J. Food and Dairy Sci., Mansoura Univ., Vol.5 (3): 187-198, 2014

VERIFICATION OF CONTROL MEASURES FOR CRITICAL CONTROL POINTS ESTABLISHED IN FOOD CHAIN OF SOME EGYPTIAN KITCHEN HOTELS

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ABSTRACT

Hazard Analysis and Critical Control Points (HACCP) system is a very important food safety tool that most countries throughout the world try to implement and make pressure for its adoption. The food safety literature demonstrates that a successful HACCP system involves a complex mix of managerial. The aim of this study was to verify the control measures of critical control points (ccp) and monitoring procedures during processing steps of food chain in two kitchen hotels. Control measures like sanitizing and its effects in reducing microbial levels of food contact surfaces (chopping machines, kitchenware, knives, worktops, and cutting boards) were verified, also critical limits of established critical control points e.g. temperature of cold stores, freezers, thawing, cooking, hot holding, cold holding, cooling and reheating units were also verified. The food contact surfaces sampled in the two kitchen hotels were within the recommended standard. Our results set a representative picture of the actual situation in the tested samples.
Keywords: CCP, Critical Limits, HACCP, verification, food safety.

INTRODUCTION

Tell me what you eat and I will tell you what you are. This simple say expressed in the past but refers to today's industrialized eating habits and hazards in our eating. In recent years; surveillance and monitoring by a number of countries and the researchers indicates that food borne illness is increasing around the world, unfortunately. Food borne illness is thought to be increasing for a variety of reasons. It is very common that the food should be safe from harmful substances from farm to fork. End point testing is not a good way to ensure food safety. The HACCP approach is to prevent hazards before it happened (Walker *et al*, 2003, McSwane *et al*, 2003). In the last decade, the HACCP system has been recognized as a cost- effective procedure for ensuring food safety. Today, this methodology is internationally accepted as a food safety tool which is applied during full food production process (Bertoloni *et al*, 2007).

HACCP is a technique used to analyze potential hazards in an operation, identifying where these may occur and how much these are critical to consumer safety. It also establishes control systems that focus on the prevention of such hazards rather than relying on end-product testing. (Sivasankar, 2002). Charisis, (2004) mentioned that the HACCP system is a scientific and systematic method aimed to assure food safety. This method is based on “prevention” from the stage of primary production to the final consumer and it is performed through identification, assessment and control of hazards significant for food safety. Otherwise, HACCP is an internationally

accepted instrument that allows obtaining the hygienic aspects of food quality. Initially conceived as a way to provide astronauts with foods of the highest level of quality, HACCP has been adopted by Pan American Health Organization and the World Health Organization, the US Food and Drug Administration, and many other agencies worldwide for the preparation of safe foods at all levels: home, restaurant, and the hotel industry. The HACCP system is based on seven principles, as follows: Principle 1: Conduct a hazard analysis. Principle 2: Determine the critical control points (CCPs). Principle 3: Establish critical limit(s). Principle 4: Establish a system to monitor control of the CCP. Principle 5: Establish the corrective action to be taken when monitoring indicates that a particular CCP is not under control. Principle 6: Establish procedures for verification to confirm that the HACCP system is working effectively. Principle 7: Establish documentation concerning all procedures and records appropriate to these principles and their application (FAO and WHO 2006).

