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ORIGINAL ARTICLE

Critical control points for preparing chicken meals in a hospital kitchen

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Abstract There are many concerns about the sanitation practices used in the preparation of the foods and the occurrence of the gastrointestinal illness affecting mainly peoples who eating in hospital. Therefore, the purpose of this study was to determine the microbiological quality of chicken roasted and chicken pane meals preparing in summer and winter season in the hospital kitchen of the National Institute of Urology & Nephrology. Flow diagrams and microbiological testing of samples collected along the production line and swabs from surfaces, utensils, and equipments were used as indicator to meals safety in this work. Different food samples were examined for counts of aerobic colony bacteria, spore forming bacteria, yeast and molds, *Escherichia coli*, total coliform, *Staphylococcus aureus,* and presence of Salmonella. Swab samples were also taken from surfaces, utensils, and equipments for microbiological analysis. Results showed contamination of raw chicken, onion, egg and spices, multiplication of the microorganisms during thawing and cutting of chicken, poor hygiene of utensils and equipment, and survival of microorganisms to the cooking process. Cooking and hot-holding were considered Critical Control Points (CCPs). The results stress the importance of the implementation of training for nutritionists and food handlers to prevent foodborne diseases. Hazard Analysis Critical Control Point (HACCP) system can be also use to control the safety and quality of prepared meals.

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Introduction

Mishandling of foods in food service operations is frequently associated with outbreaks of foodborne diseases (Bryan, 1990). The importance of safe food for hospitalized patients and the detrimental effect that contaminated food could have on their recovery have been emphasized (Kandela, 1999).

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Patients receiving foods from a single kitchen with poor food handling practices could suffer a foodborne infection which could result in an outbreak involving the whole hospital (Ayliffe, 1992). Outbreaks of foodborne infections in hospitals are preventable but are facilitated by several factors; these include staff carriers, poor hygiene conditions in the kitchens, carelessness, and lack of training of food handlers. The particular danger of contaminated food in hospitals is that such food is given to consumers in poor health (Custovic and Ibrahimagic, 2005).

Improper practices responsible for microbial foodborne illnesses have been well documented by Egan et al. (2007) and typically involve cross-contamination of raw and cooked food, inadequate cooking, and storage at inappropriate temperatures. Food handlers may also be asymptomatic carriers of food poisoning organisms. There is general agreement that good overall level of knowledge of food safety among food handlers and the effective application of such knowledge in food handling practices are essential in ensuring the consistent production of safe food in restaurant operations (Bolton et al., 2008). More procedures must be taken during the processing and by monitoring the processing procedures with a HACCP system that has been proven to be a more acceptable procedure. Food safety programs of the past tend to correct the hazard conditions after they have happened. The HACCP approach is to control problems before they happen during processing and/or serving (McSwane et al., 2003). Hazard analysis and critical control points are worldwide considered as an effective and rational means of assuring food safety, which can be applied throughout the food chain from primary production to final consumption (Domenech et al., 2008). By following the procedures of safe food production with the HACCP system, foodborne illnesses will be reduced and safer foods will be served. Today, food enterprises without an HACCP system in place are more sensitive toward food safety awareness of consumers (Jin et al., 2008).

Therefore, the aim of this study is to assess the microbiological quality of patient's meals through the preparation of meals at hospital kitchen of the National Institute of Urology & Nephrology in Cairo, to assure the safety of meals.

Materials and methods

Preparing steps of tested meals

Preparation steps of chicken roasted and pane meals obtained from local suppliers are illustrated in Figs. 1 and 2. During manufacturing of chicken roasted meal, frozen chicken were thawed at room temperature (32 °C) and then cut and mixed with flavor sauce for a period not less than two hours. The temperature measured for samples holding in the refrigerator was between 4–6 °C, and their pH value was between 4.81–4.98, and refrigerated chicken were roasted on the oven at 130 °C.

Manufacturing of chicken pane meal could be simplified as follows: frozen chicken breast were thawed in separate refrigerator, spiced with pepper, salt and onion (flavor sauce for a period not less than 2 h), and then mixed with egg and ground toasted bread before being fried. The temperature measured after mixing chicken with flavor sauce and holding in the refrigerator was between 4–6 °C and the pH value was between 4.95–5.14, and refrigerated chicken pane was fried in preheating oil at 180 °C for 10 min.

