increase the oxidation processes in meat. The elevation of lipid oxidation after cooking may be explained by the loss of antioxidant activity such as glutathione or catalase which could drop by up to 80% after heat treatment (Hoac et al., 2006). Moreover, oxidation of cooked meat can be 10 times that of fresh meat due to denaturation of proteins which result in release of inorganic chemicals such as iron. Iron is a pro-oxidant, that it has the affinity to take electrons from other molecules with subsequent oxidation of these molecules such as fatty acids, myoglobin, and sarcoplasmic and myofibrillar proteins. The release of electrons, especially in fatty acids cause rancidity and can give the meat a pungent odor and taste (Kerth, 2013) that could be the cause of relatively low sensory scores of leftovers cooked chicken cuts. Similar results were recorded by Popova and Marinova (2013) who obtained values 1.19, 1.67 mg malonaldehyde/ kg of meat for cooked meat. However, higher values of TBA were recorded by Hoac et al. (2006) after cooking and refrigerated storage. TBA value is closely related to the sensory characteristics of food as rancidity (Salem, 1992).

The Mean values of TVBN were  $9.88 \pm 1.02$  and  $11.84 \pm 1.34$  mg/100g sample. These values were within the limits of Egyptian (ESS 3493/2005) for heat treated chicken meat. Higher values were recorded by Eid et al. (2014) who recorded  $27.4 \pm 2.6$  mg/100g sample for the cooked chicken breast. However, lower values were recorded by Edris et al. (2013) who obtained  $8.17 \pm 0.31$  mg/100g in half cooked chicken fingers.

**Table 2:** Deterioration criteria of cooked leftover chicken cuts (thigh and breast)

	Min.	Max.	samples within PL.	Thigh (n=14)			Breast (n=11)				
				samples above PL.	Mean $\pm$ SD	Min.	Max.	samples within PL.	samples above PL.	Mean $\pm$ SD	
pH	6.40	6.70	2	12	$6.48 \pm 0.09$	6.02	6.28	11	0	$6.15 \pm 0.09$	
TVBN	8.40	11.48	14	0	$9.88 \pm 1.02$	10.08	14.56	11	0	$11.84 \pm 1.34$	
TBA**	0.33	2.26	3	11	$1.43 \pm 0.61$	0.09	1.53	7	4	$0.85 \pm 0.42$	

\*TVBN expressed as mg/100g sample.

\*\*TBARS expressed as milligrams of malonaldehyde/kg meat

PL (permissible limits pH=6.4, TBA=0.09 mg malonaldehyde/kg sample) E.S.S (ES 3493 (2005))

#### Sensory quality

The results of sensory scores of leftover cooked chicken cuts are presented in Table 3. The results showed relatively lower flavor scores especially for thigh where 4 samples out of 14 were lower

than the acceptable scores (3.5) that may be attributed to the development of warmed-over flavor which is characteristic for the cooked stayed meat as a result of protein denaturation after

cooking. This denaturation of proteins allows for inorganic chemicals such as iron to be released. Iron is a pro-oxidant that has the affinity to take electrons from other molecules. These molecules such as fatty acids, myoglobin, and sarcoplasmic and myofibrillar proteins can be oxidized readily. The release of electrons, especially in fatty acids cause rancidity and can give the meat a pungent odor and taste (Kerth et al., 2013). This may be explained by the strong relationship between high values of TBA, and the lower flavor scores of meat. Similar results were obtained by Byrne et al., (2002) who observed that increasing cooking temperature resulted in meat with more roasted, toasted, bitter sensory nature. Moreover, lower

scores were recorded for the juiciness and tenderness of leftovers especially that of breast cuts where 4 samples out of 11 samples were under acceptable scores (3.5). These observations are in good agreement with those of Pizato et al., (2015) who found that sensory shelf life was lower when compared to the microbial shelf life. This is related to the fact that several microorganisms cause a rapid development of odor and color due to its chemical reactions, which are undesirable for the product (Prändl et al., 1994). This implies that visually the product may no longer fit for consumption, but microbiologically it is still consumable.

**Table 3:** Sensory quality of cooked leftover chicken cuts (thigh and breast) (scores 1-7; 1, extremely unacceptable; 7, extremely acceptable)

	Thigh(n=14)					Breast(n=11)				
	Min.	Max.	Mean±SD	Samples below acceptable score	Samples above acceptable score	Min.	Max.	Mean±SD	Samples below acceptable score	Samples above acceptable score
Appearance	4.33	6.00	5.33±0.47	0	14	5.00	6.00	5.52±0.27	0	11
Flavor	3.33	5.00	4.26±0.49	4	10	3.67	5.33	4.45±0.52	2	9
Tenderness	3.33	5.67	4.98±0.63	1	13	2.33	4.67	3.67±0.75	4	7
Juiciness	3.67	5.67	5.07±0.53	1	13	2.33	4.67	3.58±0.65	4	7
Overall acceptable	4.33	5.33	4.91±0.35	0	14	3.38	4.92	4.30±0.36	3	8

### Conclusion

It can be concluded from the present study that the leftover cooked chicken cuts served in the student hostel of the Cairo University are bacteriologically acceptable in accordance with the Egyptian

Standard Specifications. However, These cuts revealed lower scores for sensory evaluation especially flavor and tenderness scores due to development of warmed over flavor after cooking.

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## المستخلص العربي

تمت هذه الدراسة لفحص جودة متبقيات لحوم قطعيات الدواجن المطبوخة بالمدينة الجامعية بجامعة القاهرة. ولاتمام هذه الدراسة قامت الباحثة بتجميع ٢٥ عينة من متبقيات قطعيات الدواجن ( عدد ١ ورك و ١١ كتف) وقد اجريت عليها هذه الفحوصات ١- الفحص البكتيريولوجي (العد الكلي للبكتيريا الهوائية والعد البكتيري للميكروب العنقودي الذهبي والبكتيريا القولونية) والبكتيريا المقاومة للبرودة وميكروبي السودومونس و الايرومونس وعزل ميكروبي السالمونيلا والايشريكية القولونية). ٢- فحص الجوده الحسية. ٣- قياس دلائل بدايات الفساد الغير ظاهري لهذه العينات (تركيز الاس الهيدروجيني، حامض الثيوباربيتيورك وقياس مجموع القواعد النيتروجينية المتطايره) وقد اظهرت نتائج العد البكتيري لعينات الورك  $2.12 \pm 0.27$ ,  $1.88 \pm 0.45$ ,  $3.29 \pm 1.07$ ,  $2.07 \pm 0.17$ ,  $2.39 \pm 0.38$  لوغاريتم لكل جرام على التوالي وكان العد البكتيري لعينات الكتف  $2.30 \pm 0.42$ ,  $2.27 \pm 0.33$ ,  $3.73 \pm 1.67$ ,  $2.31 \pm 0.35$ ,  $2.53 \pm 0.49$  لوغاريتم لكل جرام على التوالي وقد اثبتت النتائج خلوها من ميكروبي السالمونيلا والايشريكية القولونية وقد كانت نتائج الفحص البكتيري مرضيه على الرغم من ان نتائج الفحص الحسي كانت قليلة نوعا ما خاصة الطعم والرائحة والعصريه نتيجة التخزين والتغيرات الكيميائية في الدهون التي تتبعه خاصة في اللحوم المطبوخة.