Codex Alimentarius Commission, (1997) explained that HACCP can be applied in order to achieve a greater assurance that the produced, processed or manufactured food is safe. It identifies what is needed to make food safe and makes sure that what is planned is correctly implemented. Therefore today HACCP is part of food hygiene, or the food safety assurance system. Food hygiene can itself be placed in the context of food quality assurance programmers. HACCP should be considered as a combination of measures and methods used in the field of Food Safety, which complements the general aspects of a total quality management as well as specific principles of food hygiene, and ensures that essential safety measures are implemented. Verification should also identify several activities that are conducted daily or more frequently for each Critical Control Point (CCP) in the HACCP plan. The HACCP plan depends on accurately applying the critical limit for each identified CCP, including accuracy in measurement and completeness in records. Daily verification includes: 1) record review, 2) review of corrective actions, and 3) calibration of instruments. Additionally, the HACCP plan should operate effectively in the production system. Verification of the records at each CCP is conducted to assure the following: The record was recorded according to the frequency identified in the monitoring procedures and by the person identified in the HACCP plan. The record form was prepared correctly, i.e. no ditto marks, actual temperatures and times are recorded, and signatures are present. All monitoring periods during production were included. All critical limits were met. Any deviation from the critical limit is identified and a corrective action was indicated.

According to NACMCF (1997) verification as those activities other than monitoring procedures that determine the validity of the HACCP plan and that the system is operating according to the plan. Thereby, validation is collecting and evaluating scientific and technical information to determine whether the HACCP plan, when properly implemented, will effectively control the hazards. Charisis, (2004), defined verification as all activities undertaken to check compliance with the plan and its implementation. The verification activities are mentioned in more detailed as follow; (1) analyze the HACCP plan documents and its registers, (2) scientifically evaluate all hazards (3) analyze

deviations of critical limits (4) analyze corrective actions taken for each deviation in the past (5) guarantee that all CCP are under control (6) guarantee -through calibration- that all measuring equipment are working properly (7) perform laboratory analysis to guarantee that the critical limits are well established (8) evaluate suppliers for quality assurance.

A general and simplified example of food preparation and production flow chart (generic flow diagram for catering operations) was illustrated by Griffith (2000) along with possible CCPs in the process. The most commonly used CCPs in kitchen operations are cooking, cooling, reheating, and hot/cold holding. Kvenberg and Schwalm (2000) recommended that microbiological testing is an important mechanism for collecting data used in developing and implementing an HACCP plan. Microbial sample data can help establish standard operating procedures (SOPs) for sanitation, assess the likelihood of the occurrence of hazards, establish critical limits, and assess the validity of the HACCP plan. The use of a performance standard to assess whether microbiological hazards have been reduced to an acceptable level creates an especially important use for microbial analysis. Microbial testing is also useful in implementing an HACCP plan by helping to monitor the effectiveness of sanitation SOPs, the compliance of incoming ingredients with safety criteria, the safety of product being held for corrective action, and the safety of the finished product. The verification audits demonstrate that all control measures have been applied as designed in the HACCP plan. Although auditing HACCP records is the primary means of verification, microbial sampling can play an important role as well.

Therefore the aim of the present study is to verify the efficacy of the critical control points established in the food chain preparing of meals in hotels.

MATERIAL AND METHODS

Inspection of kitchens:

During 2013 two phases of inspections was undertaken on the two different hotel's kitchens in Sharm El Sheikh (Egypt). Each inspection includes: The first phase was collection of information about the prerequisite programs for implementation of HACCP plan such as hygienic state of the buildings, employers, utensils and equipments that used in preparing foods and an evaluation of the production process by using the food safety checklist according to USDA, (2005). The aspects taken into account were: (1) structural characteristics (walls, covering, floor, etc.), (2) equipments and utensils, (3) employers who preparing foods (4) procedures of food production and storage. The information was recorded on specially prepared forms in order to standardize data for each of the different operators.

The second phase involved the collection of swab samples from various surfaces "which are in contact with the food" during the processing and after normal cleaning procedures. Swab samples were collected from the hands of plan workers, meat grinder, work surfaces (tables and Teflon cutting boards), utensils and containers (pans, plates and dishes), cutlery (spoons, , knives and forks), and interior surfaces of the refrigerators, by using a sterile swab

remoistened by dipping into 10 ml of sterlized 0.1% sterile peptone water according to Stinson and Tiwari (1978). All swab samples were placed in an ice box and taken immediately to the laboratory for microbiological analysis. The temperature of the different component of tested meals was measured in internal regions of each throughout or just immediately after cooking with a pre-calibrated thermometer.The calibration was by a thermocouple thermometer.

