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APPLICATION OF ISO 22000 FOOD SAFETY MANAGEMENT SYSTEM IN THERAPEUTIC NUTRITION AT SOME HOSPITALS

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ABSTRACT: *Hazard analysis was conducted to identify critical control points (CCPs) during preparation of kofta, boiled chicken and green salad and applied HACCP plan. During the process, the different biological, physical and chemical hazards identified at each processing stage in the hazard analysis worksheet which incorporated into the HACCP plan to assess the risks associated with the processes. Physical hazards such as foreign matter; chemical hazards such as pesticide, mycotoxins and heavy metals; and microbiological hazards such as Staphyloccous aureus, coliforms, Salmonella were identified. Results shows the thawing operation of meat & chicken should be controlled and monitored to prevent growth of pathogenic microorganisms that may be produce toxins if temperature is not controlled, Green salad should be washed effectively and disinfected with chlorine. This process reduces the initial microbial load and minimises the pathogenic microorganisms. Monitoring systems were established for the CCPs identified and these included a preventive measures, critical limits, corrective actions, assignment of responsibilities and verification procedures.*

Key words: *HACCP, ISO 22000, nutrition, hospitals.*

INTRODUCTION

Food safety is an increasingly important public health issue on global level. The main reasons for increasing level of food borne illnesses are lack of knowledge, lack of competent person in food production facilities, governmental food safety agencies, and public.

Food-borne diseases become of paramount importance in hospitals. Hospitals have been identified as high food safety risk institutions because they serve potentially hazardous foods to vulnerable people .These people are more susceptible to food-borne illnesses than the general population (South Australia Department of Health, 2008). Although providing safe food to patients who are at risk of acquiring infection is a major duty in hospitals epidemiological and surveillance data suggest that faulty practices in food service establishments and home play a crucial role in the causal chain of food-borne diseases (Dryden *et al.*, 1994; Khuri-Bulos*et al.*, 1994; Gullar *et al.*, 2004). The Hazard Analysis and Critical Control Points (HACCP) system is science based and systematic. It identifies specific hazards and measures for their control to ensure the safety of food. Any HACCP system is capable of accommodating change, such as advances in equipment design, processing procedures or technological developments (Codex Alimentarius Commission, 1999). Its concept permits a systematic approach to the identification of hazards and an assessment of the likelihood of their occurrence during the manufacture, distribution and use of a food product, and defines measures for their control (Van Schothorst, 2004).

The ISO 22000 international standard specifies the requirements for a food safety management system. This standard further clarifies the concept of pre-requisite programmes which are divided into two sub-categories: infrastructure and maintenance programmes and operational pre-requisite programmes. Infrastructure and maintenance programmes are used to address basic requirements of food hygiene, and accepted good practice of a more permanent nature, whereas operational pre-

requisite programmes are used to control or reduce the impact of identified food safety hazards in the product or the processing environment (Faergemand and Jesperson, 2004).

MATERIALS AND METHODS

Food preparation place:

The study was conducted on two randomly selected hospitals (HP-1 and HP-2) kitchens in Menoufia governorate – Egypt. HP1 hospital serves an estimated 750 meals per day including patient and staff meals while HP2 hospital serves an estimated 800 meals per day including patient and staff meals. The kitchen has an area for reception of raw materials, butchery, poultry and special areas for handling of vegetables and cooking.

Prerequisite programs

Good Manufacturing Practices (GMP):

GMP was represented a combination of technical, instructions and quality assurance procedures.

According to the South African National Standard (SANS 2011) describes Good Manufacturing Practices (GMP) or prerequisites for HACCP as basic good hygiene practices that need to be in place before HACCP can be implemented.

Standard Operating Procedures (SOPs)

Standard Operating Procedures (SOPs) must be employed throughout an operation. Prerequisite programs for HACCP would include SOPs for supplier control, written specifications, written cleaning and sanitation procedures and documented employee training (Youn& Sneed, 2003).

Implementation of HACCP plan

Four Stages for the implementation of HACCP according to Mortimore, (2001) and Norton, (2002).

RESUTLS AND DISCUSSION

Data presented in Table (1) and Fig. (1) show that the type of hazards during preparation of kofta meal and control measure that should be used to control identified hazards. Using the NACMCF (1992) decision tree, the following steps in the preparations of kofta were considered as critical control points:

Frozen meat receiving – CCP1

Receiving of frozen meat was considered as a critical control point, which is maintained at temperatures of -12°C or below.

According to Bryan (1981) raw meat may present spores of *C. perfringens, Salmonella, S.aureus* and other pathogens. To prevent these hazards it would be necessary to require periodical microbiological analysis of raw meat supplied by the butchery, and to change the meat supplier when the analysis shows an inadequate count of microorganisms.