Inspections and sample collection

During the summer and winter seasons of 2010–2011, inspections were undertake on the kitchen of the National Institute of Urology & Nephrology Hospital. Each inspection consisted of two phases: the first phase involved the collection of information about the hygienic state of equipments and utensils used, and evaluation of the production process according to the HACCP system **(**ISO 22000, 2005**)**. The aspects taken into account were the following: (1) equipments and utensils, (2) employers who preparing foods, and (3) procedures of food production and storage. The second phase involved the collection of samples from foods (raw materials, during processing steps and from final products). In addition, swab samples were taken from various surfaces in contact with the food, after normal cleaning procedures had been completed.

Different food samples were examined for aerobic colony bacterial count, spore forming bacteria count, yeast and mold counts, *Escherichia coli* count, total coliform counts, *Staphylococcus aureus* count, and presence of Salmonella. All previous tests were used to reflect the microbiological quality of the foods. Swab samples were tested for aerobic colony bacterial count, yeast and mold counts, *E. coli* count, total coliform counts, and *S. aureus* (Oranusi et al., 2007).

The different separate triplicate samples from raw materials, ingredients, during different processing steps, and final products of selected meals during the tested period were selected randomly, put into sterile plastic bags, and quickly transported to the laboratory in an insulated and refrigerated box. An aliquot of 10 g or 10 ml of each food sample was homogenized in 90 ml of sterile diluents (0.1% peptone water) with a Stomacher (Seward, Model 400, England) for 30 s. Serial dilutions were prepared in peptone water, and one milliliter aliquots were plated in each specific medium and incubated at different temperatures according to Stinson and Tiwari (1978) as listed in Table 1.

For spore forming bacterial count, serial dilutions of different samples were pasteurized in water bath at 80 °C for 20 min and one milliliter aliquots were plated in the medium.

The method used for isolation of Salmonella was carried out according to the method of **(**ISO 6579, 2002**)**. Twenty-five grams or milliliters from each sample was used in the pre-enrichment process in 225 ml of buffer peptone water and was incubated at 37 °C for 16–24 h. For selective enrichment, one milliliter of peptone broth was transferred to 9 ml each of tetrathionat broth and was incubated at 37 °C for 24 h. From each selective enrichment broth, a 5-mm loopfull was streaked on selective plates of bismuth sulfite agar and incubated at 37 °C for 24 h.

Swab samples were collected from the work surfaces (tables, wooden and plastic cutting boards), utensils and containers (pans, trays, large utensils, and small utensils), cutlery (spoons, knives, and forks), and interior surfaces of the refrigerators, large equipment, by using a sterile swab premoistened by dipping into 10 ml of 0.1% sterile peptone water according to Stinson and Tiwari (1978). All swab samples were placed in an icebox and taken immediately to the laboratory for microbiological analysis.