Microbiological analysis:

Swab samples were tested for total aerobic colony count, *Staphylococcus aureus* and *Escherichia coli.* The result of these tests used to reflect the hygienic state of the employers, utensils and equipments. Media and incubation conditions used for microbiological analysis were showed 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 ml aliquots were plated in the medium.

Table (1): Media and incubation conditions used for microbiological analysis.

Microbiological analysis	Incubation conditions		
	Time (h)	Temp (^{o}C)	Growth medium
Total aerobic colony count	48	37	Plate count agar
Aerobic spore forming bacterial	48	37	Plate count agar
E. coli	24	44.5	MacConkey agar
Staphylococcus aureas	48	37	Baird parker agar

All media were obtained from Oxoid and isolation of Salmonella was carried out according to the method of ISO (1990).

Statistical analysis:

All data were analyzed using Microsoft Excel program. According to Wei *et al,* (2006) Chi-square (X2) test was used to determined the existence of statistically significant differences amongst the frequencies of samples for unsatisfactory microbiological quality between various type of meals and swab samples obtained from different two kitchens (A & B). ($p < 0.05$) was considered statistically significance.

RESULTS AND DISCUSSIONS

Verification procedures were conducted in the form of internal audits. This is not given priority in most hotels, and there was concurrence among key informants that one of the challenges facing the staff is that they did not fully understand the need for the program. These programs are driven by policies that provide standards for purchasing / supply of foods and formal surveillance systems with mandatory reporting of illnesses and health events on a weekly basis and sampling of potentially hazardous foods for food-borne illness surveillance. Potable water sampling is done routinely to assess bacteriological quality.

Assessment the safety of the procedures in the selected kitchens:

For assessment the safety of the manufacturing procedures during the working day of the two selected kitchens under investigation, the food safety

checklist of USDA, (2005) were used and the results were tabulated in Table (2). It could be noticed that personal hygiene in kitchen (A) was better than personal hygiene in kitchen (B).

Table (2a): Record keeping of daily checklist in two kitchens during visiting

Operations	Kitchen (A) /(20)*		Kitchen (B) /(20)*	
FOOD PREPARATION	Yes	Percentage	Yes	Percentage
All food stored or prepared in facility is from approved sources.	20	100	20	100
Food equipment, utensils and food contact surfaces are properly washed, rinsed, and sanitized before every use.	20	100	13	65
Frozen food is thawed under refrigeration or in cold running water.	20	100	14	70
Preparation is planned so ingredients are kept out of the temperature danger zone to the extent possible.	20	100	20	100
Food is tasted using the proper procedure	20	100	13	65
Food is handled with suitable utensils, such as, single use gloves or tongs.	20	100	8	40
Food is prepared in small batches to limit the time it is in the temperature danger zone (+5^{o}C : +65^{o}C).	20	100	20	100
Clean reusable towels are used only for sanitizing equipment, surfaces and not for drying hands, utensils, or floor.	20	100	20	100
Food is cooked to the required safe internal temperature for the appropriate time. The temperature is tested with a calibrated food thermometer.	NA	NA	NA	NA
The internal temperature of food being cooked is monitored and documented.	NA	NA	NA	NA
HOT AND COLD HOLDING UNITS	Yes	Percentage	Yes	Percentage
Hot holding unit is clean.	20	100	17	85
Food is heated to the required safe internal temperature before placing in hot holding.	20	100	20	100
Hot holding units are not used to reheat potentially hazardous foods.	20	100	20	100
Hot holding unit is pre-heated before hot food is placed in unit.	20	100	20	100
Temperature of hot food being held is at or above 65^{o}C.	20	100	16	80
REFRIGERATORS AND FREEZERS	Yes	Percentage	Yes	Percentage
Food is protected from contamination.	20	100	15	75
Refrigerators are kept clean and organized.	20	100	13	65
Temperature of cold food being held is at or below 5^{o}C.	19	95	15	75
Thermometers are available and accurate.	NA	NA	NA	NA
Refrigerator and freezer units are clean and neat.	20	100	12	60
All food is properly wrapped, labeled, and dated.	20	100	20	100
The FIFO (First In, First Out) method of inventory management is used.	20	100	20	100