Frozen meat storage – CCP2

Storage was considered as a critical control point, which is maintained at temperatures of -12°C or below. Freezing also prevents growth, multiplication and toxin production by bacterial contaminants.

According to the storage of raw material (Jay, 1992) foodstuffs should be kept at different temperatures, and in different places and relative humidity of the storing places might change from 80% to 95% to avoid the cross contamination.

Preparation of Parsley– CCP3

Preparation of parsley was considered as a critical control point, sorting is carried out at this stage where dirt removed from the surface of the parsley. Following that, washing and cut into small pieces. Cutting knives should be disinfected at every change. Parsley is washed effectively and disinfected with chlorine. This process reduces the initial microbial load and minimises the pathogenic microorganisms. Water is used; however, its effectiveness is improved by the addition of chlorine. Water should be free of foreign matter, temperature of 1 - 4°C, and concentration of disinfectant solution at 100 - 150 ppm.

Table (1) HACCP worksheet for critical control points of kofta preparation in hospital kitchen

Critical control point	Hazard	Preventive measures	Critical limits	Monitoring & Recording	Corrective action	· Verification
Receiving of frozen meat	Biological	Receive at -18°C or lower	Frozen meat at or less than -12°C	check the surface temperature of the frozen meat by using disinfected probe& record	Reject thawing meat	supervisor will observe the accuracy of the product temperature & log supervisor will check thermometer used for monitoring and verification
Storage of frozen meat	Biological	Store at -18°C or lower	Frozen meat at or less than -12°C	check the surface temperature of the frozen meat in the freezer at least once per day by using disinfected probe& record	Place in chilled storage or use immediately (if the surface temperature of the food has not reached 10°C or higher) Discard the food (if the surface temperature of the food has reached 10°C or higher)	supervisor will observe the accuracy of the product temperature & log supervisor will check thermometer used for monitoring and verification
Preparation of Parsley	Chemical	Assurance of critical limits observance	Chlorine 100 -150 ppm pH 6-7.5	Check sodium hypo chlorite (Chlorine) solution by chlorine test strip and record	Manually adjust water Hold produce from last correct reading and rewash Staff training repeated for chemical use	Daily record review by supervisor
Thawing	Biological	remove from freezer the day before and store at the bottom of refrigerator	Core temperature 2°C to 5°C, 24 hours or less time between thawing and cooking	Check core and surface temperature of meat at least twice per day by using disinfected probe & record Check thawing time	Continue thawing if the core temperature is less than 2°C Discard the food if the surface temperature of the food has reached 10°C or higher	supervisor will observe the accuracy of the product temperature & log supervisor will check thermometer used for monitoring and verification

Table (1) Cont.

Critical control point	Hazard	Preventive measures	Critical limits	Monitoring & Recording	Corrective action	Verification
Mixing and rolled meat	Biological	Temperature/time control	Core temperature 2°C to 5°C, 24 hours or less time between thawing and cooking	Check core and surface temperature of meat at least twice per day by using disinfected probe & record Check thawing time	Continue thawing if the core temperature is less than 2°C Discard the food if the surface temperature of has reached 10°C or higher	supervisor will observe the accuracy of the product temperature & log supervisor will check thermometer used for monitoring and verification
Cooking (Deep frying)	Biological	Temperature/time control Heating time.	Ensure kofta is cooked for appropriate time & to appropriate 100 °C or higher (core temperature ≤ 180° C)	Check temperature Check heating time Visual check	Continue cooking until the core temperature is achieved Discard food if contamination occurs	supervisor will observe the accuracy of the product temperature & log supervisor will check thermometer used for monitoring and verification
Hot Holding	Biological	Ensure kofta is placed in the Bain Marie before the temperature decreases to below 63°C and held at this temperature or higher	63°C or higher	Use disinfected probe to check core temp & record	increase the temperature of the Bain Marie	supervisor will observe the accuracy of the product temperature & log supervisor will check thermometer used for monitoring and verification