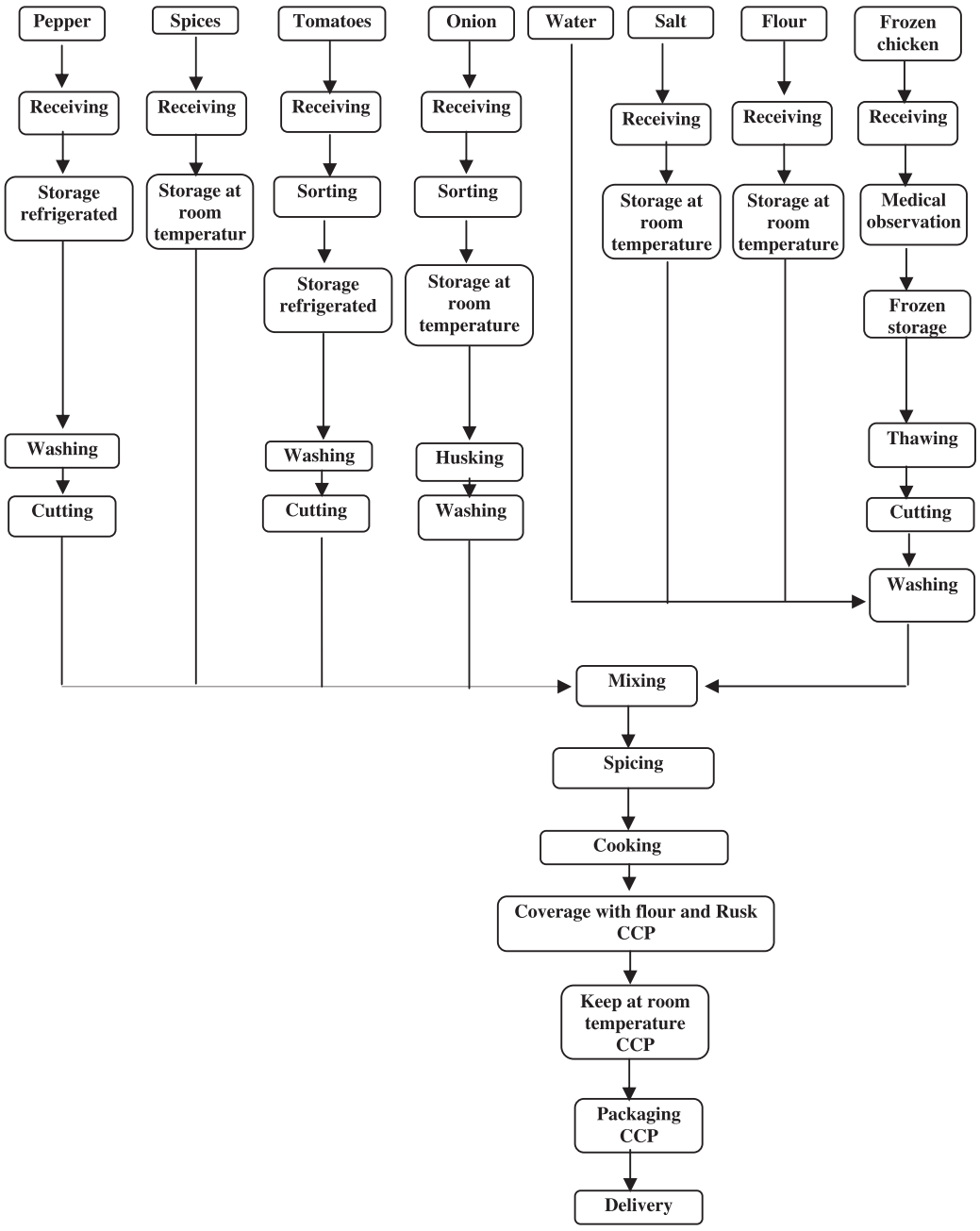

Fig. 1 Flow diagram of preparation of Chicken roasted.

Application of HACCP system

In this study, two meals were selected for investigation, and the first one was "Chicken roasted meal" which consists of chicken, pepper, tomatoes, onion, and spices. The second one was "Chicken pane meal" that contains chicken breast, garlic, lemon juice and onion juice, spices, egg, rusk, and flour. According to the NACMCF (1992), HACCP system was applied in establishment based in the following seven principles: (1) Conduct a hazard analyses. (2) Identify the Critical Control Points (CCPs). (3) Establish critical limits for preventive measures associated with each identified CCP. (4) Establish CCP monitoring requirements. (5) Establish corrective actions to be taken when monitoring indicates a deviation from an established critical limit. (6) Establish verification procedures and (7) Establish record-keeping and documentation procedures. The studied meals are summarized with reference to CCPs and their monitoring on the HACCP worksheet for Chicken roasted and pane meals (Tables 4 and 7).

Data analysis

All experiments were performed in triplicate. The data were recorded as means and were analyses with SPSS software (Norusis, 2008)