Table (2b): Record keeping of daily checklist in two kitchens during visiting

Operations	Kitchen (A) /(20)*		Kitchen (B) /(20)*	
FOOD STORAGE	Yes	Percentage	Yes	Percentage
All food and paper supplies are stored 15 cm to30 cm off the floor.	20	100	20	100
All food is labeled with name and received date.	20	100	20	100
Open bags of food are stored in containers with tight fitting lids and labeled with common name.	20	100	20	100
The FIFO (First In, First Out) method of inventory management is used.	20	100	20	100
There are no bulging or leaking canned goods.	20	100	20	100
All food surfaces are clean.	20	100	15	75
Chemicals are clearly labeled and stored away from food and food related supplies and the Material Safety Data Sheets (MSDS) are provided.	20	100	20	100
CLEANING AND SANITIZING	Yes	Percentage	Yes	Percentage
Water is clean and free of grease and food particles.	20	100	20	100
Sponges are stored in sanitizing solution while in use.	20	100	20	100
UTENSILS AND EQUIPMENT	Yes	Percentage	Yes	Percentage
Work surfaces and utensils are clean.	20	100	14	70
Work surfaces are cleaned and sanitized between uses.	20	100	11	55
UTENSILS AND EQUIPMENT	Yes	Percentage	Yes	Percentage
All small equipment and utensils, including cutting boards and knives, are cleaned and sanitized between uses	20	100	14	70
Small equipment and utensils are washed, sanitized, and air-dried.	19	95	16	80
Thermometers are cleaned and sanitized after each use.	NA	NA	NA	NA
Thermometers are calibrated on a routine basis.	NA	NA	NA	NA

(20)*: No. of daily checklist Recorded during visit the establishment in two kitchens, NA: not applicable

Employees in two kitchens were almost didn't worn hair restraints (60% of recording in kitchen A and 90% of recording in kitchen B), employees also didn't wash hands properly at appropriate times in 10% and 55% of recording daily checklist of kitchen A and kitchen B, respectively, in the same time, they were eating, drinking and smoking during preparing food in kitchen B only (60% of recording).

The conditions of preparing area of meals in kitchen A were also better than that in kitchen B. 35% of recording in kitchen B showed that surfaces contact food were not washed, rinsed, and sanitized before every use, also food was tasted by using improper procedure in 35% of recording in kitchen B. Frozen food was thawed at room temperature in 30% of recording in kitchen B only.

From the same table it could be showed that employees used bar hands during preparing ready to eat food in 60% of recording in kitchen B only, in spite of present single use gloves and tongs. There were no thermometer to measure and monitoring the internal temperature of cooked meals in two kitchens (kitchen A & B). The sanitation conditions of hot holding units, refrigerators and freezers in kitchen A was better than that at kitchen B. There were no thermometers to ensure the temperatures inside these equipments. 20% and 25% of recording in kitchen B showed that temperatures of foods being held in hot holding units and refrigerators, respectively, were not agree with recommended temperatures. Record keeping of daily checklist in two kitchens (kitchen A& B) showed that work surfaces were not cleaned between uses in 45% of recording in kitchen B only, also utensils and equipment were not cleaned between uses in 30% of recording in kitchen B. Kitchen garbage cans in kitchen B were not clean and kept covered in 25% of record daily checklist.

Verification of sanitizing procedures for food contact surfaces:

The results of bacterial contamination of surfaces are in contact with the food in kitchen A and kitchen B were presented in Tables (3 & 4), respectively. The parameters taken for reference are the total aerobic 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, only 71.05% and 53.31% were conforming to the advisory standards for the total aerobic colony count in kitchen A and kitchen B, respectively. Moreover, 3.95% of samples in kitchen A and 14.06% of samples in kitchen B were totally unsuitable for contact with food, with significantly difference ($p<0.05$) between kitchen A and kitchen B, (Table 5).