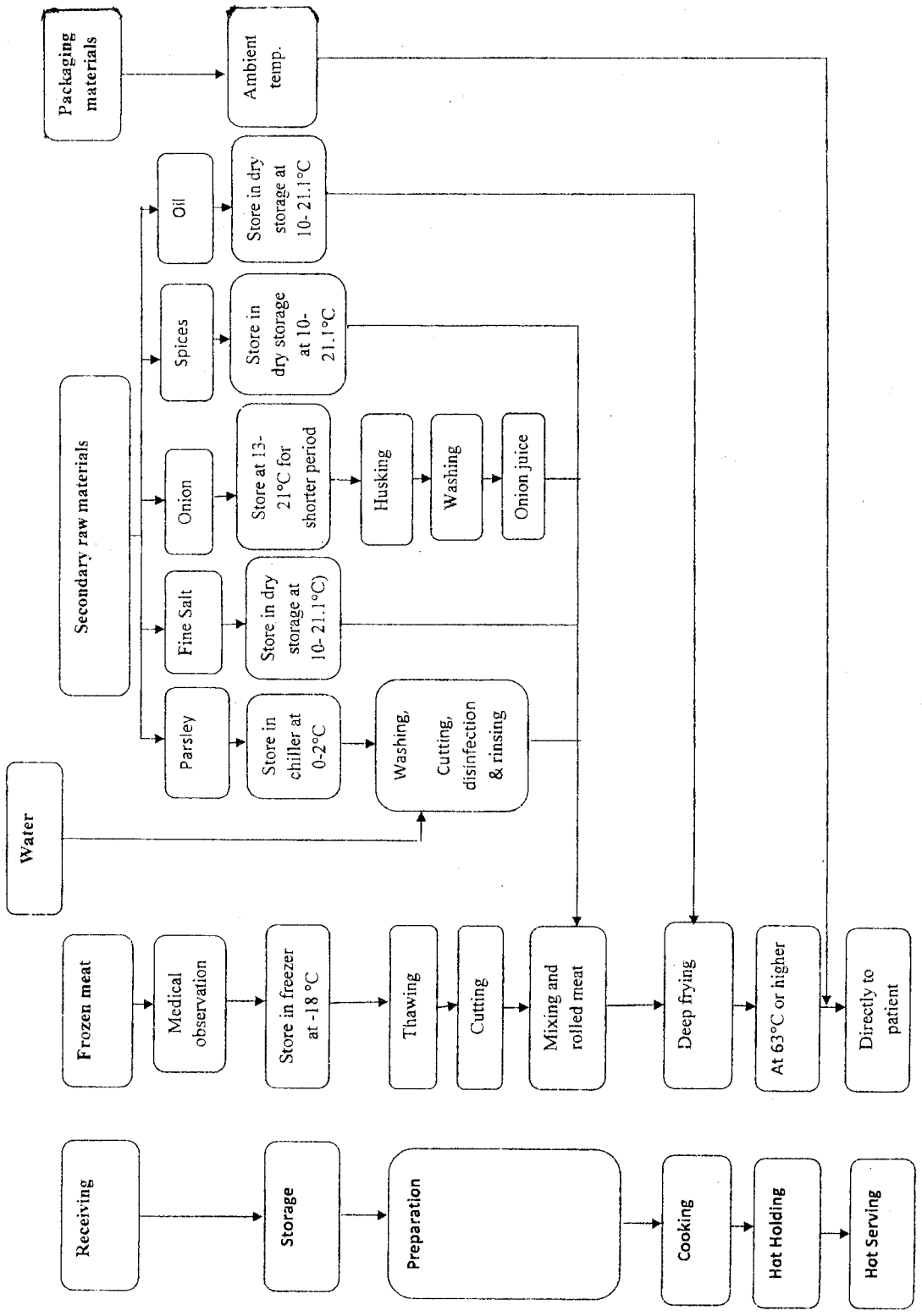

Figure1: Flow diagram of preparation of kofta

Aran *et al.*, (1987) mentioned that 50-125 ppm active chlorine is adequate for eliminating the microbial risks of the fruits and vegetables. For very dirty raw materials 1-5 ppm active chlorine should be added to the final rinsing water. To avoid the contamination from water used for washing, water analysis (chemical and microbiological) should be performed by authorized laboratories periodically. It is noteworthy that sanitizing agents such as chlorine are used in the wash water, mainly to reduce the microbial load in fresh-cut vegetables (Soliva-Fortuny and Martin-Belloso, 2003).

Thawing – CCP4

The thawing operation was considered as a critical control point, 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.

Thawing should be performed only in: (a) A refrigerator or purpose-built thawing cabinet maintained at a temperature of 4°C; or (b) Running potable water maintained at a temperature not above 21°C for a period not exceeding 4 hours; or (c) A commercial microwave oven only when the food will be immediately transferred to conventional cooking units as part of a continuous cooking process or when the entire, uninterrupted cooking process takes place in the microwave oven.

Mixing and rolled meat– CCP5

The mixing and rolled meat 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.

Cooking (deep frying) – CCP6

Cooking (deep frying of kufta) was considered as CCPs, These results were in accordance with those obtained by Bryan and Lyon (1984) who found that the cook/hot- hold operation the CCPs were cooking and hot-holding.

Temperature control criteria for processes can be set and strictly adhered to; for example, all microbiologically sensitive foods should be cooked to an internal (geometric centre) temperature at least 70°C for a given period of time (Bryan, 1981, 1992).