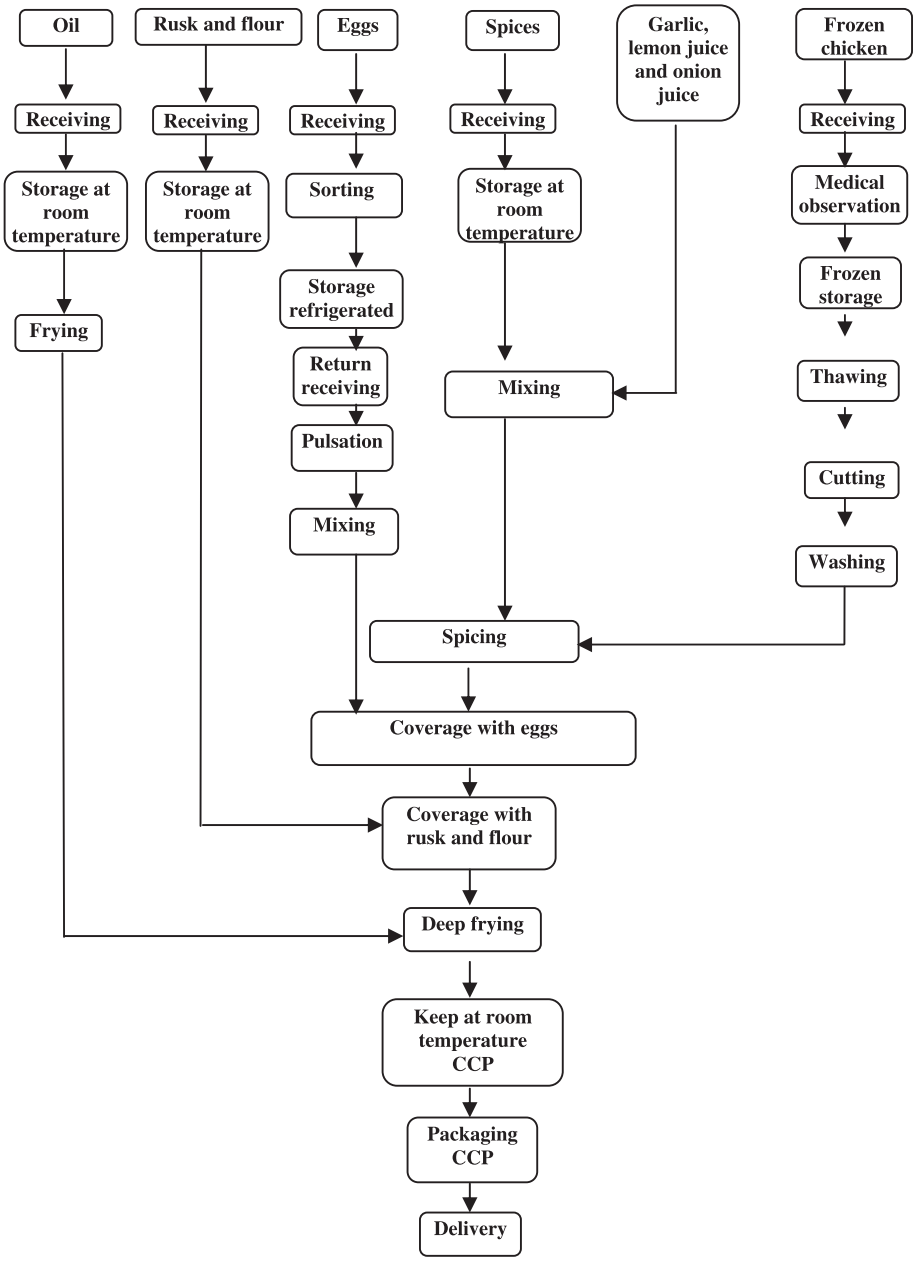

Fig. 2 Flow diagram of preparation of Chicken pane meal.

Results and discussion

Hazard analysis and HACCP control chart of manufacturing Chicken roasted meal

Typical preparation, associated hazards, and critical control point of Chicken roasted meal are illustrated in flow diagram in Fig. 1. The possibilities of contamination, survival of contaminants, and growth of microorganisms are analyzed in process reviews. Sources of contamination are workers who handle foods and utensils that the foods contact as well as the raw foods.

Data in Tables 2 and 3 cleared that the microbiological profile of chicken roasted in kitchen was taken in winter and summer season, respectively. It could be noticed that the aerobic bacteria count found in thawing, cutting, spices, and treatment with sauce were 4.65, 6.78, 4.52, and 5.80 log cfu/g samples in winter; on the other hand, the aerobic count in summer was higher than that found in winter being 5.78, 6.80, 4.94, 6.02 log cfu/g samples. Coliform and *S. aureus* were detected in chicken thighs during the treatment with sauce (spicing) in a count 2.42 and 1.12 log cfu/g samples, respectively. The samples taken in winter were 2.42 and 1.12 log cfu/g, while in summer were 3.48 and 2.31 log cfu/g samples, respectively. Salmonella were not detected in any samples during different preparing steps. According to Hospitality Institute of Technology and Management (2006), reducing the pH values by adding vinegar or lemon juice and holding mixed products at temperature < 5 °C will prevent the growth of mesophilic bacterial pathogens according to Bolton and Maunsell (2004).

The core temperature measured for the thighs after grilling was between 76–80 °C, and these temperatures were enough to kill pathogens bacteria as it seen in Tables 2 and 3. The total colony count was decreased during grilling and holding at room temperature due to the effect of heating. But the contamination may occur during the packaging in winter and summer seasons.