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From the data tabulated in Tables (5) it could be noticed that 2.63% and 7.89% of swab samples in kitchen A and 12.50% and 26.56% of swab samples in kitchen B were found to be contaminated by *E. coli* >1 cfu/cm^2, and *S. aureus* >1 cfu/cm^2 respectively, with significantly difference between kitchen A and kitchen B ($p< 0.05$) for *E. coli* and ($p<0.01$) for *S. aureus* (Table5).

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.

Table (5): Unsatisfactory rate of Total aerobic colony count, *E. coli* and *Staphylococcus aureus* in swab samples of surfaces in contact with food at different kitchens.

Kitchen	T.A.C.C (%)	*E. coli* (%)	*S. aureus* (%)
Swab samples in kitchen (A)	(76) 3.95%	(76) 2.63%	(76) 7.89%
Swab samples in kitchen (B)	(64) 14.06%	(64) 12.50%	(64) 26.56%
P-Value	0.0357 **	0.0239 **	0.00298 **

( ):No. of samples, %: The value represents the unsatisfactory rate of samples, T.A.C.C: Total aerobic colony count. **: statistically significant (p < 0.05).

According to the data recorded in Table (5) it could be showed that the statistical analysis of the unsatisfactory rate of total aerobic colony count, *E. coli* and *S. aureus* for swab samples of surfaces in contact with food at two kitchens (A& B). It could be noticed that there were significantly differences between kitchen A and kitchen B at $p<0.05$ for total aerobic colony counts, *E. coli* and *S. aureus*. It could be noticed also that the unsatisfactory rats of swab samples in kitchen B were more than that they are in kitchen A.

Verification of the microbiological quality of water used in two selected kitchens:

The results of microbiological analysis of water used in the different processing steps and other activities in the kitchens under investigation were presented in Table (6). It could be noticed that, total aerobic colony counts in water samples obtained from two kitchens were $<10^4$ cfu/ml. Coliforms, *E. coli*, *S.aureus* and *Salmonella* cells were not detected in the examined samples in two kitchens.

Table (6): Microbiological analysis of tap water in two selected kitchens

Sample	Microbiological analysis (cfu/ml)				
	A.C.C.	*E. coli*	Coliform	*S. aureus*	*Salmonella sp.*
Tap water in kitchen A (n=10)	$4.5x10^3$	$<10^1$	$<10^1$	$<10^1$	ND
Tap water in kitchen B (n=11)	$6.2x10^3$	$<10^1$	$<10^1$	$<10^1$	ND

cfu/ml: Colony forming unit per milliliter, A.C.C.: aerobic colony count, ND: Not Detected

CONCLUSION

According to the results of our investigation it could be concluded that, catering establishments have been frequently associated with outbreaks of food poisoning. There are microbiological hazards and risks associated with preparation and storage of foods throughout all links of the food chain from production to consumption. If these hazards are not controlled, food borne illness can occur and shelf-life of products will be shortened and spoilage can result**.** An adequate protection of the consumer from food borne illness can be achieved by inspection and personnel training based on good manufacture practices and hygienic food preparation, moreover, the application of a systematic approach to the identification and evaluation of food safety hazards as is the HACCP system must be carried out to achieve food safety**.**

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التحقق من إجراءات التحكم في النقاط الحرجة المدرجة بسلسلة تداول الغذاء لبعض مطابخ الفنادق المصرية