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

Hot - Holding – CCP7

Hot - Holding was considered as CCPs, which is maintained at an internal temperature of 63°C or higher and only use hot-holding equipment that can keep foods at the proper temperature. The FDA Food Code (2005) requires that all hot foods be maintained at 135 °F or above. When temperatures of food fall below 135 °F, they are in the temperature danger zone—temperatures at which bacteria grow rapidly. NACMCF (1992) reported that, during hot-holding food temperature should be at least 63ºC. To maintain this temperature, the water temperature in the water bath should be higher than 85ºC and pass-through temperature should be at least 63ºC. Besides, the bottom of the pans should be in contact with the steam table water.

These results were in accordance with those obtained by Bryan and Lyon (1984) who found that the cook/hot- hold operation the CCPs were cooking and hot-holding.

Typical preparation of Chicken meal, associated hazards, and critical control point are illustrated in Table (2) and Fig. (2). The possibilities of contamination, survival of contaminants, and growth of microorganisms are analyzed in process reviews, and the product of chicken

Frozen chicken receiving – CCP8

Receiving was considered as a critical control point, which is maintained at temperatures of -12°C or below. According to Mossel *et al.*, (1995) raw chicken can be contaminated with *Salmonella*, *Campylobacter* and other pathogens. To

Table (2): HACCP worksheet for critical control points of boiled chicken in hospital kitchen

Critical control point	Hazard	Preventive measures	Critical limits	Monitoring & Recording	Corrective action	Verification
Receiving of frozen chicken	Biological	Receive at -18°C or lower	Frozen chicken at or less than -12°C	check the surface temperature of the frozen chicken by using disinfected probe & record	Reject thawing chicken	supervisor will observe the accuracy of the product temperature & log supervisor will check thermometer used for monitoring and verification
Storage of frozen chicken	Biological	Store at -18°C or lower	Frozen chicken at or less than -12°C	check the surface temperature of the frozen chicken in the freezer at least once per day by using disinfected probe & record	Place in chilled storage or use immediately (if the surface temperature of the food has not reached 10°C or higher) Discard the food (if the surface temperature of the food has reached 10°C or higher)	supervisor will observe the accuracy of the product temperature & log supervisor will check thermometer used for monitoring and verification
Thawing	Biological	remove from freezer the day before and store at the bottom of refrigerator	Core temperature 2°C to 5°C, 24 hours or less time between thawing and cooking	Check core and surface temperature of the food at least twice per day by using disinfected probe & record Check thawing time	Continue thawing if the core temperature is less than 2°C Discard the food if the surface temperature of the food has reached 10°C or higher	supervisor will observe the accuracy of the product temperature & log supervisor will check thermometer used for monitoring and verification

Table (2): Cont.

Critical control point	Hazard	Preventive measures	Critical limits	Monitoring & Recording	Corrective action	Verification
Cooking	Biological	Ensure chicken is cooked for appropriate time & to appropriate core temperature above 75°C and Ensure frozen joints is completely thawed	75°C or higher (core temperature)	Use disinfected probe to check core temp & record	Continue cooking until the core temperature is achieved Discard food if contamination occurs	supervisor will observe the accuracy of the product temperature & log supervisor will check thermometer used for monitoring and verification
Hot Holding	Biological	Ensure chicken is placed in the Bain Marie before the temperature decreases to below 63°C and held at this temperature or higher	63°C or higher	Use disinfected probe to check core temp & record	increase the temperature of the Bain Marie	supervisor will observe the accuracy of the product temperature & log supervisor will check thermometer used for monitoring and verification