Type of hazards during manufacturing chicken roasted meal and control measure that should be used to control an identified hazards are illustrated in Table 4. By using the NACMCF (1992) decision tree, the following steps in the preparations of chicken roasted meal were considered as critical control points: the thawing operation is critical control points for skinless boneless chicken breast which is frequently contaminated by enteric pathogens. Temperature in these steps should be controlled and monitored to prevent growth of pathogenic microorganisms that may be produce toxins if temperature is not controlled.

The mixing with flavored sauce for a period not less than 2 h was considered as a critical control point, because of the possibility of pathogenic microorganisms to grow and produce heat resistant toxins which are not destroyed when the food is heated. Grilling was consider as CCP, where the core temperature should be controlled and monitored to destroy pathogenic bacteria which may presenting in raw material or reach during preparation.

The HACCP control chart of chicken roasted meal (Table 4) showed that the control measures during preparation, cutting, thawing, and mixing were good hygiene practice (GHP) and good manufacturing practices (GMP). The procedures of monitoring were to do visual inspection of washing and cutting operations to ensure GHP and GMP during preparing.

Hazard analysis and HACCP control chart of manufacturing Chicken pane

Typical preparation of Chicken pane meal, associated hazards, and critical control point are illustrated in Fig. 2. The possibilities of contamination, survival of contaminants, and growth of microorganisms are analyzed in process reviews, and the product of chicken pane spiced with pepper, salt, and onion was then mixed with egg and rusk before being fried.

Data in Tables 5 and 6 summarized the microbiological profiles of Chicken pane meal ingredients during different processing steps in kitchen during winter and summer seasons. It could be observed that Salmonella was not detected in any sample. The aerobic bacterial counts found in steps of thawing, cutting chicken, onion, egg, spices, and treatment with flavored sauce were 3.63, 4.01, 3.94, 3.28, 4.57, and 5.49 log cfu/g samples in winter season, respectively, which was lower than the count of aerobic bacteria in summer season. Mold and yeast were recorded of the all steps and the higher values reached 2.55, 2.56, and 3.20 log cfu/g in summer season, in comparison with less values obtained in winter season.

The total bacterial count decreased during frying chicken due to the effect of heating. Frying of the chicken pane at 185 °C for 10 min might be enough to destroy the microorganisms. According to the decision tree matrix, thawing and mixing were Critical Control Points (CCP_s).

Thawing operation is a critical control point for skinless boneless chicken breast which is frequently contaminated by

Table 2 Microbiological analysis of chicken roasted meal in winter season.

Sample	Microbiological analysis (Mean log cfu/g)						
	A.b.c	S.F.B.C	Y&M C	*E. coli*	Coliform	*S. aureus*	*Salmonella*
Thawing Chicken thighs	4.65	1.81	1.04	1.12	1.50	< 1	ND
Cutting Chicken thighs	6.78	2.95	3.00	1.52	2.00	< 1	ND
Spices	4.52	2.14	2.17	< 1	< 1	< 1	ND
Chicken treatment with flavor sauce (spicing)	5.80	3.57	4.31	1.43	2.42	1.12	ND
Keep at room after cooking	1.56	< 1	< 1	< 1	< 1	< 1	ND
Chicken after packaging	2.11	< 1	< 1	< 1	< 1	< 1	ND

A.b.c: Aerobic bacterial count; S.F.B.C: spore forming bacteria count; Y&M.: yeast and mold count, Salmonella was detected (+ or −); < 1: viable colony was not detected at detection limit $< 10^1$ cfu/g, cfu/g: Colony forming unit per gram, and ND: no detected.

Table 3 Microbiological analysis of chicken roasted meal in summer season.

Sample	Microbiological analysis (Mean log cfu/g)						
	A.b.c	S.F.B.C	Y&M.C	*E. coli*	Coliform	*S. aureus*	*Salmonella*
Thawing Chicken	5.78	2.93	1.97	1.25	1.72	< 1	ND
Cutting Chicken	6.80	3.84	3.84	1.33	2.28	< 1	ND
Spices	4.94	2.88	2.26	< 1	< 1	< 1	ND
Chicken treatment with flavor sauce (spicing)	6.02	4.07	5.82	1.15	3.48	2.31	ND
Keep at room after cooking	1.89	< 1	< 1	< 1	< 1	< 1	ND
Chicken after packaging	2.87	1.15	< 1	< 1	1.24	< 1	ND

A.b.c: Aerobic bacterial count; S.F.B.C: spore forming bacteria count; Y&M.C: yeast and mold count; < 1: viable colony was not detected at detection limit $< 10^1$ cfu/g; ND: no detected.