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نظام تحليل المخاطر ونقاط التحكم الحرجة (HACCP) هو نظام مهم جداً لسلامة الأغذية لدرجة أن كثير من حكومات بلدان العالم تقوم بالضغط من أجل محاولة اعتماده داخل بلدانهم. وعند الرغبة فى تطبيق نظام سلامة الغذاء (HACCP) بنجاح فيتطلب ذلك الخوض فى بعض الاجراءات التى قد تبدو متداخلة. والهدف من هذه الدراسة هو التحقق من سلامة تطبيق اجراءات الـ (HACCP) داخل مطبخين لفندقين وذلك من خلال فحص بعض معايير التحكم فى النقاط الحرجة وكذلك فحص طرق المراقبة للحدود الحرجة والمرتبطة بمدى نظافة وتطهير الأسطح التى تلامس الغذاء (مثل المناضد وأيدى العاملين وأسطح التقطيع والسكاكين وبعض معدات الطهى) كذلك شمل التحقق من بعض الحدود الحرجة المتعلقة بالحرارة (مثل درجات حرارة غرف التبريد والتجميد وعمليات الصهر والطهى والحفظ بعد الطهى كذلك التبريد للساخن واعادة تسخين البارد). وكانت النتائج المتحصل عليها للعينات المفحوصة توضح أن الأسطح الملامسة للأغذية فى مطبخ فندقين كانت ضمن المعايير الموصى بها كما عكست النتائج الوضع الفعلي فى العينات التى تم اختبارها.

قام بتحكيم البحث

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Table (3): Conformity microbiological analysis of surfaces in contact with food in kitchen (A):

Surfaces	Total aerobic colony count			*E. coli*		*S. aureus*	
	Satisfac-tory <50 cfu/cm^2 %	Fairly sat-isfactory 50-10^4 cfu/cm^2 %	Unsatisfa-ctory>10^4 cfu/cm^2 %	Satisfac-tory <1 cfu/cm^2 %	Unsatisfa-ctory >1 cfu/cm^2 %	Satisfac-tory <1 cfu/cm^2 %	Unsatisfa-ctory >1 cfu/cm^2 %
The hands of plan workers n:12	58.33	33.33	8.33	91.67	8.33	91.67	8.33
Meat grinder n:12	41.67	50.00	8.33	100.00	0.00	83.33	16.67
Work surfaces (tables and Teflon cutting boards, etc.) n:16	56.25	37.50	6.25	93.75	6.25	87.50	12.50
Containers (pans, trays, plates, dishes, etc.) n:14	85.71	14.29	0.00	100.00	0.00	92.86	7.14
Cutlery (spoons, , knives , and forks) n:11	90.91	9.09	0.00	100.00	0.00	100.00	0.00
Interior surfaces of refrigerators n:11	100.00	0.00	0.00	100.00	0.00	100.00	0.00
All surfaces n:76	71.05	25.00	3.95	97.37	2.63	92.11	7.89

Table (4): Conformity microbiological analysis of surfaces in contact with food in kitchen (B):

Surfaces	Total aerobic colony count			*E. coli*		*S. aureus*	
	Satisfac-tory <50 cfu/cm^2 %	Fairly sat-isfactory 50-10^4 cfu/cm^2 %	Unsatisfa-ctory>10^4 cfu/cm^2 %	Satisfac-tory <1 cfu/cm^2 %	Unsatisfa-ctory >1 cfu/cm^2 %	Satisfac-tory <1 cfu/cm^2 %	Unsatisfa-ctory >1 cfu/cm^2 %
The hands of plan workers n:12	16.67	58.33	25.00	83.33	16.67	58.33	41.67
Meat grinder n: 0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Work surfaces (tables and Teflon cutting boards, etc.) n:16	31.25	37.50	31.25	68.75	31.25	56.25	43.75
Containers (pans, trays, plates, dishes, etc.) n:14	64.29	28.57	7.14	92.86	7.14	78.57	21.43
Cutlery (spoons, , knives , and forks) n:11	72.73	27.27	0.00	100.00	0.00	81.82	18.18
Interior surfaces of refrigerators n:11	90.91	9.09	0.00	100.00	0.00	100.00	0.00
All surfaces n: 64	53.13	32.81	14.06	87.50	12.50	73.44	26.56