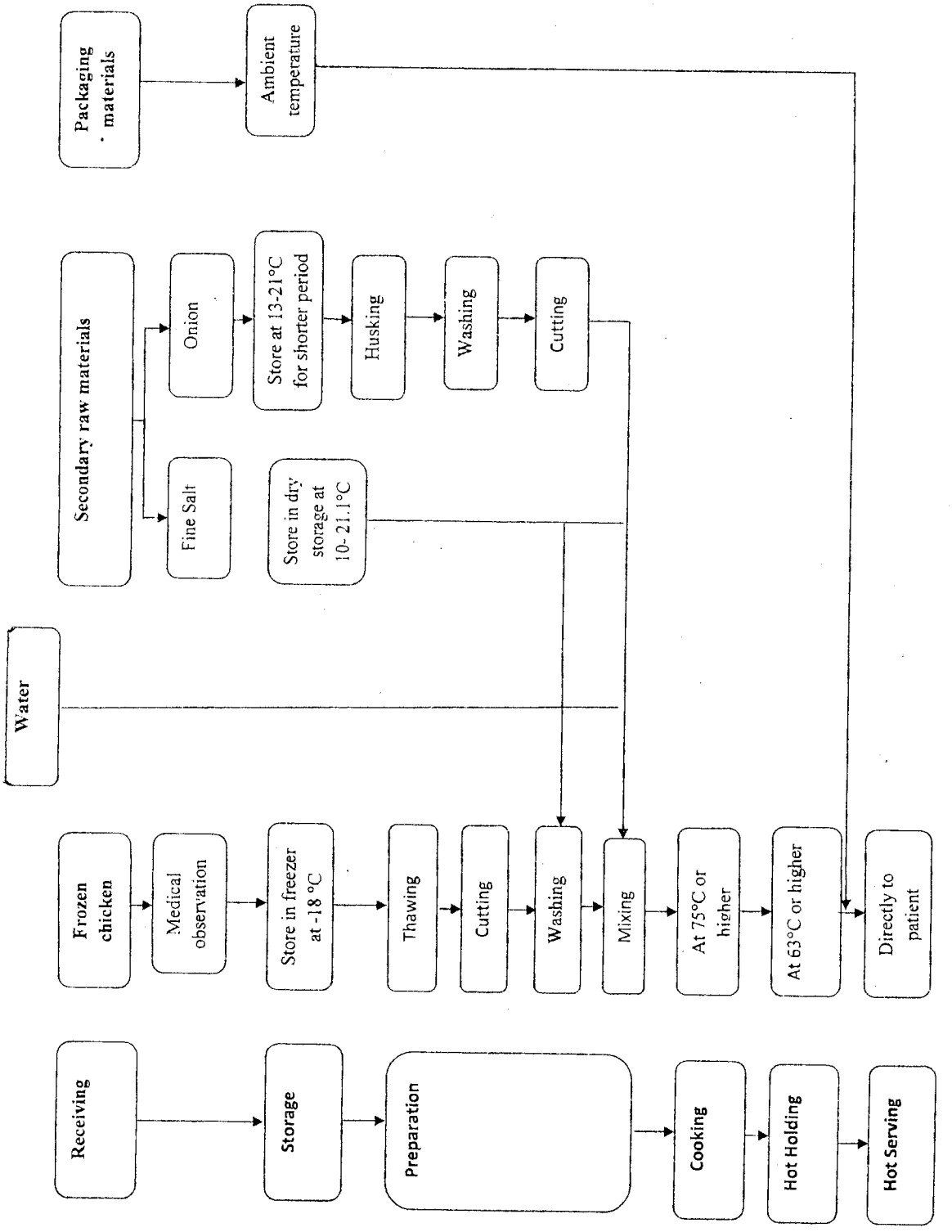

Figure2: Flow diagram of preparation of boiled chicken

prevent these hazards, it would be necessary to require periodical microbiological analysis of raw chicken supplied by the supplier, and to change the chicken supplier when the analysis shows an inadequate count of microorganisms.

Frozen chicken storage – CCP9

Storage was considered as a critical control point, which is maintained at temperatures of -12°C or below. Freezing also prevents growth, multiplication and toxin production by bacterial contaminants.

According to the storage of raw material Jay (1992) foodstuffs should be kept at different temperatures, and in different places and relative humidity of the storing places might change from 80% to 95% to avoid the cross contamination.

Thawing – CCP10

The thawing operation was considered as a critical control point, 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.

Thawing should be performed only in: (a) A refrigerator or purpose-built thawing cabinet maintained at a temperature of 4°C; or (b) Running potable water maintained at a temperature not above 21°C for a period not exceeding 4 hours; or (c) A commercial microwave oven only when the food will be immediately transferred to conventional cooking units as part of a continuous cooking process or when the entire, uninterrupted cooking process takes place in the microwave oven.

Cooking – CCP11

Cooking was considered as CCPs, The cooking process must be designed to eliminate *Salmonella*, which is the most heat-resistant pathogen of public health concern for raw poultry. Although *L. monocytogenes* is more heat resistant, it is considered a hazard from post-process contamination rather than undercooking.

According to the NACMCF (1992) a single minimum internal product endpoint temperature of 73.9◦C for cooking without a time limitation should be recommended to the consumer to ensure the microbiological safety of cooked poultry. This temperature will destroy *Salmonella*, the most heat-resistant pathogen of public health concern in raw poultry. Guidance to the consumer should indicate that higher final temperatures may be needed for consumer acceptability and palatability (e.g. 76.7◦C for whole muscle breast meat, 82.2◦C for whole muscle thigh meat in order to eliminate the pink appearance and rubbery texture.
According to Pearce *et al.*, (2006) during cooking, core temperature should reach 75°C or higher to destroy vegetative cells of pathogens bacteria..

Mackey *et al.*, (1990) reported that during cooking, core temperature should reach at least 70°C at least 2 minutes or achieving at least 75°C (core temperature) are sufficient to destroy bacteria like *Salmonella*, *Campylobacter*, *L. monocytogenes* and *Y. enterocolitica*.