Table 4 HACCP worksheet for critical control points of chicken roasted in hospital kitchen.

Critical control point	Hazard	Control measures	Critical limit	Monitoring frequency/ documentation	Corrective action
1. Thawing frozen chicken breast	Biological	Temperature/time control	Core temperature < 5 °C 24 h or less time between thawing and cooking	Check core and surface temperature of the food at least twice per day Check thawing time	Investigate temperature/ time Discard the food if the surface temperature has reached 10 °C or higher
2. Mix chicken breast with flavored sauce for a period not less than 2 h	Biological	Temperature/time control	Core temperature < 5 °C, 24 h or less time between thawing and cooking	Check core and surface temperature of the food at least twice per day (preferably at a busy time of the day) Check thawing time	Investigate temperature and evaluate risk Discard the food if the surface temperature has reached 10 °C or higher
3. Cooking (grilling chicken thighs)	Biological Chemical Physical	Core Temperature control Temperature Heating time Removing foreign material	75 °C or higher (core temperature) Temperature ⩽180 ° C Avoid intermittent Removing foreign material	Check temperature Check temperature Check heating time Visual checks	Continue cooking until core temperature is achieved and investigate temperature/time abuse and evaluate risk Discard food if contamination occurs

Table 5 Microbiological analysis of chicken pane in winter season.

Sample	Microbiological analysis (log cfu/g)						
	A.b.c	S.F.B.C	Y&M	*E. coli*	Coliform	*S. aureus*	*Salmonella*
Thawing of frozen chicken	3.63	2.16	2.43	1.00	1.32	1.73	ND
Cutting chicken breast	4.01	2.22	2.19	< 1	1.21	1.45	ND
Cutting onion	3.94	2.81	2.46	< 1	< 1	< 1	ND
Egg	3.28	1.70	1.31	< 1	1.43	< 1	D
Spices	4.57	2.05	2.12	< 1	< 1	< 1	ND
Chicken breast treatment with flavored sauce and covered with egg and flour	5.49	3.02	2.78	1.01	1.31	1.75	D
Chicken pane after frying	1.21	1.11	< 1	< 1	< 1	< 1	ND
Chicken pane after packaging	1.98	1.04	1.73	< 1	< 1	1.35	ND

A.b.c: Aerobic bacterial count; S.F.B.C: spore forming bacteria count; Y&M: yeast and mold; < 1: viable colony was not detected at detection limit $< 10^1$ cfu/g; ND: no detected and D: detected.

Table 6 Microbiological analysis of chicken pane in summer season.

Sample	Microbiological analysis (Mean log cfu/g)						
	A.b.c	S.F.B.C	Y&M.C	*E. coli*	Coliform	*S. aureus*	*Salmonella*
Thawing of frozen chicken	5.86	2.98	2.55	1.01	1.52	1.73	ND
Cutting chicken breast	6.93	3.33	2.29	< 1	1.35	1.43	ND
Cutting onion	3.16	3.20	2.56	1.02	1.52	< 1	ND
Egg	4.92	1.97	1.62	< 1	1.32	1.35	ND
Spices	5.97	2.48	2.46	< 1	< 1	< 1	ND
Chicken breast treatment with flavored sauce and covered with egg and flour	6.53	3.49	3.20	1.13	1.62	2.29	ND
Chicken pane after frying	1.61	< 1	< 1	< 1	< 1	< 1	ND
Chicken pane after packaging	2.43	1.08	1.03	< 1	< 1	1.42	ND

A.b.c: Aerobic bacterial count; S.F.B.C: spore forming bacteria count; Y&M.C: yeast and mold count; < 1: viable colony was not detected at detection limit $< 10^1$ cfu/g; ND: no detected.

enteric pathogens. Mixing skinless boneless chicken breast with flavored sauce for a period not less than 2 h and storage skinless boneless breast in refrigerator at 5 °C after coating with eggs, flour, and crumb bread power until frying during preparing chicken were considered as CCP_s. Cooking (deep frying of breast) was considered as CCP_s, according to Pearce

Table 7 HACCP worksheet for critical control points of chicken pane meals in hospital kitchen.

Critical control point	Hazard	Control measures	Critical limit	Monitoring frequency/ documentation	Corrective action
1. Thawing	Biological	Temperature/ time control	Core temperature < 5 °C 24 h or less time between thawing and cooking,	Check core and surface temperature of the food at least twice per day Check thawing time	Investigate temperature/time Discard the food if the surface temperature has reached 10 °C or higher
2. Mixing the chicken breast with flavored sauce for a period not less than 1 h	Biological	Temperature/ time control	Core temperature < 5 °C 24 h or less time between thawing and Cooking	Check core and surface temperature of the food at least twice per day (preferably at a busy time of the day)Check thawing time	Investigate temperature and evaluate risk discard the food if the surface temperature has reached 10 °C or higher
3. Covering the chicken breast with egg, flour and Rusk	Biological	Temperature/ time control	Core temperature < 5 °C 24 h or less time between thawing and cooking	Check temperature Check holding time	Investigate temperature and evaluate risk. Discard the food if the surface temperature has reached 10 °C or higher
4. Deep frying chicken pane	Biological Chemical Physical	Temperature/ time control Heating time	100 °C or higher (core temperature) $\leqslant 180$ °C	Check temperature Check heating time Visual checks	Continue cooking until core temperature is achieved Investigate temperature/ time abuse and evaluate risk Discard contaminated food

Table 8 Microbiological analysis of surfaces in contact with food in hospital kitchen.

Surfaces	Microbiological analysis (Mean log cfu/100 cm^2)									
	A.b.c		Y & M C.		*E. coli*		Coliform		*S. aureus*	
	W	S	W	S	W	S	W	S	W	S
Work surfaces										
Tables	3.54	3.67	2.04	2.63	< 1	1.01	1.0	1.53	1.56	2.02
Blastic cutting	3.29	4.30	2.72	2.95	1.13	1.25	1.34	1.67	1.22	2.89
Wooden cutting	5.42	6.76	3.85	3.13	1.01	1.24	1.55	1.79	2.87	3.32
Utensils cooking										
Pans	2.65	2.73	1.00	1.98	< 1	< 1	1.47	1.02	1.97	1.86
Trays	2.05	2.54	1.35	1.84	< 1	< 1	1.56	2.00	1.56	2.05
Large Utensils	2.48	3.83	1.79	2.04	< 1	< 1	1.03	1.43	< 1	1.12
Small Utensils	1.75	2.02	1.56	2.68	< 1	1.11	1.44	1.13	< 1	1.00
Cutlery										
Spoons	3.27	3.55	2.06	2.87	< 1	< 1	1.23	1.94	2.87	2.88
Knives	2.69	1.85	1.24	1.64	< 1	< 1	1.05	1.30	1.96	1.85
Forks	2.40	1.64	1.85	1.43	< 1	1.02	1.35	1.46	1.93	1.82
Interior surfaces of refrigerators										
Refrigerators	2.00	2.05	1.08	1.21	< 1	< 1	1.00	1.11	1.00	1.25
Large Equipment										
Oven	2.73	2.88	1.39	1.75	< 1	< 1	1.27	1.48	1.65	1.83
Wall surfaces										
Storing room	2.84	3.21	2.87	2.95	< 1	< 1	< 1	1.21	< 1	1.00
Processing room	4.36	4.85	2.74	3.04	< 1	1.13	< 1	1.76	< 1	1.45
Floor Surface										
Processing room	4.85	5.28	2.09	3.26	1.31	2.41	2.56	3.54	1.05	2.00
Storing room	5.45	6.75	4.14	4.45	1.02	1.05	2.45	3.11	1.00	1.23
Equipment transfer food										
Inside	3.94	4.24	1.76	1.02	< 1	< 1	< 1	1.12	< 1	< 1
Outside	4.79	5.45	1.57	1.09	< 1	< 1	< 1	1.00	< 1	< 1

Where: W: winter; S: summery; A.b.c: Aerobic bacterial count; Y&M C.: yeast and mold count and log cfu/100 cm^2: logarithmic colony forming units/100 cm $<$ 1: viable colony was not detected at detection limit $< 10^1$ cfu/100 cm^2.

et al. (2006). During cooking, core temperature should reach 75 °C or higher to destroy vegetative cells of pathogens bacteria.