These results were in accordance with those obtained by Bryan and Lyon (1984) who found that the cook/hot- hold operation the CCPs were cooking and hot-holding.

Hot - Holding – CCP12

Hot - Holding was considered as CCPs, which is maintained at an internal temperature of 63°C or higher and only use hot-holding equipment that can keep foods at the proper temperature. The FDA Food Code (2005) requires that all hot foods be maintained at 135 °F or above. When temperatures of food fall below 135 °F, they are in the temperature danger zone — temperatures at which bacteria grow rapidly.

Bacterial colonisation and growth is limited by holding hot foods hot, cold foods cold, and by ensuring that hot food are cooled to appropriate storage temperatures before bacterial multiplication (Baker, 2002).

NACMCF (1992) reported that, during hot-holding food temperature should be at least 63°C. To maintain this temperature, the water temperature in the water bath should be higher than 85°C and pass-through temperature should be at least 63°C. Besides, the bottom of the pans should be in contact with the,steam table water.
These results were in accordance with those obtained by Bryan and Lyon (1984) who found that the cook/hot- hold operation the CCPs were cooking and hot-holding.

Data presented in Table (3) and Figures (3 and 4) show that the type of hazards during preparation of green salad and control measure that should be used to control an identified hazards. Using the NACMCF (1992) decision tree, the following steps in the preparations of green salad were considered as critical control points:

Storage of raw materials – CCP13

Storage of tomato ripe, cucumber and green pepper were considered as a critical control point, McGregor (1989) reported that tomato, ripe should be maintained at 13 to 15°C (55 to 60°F), 85-90% relative humidity and cucumber and green pepper should be maintained at 10°C (50°F), 85-90% relative humidity to avoid the cross contamination.

Preparation – CCP14

Preparation was considered as a critical control point, sorting is carried out at this stage where dirt removed from the surface of tomato, cucumber and green pepper. Following that, washing and cut into small pieces. Cutting knives should be disinfected at every change. Tomato, cucumber and green pepper were washed effectively and disinfected with chlorine. This process reduces the initial microbial load and minimises the pathogenic microorganisms. Water is used, however, its effectiveness is improved by the addition of chlorine. Water should be free of foreign matter, temperature of 1 - 4°C, and concentration of disinfectant solution at 100 - 150 ppm for carrot and cucumber while tomato 200-350 ppm.

Aran *et al.*, (1987) mentioned that 50-125 ppm active chlorine is adequate for eliminating the microbial risks of the fruits and vegetables. For very dirty raw materials 1-5 ppm active chlorine should be added to the final rinsing water. To avoid the contamination from water cused for washing, water analysis (chemical and microbiological) should be performed by authorized laboratories periodically. It is noteworthy that sanitizing agents such as chlorine are used in the wash water, mainly to reduce the microbial load in fresh-cut vegetables (Soliva-Fortuny and Martin-Belloso, 2003)

Cold - Holding – CCP15

Cold - Holding was considered as CCPs, which is maintained at temperatures of 4°C or below and only uses cold-holding equipment that can keep foods at the proper temperature and do not store food directly on ice. The FDA Food Code (2005) requires that all cold foods should be maintained at 41 °F or below. When temperatures of food are above 41 °F, they are in the temperature danger zone—temperatures at which bacteria grow rapidly.

Table (3) HACCP worksheet for critical control points of green salad in hospital kitchen

Critical control point	Hazard	Preventive measures	Critical limits	Monitoring & Recording	Corrective action	Verification
Storage of raw materials (Tomato ripe, cucumber and green peppers)	Biological	Temperature control and relative humidity	Tomato ripe at 13-15°C & relative humidity 85-90% Cucumber and green peppers at 10°C and relative humidity 85-90%	check the surface temperature of raw materials at least once per day by using infrared thermometer & record	Use Immediately if the temperature and relative humidity was exceed critical limits	supervisor will observe the accuracy of the product temperature & log supervisor will check thermometer used for monitoring and verification
Preparation	Chemical	Assurance of critical limits observance	Chlorine 100-150 ppm for carrot and cucumber while tomato 200-350 ppm pH 6-7.5	Check sodium hypo chlorite (Chlorine) solution by chlorine test strip and record	Manually adjust water Hold produce from last correct reading and rewash Staff training repeated for chemical use	Daily record review by supervisor
Cold Holding	Biological	Assurance of critical limits observance	At 4°C or below	Use disinfected probe to check core temp & record	Discard product if the temperature was exceed critical limits	supervisor will observe the accuracy of the product temperature & log supervisor will check thermometer used for monitoring and verification

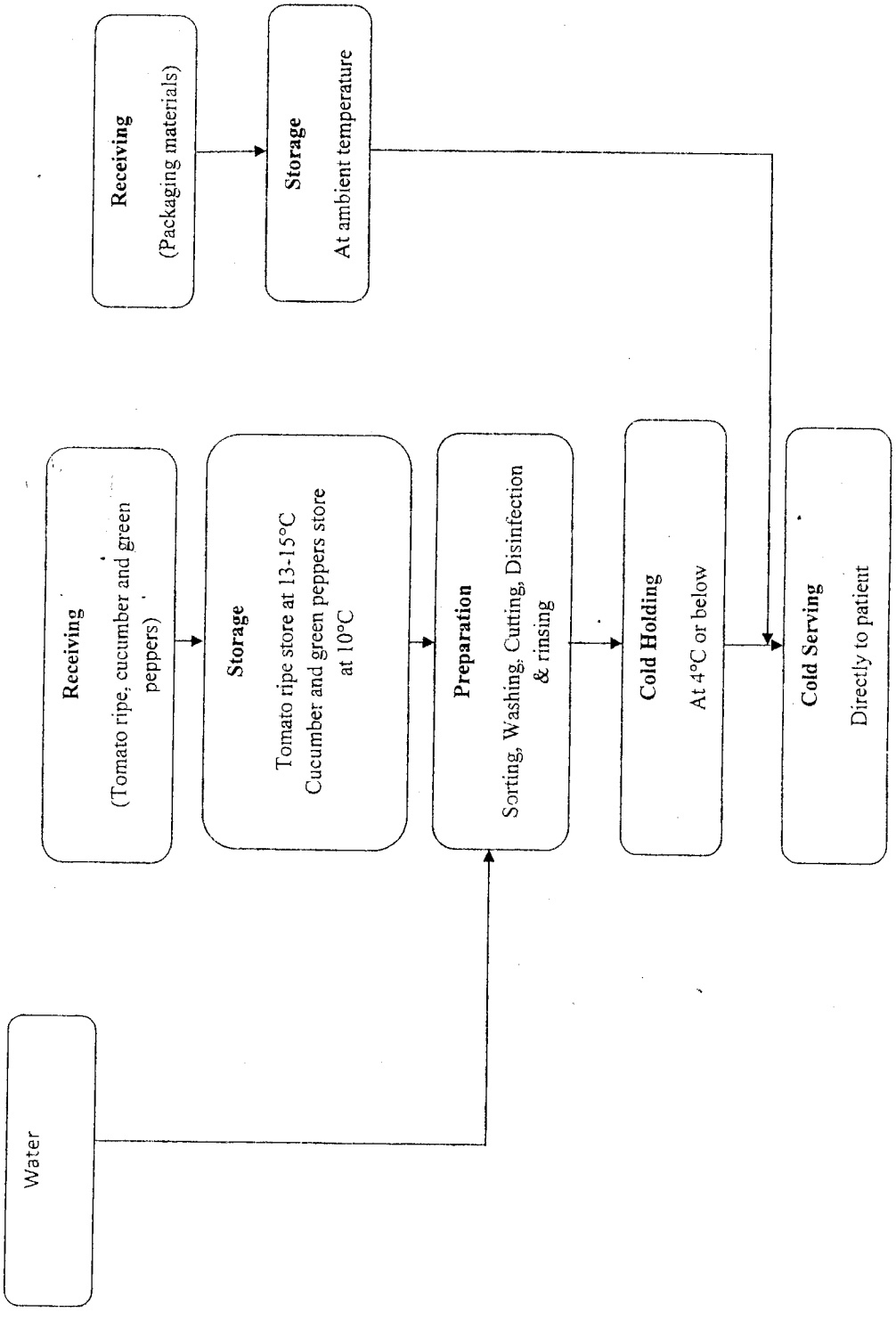

Figure3: Flow diagram of preparation of green salad

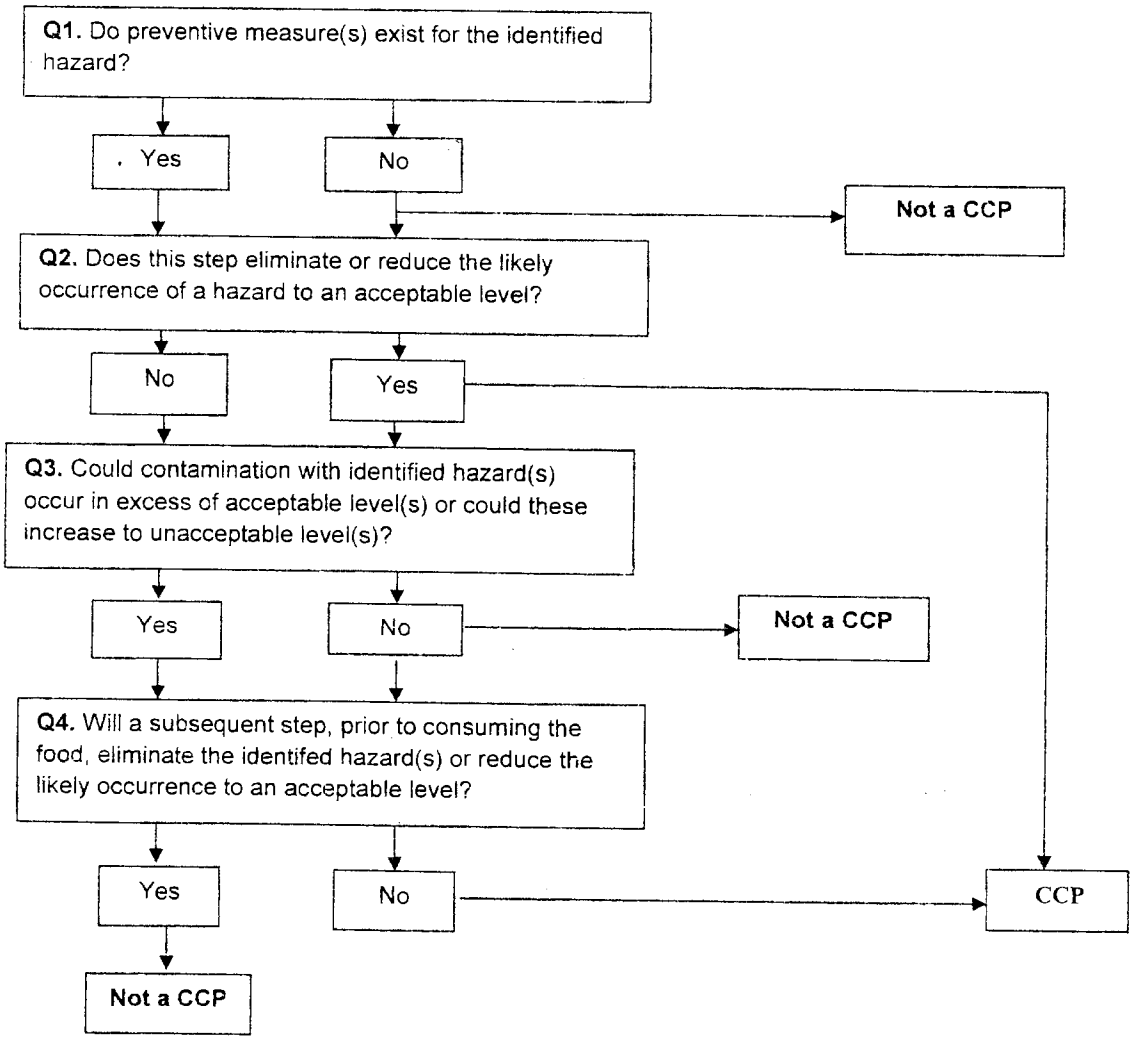

Figure 4: The NACMCF (1992) Critical Control Point decision tree

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تطبيق نظام إدارة سلامة الغذاء أيزو ٢٢٠٠٠ في التغذية العلاجية ببعض المستشفيات

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قسم التغذية وعلوم الأطعمة – كلية الاقتصاد المنزلي – جامعة المنوفية

الملخص العربي

أجري تحليل المخاطر لتحديد نقاط التحكم الحرجة أثناء إعداد الكفتة والدجاج المسلوق والسلطة الخضراء وتطبيق خطة الهاسب وأدرجت خطة الهاسب في ورقة عمل تحليل المخاطر لتقييم المخاطر المرتبطة بالعمليات عن طريق تحديد مختلف المخاطر البيولوجية والفيزيائية والكيميائية في كل مرحلة من مراحل التجهيز . وحددت المخاطر الفيزيائية مثل المواد الغريبة والمخاطر الكيميائية مثل المبيدات والسموم الفطرية والمعادن الثقيلة والمخاطر البيولوجية مثل الأستافيلوكوكس أوريس والكوليفورم والسالمونيلا. وتوضح النتائج ان عملية ذوبان الثلج للحم المجمد والدجاج المجمد يجب أن يتم التحكم والرصد لمنع نمو الميكروبات الممرضة المسببة للأمراض التي تنتج السموم إذا لم يتم التحكم في درجة حرارتها. يجب غسل السلطة الخضراء بالكلورين لتقليل الحمل الميكروب للوصول الي أدنى حد من الميكروبات. وتم إنشاء نظام الرصد لتحديد نقاط التحكم الحرجة والتي شملت الإجراءات الوقائية والحدود الحرجة والإجراءات التصحيحية وتوزيع المسئوليات وإجراءات التحقق.