Consequently, the presence of coliforms and *E. coli* in the main dish indicates poor handling practices of food handlers and cross-contamination in the kitchen. On the other hand, the presence of coagulase positive staphylococci in foods constitutes a significant risk of contamination by food handlers, and it can be also used as an indicator of cross-contamination (Mossel and Netten, 1991; Aycıcek et al., 2004). According to (Aycıcek et al., 2004), these results indicate that the level of personnel hygiene, using protective utensils during processing (mask, gloves, hats, etc.), and cross-contamination precautions should be improved in the kitchen and serving units. Chicken pane meals were subject to contamination during serving. They were frequently eaten shortly after cooking, which was good factor to prevent health risks. FDA (2001) reported that to keep food safe during serving in the caterings, pathogenic spores that survive cooking must not be allowed to grow out and multiply. FDA also cleared that hot food will maintain optimum quality and nutrient value if eaten within 30 min after preparation. Table 7 summarized the work sheet of HACCP system as which could be a guideline for application HACCP system as a food safety tool in the preparing Chicken pane meals.

Assessment bacterial contamination of surfaces in contact with the food

Results of the bacterial contamination of surfaces in contact with the food in the kitchen in winter and summer seasons are given in Table 8. The parameters taken for reference are the aerobic bacterial count which is correlated although not specifically with hygiene procedures, and the traditional indicators *E. coli* and *S. aureus*. Considering all the types of surfaces, Table 8 cleared the microbial counts of the swab taken from work surfaces, utensils cooking, cutlery, refrigerators, oven, wall surfaces, floor surface, and equipment transfer at winter and summer seasons in Urology Institute kitchen.

The obtained results of the swabs taken from the work surfaces (tables, blastic cutting, and wooden cutting) showed a total aerobic bacteria colony count, yeast and mold, *E. coli*, coliform, and *S. aureus* of (3.67, 4.30 and 6.76), (2.63, 2.95 and 3.13), (1.01, 1.25 and 1.24), (1.53, 1.67 and 1.79) and (2.02, 2.89 and 3.32 log cfu/g), respectively, in summer season, while less counts of microorganisms were observed in winter, due to the lack of hygiene and water disinfectants necessary.

Highest content of microorganisms were observed in the swabs taken from floor surface in storing room and processing room 6.75, 4.45, 1.05, 3.11, and 1.23 log cfu/g for total aerobic bacteria colony count, yeast and mold, *E. coli*, coliform and *S. aureus*, respectively, were found in summer season.

Microorganisms can remain viable on food contact surfaces for significant periods, increasing the risk of cross-contamination events between food handlers, food products, and food contact surfaces (De cesare et al., 2003). The role of food workers in food borne outbreaks has been clearly demonstrated by Todd et al. (2009). Hanssen et al. (2005) indicated that 25% of reported outbreaks are caused by inadequate consumer handling and food preparation. In fact, epidemiological studies have revealed that a significant number of consumers follow unsafe and risky practices during meal preparation (Redmond and Griffith, 2003) and do not implement proper hygienic measures to prevent cross-contamination events (Fischer et al., 2007). In a survey performed by klontz et al. (1995) about hygiene practices, 25% of respondents were reported reutilize cutting boards without cleaning after cutting raw chicken. Therefore, it is reasonable to expect a reduction of microorganisms and other food borne diseases if consumers would apply safe food handling practices. Cross-contamination and transfer rates of microorganisms from foods to lettuce were assessed by Ravishankar et al. (2010) under different food-handling scenarios, with and without washing procedures, Elena et al. (2012) revealed that the washing using only water is not enough to remove microorganisms while washing procedures including soap, hot water, and vigorous mechanical scrubbing are suitable to reduce cross-contamination. The contamination of hand swab samples highlights the need for improved personal hygiene as a major step in minimizing possible food poisoning outbreaks (Gadaga et al., 2008). According to Landeiro et al. (2007) in restaurants, foods are more likely than drinks to contain *S. aureus* because of repeated hand contact. Staphylococcal food poisoning results from the consumption of a food in which enterotoxigenic *staphylococci* have grown and formed enterotoxin(s). Recognition of the sources of transmission and outbreaks of enterotoxigenic *staphylococci* are important to prevent this type of food poisoning (Miokovic et al., 2001).

Conclusion

In general, food preparation and handling abuse were a characteristic of the kitchen and the data presented here have highlighted the potential food safety hazards in the preparation of meals. The microbiological conditions of meals were similar, such as those observed on surfaces and utensils. Thus, it is apparent that the microbiological conditions of the meals are determined by the way the processes are implemented and not by the type or condition of the incoming stock. Due to several hazards determined during chicken roasted and pane preparations, it seems that training programs for nutritionists and food handlers are necessary. This training program should contain principles of food microbiology, food safety, microbiological hazards, food processing, determination of critical control points, practical control measures, and monitoring procedures which are important to prevent foodborne diseases.

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